



PRESIDENCY UNIVERSITY

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Approved by AICTE, New Delhi | Approved By BCI



PRESIDENCY SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Program Regulations and Curriculum 2026-2030

BACHELOR OF TECHNOLOGY (B.Tech.) in ELECTRONICS AND COMMUNICATION ENGINEERING based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

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PART A – PROGRAM REGULATIONS

1. Vision & Mission of the University and the School / Department

1.1 Vision of the University

To be a Value-driven Global University, excelling beyond peers and creating professionals of integrity and character, having concern and care for society.

1.2 Mission of the University

- Commitment to be an innovative and inclusive institution by seeking excellence in teaching, research and knowledge-transfer.
- Pursue Research and Development and its dissemination to the community, at large.
- Create, sustain and apply learning in an interdisciplinary environment with consideration for ethical, ecological and economic aspects of nation building.
- Provide knowledge-based technological support and services to the industry in its growth and development.
- To impart globally-applicable skill-sets to students through flexible course offerings and support industry's requirement and inculcate a spirit of new-venture creation.

1.3 Vision of Presidency School of Engineering

To be a value based, practice-driven School of Engineering and Technology, committed to developing globally-competent Engineers, dedicated to transforming Society.

1.4 Mission of Presidency School of Engineering

- Cultivate a practice-driven environment with a contemporary Learning-pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the field of Core Engineering.
- Establish state-of-the-art facilities for effective Teaching and Learning-experiences.
- Promote Interdisciplinary Studies to nurture talent and impart relevant skill-sets for global impact.
- Instil Entrepreneurial and Leadership Skills to address Social, Environmental, and Community-needs.

1.5 Vision of Department of Electronics and Communication Engineering

To be a leader in education and research in Electronics and Communication Engineering domains by developing ethical, innovative and globally competent professionals committed to societal well-being.

1.6 Mission of Department of Electronics and Communication Engineering

- Achieve Academic and professional excellence in Electronics and Communication Engineering that equip students with strong technical foundations, and globally-relevant skills.
- Promote cutting-edge research, innovation and industry collaboration for knowledge transfer, technological support, entrepreneurship, and nation-building initiatives.
- Engage in life-long learning to solve real-world problems with ethical, environmental and societal considerations.

2. Preamble to the Program Regulations and Curriculum

This is the subset of Academic Regulations and it is to be followed as a requirement for the award of B.Tech degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Social Project Based Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations of the University, the Academic Council hereby makes the following Regulations.

3. Short Title and Applicability

- a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2025-2029.
- b. These Regulations are subject to, and pursuant to the Academic Regulations.
- c. These Regulations shall be applicable to the ongoing Bachelor of Technology Degree Program of the 2025-2029 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
- d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
- e. These Regulations shall come into force from the Academic Year 2025-2026.

4. Definitions

In these Regulations, unless the context otherwise requires:

- a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;
- b. "Academic Council" means the Academic Council of the University;
- c. "Academic Regulations" means the Academic Regulations, of the University;
- d. "Academic Term" means a Semester or Summer Term;
- e. "Act" means the Presidency University Act, 2013;
- f. "AICTE" means All India Council for Technical Education;
- g. "Basket" means a group of courses bundled together based on the nature/type of the course;
- h. "BOE" means the Board of Examinations of the University;
- i. "BOG" means the Board of Governors of the University;
- j. "BOM" means the Board of Management of the University;
- k. "BOS" means the Board of Studies of a particular Department/Program of Study of the University;
- l. "CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;
- m. "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;
- n. "COE" means the Controller of Examinations of the University;
- o. "Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;
- p. "Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;
- q. "Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some

teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;

- r. "Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.*
- s. "DAC" means the Departmental Academic Committee of a concerned Department/Program of Study of the University;*
- t. "Dean" means the Dean / Director of the concerned School;*
- u. "Degree Program" includes all Degree Programs;*
- v. "Department" means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;*
- w. "Discipline" means specialization or branch of B.Tech. Degree Program;*
- x. "HOD" means the Head of the concerned Department;*
- y. "L-T-P-C" means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;*
- z. "MOOC" means Massive Open Online Courses;*
- aa. "MOU" means the Memorandum of Understanding;*
- bb. "NPTEL" means National Program on Technology Enhanced Learning;*
- cc. "Parent Department" means the department that offers the Degree Program that a student undergoes;*
- dd. "Program Head" means the administrative head of a particular Degree Program/s;*
- ee. "Program Regulations" means the Bachelor of Technology Degree Program Regulations and Curriculum, 2025-2029;*
- ff. "Program" means the Bachelor of Technology (B.Tech.) Degree Program;*
- gg. "PSOE" means the Presidency School of Engineering;*
- hh. "Registrar" means the Registrar of the University;*
- ii. "School" means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;*
- jj. "Section" means the duly numbered Section, with Clauses included in that Section, of these Regulations;*
- kk. "SGPA" means the Semester Grade Point Average as defined in the Academic Regulations;*
- ll. "Statutes" means the Statutes of Presidency University;*
- mm. "Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;*
- nn. "Summer Term" means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;*
- oo. "SWAYAM" means Study Webs of Active Learning for Young Aspiring Minds.*
- pp. "UGC" means University Grant Commission;*
- qq. "University" means Presidency University, Bengaluru; and*
- rr. "Vice Chancellor" means the Vice Chancellor of the University.*

5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2025-2029 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2025-2029 offered by the Presidency School of Engineering (PSOE):

1. Bachelor of Technology in Civil Engineering, abbreviated as B.Tech. (Civil Engineering)
2. Bachelor of Technology in Electronics and Communication Engineering, abbreviated as B.Tech. (Electronics and Communication Engineering)
3. Bachelor of Technology in VLSI, abbreviated as B.Tech. (VLSI)
4. Bachelor of Technology in Electrical and Electronics Engineering, abbreviated as B.Tech. (Electrical and Electronics Engineering)
5. Bachelor of Technology in Mechanical Engineering, abbreviated as B.Tech. (Mechanical Engineering); and
6. Bachelor of Technology in Petroleum Engineering, abbreviated as B.Tech. (Petroleum Engineering)

5.1 These Program Regulations shall be applicable to other similar programs, which may be introduced in future.

5.2 These Regulations may evolve and get amended or modified or changed through appropriate approvals from the Academic Council, from time to time, and shall be binding on all concerned.

5.3 The effect of periodic amendments or changes in the Program Regulations, on the students admitted in earlier years, shall be dealt with appropriately and carefully, so as to ensure that those students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised Program Regulations, without any undue favour or considerations

6. Minimum and Maximum Duration

- 6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.
- 6.2 A student, who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.
- 6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause 16.1 of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.
- 6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through

hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

- 6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.0 of Academic Regulations) in the prescribed maximum duration (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

After four years of successful completion of the program, the graduates shall be:

PEO-1: Establish themselves as successful Electronics and Communication Engineers committed to high moral and ethical standards.

PEO-2: Become competent professionals in communication systems, VLSI technologies and allied areas in both industry and research.

PEO-3: Engage in lifelong learning to adapt state of the art technologies and societal needs.

8 Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

8.1 Programme Outcomes (PO)

On successful completion of the Program, the students shall be able to:

PO1. Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3. Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4. Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5. Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6. The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7. Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8. Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

- PO9.** Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10.** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11.** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

8.2 Program Specific Outcomes (PSOs):

On successful completion of the Program, the students shall be able to:

- PSO1:** Demonstrate proficiency in analysing, designing, and implementing electronic circuits, communication systems, VLSI technologies.
- PSO2:** Identify and solve real-world complex engineering problems in VLSI and communication domains through conduct of experiments and research activities.
- PSO3:** Plan, design, and execute projects in electronics and communication engineering through collaboration with industries and higher learning institutions.

9 Admission Criteria (as per the concerned Statutory Body)

The University admissions shall be open to all persons irrespective of caste, class, creed, gender or nation. All admissions shall be made on the basis of merit in the qualifying examinations; provided that forty percent of the admissions in all Programs of the University shall be reserved for the students of Karnataka State and admissions shall be made through a Common Entrance Examination conducted by the State Government or its agency and seats shall be allotted as per the merit and reservation policy of the State Government from time to time. The admission criteria to the B.Tech. Program is listed in the following Sub-Clauses:

- 9.1 An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.
- 9.2 Provided further, the applicant must have taken Physics and Mathematics as compulsory subjects in the Pre-University / Higher Secondary / (10+2) / (11+1) examination, along with either Chemistry / Biology / Electronics / Computer Science / Biotechnology subject, and, the applicant must have obtained a minimum of 45% of the total marks (40% in case of candidates belonging to the Reserved Category as classified by the Government of Karnataka) in these subjects taken together.
- 9.3 The applicant must have appeared for Joint Entrance Examinations (JEE) Main / JEE (Advanced) / Karnataka CET / COMED-K, or any other State-level Engineering Entrance Examinations.
- 9.4 Reservation for the SC / ST and other backward classes shall be made in accordance with the directives issued by the Government of Karnataka from time to time.
- 9.5 Admissions are offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission, issued from time to time, by the Government of India.

- 9.6 Candidates must fulfil the medical standards required for admission as prescribed by the University.
- 9.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation and any other falsification, the Registrar shall report the matter to the Board of Management (BOM), recommending revoking the admission of the candidate.
- 9.8 The decision of the BOM regarding the admissions is final and binding.

10 Lateral Entry / Transfer Students requirements

10.1 Lateral Entry

The University admits students directly to the second year (3rd Semester) of the B.Tech. Degree program as per the provisions and/or regulations of the Government of Karnataka pertaining to the "Lateral Entry" scheme announced by the Government from time to time. Further, the general conditions and rules governing the provision of Lateral Entry to the B.Tech. Program of the University are listed in the following Sub-Clauses:

- 10.1.1 Admission to 2nd year (3rd Semester) of the B.Tech. Degree program shall be open to the candidates who are holders of a 3-year Diploma in Engineering (or equivalent qualification as recognized by the University), who have secured not less than forty-five percentage (45%) marks in the final year examination (5th and 6th Semesters of the Diploma Program) in the appropriate branch of Engineering. Provided that, in case of SC / ST and OBC candidates from Karnataka the minimum marks for eligibility shall be forty percent (40%).
- 10.1.2 Provided further that, candidates seeking Lateral Entry may be required to complete specified bridge Courses as prescribed by the University. Such bridge Courses, if any, shall not be included in the CGPA computations.
- 10.1.3 All the existing Regulations and Policies of the University shall be binding on all the students admitted to the Program through the provision of Lateral Entry.
- 10.1.4 The Course requirements prescribed for the 1st Year of the B.Tech. Program shall be waived for the student(s) admitted through Lateral Entry and the duration of the B.Tech. Program for such students is three (03) years, commencing from the 3rd Semester (commencement of the 2nd Year) of the B.Tech. Program and culminating with the 8th Semester (end of the 4th Year) of the B.Tech. Program.
- 10.1.5 Provided that, if a Lateral Entry student misses any mandatory program specific courses that are typically offered in the 1st year (1st or 2nd semesters), then those courses must be cleared by the students as soon as possible, preferably during the Summer Term.
- 10.1.6 The existing Program Regulations of the concerned Program to which the student is admitted through the provision of Lateral Entry shall be binding on the student with effect from the 3rd Semester of the Program. i.e., the Program Structure and Curriculum from the 3rd to 8th Semesters of the Program concerned shall be binding on the student admitted through Lateral Entry. Further, any revisions / amendments made to the Program Regulations thereafter, shall be binding on all the students of the concerned Program.
- 10.1.7 All the Courses (and the corresponding number of Credits) prescribed for the 1st Year of the concerned B.Tech. Program shall be waived for the student(s) admitted to the concerned B.Tech Program through Lateral Entry. Further, the *Minimum Credit Requirements* for the award of the B.Tech. Degree in the concerned Program shall be prescribed / calculated as follows:

The **Minimum Credit Requirements** for the award of the Bachelor of Technology (B.Tech.) Degree prescribed by the concerned Bachelor of Technology Degree Program Regulations and Curriculum, 2025-2029, minus the number of Credits prescribed / accepted by the Equivalence Committee for the 1st Year (1st and 2nd Semesters) of the B.Tech. Program.

For instance, if the *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree as prescribed by the Regulations for B.Tech. (Electronics and Communication Engineering) is "N" Credits, and, if the total credits prescribed in the 1st Year (total credits of the 1st and 2nd Semesters) of the Program concerned is "M" Credits, then the *Minimum Credit Requirements* for the award of the B.Tech. in Electronics and Communication Engineering for a student who joins the Program through the provision of the Lateral Entry, shall be "N – M" Credits.

- 10.1.8 Further, no other waiver except the Courses prescribed for the 1st year of the B.Tech. Program of the University shall be permissible for students joining the B.Tech. Program through the provision of Lateral Entry.

10.2 Transfer of student(s) from another recognized University to the 2nd year (3rd Semester) of the B.Tech. Program of the University

A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the B.Tech. / B.E. / B.S., Four-Year Degree Program from another recognized University, may be permitted to transfer to the 2nd Year (3rd Semester) of the B.Tech. Program of the University as per the rules and guidelines prescribed in the following Sub-Clauses:

- 10.2.1 The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3.
- 10.2.2 The student shall submit the Application for Transfer along with a non-refundable Application Fee (as prescribed by the University from time to time) to the University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) B.Tech. Program commencing on August 1 on the year concerned.
- 10.2.3 The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.
- 10.2.4 The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the B.Tech. / B.E. / B.S. Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.
- 10.2.5 The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

11. Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Tech. Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the B.Tech. Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

- 11.1 Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the B.Tech. Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester shall be eligible for consideration for a change of Branch.
- 11.2 Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the B.Tech. Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.
- 11.3 The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the B.Tech. Program, the Fee Policy pertaining to that Branch of the B.Tech. Program, and, all other rules pertaining to the changed Branch existing at the time.
- 11.4 Change of Branch once made shall be final and binding on the student. No student shall be permitted, under any circumstances, to refuse the change of Branch offered.
- 11.5 The eligible student may be allowed a change in Branch, strictly in order of *inter se* merit, subject to the conditions given below:
 - 11.5.1 The actual number of students in the 3rd Semester in any particular Branch to which the transfer is to be made, should not exceed the intake fixed by the University for the concerned Branch;
 - 11.5.2 The actual number of students in any Branch from which transfer is being sought does not fall below 75% of the total intake fixed by the University for the concerned Branch.

The process of change of Branch shall be completed within the first five days of Registration for the 3rd Semester of the B.Tech. Program.

12 Specific Regulations regarding Assessment and Evaluation (including the Assessment Details of NTCC Courses, Weightages of Continuous Assessment and End Term Examination for various Course Categories)

- 2.1 The academic performance evaluation of a student in a Course shall be according to the University Letter Grading System based on the class performance distribution in the Course.
- 2.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 2.5) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.
- 2.3 Format of the End-Term examination shall be specified in the Course Plan.
- 2.4 Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:
 - Non-Teaching Credit Courses (NTCC)
 - Courses with a class strength less than 30

Absolute grading method may be adopted, where necessary with prior approval of concerned DAC.

Grading shall be done at the end of the Academic Term by considering the aggregate performance of the student in all components of Assessments prescribed for the Course. Letter Grades (Clause 8.10) shall be awarded to a student based on her/his overall performance relative to the class performance distribution in the concerned Course. These Letter Grades not only indicate a qualitative assessment of the student's performance but also carry a quantitative (numeric) equivalent called the Grade Point.

2.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage for different category of Courses		
Nature of Course and Structure	Evaluation Component	Weightage
Lecture-based Course L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	Continuous Assessments	50%
	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	75%
	End Term Examination	25%
Skill based Courses like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure	Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable.	

The exact weightages of Evaluation Components shall be clearly specified in the concerned PRC and respective Course Plan.

Normally, for Practice/Skill based Courses, without a defined credit structure (L-T-P) [NTCC], but with assigned Credits (as defined in the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of evaluation/assessment, shall be as decided and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

2.6 Minimum Performance Criteria:

2.6.1 Theory only Course and Lab/Practice Embedded Theory Course

A student shall satisfy the following minimum performance criteria to be eligible to earn the credits towards the concerned Course:

- a. A student must obtain a minimum of 30% of the total marks/weightage assigned to the End Term Examinations in the concerned Course.
- b. The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of the components of Continuous Assessments, Mid Term Examinations and End Term Examinations in the concerned Course.

2.6.2 **Lab/Practice only Course and Project Based Courses**

The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of all assessment components in the concerned Course.

- 2.6.3 A student who fails to meet the minimum performance criteria listed above in a Course shall be declared as "Fail" and given "F" Grade in the concerned Course. For theory Courses, the student shall have to re-appear in the "Make-Up Examinations" as scheduled by the University in any subsequent semester, or, re-appear in the End Term Examinations of the same Course when it is scheduled at the end of the following Semester or Summer Term, if offered. The marks obtained in the Continuous Assessments (other than the End Term Examination) shall be carried forward and be included in computing the final grade, if the student secures the minimum requirements (as per Clause 2.6.1, 2.6.2 of academic regulations) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

13 Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc. – Note: These are covered in Academic Regulations

The University allows students to acquire credits from other Indian or foreign institutions and/or Massive Open Online Course (MOOC) platforms, subject to prior approval. These credits may be transferred and counted toward fulfilling the minimum credit requirements for the award of a degree. The process of transfer of credits is governed by the following rules and guidelines:

- 3.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer Annexure B of academic regulations) and approved by the Dean - Academics.
- 3.2 Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.
- 3.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the

transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

- 3.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 3.3 (as per academic regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.
- 3.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 3.3 (as per academic regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.
- 3.3.3 Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.
- 3.3.4 Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.
- 3.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 3.3.2 above.
- 3.3.6 SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.
- 3.3.7 A student, who has successfully completed the approved SWAYAM/NPTEL / other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.
- 3.3.8 The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the academic regulations.

Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses		
Sl. No.	Course Duration	Credit Equivalence
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

3.3.9 The maximum permissible number of credits that a student may request for credit transfer from MOOCs shall not exceed 20% of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree.

3.3.10 The University shall not reimburse any fees/expense; a student may incur for the SWAYAM/NPTEL/other approved MOOCs.

3.4 The maximum number of credits that can be transferred by a student shall be limited to forty percent (40%) of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree. However, the grades obtained in the Courses transferred from other Institutions/MOOCs, as mentioned in this Section (13.0), shall not be included in the calculation of the CGPA.

14. Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The B.Tech. (Electronics and Communication Engineering) Program Structure (2025-2029) totalling 160 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. (Electronics and Communication Engineering) 2025-2029: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets		
Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	09
2	Basic Science Courses (BSC)	24
3	Engineering Science Courses (ESC)	23
4	Professional Core Courses (PCC)	64
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Project Work (PRW)	16
8	Mandatory Courses (MAC)	0
	Total Credits	160

In the entire Program, the practical and skill-based course component contribute to an extent of approximately 57% out of the total credits of 160 for B.Tech. (Electronics and Communication Engineering) program of four years' duration.

15. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 160 credits is required for the award of a B.Tech. Degree.

16. Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies,

- 16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University.
- 16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:
- Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;
 - Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause a of Academic Regulations;
 - No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and
 - No disciplinary action is pending against her/him.

17. Structure – Basket Wise Course List

Table 3.1: List of Humanities and Social Sciences including Management Courses (HSMC)						
S.No	Course Code	Course Name	L	T	P	C
1	ENG1030	Fundamentals of Communication	1	0	2	2
2	ENG2030	Communication in Practice	1	0	2	2
3	APT4005	Aptitude for Employability	0	0	2	1
4	PPS3018	Preparedness for Interview	0	0	2	1
5	FIN1005	Finance Essentials for Decision Making	3	0	0	3
Total No. of Credits						09

Table 3.2: List of Basic Science Courses (BSC)						
S.No	Course Code	Course Name	L	T	P	C
1	MAT1211	Linear Algebra, Differential Equations and Statistical Methods	3	1	0	4
2	MAT1213	Differential Equations, Complex Variables and Fourier Series	3	1	0	4
3	MAT2312	Transforms techniques and Vector Calculus for Communication Systems	3	1	0	4
4	MAT2322	Partial Differential Equations and Numerical Methods for Communication Systems	3	1	0	4
5	PHY2502	Advanced Materials and Quantum Physics for Engineers	3	0	0	3
6	PHY2505	Advanced Materials and Quantum Physics for Engineers Lab	0	0	2	1
7	CHE2503	Applied Chemistry for Engineers	3	0	0	3
8	CHE2504	Applied Chemistry for Engineers Lab	0	0	2	1

						Total No. of Credits	24
Table 3.3: List of Engineering Science Courses (ESC)							
S.No	Course Code	Course Name	L	T	P	C	
1	CIV1200	Foundations of Integrated Engineering	2	0	0	2	
2	MEC1006	Engineering Graphics	2	0	0	2	
3	EEE1200	Basics of Electrical and Electronics Engineering	3	0	0	3	
4	EEE1251	Basics of Electrical and Electronics Engineering Lab	0	0	2	1	
5	ECE1512	Design Thinking in Practice	2	0	2	3	
6	CSS2280	C Programming and Data Structures	3	0	0	3	
7	CSS2281	C Programming and Data Structures Lab	0	0	4	2	
8	CSS2264	Essentials of AI	3	0	0	3	
9	CSS2265	Essentials of AI Lab	0	0	2	1	
10	CSS1500	Computational Thinking Using Python	2	0	2	3	
						Total No. of Credits	23

Table 3.4: Professional Core Courses (PCC)							
S.No	Course Code	Course Name	L	T	P	C	
1	EEE2500	Network Theory	3	1	0	4	
2	ECE2023	Digital Electronics	3	0	0	3	
3	ECE2051	Digital Electronics Lab	0	0	2	1	
4	ECE2500	Signals and Systems	3	0	0	3	
5	EEE2504	Control Systems Engineering	3	0	0	3	
6	ECE2535	Linear Integrated Circuits	3	0	0	3	
7	ECE2550	Signals and Systems Lab	0	0	2	1	
8	ECE2551	Linear Integrated Circuits Lab	0	0	2	1	
9	ECE2534	Digital Signal Processing	3	0	0	3	
10	ECE2521	Embedded Systems Design using Microcontrollers	4	0	0	4	
11	EEE2501	Electromagnetic Field Theory	3	1	0	4	
12	CSS2257	Computer Organization and Architecture	3	0	0	3	
13	ECE2570	Digital Signal Processing Lab	0	0	2	1	
14	ECE2571	Embedded Systems Design using Microcontrollers Lab	0	0	2	1	
15	ECE2533	Analog Communication	3	0	0	3	
16	ECE2522	CMOS VLSI Design	3	0	0	3	
17	ECE2552	Analog Communication Lab	0	0	2	1	
18	ECE2572	CMOS VLSI Design Lab	0	0	2	1	
19	ECE2505	Transmission Lines and Waveguides	3	0	0	3	
20	ECE2503	Digital Communication	3	0	0	3	
21	ECE2523	Digital VLSI Design	3	0	0	3	
22	ECE2524	Data Communication and Networking	3	0	0	3	
23	ECE2553	Digital Communication Lab	0	0	2	1	
24	ECE2573	Digital VLSI Design Lab	0	0	2	1	
25	ECE2504	Microwave Antenna and Wave Propagation	3	0	0	3	
26	ECE2554	Microwave Antenna and Wave Propagation Lab	0	0	2	1	
27	ECE2527	Mobile Communication	3	0	0	3	
						Total No. of Credits	64

Table 3.5: List of course in Project Work basket (PRW)						
S.No	Course Code	Course Name	L	T	P	C
1	ECE7000	Internship	-	-	-	2
2	ECE7100	Minor Project	-	-	-	4
3	ECE7300	Capstone Project	-	-	-	10
Total No. of Credits						16

Table 3.6: Mandatory Course**						
S.No	Course Code	Course Name	L	T	P	C
1	LAW7601	Indian Constitution	0	0	0	0
2	CIV7601	Universal Human Values and Ethics	0	0	0	0
3	PPS1025	Industry Readiness Program - I	0	0	2	0
4	PPS1026	Industry Readiness Program - II	0	0	2	0
5	APT4002	Introduction to Aptitude	0	0	2	0
6	APT4004	Aptitude Training - Intermediate	0	0	2	0
7	APT4006	Logical and Critical Thinking	0	0	2	0
Total No. of Credits						0

****These are non-credited courses in which the student has to earn a Satisfactory (S) Letter Grade in order to complete their degree.**

18. Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip B.Tech. graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations). The same shall be prescribed in the Course Handout.

18.1 Internship

A student may undergo an Internship for a period of 12-14 weeks in an industry / company or academic / research institution during the 7th or 8th Semesters, subject to the following conditions:

18.1.1 The Internship shall be conducted in accordance with the Internship Policy prescribed by the University from time to time.

- 18.1.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Internship to a student;
- 18.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 2.6.1.2 above.
- 18.1.4 A student may opt for Internship in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Internship confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University.
- 18.1.5 A student selected for an Internship in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

18.2 Project Work

A student may opt to do a Project Work for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters, subject to the following conditions:

- 18.2.1 The Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.
- 18.2.2 The student may do the project work in an Industry / Company or academic / research institution of her / his choice subject to the above-mentioned condition (Sub-Clause 2.6.2.1). Provided further, that the Industry / Company or academic / research institution offering such project work confirms to the University that the project work will be conducted in accordance with the Program Regulations and requirements of the University.

18.3 Capstone Project

A student may undergo a Capstone Project for a period of 12-14 weeks in an industry / company or academic / research institution in the 7th / 8th Semester as applicable, subject to the following conditions:

- 18.3.1 The Capstone Project shall be conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.
- 18.3.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Capstone Project to a student;
- 18.3.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 2.6.3.2 above.

18.3.4 A student may opt for Capstone Project in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.3.5 A student selected for a Capstone Project in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Capstone Project Policy of the University.

18.4 Research Project / Dissertation

A student may opt to do a Research Project / Dissertation for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Capstone Project, subject to the following conditions:

18.4.1 The Research Project / Dissertation shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above-mentioned condition (Sub-Clause 2.6.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

19. List of Elective Courses under various Specialisations / Stream Basket

Table 3.7: Discipline Elective Courses						
S. No.	Course Code	Course Name	L	T	P	C
General Basket						
1	ECE3200	Measuring Instruments and Sensors	3	0	0	3
2	ECE3201	Biomedical Instrumentation	3	0	0	3
3	ECE3202	Data Acquisition Techniques	3	0	0	3
4	ECE3203	Printed Circuit Board Design	3	0	0	3
5	ECE3204	Electronic Controlled Converters	3	0	0	3
6	ECE3205	Industrial Automation and Control	3	0	0	3
7	ECE3206	Linear Algebra for Communication Engineering	3	0	0	3
8	ECE3207	Fuzzy Logic and its Engineering Applications	3	0	0	3
Signal Processing Basket						
1	ECE3400	Speech Signal Processing	3	0	0	3
2	ECE3401	Digital Image Processing	3	0	0	3
3	ECE3402	Biomedical Signal Processing	3	0	0	3
4	ECE3403	Adaptive Signal Processing	3	0	0	3
5	ECE3404	Multimedia Signal Processing	3	0	0	3
6	ECE3405	Wavelets and Filter Banks	3	0	0	3
7	ECE3406	Probabilistic Systems analysis	3	0	0	3
8	ECE3407	Video Processing and Computer Vision	3	0	0	3

Table 3.7: Discipline Elective Courses						
S. No.	Course Code	Course Name	L	T	P	C
VLSI Design Basket						
1	ECE3408	IC Fabrication Technology	3	0	0	3
2	ECE3409	Sensor Technology	3	0	0	3
3	ECE3410	MEMS and Nanotechnology	3	0	0	3
4	ECE3411	Photonic Integrated Circuits	3	0	0	3
5	ECE3412	Mixed Signal Circuit Design	3	0	0	3
6	ECE3413	Low Power VLSI Design	3	0	0	3
7	ECE3414	CAD for VLSI	3	0	0	3
8	ECE3415	Design for Testability	3	0	0	3
Embedded Systems Basket						
1	ECE3467	Software for Embedded Systems	3	0	0	3
2	ECE3416	Real Time Systems	3	0	0	3
3	ECE3417	DSP Processors	3	0	0	3
4	ECE3418	FPGA Design for Embedded Systems	3	0	0	3
5	ECE3419	Developing Secure Embedded Systems	3	0	0	3
6	ECE3420	Introduction to Embedded Machine Learning	3	0	0	3
7	ECE3421	Deep Learning Using FPGAs	3	0	0	3
8	ECE3422	Fault-Tolerant Embedded Systems	3	0	0	3
Communication Basket						
1	ECE3423	Information Theory and Coding	3	0	0	3
2	ECE3424	Satellite Communication	3	0	0	3
3	ECE3425	Wireless Communication and Networks	3	0	0	3
4	ECE3426	Radar Engineering	3	0	0	3
5	ECE3427	RF Engineering	3	0	0	3
6	ECE3428	Wireless Adhoc Networks	3	0	0	3
7	ECE3429	Optical Communication	3	0	0	3
8	ECE3430	Vehicular Communication Systems	3	0	0	3
Wearable Technologies Basket						
1	ECE3431	Fundamentals of Wearable Sensing	3	0	0	3
2	ECE3432	Flexible Electronics and Sensors	3	0	0	3
3	ECE3433	Wearable Devices and Its Applications	3	0	0	3
4	ECE3434	Embedded Platforms for Wearables	3	0	0	3
5	ECE3435	Wireless Technologies for Wearables	3	0	0	3
6	ECE3436	Wearable Internet of Things	3	0	0	3
7	ECE3437	Wearable and Ubiquitous Computing	3	0	0	3
8	ECE3438	Wearable Prosthetics and Robots	3	0	0	3
IoT & Sensor Technologies Basket						
1	ECE3439	IoT Architecture and Protocols	3	0	0	3
2	ECE3440	Hardware and Software Architectures for IoT Systems	3	0	0	3

Table 3.7: Discipline Elective Courses						
S. No.	Course Code	Course Name	L	T	P	C
3	ECE3441	IoT Edge Nodes and its Applications	3	0	0	3
4	ECE3442	IoT and Cloud Computing	3	0	0	3
5	ECE3443	Data Science for IoT	3	0	0	3
6	ECE3444	Industrial Internet of Things	3	0	0	3
7	ECE3445	Internet of Medical Things	3	0	0	3
8	ECE3446	Internet of Agricultural Things	3	0	0	3
Artificial Intelligence Basket						
1	ECE3447	Computational Intelligence and Machine Learning	3	0	0	3
2	ECE3448	Neural Networks and Deep Learning	3	0	0	3
3	ECE3449	Applications of Deep Learning	3	0	0	3
4	ECE3450	Applied Pattern Recognition	3	0	0	3
5	ECE3451	AI & Digital Health	3	0	0	3
6	ECE3452	Natural Language Processing	3	0	0	3
7	ECE3453	Reinforcement Learning	3	0	0	3
8	ECE3454	Explainable AI	3	0	0	3

20. List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters.

Sl. No.	Course Code	Course Name	L	T	P	C	Anti-requisites
Chemistry Basket							
1	CHE3001	Smart Materials and 3D Printing	3	0	0	3	-
2	CHE3002	Energy and Sustainability	3	0	0	3	-
3	CHE3003	Nano technology and its applications	3	0	0	3	-
4	CHE3004	Corrosion and control	3	0	0	3	-
5	CHE3005	Green Chemistry and Sustainable Technology	3	0	0	3	-
6	CHE3006	Food Technology	3	0	0	3	-
Civil Engineering Basket							
1	CIV3100	Disaster mitigation and management	3	0	0	3	-
2	CIV3101	Sustainability Concepts in Engineering	3	0	0	3	-
3	CIV3102	Occupational Health and Safety	3	0	0	3	-
4	CIV3103	Sustainable Materials and Green Buildings	3	0	0	3	-
5	CIV3104	Integrated Project Management	3	0	0	3	-
6	CIV3105	Environmental Impact Assessment	3	0	0	3	-
7	CIV3106	Infrastructure Systems for Smart Cities	3	0	0	3	-
8	CIV3107	Geospatial Applications for Engineers	2	0	2	3	-
9	CIV3108	Environmental Meteorology	3	0	0	3	-
10	CIV3109	Project Problem Based Learning	3	0	0	3	-
11	CIV3110	Sustainability for Professional Practice	3	0	0	3	-
Commerce Basket							
1	MGT2015	Engineering Economics	3	0	0	3	-

Sl. No.	Course Code	Course Name	L	T	P	C	Anti-requisites
2	MGT2020	Marketing Fundamentals for Engineers	3	0	0	3	-
3	MGT2021	Finance for Engineers	3	0	0	3	-
4	MGT2007	Digital Entrepreneurship	3	0	0	3	-
5	COM1020	Business Accounting & Financial Analysis	2	1	0	3	-
6	BBA2088	Management and Behavioural Practices	3	0	0	3	-
Electrical and Electronics Basket							
1	EEE3100	IoT based Smart Building Technology	3	0	0	3	-
2	EEE3101	Basic Circuit Analysis	3	0	0	3	-
3	EEE3102	Fundamentals of Industrial Automation	3	0	0	3	-
4	EEE3103	Electric Vehicles & Battery technology	3	0	0	3	-
5	EEE3104	Smart Sensors for Engineering Applications	3	0	0	3	-
Electronics and Communication Engineering Basket							
1	ECE3800	Fundamentals of Electronics	3	0	0	3	
2	ECE3801	Microprocessor based systems	3	0	0	3	
3	ECE3802	Artificial Neural Networks	3	0	0	3	
4	ECE3803	Smart Electronics in Agriculture	3	0	0	3	
5	ECE3804	Environment Monitoring Systems	3	0	0	3	
6	ECE3805	Consumer Electronics	3	0	0	3	
7	ECE3806	Product Design of Electronic Equipment	3	0	0	3	
8	ECE3807	Introduction to Data Analytics	3	0	0	3	
9	ECE3808	Machine Vision for Robotics	3	0	0	3	
English Basket							
1	ENG1906	Law and Crime in Popular Imagination	3	0	0	3	
2	ENG1909	Exploring Gender: Narratives from Campus to Community	3	0	0	3	
3	ENG1910	Trauma Narratives: From Page to Pixel	3	0	0	3	
4	ENG1911	'Nonsense' Across Media	3	0	0	3	
5	ENG1912	Language and Interpretation	3	0	0	3	
Law Basket							
1	LAW2015	Cyber Law	3	0	0	3	-
2	LAW5005	Law relating to Infrastructure Projects	3	0	0	3	
Mathematics Basket							
1	MAT3030	Optimization Techniques for Engineers	3	0	0	3	-
2	MAT3031	Basic Statistics & Data Analysis	3	0	0	3	-
3	MAT3032	Mathematics for Machine Learning	3	0	0	3	-
4	MAT3033	Bioinformatics & Computational Biology	3	0	0	3	-
5	MAT3034	Time-Frequency Transforms for Signal Analysis	3	0	0	3	-
6	MAT3035	Mathematical Modelling	3	0	0	3	-
7	MAT3036	Bio-Statistics and Bio-Modelling	3	0	0	3	-
8	MAT3037	Linear Algebra & Matrix Theory	3	0	0	3	-
9	MAT3038	Financial Mathematics	3	0	0	3	-
10	MAT3039	Fuzzy Logic & Neural Networks	3	0	0	3	-
11	MAT3040	Discrete Mathematics	3	0	0	3	-
Media Studies Basket							
1	BAJ3006	Brand Management	3	0	0	3	-
2	BAJ3007	Communication for Social Impact	3	0	0	3	-
3	BAJ3035	Business Journalism	3	0	0	3	-

Sl. No.	Course Code	Course Name	L	T	P	C	Anti-requisites
4	BAJ3017	Political Communication	3	0	0	3	-
5	BAJ3042	Media Literacy Education	3	0	0	3	-
Mechanical Basket							
1	MEC3250	Engineering Drawing	1	0	4	3	-
2	MEC3251	Supply Chain Management	3	0	0	3	-
3	MEC3252	Six Sigma for Professionals	3	0	0	3	-
4	MEC3253	Fundamentals of Aerospace Engineering	3	0	0	3	-
5	MEC3254	Safety Engineering	3	0	0	3	-
6	MEC3255	Additive Manufacturing	3	0	0	3	-
7	MEC3256	Sustainable Technologies and Practices	3	0	0	3	-
8	MEC3257	Industry 4.0	3	0	0	3	-
Petroleum Basket							
1	PET3301	Energy Industry Dynamics	3	0	0	3	-
2	PET3302	Energy Sustainability Practices	3	0	0	3	-
Management Basket - I (One Course to be opted as part of HSMC Basket)							
1	MGTXXXX	Managerial Economics and Finance	3	0	0	3	-
2	MGT2004	Development of Enterprises	3	0	0	3	-
3	MGT2010	Managing People and Performance	3	0	0	3	-
4	MGT2020	Marketing for Engineers	3	0	0	3	-

21. List of MOOC (NPTEL) Courses

21.1 NPTEL - Discipline Elective Courses for B. Tech. (Electronics and Communication Engineering)

Sl. No.	Course ID	Course Name	Duration
1	noc25-cs22	Deep Learning for Natural Language Processing	12 Weeks
2	noc25-ee13	Computer Vision And Image Processing - Fundamentals And Applications	12 Weeks
3	noc25-ee25	Digital VLSI Testing	12 Weeks
4	noc25-ee31	Embedded Sensing, Actuation and Interfacing Systems	12 Weeks
5	noc25-ee58	Optical Fiber Sensors	12 Weeks
6	noc25-ee62	Physics of Nanoscale Devices	12 Weeks
7	noc25-ee73	RF Transceiver Design	12 Weeks
8	noc25-ee79	Smart Grid: Basics to Advanced Technologies	12 Weeks
9	noc25-ee83	VLSI Physical Design with Timing Analysis	12 Weeks
10	noc25-ee75	Semiconductor Devices for Next Generation Field Effect Transistors (More than Moore): A Physics Perspective	12 Weeks

21.2 NPTEL - Open Elective Courses for B. Tech. (Electronics and Communication Engineering)

Sl. No.	Course ID	Course Name	Duration
1	noc25-cs04	Affective Computing	12 Weeks
2	noc25-cs08	Blockchain and its Applications	12 Weeks
3	noc25-cs11	Cloud Computing	12 Weeks
4	noc25-cs32	Foundations of Cyber Physical Systems	12 Weeks
5	noc25-cs38	Human Computer Interaction (In English)	12 Weeks
6	noc25-cs51	Natural Language Processing	12 Weeks
7	noc25-cs45	Introduction to Large Language Models (LLMs)	12 Weeks
8	noc25-cs02	Advanced Computer Networks	12 Weeks
9	noc25-cs70	Theory of Computation	12 Weeks

22. Recommended Semester Wise Course Structure / Flow including the Programme / Discipline Elective Paths / Options

Semester 1 (Chemistry Cycle)										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1	MAT1211	Linear Algebra, Differential Equations and Statistical Methods	3	1	0	4	4	BSC	S	HP
2	CIV1200	Foundations of Integrated Engineering	2	0	0	2	2	ESC	S	
3	EEE1200	Basics of Electrical and Electronics Engineering	3	0	0	3	3	ESC	S	
4	EEE1251	Basics of Electrical and Electronics Engineering Lab	0	0	2	1	2	ESC	S/EM	
5	CHE2503	Applied Chemistry for Engineers	3	0	0	3	3	BSC	S	
6	CHE2504	Applied Chemistry for Engineers Lab	0	0	2	1	2	BSC	S	
7	CSS1500	Computational Thinking Using Python	2	0	2	3	4	ESC	S	
8	ENG1030	Fundamentals of Communication	1	0	2	2	3	HSMC	S	
9	PPS1025	Industry Readiness Program - I	0	0	2	0	2	MAC	EM	HP
		TOTAL				19	25	-	-	-

Semester 2 (Physics Cycle)										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1	MAT1213	Differential Equations, Complex Variables and Fourier Series	3	1	0	4	4	BSC	S	
2	MEC1006	Engineering Graphics	2	0	0	2	2	ESC	S	
3	PHY2502	Advanced Materials and Quantum Physics for Engineers	3	0	0	3	3	BSC	S	
4	PHY2505	Advanced Materials and Quantum Physics for Engineers Lab	0	0	2	1	2	BSC	S	
5	ECE2023	Digital Electronics	3	0	0	3	3	PCC	EM / EN	
6	ECE2051	Digital Electronics Lab	0	0	2	1	2	PCC	EM / EN	
7	ECE1512	Design Thinking in Practice	2	0	2	3	4	HSMC	S	HP
8	ENG2030	Communication in Practice	1	0	2	2	3	HSMC	S	
9	PPS1026	Industry Readiness Program - II	0	0	2	0	2	MAC	S	HP
		TOTAL				19	25			

Semester 3										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1	MAT2312	Transforms techniques and Vector Calculus for Communication Systems	3	1	0	4	4	BSC	S	
2	EEE2500	Network Theory	3	1	0	4	4	PCC	S	
3	ECE2500	Signals and Systems	3	0	0	3	3	PCC	EM / EN	
4	FIN1005	Finance Essentials for Decision Making	3	0	0	3	3	HSMC	EM	
5	CSS2280	C Programming and Data Structures	3	0	0	3	3	ESC	S/EM	
6	ECE2550	Signals and Systems Lab	0	0	2	1	2	PCC	S / EM	HP
7	ECE2533	Analog Communication	3	0	0	3	3	PCC	S	
8	ECE2552	Analog Communication Lab	0	0	2	1	2	PCC	S	
9	CSS2281	C Programming and Data Structures Lab	0	0	4	2	4	ESC	F/S	
10	APT4002	Introduction to Aptitude	0	0	2	0	2	MAC	AT	
11	CHE7601	Environmental Studies	-	-	-	0	0	MAC	S	ES
		TOTAL				24	30			

Semester 4										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE				CONTACT HOURS	BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C				
1	MAT2322	Partial Differential Equations and Numerical Methods for Communication Systems	3	1	0	4	4	BSC	S	
2	EEE2501	Electromagnetic Field Theory	3	1	0	4	4	PCC	S	
3	ECE2534	Digital Signal Processing	3	0	0	3	3	PCC	S	
4	ECE2570	Digital Signal Processing Lab	0	0	2	1	2	PCC	S	
5	EEE2504	Control Systems Engineering	3	0	0	3	3	PCC	EM / EN	ES
6	ECE2521	Embedded Systems Design using Microcontrollers	4	0	0	4	4	PCC	S/ EM	ES
7	ECE2571	Embedded Systems Design using Microcontrollers Lab	0	0	2	1	2	PCC	S / EM / EN	ES / HP
8	ECE2535	Linear Integrated Circuits	3	0	0	3	3	PCC	S/ EM	ES
9	ECE2551	Linear Integrated Circuits Lab	0	0	2	1	2	PCC	S / EM / EN	ES / HP
10	APT4004	Aptitude Training - Intermediate	0	0	2	0	2	MAC	AT	
11	CIV7601	Universal Human Values and Ethics	1	0	0	0	0	MAC	S	HP
		TOTAL				24	29			

Semester 5										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE				CONTACT HOURS	BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C				
1	ECE2503	Digital Communication	3	0	0	3	3	PCC	S / EM / EN	ES / HP
2	ECE2553	Digital Communication Lab	0	0	2	1	2	PCC	S / EM / EN	ES / HP
3	CSS2257	Computer Organization and Architecture	3	0	0	3	3	PCC	S	
4	ECE2522	CMOS VLSI Design	3	0	0	3	3	PCC	S / EM / EN	
5	ECE2572	CMOS VLSI Design Lab	0	0	2	1	2	PCC	S / EM / EN	ES / HP
6	CSS2264	Essentials of AI	3	0	0	3	3	ESC	F/S	
7	ECEXXXX	Professional Elective - I	3	0	0	3	3	PEC	S/EM	
8	ECEXXXX	Professional Elective - II	3	0	0	3	3	PEC	S/EM	
9	CSS2265	Essentials of AI Lab	0	0	2	1	2	ESC	S/EM	

10	APT4006	Logical and Critical Thinking	0	0	2	0	2	MAC	S	
11	LAW7601	Indian Constitution	0	0	0	0	0	MAC	S	HP
		TOTAL				21	26			

Semester 6										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1	ECE2527	Mobile Communication	3	0	0	3	3	PCC	S / EM	
2	ECE2523	Digital VLSI Design	3	0	0	3	3	PCC	S / EM	ES
3	ECE2505	Transmission Lines and Waveguides	3	0	0	3	3	PCC	S / EM	ES
4	ECEXXXX	Professional Elective - III	3	0	0	3	3	PEC	S/EM	
5	ECEXXXX	Professional Elective - IV	3	0	0	3	3	PEC	S/EM	
6	XXXXXXX	Open Elective - I	3	0	0	3	3	OEC		
7	ECE2573	Digital VLSI Design Lab	0	0	2	1	2	PCC	S / EM	ES
8	ECE7100	Minor Project	-	-	-	4	-	PRW	EM	HP/ ES
9	APT4005	Aptitude for Employability	0	0	2	1	2	HSMC	AT	
		TOTAL				24	22			

Semester 7											
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL		COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET			
1	ECE2504	Microwave Antenna and Wave Propagation	3	0	0	3	3	PCC	S / EM		HP
2	ECE2524	Data Communication and Networking	3	0	0	3	3	PCC	S / EM		HP
3	ECEXXXX	Professional Elective - V	3	0	0	3	3	PEC	S/EM		
4	ECEXXXX	Professional Elective - VI	3	0	0	3	3	PEC	S/EM		
5	ECE2554	Microwave Antenna and Wave Propagation Lab	0	0	2	1	2	PCC	S / EM		HP
6	XXXXXXX	Open Elective - II	3	0	0	3	3	OEC	S/EM		
7	ECE7000	Internship	-	-	-	2	-	PRW	HSMC		EM
8	PPS3018	Preparedness for Interview	0	0	2	1	2	HSMC	PRW		EM
		TOTAL				19	19				

Semester 8										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1	ECE7300	Capstone Project	-	-	-	10	-	PRW	EM	HP/ ES
		TOTAL				10	-			

Course Catalogue

Course Catalogue of all Courses Listed including the Courses Offered by other School / Department and Discipline / Programme Electives – Course Code, Course Name, Prerequisite, Anti-requisite, Course Description, Course Outcome, Course Content (with Blooms Level, CO, No. of Contact Hours), Reference Resources.

HSMC Basket

Course Code: ENG1030	Course Title: Fundamentals of Communication Type of Course: Integrated	L-T-P-C	1	0	2	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Fundamentals of Communication is a lab intensive, practice first integrated course designed to introduce first-year undergraduate engineering and computer science students to the foundational principles and advanced applications of effective communication across interpersonal, spoken, written, and digital contexts. Anchored in real world scenarios directly relevant to college life, cross-functional technical teams, and digital workplaces, the curriculum develops students' abilities to navigate cultural differences, speak with clarity, read texts critically, and write with precise audience awareness. The course explicitly relies on scenario-based learning, interactive case studies, and hands-on lab applications to ensure that theoretical communication frameworks are immediately actionable. By guiding students from reflective self-awareness to complex digital and AI-mediated content creation, the course builds an enduring communicative foundation optimized for performance-oriented professional practice.					
Course Objective	The course aims to explain the key principles of interpersonal, intercultural, and professional communication and apply them to real-world scenarios. It also focuses on developing spoken communication strategies, including structured delivery and impromptu responses, for academic and group contexts. Furthermore, it aims to develop effective writing skills to produce clear, coherent, and audience-appropriate texts across formal and professional contexts.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1. Understand the principles of interpersonal, intercultural, and professional communication in academic, social, and technical team contexts. CO2. Demonstrate audience-centered spoken communication in individual presentations, group discussions, and simulated professional scenarios through vocal control, adaptive register, and collaborative engagement. CO3. Interpret written, multimodal, and AI-generated texts to identify underlying assumptions, rhetorical strategies, logical errors, and credibility markers across diverse media and professional contexts. CO4. Utilize plain-language principles and professional conventions to produce clear, purposeful, and appropriately formatted written and					

	multimodal communication, including technical content adapted for non-specialist audiences. CO5. Employ responsible and critical practices in AI-assisted communication by designing iterative prompts, evaluating generated outputs, and applying ethical frameworks in academic and professional contexts.			
Course Content: Fundamentals of Communication				
Module 1	Communication in a New World	CA1 + Project Milestone	Deep Listening and Contextual Response Lab	06 Sessions
The topics will be discussed through case studies: • The Communication Process: How Messages Are Sent, Received, and Misread • Verbal, Non-Verbal, and Vocal Communication in Everyday Contexts • Communication Breakdown: Recognising Barriers Across Psychological, Cultural, and Semantic Dimensions • Active Listening: Attention, Paraphrasing, and Purposeful Response; asking for clarification • Interpersonal Communication and Self-Awareness (<i>including cross-cultural dimensions</i>)				
Module 2	Contemporary Speaking Practices	CA2, CA3, CA4	Narrative and Adaptive Oral Delivery Facilitated Stakeholder Group Discussion Simulated Workplace Crisis Briefing	15 Sessions
The topics will be discussed through structured, individual presentations and group discussions: • Elements of Spoken Communication: Voice, Clarity, and Presence • Storytelling and Narrative in Spoken Contexts • Structuring Spoken Messages: From Idea to Delivery • Speaking with Confidence: Managing Anxiety and Building Presence • Communicating in Groups: Participation, Productive Disagreement, and Turn-Taking • Giving and Receiving Feedback Effectively • Presentation Design and Delivery: Structure, Evidence, and Audience Engagement; eliciting responses • Speaking for Technical and Non-Technical Audiences				
Module 3	Critical Reading	Project Milestone	Source Audit and Fallacy Brief	09 Sessions
The topics will be discussed through case studies and real-world scenarios: • Critical Reading: Purpose, Context, and Analytical Approach • Perspective and Persuasion: Identifying Tone, Bias, and the Fact-Opinion Distinction • Understanding Flawed Reasoning (<i>patterns of weak argumentation in everyday contexts</i>) • Evaluating Sources: Credibility, Reliability, and AI-Generated Content; accuracy of the content • Reading Multimodal Texts: Images, Infographics, and Digital Media				
Module 4	Writing with Purpose	CA 5 + Project Milestone	Technical Translation and Annotated Script	09 Sessions
The topics will be discussed through case studies: • Principles of Effective Writing: Clarity, Coherence, Precision and Concise; audience analysis • Plain Language and Technical Communication: Making Complex Ideas Accessible				

• Writing for Professional Contexts: Email, Formal Reports, and Correspondence • Argumentative Writing: Claim, Evidence, and Logical Progression • Summary Writing and Short-Form Academic Response				
Module 5	Communication in the Age of AI	CA 6 – Project Milestone	CA 6: Cross-Disciplinary Case Analysis and Defence	06 Sessions
The topics will be discussed through case studies featuring real-world examples: • AI as a Communication Tool: Capabilities, Limitations, and the Hallucination Problem • Prompt Engineering: Communicating Effectively with AI Systems • AI-Assisted Writing: Drafting, Refining, and Maintaining Your Voice • Ethical and Legal Dimensions of AI in Communication (<i>includes India's Digital Personal Data Protection Act, 2023</i>) • AI, Bias, and Critical Evaluation: Reading AI Outputs Responsibly				
Targeted Application & Tools that can be used: Otter.ai, Microsoft Word/PowerPoint/Teams/Clipchamp/Whiteboard/OneNote/Forms/Copilot, Miro, Padlet, Canva, Mentimeter, AllSides Media Bias Ratings, Ad Fontes Media Bias Chart, Snopes/factcheck.rog, Zotero, NotebookLM, Canva, Adobe Express, CapCut, OBS Studio, Claude, ChatGPT, Gemini, DeepSeek, Google Docs				
Project Work / Assignment:				
1. Multimodal Communication Portfolio (Project) with multiple milestones: Continuous, milestone based. Developed across all five modules. Final consolidated submission at the end of the course. Develop a progressive, publicly shareable communication portfolio that demonstrates the student's ability to move a technical concept across multiple audiences, formats, and media. 2. Active Listening and Contextual Response Lab (Individual): Students listen to an unedited, multi-speaker audio recording of a real or simulated professional scenario. Under timed conditions, students produce a structured written brief consisting of four parts. Assessed on comprehension accuracy, analytical precision, quality of questioning, and practicality of the proposed strategy. 3. Narrative and Adaptive Oral Delivery (Individual): Each student delivers a 4-minute structured presentation. At the 3-minute mark, the faculty assessor introduces a counter-perspective or an unexpected constraint, and the student must adapt their argument in real time for the remaining minute. The assessment evaluates: the quality of the prepared 3 minutes; the quality of the improvised adaptation; and the degree to which the full 4 minutes function as a coherent whole. 4. Facilitated Stakeholder Group Discussion (Group): Groups of 5–6 students are each assigned a distinct stakeholder position within a shared scenario. and must engage in a live, facilitated discussion to resolve a stated policy impasse. No prepared scripts are permitted; students receive their role brief 15 minutes before the discussion begins. Assessment is individual, not group-level. 5. Simulated Workplace Crisis Briefing (Group): Groups of 4–5 students receive an unexpected corporate or institutional emergency brief. Teams have exactly 30 minutes to read the brief, distil the critical information, assign speaking roles, and prepare a 5-minute status update for a simulated leadership panel. 6. Technical Translation and Annotated Script (Individual): Students receive a dense, jargon-heavy technical document. Students must: (a) read and fully comprehend the document; (b) identify the core idea that a non-specialist audience needs to understand; and (c) produce an annotated script for a 90-second public explainer. 7. Cross-Disciplinary Case Analysis and Defence (Group): Groups of 3–4 students select one case from a faculty-curated shortlist of five to six approved cases. The group delivers a 10-minute structured presentation that goes beyond narrative description - identify the specific communication failures, explain the ethical or regulatory dimensions of those failures, and propose what a communication-competent response would have looked like. This is followed immediately by a 5-				

minute live Q&A in which individual group members must defend their analytical assertions against probing questions from both faculty and peers.	
Text Book(s):	
1. Markel, M., & Selber, S. A. (2021). <i>Technical Communication</i> (13th ed.). Bedford/St. Martin's.	
Reference Book(s):	
R1. Carnegie, D. (1936/1998). <i>How to Win Friends and Influence People</i> . Simon & Schuster. R2. Orwell, G. (1946). <i>Politics and the English Language</i> . R3. Strunk, W., & White, E. B. (1999). <i>The Elements of Style</i> (4th ed.). Longman. R4. Kahneman, D. (2011). <i>Thinking, Fast and Slow</i> . Farrar, Straus and Giroux. R5. O'Neil, C. (2016). <i>Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy</i> . Crown Publishers. R6. Adler, R. B., Rodman, G., & DuPré, A. (2019). <i>Understanding Human Communication</i> (14th ed.). Oxford University Press.	
Web Sources:	
• owl.purdue.edu • plainlanguage.gov • allsides.com • adfontesmedia.com • ted.com • economist.com/styleguide • factcheck.org • ailliteracy.org • learnprompting.org • unesco.org/en/artificial-intelligence/ethics	
Topics relevant to "SKILL DEVELOPMENT": Active listening, verbal and non-verbal communication, interpersonal communication and self-awareness, elements of spoken communication — voice, clarity, and presence, storytelling and narrative in spoken contexts, structuring spoken messages, speaking with confidence, group communication and productive disagreement, giving and receiving feedback, presentation design and delivery, speaking for technical and non-technical audiences, critical reading, identifying tone and bias, understanding flawed reasoning, source credibility and information evaluation, reading multimodal texts, principles of effective writing, plain language and technical communication, professional writing — email, reports, and correspondence, argumentative writing, summary writing, prompt engineering, AI-assisted writing, ethical AI use in academic and professional communication, AI bias and critical evaluation.	
Catalogue prepared by	Dr Ajith K and Dr Shahanas Punnilath Shanavas
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: PPS 018	Course Title: Preparedness for Interview Type of Course: Practical Only Course	L- T- P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					
Course Description	This course is designed to enable students to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of “Preparing for Interview” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Develop professional Resumes CO2: Illustrate Resumes effectively CO3: Apply skills and knowledge learnt for active and effective Group Discussions and Interview					
Course Content:						
Module 1	Resume Building	Classroom activity		10 Hours		
	Topics: Resume structure, use of templates, Do’ s and Don'ts, ATS methods, Cover Letter and Video Resume Activity: Real world scenarios					
Module 2	Group Discussion	Mock G D		9 Hours		
	Topics: -Group discussion as a placement process, GD techniques like Keyword. SPELT & POV of affected parties. Do & Don’ t of GD, Case-lets and topics for GD, practice session and evaluation Activity:- Real world scenarios					
Module 3	Personal Interview	Grooming checks + Evaluation + Mock Interview+ Role Play		9 Hours		
	Topics: Placement process, Different interview rounds, HR interviews, Interview questions and desired answers, Different types of interviews, Do’ s and Don'ts. Activity: - Role Play & Real-world scenario					
Module 4	Recap/Revision / Feedback Session	Practice sessions		2 Hours		
	Targeted Application & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Role Play activities					
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					

	Continuous Individual Assessment
	The Topics related to Skill Development: Art Of Presentation and Group Discussion for Skill Development through Participative Learning Tech- niques. This is attained through assessment Component mentioned in course handout.
Catalogue prepared by	Faculty of L&D
Recommended by the Board of Studies on	BOS held on
Date of Approval by the Academic Council	Academic Council Meeting held on

Course Code: APT4005	Course Title: Aptitude For Employability Type of Course: Practical Only		L- T-P- C	0	0	2	1
Version No.	1.0						
Course Pre-requisites	Students should have the basic concepts of Quantitative aptitude, Verbal ability along with its applications in real life problems.						
Anti-requisites	Nil						
Course Description	This course is designed to enable the students to enhance their skills in quantitative aptitude and verbal ability skills.						
Course Objective	The objective of the course is to familiarize the learners with concepts in Quantitative Aptitude and Verbal ability through problem solving techniques suitable for their career development.						
Course Outcomes	On successful completion of the course the students shall be able to: CO1] Recall all the basic mathematical concepts CO2] Identify the principal concept needed in a question CO3] Solve the quantitative and logical ability questions with the appropriate concept.						
Course Content:							
Module 1	Quantitative Ability	Lab-10hrs		Platform Assessment-10hrs		20 Hours	
Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Simple Interest and Compound Interest, Probability, Permutation and Combination.							
Module 2	Verbal Ability	Lab-5hrs		Platform Assessment-5hrs		10 Hours	
Topics: - Parts of Speech, Subject Verb Agreement, Spotting Error, Cloze Test, Verbal Analogies, Reading Comprehension, Idioms & Phrases, Para Jumbles							

Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS	
Evaluation	Continuous Evaluation Topic wise evaluation
Text Book - Fast track objective by Rajesh Verma - R S Aggarwal - S.P Bakshi	
References www.indiabix.com www.testbook.com www.youtube.com/c/TheAptitudeGuy/videos	
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Faculty of L&D
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: FIN1005	Course Title: Finance Essentials for Decision Making Type of Course: HSMC	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	This course is designed to be accessible to all students, regardless of their prior financial knowledge.					
Anti-requisites						
Course Description	This course is designed to equip students with a foundational understanding of key financial concepts and principles. It will enable them to comprehend the core functions of finance, delve into the intricacies of financial management within organizations, and gain insights into the fundamental aspects of taxation. The course aims to develop students' abilities to interpret financial statements, evaluate investment opportunities, understand capital structure decisions, and navigate the basics of tax implications.					
Course Objective	Upon successful completion of this course, students will be able to: - Understand the basic forms of business organization and their financial implications. - Understand the fundamental principles and concepts that influence financial decision-making in various contexts. - Analyse and interpret financial statements to assess the financial health and performance of an organization. - Identify income under various heads of income as per Income Tax Act, 1961 and determine the tax liability.					
Course Outcomes	List the course outcomes On successful completion of this course the students shall be able to: Understand the basic concepts of finance and financial markets and organizations.					

	1. Apply and interpret financial information for business decision making. 2. Identify various heads of income and deduction under Income Tax Act, 1961.			
Course Content:				
Module 1	Introduction to Finance	Assignment/ Quiz	Numerical solving Task	10 Sessions
Definition and Scope of Finance, Areas of Finance: Corporate Finance, Investments, Financial Institutions, International Finance; Types of Financial Markets: Money Markets vs. Capital Markets, Primary vs. Secondary Markets; Forms of Business Organization and Financial Goals: Shareholder Wealth Maximization vs. Profit Maximization; Understanding Financial Statements: Balance Sheet and Income Statement- Simple Numerical.				
Module 2	Financial Management	Assignment/ Quiz	Numerical solving Task	18 Sessions
Capital Budgeting Decisions: Payback Period, Net Present Value (NPV), Profitability Index (PI), Internal Rate of Return (IRR); Leverage- Basic Numerical; Capital Structure Decisions: Optimal Capital Structure, Trade-off Theory of Capital Structure; Cost of Capital: Equity, Debt, WACC; Dividend Policy: Factors influencing Dividend Policy.				
Module 3	Taxation	Assignment/ Quiz	Numerical solving Task	17 Sessions
Principles of a Good Tax System: Equity, Certainty, Convenience, Economy; Direct vs. Indirect Taxes; Residential Status of an Individual- Basic Problems; Heads of Income; Salary, House Property- Basic Numerical; Deductions under Chapter VI-A; Computation of Taxable Income and Tax Liability; E-Filing procedure.				
Targeted Application & Tools that can be used: Textbooks, PPT, Spreadsheet Software (e.g., Microsoft Excel), Official Website of Income Tax Department.				
Project Work/ Assignment:				
1. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 2. Case Study: - At the end of the course students will be given a ‘real-world’ cases like business models of successful companies or tax evasion by reputed companies on which they have to come up with detailed analysis and assessment.				
Text Book(s): 1. Dr. Vinod K. Singhania & Dr. Monica Singhania. (Latest Assessment Year Edition). <i>Students' Guide to Income Tax including GST</i> . Taxmann Publications. 2. Pandey, I. M. (2025). <i>Financial Management</i> . Vikas Publishing House.				
Reference Book (s): 1. Bhole, L.M., & Mahakud, J. (Current Edition). <i>Financial Institutions and Markets: Structure, Growth and Innovations</i> . McGraw Hill Education India. 2. Mehrotra, H.C., & Goyal, S.P. (Latest Assessment Year Edition). <i>Income Tax Law & Practice</i> . Sahitya Bhawan Publications. 3. Gordon, E., & Natarajan, K. (Current Edition). <i>Financial Markets and Services</i> . Himalaya Publishing House. Online Resources (e-books, notes, ppts, video lectures etc.): 1. https://presidencyuniversity.linways.com 2. https://onlinecourses.nptel.ac.in/noc24_ec01/preview 3. https://www.incometax.gov.in/iec/foportal/				
Topics relevant to "SKILL DEVELOPMENT": This course is designed to provide practical financial skills through participative learning techniques. Students will engage in performing suitable calculations to determine financial parameters (e.g., time value of money, investment returns, tax liabilities) and analysing financial statements to assess organizational performance and make informed decisions.				
Catalogue prepared by	Dr. Amit Saha			

Recommended by the Board of Studies on	BoS No: 6 th BOS, 5 June 2025
Date of Approval by the Academic Council	26 th Academic Council Meeting held on June 2025

BSC Basket

Course Code: MAT1211	Course Title: Linear Algebra, Differential Equations and Statistical Methods Type of Course:1] School Core	L-T- P- C	3	1	0	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces fundamental mathematical concepts from linear algebra, differential calculus, ordinary differential equations and statistics. The content includes matrices, systems of linear equations, eigenvalues and eigenvectors, functions of several variables, differential equations, correlation and regression analysis, and curve fitting techniques. The course combines theoretical developments with illustrative applications drawn from scientific and engineering settings. The course emphasizes the application of these mathematical tools in solving problems in science and engineering. It extends student’s problem-solving abilities through analytical and computational approaches, with focus on both theoretical understanding and applications.					
Course Objective	The objective of this course is to provide students with a strong mathematical foundation required for engineering and scientific studies. The course introduces fundamental concepts from linear algebra, differential calculus, ordinary differential equations, and statistical methods that are widely used in modeling, analysis and problem solving. It aims to familiarize students with mathematical techniques for representing engineering systems, studying relationships among variables, describing dynamic processes and interpreting data. The course serves as a foundation to prepare students for advanced engineering subjects that rely on mathematical modeling, computation and analytical methods.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Use linear algebra concepts to evaluate properties of matrices and quadratic forms. (L3) CO2: Apply matrix-based methods to solve systems of linear equations. (L3) CO3: Use fundamental theorems and analytical techniques of differential calculus to single variable functions. (L3) CO4: Apply the concepts of partial derivatives to multivariable functions. (L3) CO5: Solve first order ordinary differential equations using analytical methods. (L3) CO6: Employ statistical techniques for data analysis and to interpret relationships between variables. (L3)					
Course Content:						
Module 1	Fundamentals of Linear Algebra	(15L+5T=20 Sessions)				
Matrices, echelon forms, rank of matrix, Systems of linear equations: Consistency, solution to system of linear homogeneous and non-homogeneous equations- Gauss elimination method, Gauss-Jordan method (Self-study), LU decomposition method, Network analysis using linear systems, Design of traffic patterns, Electrical circuits. Eigenvalue and eigenvector, diagonalization of symmetric matrices, quadratic forms.						
Module 2	Differential Calculus	(15L+5T=20 Sessions)				

Introduction, limit, continuity, Rolle's theorem, mean value theorems, Indeterminate forms and L'Hôpital's rule. Partial derivatives, Euler's theorem, total derivative, Jacobians, Taylor's and Maclaurin's theorems, maxima, minima and saddle points, method of Lagrange multipliers, Current Growth in an RL Circuit, Velocity Estimation, Fuel consumption optimization, Cost function optimization.		
Module 3	Ordinary Differential Equations	(6L+2T=8 Sessions)
Definition, types of differential equations-variable separable, homogeneous, exact, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p , equations solvable for y , equations solvable for x and Clairaut's type, Newton's law of cooling, Current in RL circuit.		
Module 4	Statistical Methods and Curve Fitting	(9L+3T=12 Sessions)
Measures of central tendency, moments, skewness, and kurtosis. Correlation - Karl Pearson's coefficient of correlation, rank correlation, multiple correlation. Regression analysis - lines of regression, multiple regression. Principle of least square, curve fitting- straight line, parabola and exponential curves, Stress and strain curve fitting, Feature selection and Prediction models.		
Targeted Applications & Tools that can be used: • Linear Algebra is applied to solve systems of equations in circuits, traffic flow, and network analysis, with eigenvalues and quadratic forms aiding stability and optimization studies. • Differential Calculus supports process speed analysis, velocity estimation, and optimization techniques such as minimizing fuel consumption and cost functions. • Differential Equations model dynamic behaviours like current in RL circuits, heat transfer in materials, and growth or decay in environmental and nuclear engineering. • Statistical Methods and Curve Fitting enable effective data analysis through correlation, regression, and curve fitting, supporting predictive modeling and interpretation of experimental data such as stress-strain relationships. Software: MATLAB, Python, R Programming, Mathematica, Scilab, Octave		
Assignment:		
Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – obtain the solution and compare the solution sets by varying the values of the dependent variable.		
Text Book		
1. B. S. Grewal, <i>Higher Engineering Mathematics</i> , 44th ed. New Delhi, India: Khanna Publishers, 2017. 2. D. C. Montgomery and G. C. Runger, <i>Applied Statistics and Probability for Engineers</i> , 7th ed. Hoboken, NJ, USA: Wiley, 2018.		
References:		
1. P. V. O'Neil, <i>Advanced Engineering Mathematics</i> , 8th ed. Boston, MA, USA: Cengage Learning, 2018. 2. R. I. Miller and J. E. Freund, <i>Probability and Statistics for Engineers</i> , 9th ed. Noida, India: Pearson Education Ltd., 2017. 3. E. Kreyszig, <i>Advanced Engineering Mathematics</i> , 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2011. 4. V. Henner, T. Belozerovala, and M. Khenner, <i>Ordinary and Partial Differential Equations</i> . Boca Raton, FL, USA: CRC Press, 2013.		
E-resources/ Web links:		
1. https://nptel.ac.in/courses/111105121 2. https://nptel.ac.in/courses/111106146 3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASE&unique_id=EBSCO95_30102024_106839 4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASE&unique_id=EBSCO95_30102024_61605 5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASE&unique_id=EBSCO95_30102024_134719		

6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASE&unique_id=TEXTBOOK_LIBRARY01_06082022_174

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of differential calculus, differential equations and statistical methods with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving. This is attained through the assessment component mentioned in course handout.

Catalogue prepared by	Dr. Kavita Permi, Dr. Rahul M. P. and Dr. Athmakoori Prashant
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MAT1213	Course Title: Differential Equations, Complex Variables and Fourier Series Type of Course:1] School Core	L-T- P- C	3	1	0	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course provides a comprehensive study of advanced mathematical methods essential for engineering, scientific, and applied mathematical analysis. It covers techniques of integral calculus, including reduction formulae, Beta and Gamma functions, and their applications; methods for solving second and higher-order ordinary differential equations; fundamental concepts of complex analysis such as analytic functions, conformal mappings, complex integration, and residue theory; and Fourier series representations of periodic functions. The course emphasizes both theoretical understanding and practical problem-solving skills, enabling students to apply mathematical techniques to model, analyze, and solve real-world problems in engineering and science.					
Course Objective	The main objective of the course is that students should develop skills in advanced integration techniques and special functions. It teaches students how to solve higher-order ordinary differential equations. Students can think logically and apply the theoretical knowledge of Fourier series to analyze periodic phenomena. It will enhance knowledge mathematical modeling and problem-solving abilities.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Apply advanced integration techniques to solve mathematical problems. (L3) CO2: Solve linear ordinary differential equations of higher order. (L3) CO3: Apply the principles of analyticity and harmonicity to solve problems involving complex functions. (L3) CO4: Evaluate contour integrals using residue theory. (L3) CO5: Represent functions through Fourier series and half-range expansions. (L3) CO6: Use mathematical tools in engineering and scientific applications. (L3)					
Course Content:						
Module 1	Integral Calculus	(13L+4T=17 Sessions)				
Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.						

Double integrals (Cartesian), Change of order of integration in double integrals, Triple integrals, Change of variables (Cartesian to polar, cylindrical and spherical coordinates), areas, volume - Center of mass and Gravity (constant and variable densities), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds, application problems.		
Module 2	ODE - Second and Higher Order	(8L+3T=11 Sessions)
Linear differential equations of second and higher order with constant coefficients - non-homogeneous term of the type $Q(x) = e^{ax}, \sin ax, \cos ax, e^{ax}v(x), x^n v(x)$ - Method of variation of parameters, Analysis of RLC Circuits Using Second-Order Differential Equations, Voltage and Current Response in Electrical Networks.		
Module 3	Complex Analysis	(15L+5T=20 Sessions)
Introduction, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; Conformal mappings. Complex Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Transmission Line Modelling, Residue-Based Circuit Analysis.		
Module 4	Fourier Series	(9L+3T=12 Sessions)
Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis, Representation of a Square Wave Using Fourier Series.		
Targeted Applications & Tools that can be used: • Computation of areas, volumes, center of mass, and moments in engineering systems; evaluation of multiple integrals in fluid flow, heat transfer, electromagnetics, and 3D geometric modeling. • Modeling and analysis of dynamic systems, RLC circuits, electrical networks, mechanical vibrations, control systems, and transient response analysis. • Analysis of transmission lines, electrical circuits, signal processing systems, fluid flow problems, conformal mapping applications, and residue-based engineering computations. • Harmonic analysis, signal decomposition, communication systems, waveform representation, vibration analysis, image processing, and frequency-domain analysis. Software: MATLAB, Mathematica, Maple, Python, GeoGebra, Octave, R, Scilab, COMSOL Multiphysics, Wolfram Alpha.		
Assignment:		
Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor.		
Text Book		
1. N. P. Bali and M. Goyal, <i>A Textbook of Engineering Mathematics</i>, 10th ed. New Delhi, India: Laxmi Publications, 2019. 2. J. W. Brown and R. V. Churchill, <i>Complex Variables and Applications</i>, 9th ed. New York, NY, USA: McGraw-Hill Education, 2014 3. R. K. Jain and S. R. K. Iyengar, <i>Advanced Engineering Mathematics</i>, 5th ed. New Delhi, India: Narosa Publishing House, 2016.		
References:		
1. E. Kreyszig, <i>Advanced Engineering Mathematics</i>, 11th Indian Adaptation ed. New Delhi, India: Wiley India, 2025. 2. J. W. Brown and R. V. Churchill, <i>Complex Variables and Applications</i>, 9th ed. New York, NY, USA: McGraw-Hill Education, 2014. 3. D. G. Zill, <i>A First Course in Differential Equations with Modeling Applications</i>, 12th ed. Boston, MA, USA: Cengage Learning, 2024. 4. M. R. Spiegel, <i>Schaum's Outline of Advanced Mathematics for Engineers and Scientists</i>, 1st ed. New York, NY, USA: McGraw-Hill Education, 2013.		
E-resources/ Web links:		

1. https://research.ebsco.com/c/n5guci/search/details/6wtbgoqnff?request-context=plink&db=nlebk 2. https://research.ebsco.com/c/n5guci/search/details/grd6xqd7pv?db=nlebk&limiters=None&q=Fourier%20series&searchMode=boolean 3. https://research.ebsco.com/c/n5guci/search/details/qcdqrufxg5?request-context=plink&db=nlebk	
Topics relevant to SKILL DEVELOPMENT: This course fosters critical analytical and computational skills by training students to formulate and solve complex higher-order ordinary differential equations that model real-world physical systems. Additionally, analyzing complex analytic functions and synthesizing Fourier series equips the technical proficiency to interpret signal behaviors, harmonic waveforms, and boundary value problems in engineering domains.	
Catalogue prepared by	Dr. Heena Firdose
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MAT2312	Course Title: Transform Techniques and Vector Calculus for Communication Systems Type of Course:1] School Core	L-T- P- C	3	1	0	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces fundamental mathematical tools used in engineering, physics, and applied sciences. The course covers Fourier, Laplace, and Z-transforms for solving differential and difference equations arising in physical systems and signal processing. It also develops the concepts of vector calculus, including gradient, divergence, curl, line and surface integrals, and major integral theorems. Emphasis is placed on problem-solving and applications in engineering and scientific modeling.					
Course Objective	This course is designed to develop a strong foundation in integral transforms and vector calculus and to enhance analytical and problem-solving skills for engineering applications. It equips students with the ability to apply Laplace, Fourier, and Z-transform techniques to solve differential equations, difference equations, and system-related problems arising in continuous and discrete domains. The course also introduces the analysis of scalar and vector fields through gradient, divergence, curl, and vector integration, along with the application of Green's, Gauss's, and Stokes' theorems. Emphasis is placed on mathematical modelling and applications in signal processing, control systems, electrical circuits, communication systems, fluid flow, electromagnetics, and scientific computing.					
Course Out Comes	After successful completion of the course, students will be able to: CO1: Apply transformation methods to solve piecewise-defined mathematical models. (L3) CO2: Employ Laplace transform techniques to solve ordinary differential equations arising in Engineering problem. (L3) CO3: Apply Fourier transform methods to solve problems related to signals and systems. (L3) CO4: Apply Z-transform and inverse Z-transform techniques to solve difference equations and discrete-time system problems. (L3)					

	C05: Apply vector differential operators to analyze scalar and vector fields and identify solenoidal and irrotational fields. (L3) C06: Apply vector integration techniques and integral theorems to a solve engineering problems. (L3)	
Course Content:		
Module 1	Laplace Transform	12L + 4T = 16 Sessions)
Laplace transforms elementary functions. Properties of Laplace transform, Laplace transform of periodic function, unit-step function and Impulse function - related problems. Inverse Laplace transform of standard functions - problems, initial and final value theorem. Convolution theorem, solution of linear and simultaneous differential equations and LCR Circuit.		
Module 2	Fourier Transform	(9L + 3T = 12 Sessions)
Infinite Fourier transforms, Fourier sine and cosine transforms, Properties, Convolution, Inverse Fourier transforms, Problems. Application to Ordinary Differential Equations		
Module 3	Z-Transform	(9L + 3T = 12 Sessions)
Z-transforms, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Application to difference equations.		
Module 4	Vector Calculus	15L + 5T = 20 Sessions)
Vector & Scalar Functions and Fields, Derivatives, Curve, Arc length, Curvature & Torsion, Gradient of Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Physical interpretation, Solenoidal and Irrotational Vector Fields. Problems. Line Integrals, Path Independence of Line Integrals, Green's Theorem in the plane, Surface Integrals, Divergence Theorem of Gauss, Stokes's Theorem.		
Targeted Applications & Mathematical Tools: - Modeling and solving differential equations in electrical circuits, control systems, and dynamic engineering systems. - Signal analysis, frequency-domain processing, communication systems, image and audio processing. - Analysis of discrete-time systems, digital signal processing, and difference equation modeling. - Analysis of fluid flow, electromagnetic fields, heat transfer, and engineering field problems. Software: MATLAB, Python, Mathematica, Maple, Scilab, GNU Octave, MS Excel.		
Assignment:		
Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor.		
Text Book		
3. B. S. Grewal, <i>Higher Engineering Mathematics</i> , 44 th Edition, Khanna Publishers, 2017. 4. E. Kreysig, <i>Advanced Engineering Mathematics</i> , 10 th edition, Wiley Publication, 2011.		
References:		
5. Peter V. O'Neil, <i>Advanced Engineering Mathematics</i> , 7 th Edition, Cengage Learning, 2012. 6. C. Ray Wylie and Louis C Barrett, <i>Advanced Engineering Mathematics</i> , 6th Edition, McGraw-Hill, 2012. 7. Glyn James & Phil Dyke, <i>Advanced Modern Engineering</i> , 5 th Edition, Pearson Education Limited, 2018.		
E-resources/ Web links:		
1. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=VTU_CONSORTIA_DATA_14112024_23450 2. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=CUSTOM_PACKAGE_EBSCO_29052023_53751 3. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=CUSTOM_PACKAGE_EBSCO_29052023_228712 4. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=EBSCO95_10122025_145338		

5. NPTEL Laplace Transform https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ma54 6. NPTEL Fourier Transform https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ma22 7. NPTEL Vector Calculus: https://nptel.ac.in/courses/111/105/111105122/ 8. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 9. https://www.scu.edu.au/study/units/math2002/2026/	
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of Fourier Series, Fourier Transforms, Z-Transforms and Vector calculus with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem Solving. This is attained through the assessment component mentioned in the course handout.	
Catalogue prepared by	Dr Rajeshwari M
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MAT2322	Course Title: Partial Differential Equations and Numerical Methods for Communication Systems Type of Course:1] School Core	L-T- P- C	3	1	0	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces fundamental and advanced numerical techniques for solving algebraic, transcendental, and differential equations. Students will learn direct and iterative methods for linear systems, root-finding algorithms, interpolation, numerical differentiation and integration, and numerical solutions of ordinary and partial differential equations. Emphasis is placed on both theoretical foundations and practical applications in engineering and applied sciences, with attention to accuracy, stability, and convergence of methods.					
Course Objective	The objective of this course is to equip students with a solid foundation in numerical methods and their applications to algebraic, transcendental, and differential equations. It aims to develop an understanding of direct and iterative techniques for solving systems of linear equations, root-finding algorithms for nonlinear problems, and interpolation methods for data approximation. Students will gain proficiency in numerical differentiation and integration schemes, as well as in single-step and multi-step approaches for ordinary differential equations. The course further emphasizes the application of finite difference and other numerical schemes to partial differential equations, including parabolic, hyperbolic, and elliptic types, with attention to boundary value problems. By integrating theory with practical computation, the course fosters analytical skills to evaluate accuracy, stability, and convergence, preparing students to apply numerical techniques effectively in engineering, applied sciences, and mathematical modeling contexts.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Apply the method of separation of variables and Lagrange's method to obtain solutions of partial differential equations. (L3)					

	CO2: Apply appropriate techniques to solve one-dimensional heat and wave equations under prescribed initial and boundary conditions. (L3) CO3: Employ iterative numerical methods to determine the roots of algebraic and transcendental equations. (L3) CO4: Apply numerical differentiation and integration techniques to evaluate derivatives and integrals of given functions. (L3) CO5: Apply numerical methods to obtain approximate solutions of ordinary differential equations and systems of nonlinear equations. (L3) CO6: Employ finite difference and iterative methods to obtain numerical solutions of engineering problems modelled by partial differential equations. (L3)	
Course Content:		
Module 1	Numerical Methods for Algebraic Equations and Linear Systems	(12L+4T=16 Sessions)
Introduction, Jacobi iteration method, Gauss-Seidel iteration method. Solution of Algebraic and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, secant method, fixed point iteration method. Nodal Voltage Analysis in an IC Circuit.		
Module 2	Numerical Interpolation, Integration, Differentiation and ODEs	(13L+5T=16 Sessions)
Resonant Frequency of an LC Circuit Newton's method, Divided difference method, Lagrange's method, Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Gaussian quadrature rule. Solution of ordinary differential equations: Taylor series method, modified Euler's method, Newton-Raphson method for system of nonlinear equations, Runge-Kutta Method for system of first order ODEs and for second order ODEs, Estimation of MOSFET Drain Current, Delay Estimation in VLSI Interconnects.		
Module 3	Partial Differential Equations and Their Applications	(11L+3T=16 Sessions)
Formation of PDE, Solution of non-homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect to one independent variable only (Both types with given set of conditions) Method of separation of variables. (First and second order equations) Solution of Lagrange's linear PDE. of the type $Pp + Qq = R$. Derivation of one-dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Heat Dissipation in an Integrated Circuit (IC), Crosstalk Analysis Between Interconnects. Introduction, Jacobi iteration method, Gauss-Seidel iteration method. Solution of Algebraic and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, secant method, fixed point iteration method., Nodal Voltage Analysis in an IC Circuit, Resonant Frequency of an LC Circuit		
Module 4	Numerical Methods for PDEs	(9L+3T =12 Sessions)
Finite difference method for PDEs, Schmidt explicit formula, Crank-Nicolson method for parabolic PDEs, explicit finite difference method for hyperbolic PDEs, Gauss-Seidel iteration method for elliptical PDEs. Heat Diffusion in a Microprocessor, Thermal Simulation of a Silicon Wafer.		
Targeted Application & Tools that can be used: - Bubble point pressure estimation, reservoir pressure distribution, well performance analysis, nonlinear flow equations, gas compressibility factor calculations, production optimization problems. - Reservoir pressure estimation using interpolation, production rate forecasting, velocity and acceleration calculations in pipelines, cumulative production estimation, pressure decline analysis, fluid flow prediction. - Heat transfer during steam injection, heat loss in oil pipelines, groundwater flow, temperature distribution in reservoirs, enhanced oil recovery processes, contaminant transport modeling. - Reservoir pressure distribution using finite differences, seismic wave propagation, thermal recovery simulation, hydraulic fracturing studies, fluid flow in porous media, reservoir simulation and forecasting. Softwares: MATLAB, Mathematica, Maple, Python, GeoGebra, Octave, R, Scilab.		

Assignment:	
Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor.	
Text Book	
4. E. Kreyszig, Advanced Engineering Mathematics, 11th ed. Hoboken, NJ, USA: John Wiley & Sons, 2025. 5. B. S. Grewal, <i>Higher Engineering Mathematics</i>, 45th ed. New Delhi, India: Khanna Publishers, 2022. 6. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, Numerical Methods for Scientific and Engineering Computations, 8th ed. New Delhi, India: New Age International Publishers, 2022.	
References:	
1. V. Henner, T. Belozerova, and M. Khenner, Ordinary and Partial Differential Equations. Boca Raton, FL, USA: CRC Press, 2013. 2. W. Ledermann, Multiple Integrals, 1st ed. Cham, Switzerland: Springer. 3. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th ed. Noida, India: Pearson Education, 2002. 4. T. Veerarajan, Engineering Mathematics for First Year. New Delhi, India: Tata McGraw-Hill, 2008.	
E-resources/ Web links:	
5. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=EBSCO95_10122025_221436 6. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=DOAB_1_06082022_9595 7. https://projecteuclid.org/ebooks/institute-of-mathematical-statistics-lecture-notes-monograph-series/multivariate-statistics/toc/10.1214/Inms/1196285102 8. https://www.mdpi.com/books/reprint/1360-advanced-numerical-methods-in-applied-sciences 9. https://www.gutenberg.org/ebooks/33283	
Topics relevant to SKILL DEVELOPMENT: The course develops computational modeling, problem-solving, and numerical simulation skills essential for petroleum engineering applications. Students learn to apply numerical methods for approximation, interpolation, integration, and differential equations in real-world engineering applications and integrate mathematical techniques with modern computational tools for reservoir analysis, production optimization, and decision-making in the energy sector.	
Catalogue prepared by	Dr. Mohammad Javed Alam
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: PHY2502	Course Title: Advanced Materials and Quantum Physics for Engineers Type of Course: BSC	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Class 11 and 12 physics					
Anti-requisites	NIL					

Course Description	The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking and analytical skills.		
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Apply semiconductor, superconducting, and dielectric principles in problems related to basic electronic devices and their characteristics. CO2 Make use of quantum mechanics principles, problems involving wave functions, and the uncertainty principle in quantum computing CO3: Apply vector calculus, problems involving electric and magnetic fields using Gauss's and Stokes' theorems. CO4: Apply Maxwell' s equations to solve practical problems in electromagnetic theory CO5: Analyze the principles and characteristics of lasers and optical fibers in communication systems and medical applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Applied Physics for Electrical and Electronics cluster"and to attain the basic knowledge related to semiconductors, superconductors and dielectrics.		
Course Content:			
Module 1	Electrical Properties of Semiconductors, Superconductors, And Dielectrics:	Assignment	No. of Classes: 10
(Classification of materials based on bandgap, Fermi energy and Fermi level, Fermi level in semiconductors, Law of mass action, Electrical conductivity of a semiconductor, Hall effect, Superconductivity, Dielectrics, p-n junctions, Zener diode, Solar cells, I-V characteristics, and LEDs)			
Module 2	Quantum Mechanics	Assignment	No. of Classes: 12
(Introduction, de-Broglie hypothesis, Heisenberg's uncertainty principle- statement and physical significance, wave function-properties and physical significance. Time-independent Schrodinger wave equation, Probability density, and normalization of wave function. Wave Function in Ket Notation: Matrix form of wave function, Identity operator, Determination of $I 0\rangle$ and $I 1\rangle$, Pauli Matrices and its operations on 0 and 1 states, Mention of Conjugate and Transpose, Unitary Matrix U, Examples: 2x2 Matrices and their multiplication (Inner Product), Probability, Orthogonality.)			
Module 3	Electromagnetic Theory	Term paper	. No. of classes: 13
(Fundamentals of Vector Calculus. Divergence and Curl of Electric field and Magnetic field (static), Gauss' divergence theorem and Stoke's theorem. Description of laws of Electrostatics, Magnetism, Faraday's laws of EMI, Current Density, Equation of Continuity, Displacement Current (with derivation), Maxwell's equations in vacuum, Numerical Problems. The wave equation in differential form in free space (Derivation of the equation using Maxwell's equations), Plane Electromagnetic Waves in vacuum, their transverse nature.)			
Module 4	Lasers And Optical Fibers	Term paper	. No. of classes :10

(Interactions of radiations with matter, expression for energy density of a system under thermal equilibrium in terms of Einstein's coefficients, conditions for LASER action using Einstein's coefficients, Characteristics of laser, conditions and requisites of laser, Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.			
Targeted Application & Tools that can be used: 1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM. 2. Origin, excel and Mat lab soft wares for programming and data analysis.			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
Assessment Type • Midterm exam • Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.) • Quiz • End Term Exam • Self-Learning 1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons. 2. Write a report on importance of quantum entanglement in supercomputers.			
Text Books: T1: Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications, 2024. T2: Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011. T3: Introduction to Electrodynamics by David J. Griffiths, pearson publisher, 4th edition, 2021 T4: Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019			
Reference Books: R1. Elementary Solid-state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002. R2. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017. R3. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012 Online Resources 1. eBook: https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=doc_title_str&topresult=false&search_within=engineering%20physics 2. Seminar: http://ndl.iitkgp.ac.in/he_document/aklectures/aklectures/11_1_15_978?e=4 * 1. Case Study: http://ndl.iitkgp.ac.in/he_document/libretexts/libretexts/7d72ef9068399eebe6b0cdbaef5ac663 3. https://nucleares.unam.mx/~martinel/griffiths_4ed.pdf			
Topics relevant to "SKILL DEVELOPMENT" : Fundamentals of materials, Lasers and optical fibers. for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.			

Catalogue prepared by	Dr. G. Srinivas Reddy, Dr. Naveen C S, Dr. Sivasankar Reddy, Dr. Mahaboob Pasha
Recommended by the Board of Studies on	11 th BOS conducted on 4 th July 2024
Date of Approval by the Academic Council	st Academic meeting held on _____

Course Code: PHY2505	Course Title: Advanced Materials and Quantum Physics for Engineers Lab Type of Course: Basic Science Course and Laboratory only	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Class 11 and 12 physics					
Anti-requisites	NIL					
Course Description	The laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Apply fundamental principles of optics, solid-state physics, and semiconductor physics to experimentally determine key physical parameters such as wavelength, dielectric constant, Fermi energy, and Stefan’ s constant. CO2: Analyze and interpret current - voltage characteristics of electronic and optoelectronic devices including diodes, Zener diodes, LEDs, transistors, and Hall-effect materials under various biasing and field conditions. CO3: Demonstrate proficiency in using optical and electronic laboratory instruments such as spectrometers, optical fibers, lasers, Hall-effect setups, semiconductor characterization kits, and thermal radiation apparatus. CO4: Analyse experimental data using appropriate graphical methods, error analysis, and proportionality relationships to validate physical laws such as Stefan - Boltzmann law, Hall-effect relations, and semiconductor transport behavior.					

	C05: Evaluate structured laboratory reports by documenting procedures, observations, results, and conclusions with professional and ethical practices.
Course Objective	The objective of this course is to familiarize students with fundamental experimental methods in optics, semiconductor physics, solid-state physics, and thermal radiation through a series of well-designed laboratory experiments. The course aims to develop hands-on skills in precise measurement, device characterization, and use of modern optical and electronic instrumentation, while strengthening the ability to analyze experimental data, verify physical laws, and interpret material and device properties. Through experiential learning, students will enhance their experimental competence, scientific reasoning, and problem-solving skills relevant to engineering and technological applications.

List of Laboratory Tasks:

Course Content:	Total 30 sessions		
Experiment 1	Experimental	Data Collection	Analysis and Interpretation
Determine the wavelength of monochromatic light, such as sodium light, using Newton's rings.			
Experiment 2	Experimental	Data Collection	Analysis and Interpretation
To determine the wavelength of semiconductor diode Laser			
Experiment 3	Experimental	Data Collection	Analysis and Interpretation
To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier.			
Experiment 4	Experimental	Data Collection	Analysis and Interpretation
To study the I-V characteristics of a given zener diode in forward and reverse bias conditions			

Experiment 5	Experimental	Data Collection	Analysis and Interpretation
To study input and output characteristics of a given Transistor			
Experiment 6	Experimental	Data Collection	Analysis and Interpretation
Determination of Fermi energy of copper coil			
Experiment 7	Experimental	Data Collection	Analysis and Interpretation
Determination of Dielectric constant of given material			

Experiment 8	Experimental	Data Collection	Analysis and Interpretation
Calculate the numerical aperture and study the losses that occur in optical fiber cable.			
Experiment 9	Experimental	Data Collection	Analysis
Plotting I-V characteristics in forward and reverse bias for LEDs			
Experiment 10	Experimental	Data Collection	Analysis
Determination of Stefan's constant and verification of Stefan-Boltzmann Law.			
Any 8 experiments will be conducted out of 10			
Continuous Internal Assessment: • Midterm exam • Experimental Evaluation • Viva-voce • Endterm exam Text Book 1. A text book of Engineering physics practical - Dr. Ruby Das 2. Physics lab manual References: Video Links: https://www.youtube.com/@dr.spbasavaraju4939 Books: S. O. Pillai, <i>Solid State Physics</i> , 7th Edition, New Age International Publishers, New Delhi. <i>(Hall Effect, Fermi energy, dielectric properties, semiconductor basics)</i>			
The topics related to Skill Development All the experiments are relevant to Skill Development through Experiential Learning Techniques. This is attained through assessment component mentioned in course handout.			
Catalogue prepared by	Dr. Charan Prasanth S		
Recommended by the Board of Studies on	13 th BOS conducted on 6 th June 2025		
Date of Approval by the Academic Council	st Academic meeting held on _____		

Course Code: CHE2503	Course Title: Applied Chemistry for Engineers	L- T- P- C	3	0	0	3
	Type of Course: Theory only					
Version No.	1.0					
Course Pre-requisites	Basic knowledge of Chemistry					
Anti-requisites	NIL					
Course Description	The primary objective of the course is to introduce the students to the concepts and applications of chemistry in electrical and electronics engineering. The course also aims to enhance the knowledge of chemical composition and properties of chemical molecules as/in electronic materials & devices, advanced renewable energy systems. It will also cultivate an ability to identify chemistry in each of smart engineered materials and interpret solutions for the challenges connected to display and memory systems, sensor and smart technologies, advanced energy storage & conversion systems, nanofabrication and environmental management. It targets to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications.					
Course Objective	The objective of the course is ‘SKILL DEVELOPMENT’ of the student by using participative learning.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1 Apply the band theory of solids for elucidation of types of electronic materials Outline the chemistry behind electronic materials and devices. CO2 Explain the role of photo & electroactive materials in display systems and organic, polymeric and hybrid materials in memory systems. CO3 Explain the role of electrochemical sensors and synthetic materials in modern sensing and packaging solutions. CO4 Analyze various electrochemical energy systems including photovoltaics in terms of their principles, classifications & applications and their waste management for sustainable energy solutions. CO5 Explain the importance of nanomaterials and thin film deposition techniques in device fabrication.					
Course Content:						
Module 1	Introduction to electronic materials Conductors, Semiconductors & Insulators	Case study	Data Collection and analysis	8 Classes		
Conductors, Semiconductors & Insulators: Definition of conductors, semiconductor and insulators based on band theory. Semiconductors: Introduction, production of electronic grade silicon from Czochralski process (CZ) and Float Zone (FZ) methods, Chemical and electronic properties & applications of inorganic semiconductors (SiGe, GaAs, InP). Self-learning topics: Properties and functions of Cu & Quartz.						
Module 2	Chemistry of display & memory systems	Assignment	Data Collection	9 Classes		
Display Systems: Photo and electroactive materials, Liquid crystals for display (LCD) - Introduction, types, principle, properties, Basics of LED: Organic light emitting diode (OLED) and light emitting electrochemical cell (LEC). Memory Systems: Introduction, concepts of electronic memory, Classification of electronic memory device - Transistor, capacitor, resistor, charge transfer and memristor, Types of materials for memory systems - organic molecules, polymeric materials, organic-inorganic hybrid materials, Applications Self-learning topics: Biocomposite based memory devices						

Module 3	Chemistry of sensors & smart materials Sensors	Case study	Data analysis	8 Classes
Introduction, types; chemiresistor, principle and applications of electrochemical sensors with examples (glucose & VOC sensing), advanced sensor technologies mimicking human sensory organs (e-skin, e-nose) MEMS & NEMS – Introduction, components, classification, applications. Smart materials (RFID & IONT): Introduction, applications of carbonaceous/polymeric materials in smart packaging systems and data analysis Self-learning topics: Fullerene as advanced materials in organic electronics, Gas sensor-Application CO sensing				
Module 4	Advanced energy systems & e-waste management Electrochemical energy systems	Case study	Data Collection and analysis	10 Classes
Introduction to electrochemistry Battery - Basic concepts of batteries and characteristics, classification, Lithium-ion batteries; Next generation batteries Supercapacitor - Classification, principle and applications in hybrid vehicles Fuel cells - H₂-O₂ fuel cell, Principle, working and their applications. Green hydrogen - Importance and principle of generation Photovoltaics: Principle, Types (organic & inorganic solar cells, quantum dot sensitized solar cells(QDSSC' s)) E-waste Management & Green Chemistry: Introduction, e-waste hazard, battery waste recycling and management, Carbon footprint and sequestration, 12 principles of green chemistry Self-learning topics: Methanol fuel cell, Metal-air battery				
Module 5	Nanotechnology and device fabrication Nanotechnology	Case study	Data Collection and analysis	10 Classes
Introduction, Classification of nanomaterials based on dimensionality, quantum confinement, Size dependent properties, Synthesis- Sol-gel method for thin films, Synthesis, properties and applications of carbon nanomaterials - CNT & Graphene Nanofabrication: lithography, Nano imprinting and applications, Manufacturing of semiconductor chips Thin Film Deposition Techniques: Principle and applications of Chemical vapor deposition (CVD), Types - Plasma enhanced chemical vapor deposition (PECVD) and MetalOrganic chemical vapor deposition (MOCVD). Self-learning topics: Applications of nanotechnology in Nanoelectronics and health & hygiene.				
Targeted Application & Tools that can be used: Application areas are semiconducting, automobiles, electronics industry Tools: Battery simulation tools (Battery simulator, Quantum ATK)				
Project work/Assignment:				
Assessment Type • Midterm exam • Assignment (Review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.) • Quiz/ Student seminar • End Term Exam • Self-Learning Assignment: 1 Report writing on recent advances in energy storage materials Assignment 2: Identify the nanomaterials/devices you encounter in daily life				
Text Book 1. Wiley, "Engineering Chemistry" , Wiley. 2. Springer, "Introduction to Electronic Materials and Devices" , Springer. 3. Springer, " Textbook of Nanoscience and Nanotechnology" , Springer.				

Reference Books:

- R1. Advanced Semiconducting Materials and Devices, K M Gupta & Nisha Gupta (2016), Springer
- R2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications (2018), Cambridge University Press
- R3. Chemistry in microelectronics, Yannick Le Tiec, 2013, Wiley Publications, ISBN: 9781848214361.
- R4. Electronics properties of materials, Rolf E, Hummel, 2012, Springer Publications New York, 4th Edition, ISBN 9781441981639. Publishers, ISBN: 9781608055425
- R5. Smart nanomaterials for sensor application, Li S, Ge Y, Li H, 2012, Bentham Science
- R6. Energy storage and conversion materials, Skinner S, 2019, Royal society of chemistry, ISBN: 9781788010900.

Online Resources .

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASSED&unique_id=EBSCO95_30102024_97006 2.
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASSED&unique_id=EBSCO95_30102024_48504&xIndex=2 3.
3. <https://research.ebsco.com/c/n5guci/search/details/sfc3dnpvkb?db=nlebk&limiters=None&q=chemistry%20of%20materials> 4. <https://www.mdpi.com/books/pdfview/book/1069> 5.
4. <https://www.mdpi.com/books/pdfview/book/333> 6.
5. <https://www.bloomsburycollections.com/book/fuel-an-ecocritical-history/> 7.
- <https://eng.oversea.cnki.net/kns55>

Skill Sets Students should have skills in electrochemistry, materials science, energy storage, and semiconductor fabrication for optimizing electronic and electrical systems.

Catalogue prepared by	Department faculties
Recommended by the Board of Studies on	BOS- 18 th Dec 2024
Date of Approval by the Academic Council	

Course Code: CHE2504	Course Title: Applied Chemistry for Engineers Lab	L-T-P- C	0	0	2	1
	Type of Course: Laboratory only					
Version No.	1.0					
Course Pre-requisites	Before undertaking this Engineering Chemistry Lab course, students are expected to possess foundational knowledge of chemistry, including an understanding of acids and bases, oxidizing and reducing agents, various types of titrations, and the proper use of laboratory glassware. Additionally, students should be familiar with handling chemicals and glassware safely and adhering to essential laboratory safety precautions					
Anti-requisites	Basic knowledge of practical chemistry					
Course Description	The laboratory course aims to develop experimental skills and apply fundamental chemical principles to address chemistry-related problems in engineering. The experiments are carefully designed to complement the theoretical concepts covered in lectures, providing hands-on experience to deepen understanding and reinforce learning. This course is designed to cater to Environment and Sustainability.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of “Engineering Chemistry Practical” and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.
Course Outcomes (COs)	On successful completion of the course, students shall be able to: CO1 Examine the number of acids in domestic and industrial waste using conductometric and pH sensors. CO2 Determine the amount of metal ions in electronic waste using potentiometric and optical sensors. CO3 Employ the suitable titration method to quantify the metal ions in industrial waste. CO4 Apply viscometry method to find the viscoelastic property of organic solvents. CO5 Recognize the suitable method to prepare, fabricate and recover the industrially important materials
Course Content:	1. Conductometric method of determination of strength of a strong acid in battery electrolyte (Conductometric sensor). 2. Determination of pKa of organic acid in industrial wastewater using pH meter (pH sensor). 3. Estimation of Iron using potassium dichromate by Potentiometric method (Electrochemical sensor). 4. Colorimeter estimation of copper in industrial effluent (optical sensor). 5. Conductometric method for the determination of strength of a mixture of acids (e-waste recycling). 6. Determination of viscosity coefficient of lubricant by Ostwald’s viscometer (Viscoelastic property). 7. Iodometric estimation of metals (copper) in electronic discards. 8. Estimation of iron using Std. Potassium permanganate solution. 9. Flame photometric estimation of sodium in e-waste management (Optical sensor) 10. Synthesis of polyaniline for gas sensor application (Demonstration experiment). 11. Recovery of precious metals from e-waste (Electroless plating) (Demonstration experiment) 12. Fabrication of materials by 3D printing techniques -Demo only (digital technologies into manufacturing processes) Any 8 experiments will be conducted out of 12
Continuous Internal Assessment:	Midterm exam · Experimental Evaluation · Viva-voce · End Term exam
Text Book	1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S. Chand Publications, New Delhi (2022) 2. Vogel’s text book of practical organic chemistry 5th edition 3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications. 4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi 5. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
References:	R1. Engineering Chemistry Laboratory Manual (English, Paperback, Dr Manoj Kumar Solanki), Edu creation Publishing

E-resources:

1. <https://books-library.net/files/download-pdf-ebooks.org-kupd-679.pdf>

Video Links:

<https://www.youtube.com/watch?v=gd1YQr-74sw> 2.
<https://www.youtube.com/watch?v=wVJ8WQax0rQ> 3.
<https://www.youtube.com/watch?v=aWwEGCNtKwk> 4.
https://www.youtube.com/watch?v=JhBs_8DrPYo 5.
https://www.youtube.com/watch?v=5bFAx2b_6A8 6.
https://www.youtube.com/watch?v=_IVVZnAFrM 7.
<https://www.youtube.com/watch?v=BBhuXOh9vOM> 8. <https://www.youtube.com/watch?v=j-nW3Jhc794>

The topics related to Skill Development

All the experiments are relevant to Skill Development through Experiential Learning Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Faculty members of Chemistry
Recommended by the Board of Studies on	13TH BOS held on 06th June 2025
Date of Approval by the Academic Council	26th AC held on 25th July 2025

ESC Basket

Course Code: CIV1200	Course Title: Foundations of Integrated Engineering Type of Course: Theory Only	L-T- P- C	2	0	0	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the foundational principles, tools, and approaches essential to modern engineering practice. The course also integrates sustainability and systems thinking, highlighting the role of engineers in achieving sustainable development through material efficiency, sustainable design, and case-based learning. Students will gain exposure to emerging technologies such as IoT, robotics, AI, machine learning, and 3D printing. Knowledge in digital modeling, project planning, simulation, and programming are developed to prepare students for integrated engineering workflows					
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1- Explain core concepts of problem-solving, ethics, environment, and safety in engineering projects. CO2 - Describe sustainability principles and the engineer's role in sustainable development.					

	CO3 - Apply sustainability assessment tools to evaluate the environmental impact. CO4 - Explain the basic concepts of automation, IoT, robotics, AI, machine learning, and 3D printing in the context of engineering applications. CO5 - Describe the functions of digital modeling, simulation, and project management tools used in integrated engineering projects.			
Course Content:				
Module 1	Foundations of Engineering Practice	Assignment	Case studies	8 Sessions
Basics of Engineering Problem Solving and Engineering Mechanics, MultiDisciplinary Project Collaboration, Creative Thinking and Innovation in Engineering, Ethics, Environment, and Social Responsibility, Managing Cost, Safety, and Risks in Projects.				
Module 2	Sustainability and Systems Thinking in Engineering:	Assignment	Article Review	10 Sessions
Introduction to Sustainability and Systems Thinking, Role of Engineers in Driving Sustainable Development, Sustainable Engineering Tools and Approaches, Energy and Material Sustainability in Engineering, Sustainable Design Principles, Practices and Case Studies				
Module 3	Mechanical Engineering in Action	Assignment & Quiz	Data Collection	12 Sessions
Introduction to Automation and Smart Technologies, Basics of IoT and Robotics, Introduction to AI and Machine Learning, Fundamentals of 3D Printing and Its Uses. Design and drafting using digital modeling for components, systems, and structures; Project planning and management - scheduling, resource allocation, and tracking; Simulation and analysis for virtual testing of engineering problems; Programming and scripting for automation, problem solving, and system control.				
Targeted Application & Tools that can be used: Application Areas include Interdisciplinary problem-solving, Smart city planning, disaster management, Robotics prototyping, renewable energy systems, Wearable health tech, smart grids, Secure cloud systems. Tools: 3D Printers, Autocad, Tinkercad, ArcGIS / QGIS, Arduino/Raspberry Pi				
Text Books: T1: William C Oakes & Les L Leone, "Engineering Your Future: A Comprehensive Introduction to Engineering", Oxford University Press, 9th Edition, 2018 T2: Allen, D. T. and Shonnard, D. R., "Sustainability Engineering: Concepts, Design and Case Studies" , Prentice Hall, 1st Edition, 2011. T3: Bradley. A.S; Adebayo, A.O., Maria, P., "Engineering applications in sustainable design and development" , CL Engineering, 2015 T4: Ian Gibson, David Rosen, & Brent Stucker, "Additive Manufacturing Technologies" , Springer, 3rd Edition, 2021 T5: Sudip Misra, "The Internet of Things: Enabling Technologies, Protocols, and Use Cases", Wiley, 2nd Edition, 2022				

Reference Books:

- R1: Bradley. A.S; Adebayo, A.O., Maria, P., Engineering applications in sustainable design and development, CL Engineering. 2015
- R2: Robert McGinn, "The Ethical Engineer: Contemporary Concepts and Cases", Princeton University Press, 1st Edition, 2020
- R3: David Buchla, "Renewable Energy Systems: A Smart Energy Systems Approach", Pearson, 2nd Edition, 2023
- R4: Charles Platt, "Make: Electronics: Learning Through Discovery", Make Community, 3rd Edition, 2021.

Online Resources

1. New Industry 4.0 Advances in Industrial IoT and Visual Computing for Manufacturing Processes
<https://www.mdpi.com/books/reprint/2109-new-industry-4-0-advances-in-industrial-iot-and-visual-computing-for-manufacturing-processes>
2. Additive Manufacturing Technologies and Applications
<https://www.mdpi.com/books/reprint/462-additive-manufacturing-technologies-and-applications>
3. Sustainability in Construction Engineering
<https://www.mdpi.com/books/reprint/754-sustainability-in-construction-engineering>

Catalogue prepared by	Dr. Nakul Ramanna, Dr. Rajiv Ranjan Singh, Mr. N. Gopalakrishnan, Mr. Ajay H A
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MEC1006	Course Title: Engineering Graphics Type of Course: 1] Professional Core Course 2] Theory	L-T- P- C	2	0	0	2
Version No.	1.2					
Course Pre-requisites	NIL					
Anti-requisites	CAMD					
Course Description	The course is designed with the objective of giving an overview of engineering drawing with the help of software tools. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings with computerized drafting tools. Computerized drafting provides accurate and easily modifiable graphic entities, easy data storage, easy retrieval facility and it enhances creativity. It will expose students to the concept of engineering drawing and teach them to draw different views of planes and solids in different orientations. They will learn to create drawing layouts, dimensioning, the theory of projection, orthographic projection of points, lines, planes and solids, isometric projection and be introduced to the development of surfaces.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Engineering Graphics" and attain SKILL DEVELOPMENT through Problem solving methodologies.					

Course Outcomes	On successful completion of this course the students shall be able to:			
	CO1 Identify and interpret the basic principles, symbols, and conventions of engineering graphics, including lines, scales, lettering, and dimensioning.			
	CO2 Construct basic geometrical shapes and engineering curves (such as ellipse, parabola, cycloid) using appropriate drawing instruments and techniques			
	CO3 Apply orthographic projection techniques to draw points, lines, planes, and solids in various orientations.			
	CO4 Generate and interpret sectional views, true shapes, and developments of surfaces of simple objects and solids.			
	CO5 Visualize and convert 3D objects into isometric views and vice versa from orthographic projection			
	CO6 Analyse orthographic and isometric views to visualise, interpret, and evaluate the geometry of objects including hidden detail			
Course Content				
Module 1	Introduction to Drawing	Assignment	Standard technical drawing	2 sessions
Topics: Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Line conventions, dimensioning, Selection of drawing sheet size and scale.				
Module 2	Orthographic projections of Points, Straight Lines and Plane Surfaces	Assignment	Projection methods Analysis	13 sessions
Topics: Introduction, Definitions - Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points in all 4 quadrants. Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces - triangle, square, rectangle, pentagon, hexagon and circle - in different positions inclined to both the planes using change of position method only.				
Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	10 sessions
Topics: Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection).				
Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	5 sessions
Topics: Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.				

Targeted Application & Tools that can be used:

Application Area is in understanding and interpreting an object in various positions and converting it into a technical drawing which can be universally accepted.

Professionally Used Software: AutoCAD

Text Book:

1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.

References:

1. K.R. Gopalakrishna, "Engineering Graphics" , Subhash Publishers, Bangalore.
2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

Web Resources:

[Knimbus - Your Library. Anywhere, Anytime.](#)

Topics relevant to "SKILL DEVELOPMENT": Projection in first and third angle for SKILL DEVELOPMENT through Problem Solving methodologies. This is attained through the assessment component mentioned in the course handout.

Catalogue prepared by

Mr. Yeshwanth D

Recommended by the Board of Studies on

BOS NO: 15th BOS held on 27/08/2022

Date of Approval by the Academic Council

Academic Council Meeting No. 18, Dated 03/08/2022.

Course Code: EEE1200	Course Title: Basics of Electrical and Electronics Engineering. Type of Course: Engineering Science - Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This is a fundamental Course is designed to know the use of basics of electrical and electronics engineering principles in various fields of Engineering. The course emphasises the characteristics and applications of electrical and electronic devices. The course also emphasizes the working, analysis of electrical circuits. Additionally, this course ensures a foundation for future interdisciplinary applications in electrical machines manufacturing, power system, robotics, automation, communication, and oil refineries.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1 Solve DC and AC electrical circuits using KVL and KCL. CO2 Calculate various electrical parameters in AC systems					

	CO3 Illustrate the working principle of the transformer, induction machine, and special machines to obtain characteristics. CO4 Analyze the behavior of the semiconductor diode, zener diode, and rectifier circuit. CO5 Determine the operating parameters of BJT and MOSFET.			
Course Content:				
Module 1	Introduction to Electrical Circuits	Assignment/ Quiz	Numerical solving Task	9 Sessions
DC Circuits: Ohm's law, Kirchhoff's voltage and Kirchhoff's current laws, concept of circuit and network, types of elements, series-parallel connections of a resistive network. Electromagnetic Induction: Faraday's laws of electromagnetic induction, types of inductance, self-inductance, Mutual inductance, and coefficient of coupling, Practical Applications.				
Module 2	AC Circuits	Assignment/ Quiz	Memory Recall based Quizzes	9 Sessions
AC Circuits: Generation of sinusoidal voltage, Basic terminologies in AC quantity, Analysis of R, L, C, Series RL, Concept of active power, reactive power, and power factor, real-world applications. Three-phase AC Circuits: Introduction to the three-phase system, Advantages of three-phase system over the single-phase system, and relation between line and phase values in Star and Delta connections, Practical Applications.				
Module 3	Fundamentals of Electrical Machines	Assignment/ Quiz	Memory Recall-based Quizzes	9 Sessions
Electrical Machines: Single-phase transformers: Principle of operation, Types and construction of transformers. EMF equation. AC Motor: Principle Operation of Induction Motors and its characteristics, Industrial and Domestic Application. Special Machines: BLDC, Stepper motor and applications.				
Module 4	Semiconductor and Diode Applications	Assignment/ Quiz	Numerical solving Task	9 Sessions
Semiconductor and Diode Applications: Types of semiconductors (intrinsic and extrinsic), P-N junction diode - Ideal and practical behaviour, Diode forward and reverse characteristic, and Zener diode and its characteristics, half-wave and full-wave rectifier, applications. JFET (Construction, principal of Operation and Volt -Ampere characteristics). Pinch- off voltage, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes.				
Module 5	Transistor and Switching Device	Assignment/ Quiz	Numerical solving Task	9 Sessions
Transistor characteristics, Current components, types of BJT Configurations and their current gains. Operating point, Applications. MOSFET: Construction, Principle of Operation, Depletion MOSFET, Comparison of BJT and MOSFET, Practical Applications.				
Text Books: T1: Kothari D. P. & Nagrath I. J., "Basic Electrical and Electronics Engineering" , Tata McGraw Hill Education. T2: Theraja B.L. and Theraja A.K., "A Textbook of Electrical Technology: Basic Electrical				

Engineering” in S.I. System of Units, 23rd ed., New Delhi: S. Chand, 2002. T3: A.P.Malvino, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007. T4: J. Millman, C. C. Halkias and C. D. Parikh, “Millman’s Integrated Electronics” , McGraw Hill Education, 2nd Edition.	
Online Resources 1. https://presidencyuniversity.linways.com 2. https://www.digimat.in/nptel/courses/video/108105112/L01 “Fundamentals of Electrical Engineering - Basic Concepts, Examples” 3. Seminar Topic: https://nptel.ac.in/courses/108/105/108105153/ “Electrical Measurements” 4. Video lectures on “Electronic Devices” by Prof. Dr. A. N. Chandorkar, IIT Bombay http://www.satishkashyap.com/2013/03/video-lectures-on-electron-devices-by.html 5. Video lectures on “Analog Electronic Circuit” , by Prof. Shouribrata Chatterjee, IIT Delhi 6. https://www.youtube.com/watch?v=9g9dowLjmCA&list=PLp6ek2hDcoNDaw1BehPFazZ5ogPV8UIQa 7. Video lectures on “PN Junction Diodes” , by Prof. Chitrlekha Mahanta, IIT Guwahati. https://www.youtube.com/watch?v=L28F1Oenyds	
Topics relevant to “SKILL DEVELOPMENT”: Performing suitable experiments to compute the Electrical and electronics circuit parameters, performance operation of Machines, and semiconductor devices for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course plan.	
Catalogue prepared by	Mr. Sunil Kumar, Dr. Ashutosh Anand, Dr. Dharmesh Srivastav, Dr. Azra Jeelani
Recommended by the Board of Studies on	19 th BOS held on 3 rd July 2024
Date of Approval by the Academic Council	24 th Academic Council Meeting held on 03/08/2024.

Course Code: EEE1251	Course Title: Basics of Electrical and Electronics Engineering Laboratory Type of Course: ESC - Laboratory	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	This fundamental laboratory provides an opportunity to validate the concepts taught in the basics of electrical and electronics engineering and enhances the ability to visualize real system performance, using both hardware and simulation tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain Skill Development through Experiential Learning techniques.					
Basic skill sets required for the laboratory	The students shall be able to develop: 1) An attitude of enquiry. 2) Confidence and ability to tackle new problems. 3) Ability to interpret events and results. 4) Ability to work as a leader and as a member of team. 5) Assess errors and eliminate them. 6) Observe and measure physical phenomenon.					

	7) Write Reports. 8) Select suitable equipment, instruments and materials. 9) Locate faults in systems. 10) Skills for setting and handling equipment. 11) The ability to follow standard test procedures. 12) An awareness of the need to observe safety precautions. 13) To judge magnitudes without actual measurement.
Course Outcomes	On successful completion of the course, the students shall be able to: 1. Demonstrate the behavior of passive elements and fundamental electrical circuit laws 2. Determine the power factor, impedance, and phase relationship of R and RL loads under AC supply conditions. – 3. Develop electrical circuits and three-phase supply systems using MATLAB/Simulink to study resistance, voltage, and current characteristics 4. Analyze the performance characteristics of electrical machines, including single-phase transformers and three-phase induction motors, under different operating conditions. 5. Examine the output characteristics and performance parameters of half-wave and full-wave rectifiers. 6. Illustrate the performance characteristics of Zener diode and MOSFET under different operating conditions.
Course Content:	List of Laboratory Tasks: Experiment No 1: Familiarization of passive elements. Level 1: Identify and understand the function and ratings of basic passive elements. Level 2: Study the behavior of passive elements in simple electrical circuits by measuring voltage, current, and impedance. Experiment No 2: Experimental Verification of Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL). Level 1: Study and Verify KVL and KCL for the given electrical Circuit. Experiment No 3: Determination of Power Factor, and Impedance for R and RL Loads. Level 1: Determine the power factor and impedance of R and RL loads under steady-state AC supply conditions. Level 2: Analyze the effect of inductance on power factor, impedance, and phase angle for RL loads under varying load conditions. Experiment No 4: Modeling and Simulation of effective resistances in different circuit connections Using Simulink. Level 1: Model and simulate series and parallel resistor circuits in Simulink and determine their effective resistance. Level 2: Analyze the effect of different resistor combinations on total resistance, current distribution, and voltage drop. Experiment No 5: Simulation and analysis of line and phase voltages in Star-connected and Delta- connected supply systems. Level 1: Model and simulate star-connected and delta-connected three-phase supply systems and observe line and phase voltages. Level 2: Analyze and compare the relationship between line and phase voltages in star and delta connections. Experiment 6: Determination of transformation ratio of a Single-Phase Transformer Under different tapping conditions. Level 1: Determine the transformation ratio of a single-phase transformer under no-load condition for various tap settings.

	Level 2: Analyze the effect of different tapping conditions on secondary voltage, regulation, and transformer performance. Experiment No. 7: Study of the speed-torque characteristics of a Three-Phase Induction Motor. Level 1: Study and analyze the speed–torque characteristics of a three-phase induction motor. Level 2: Evaluate the effect of supply voltage and current on motor performance parameters such as slip, and torque. Experiment 8: Performance Analysis of Half-Wave and Full-Wave Rectifier Circuits Using Simulink. Level 1: Model and simulate half-wave and full-wave rectifier circuits in Simulink and analyze their output waveforms. Level 2: Evaluate and compare rectifier performance parameters such as ripple factor, efficiency, and output voltage. Experiment 9: Study of the characteristics of a Zener Diode. Level 1: Study the forward and reverse V–I characteristics of a Zener diode using DC analysis. Level 2: Analyze the Zener breakdown characteristics and determine the Zener voltage and regulation behavior. Experiment 10: Study of the Output and Transfer Characteristics of a MOSFET. Level 1: Study, analyze and implement the output characteristics of a MOSFET under different gate-source voltage conditions and observe their results. Level 2: Analyze the transfer characteristics of a MOSFET and evaluate key parameters such as threshold voltage and transconductance.
Targeted Application & Tools that can be used: Targeted Applications: Application area includes all electrical and electronic circuits (power supply unit, regulator unit, embedded devices, hardware electronics etc.). The students will be able to join a profession which involves basics to high level of electronic circuit design. Professionally Used Software: MATLAB SIMULINK Besides these software tools hardware equipment such as Multimeters, Function Generators, Power Supplies, Oscilloscopes etc., can be used to perform component/circuit testing and analysis.	
Course Material 1. Basics of Electrical and Electronics Engineering Laboratory Manual, Presidency University, Bengaluru.	
Text Book: 1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, 4th Edition, McGraw Hill Education, New Delhi, 2019. 2. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology, Volume-I: Basic Electrical Engineering in SI Units, 24th Edition, S. Chand Publishing, New Delhi, 2024.	
References 1. John Hiley, Keith Brown and Ian McKenzie-Smith, Hughes Electrical and Electronic Technology, 12th Edition, Pearson Education, 2016. 2. S. K. Bhattacharya and D. Devaraj, Basic Electrical and Electronics Engineering, 2nd Edition, Pearson Education India, 2017. 3. T. K. Nagsarkar and M. S. Sukhija, Principles of Basic Electrical Engineering, 1st Edition, Oxford University Press, 2018. 4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 12th Edition, Pearson Education, 2019. 5. A. K. Maini and Varsha Agrawal, Electronic Devices and Circuits, 2nd Edition, Wiley India, 2019. 6. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2019.	
Online Resources: 1. https://presidencyuniversity.linways.com 2. https://www.digimat.in/nptel/courses/video/108105112/L01 “Fundamentals of Electrical Engineering - Basic Concepts, Examples” 3. Video lectures on “Electronic Devices” by Prof. Dr. A. N. Chandorkar, IIT Bombay http://www.satishkashyap.com/2013/03/video-lectures-on-electron-devices-by.html	

4. NPTEL lectures on “Rectifiers”, by Prof. G. Bhuvaneswari, IIT Delhi https://nptel.ac.in/courses/108102145 5. NPTEL Lectures on “Electrical Machines II”, by Prof. G. Sridhara Rao, IIT Madras. https://nptel.ac.in/courses/108106072	
Topics relevant to “EMPLOYABILITY SKILLS”: All the experiments which are listed are for Skill Development through Experiential Learning Techniques . This is attained through the assessment component mentioned in course handout. Topics relevant to “HUMAN VALUES & PROFESSIONAL ETHICS”: Standard test methods, safety procedure.	
Catalogue prepared by	Dr. Priti Das
Recommended by the Board of Studies on	BoS No 22, Held on 18/12/2025
Date of Approval by the Academic Council	

Course Code: ECE1512	Course Title: Design Thinking in Practice	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces students to Design Thinking frameworks for identifying real-world user needs and transforming them into innovative technology solutions using embedded systems, sensors, IoT platforms, and AI-enabled computing devices. The course blends human-centered innovation methodologies with hands-on development using Arduino, Aries, ESP32, Raspberry Pi, NVIDIA Jetson, and GPU-based embedded platforms. Students will learn problem identification, ideation, rapid prototyping, sensor integration, edge AI, and intelligent system development for applications in smart automation, healthcare, agriculture, robotics, and Industry 5.0. The course emphasizes experiential and project-based learning to build future-ready innovators capable of developing scalable, intelligent, and socially impactful products.					
Course Objective	The objective of the course is to enhance students’ employability skills through participative learning techniques by integrating Design Thinking, embedded systems, IoT, and AI technologies to develop innovative, intelligent, and socially impactful real-world solutions.					

Course Outcomes	On successful completion of the course, the students shall be able to Explain the principles, framework, and process of design thinking Formulate Engineering Problem from user challenges, customer expectations, and market opportunities using design thinking process. Analyze the Engineering Problem using the basic concepts of microcontroller and sensory devices. Find alternate methods to solve the engineering problem by working with embedded computing platforms. Develop functional prototypes using embedded boards, sensors, and an intelligent system for the chosen method Validate prototype performance through testing, user feedback, and iterative improvements.			
Course Content				
Module 1	Introduction to Design Thinking			6 Sessions
Introduction to Design Thinking – Importance of Design Thinking – History of Design Thinking- Design Thinking Framework - Design Thinking process - Empathise –Define – Understanding Purpose - Ideate - What is Creativity? -Thinking Differently – Basic Rules of Design Thinking – The Creativity Heart Set – Everyone is a Designer - Activity-based with case studies				
Module 2	Basic Concepts of Microcontrollers and Sensory Devices			8 Sessions
Introduction to Arduino, ESP and NodeMCU - Pin Configuration and Architecture - Device and Platform Features - Concept of Digital and Analog Ports - Familiarizing with Arduino Interfacing Board – Programming using Arduino IDE and Embedded C - Datatypes and Variables - I/O Functions – Sensors, types and its applications - Humidity Sensor - Temperature Sensor - Water Detector / Sensor - PIR Sensor - Ultrasonic Sensor - Connecting Switches and Actuators - Sensor Interface with ESP Microcontroller - Various Cloud Platforms				
Module 3	Working with Embedded Computing Platforms and 3D printing technology			8Sessions
Introduction to Raspberry Pi boards, pin diagram, different types of Raspberry Pi boards and their applications, Configuration of Raspberry Pi boards - LED and switch control – Exploring various libraries and their functions. GPU fundamentals – Configuration of Jetson Nano board, Working with H200 GPU Servers. Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications. Introduction to online Simulators: Working with Tinker CAD Simulator.				
Module 4	Prototype Development and Validation Techniques			8 Sessions
Importance of Prototyping in Design Thinking – Concept Refinement Using Prototypes – From Idea to Functional Prototype – User Testing and Validation – Iteration and Design Optimization – Prototype Readiness for Product Development (DFM & Market Feasibility – overview) – Activity-based with case studies.				
Prototype Development Tasks: Total Sessions: 30 - Smart Illumination System Design using Arduino - Intelligent Plant Health Monitoring System. - Aries Rover Drive and Control System Development - IoT-Based Environmental Intelligence System using ESP32 - Edge Computing Platform Setup using Raspberry Pi				

6. Raspberry Pi-Based Smart Lighting Controller
7. VoiceX: AI-Powered Smart Home Automation System
8. VisionAI: Intelligent Object Recognition System.
9. Smart Traffic Management System using NVIDIA Jetson Nano
10. High-Performance AI Vision Analytics using H200-GPU Computing.
11. Digital-to-Physical Product Prototyping through CAD and Additive Manufacturing.

Topics: Types of embedded boards, Thonny Python, Python IDLE, sensors, 3D Printer, Jetson Nano board, GPUs

Targeted Application & Tools that can be used:

Application Area:

Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino, Aries, ESP32, Raspberry Pi, and sensors can be applied. The flexibility and affordability of all embedded boards, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: Students can use open-source software, such as Arduino IDE, Blynk console, Tinker CAD, Thonny Python, Python IDLE, etc.

Project work/Assignment:

- **Projects:** At the end of the course, students will be completing the project work on solving many real-time problem statements on different domains, such as women-centric, agritech, medtech, climate cell, robotics, drones, and smart cities etc.
- **Book/Article review:** At the end of each module, a book reference or an article topic will be given to an individual or a group of students. They need to refer to the library resources and write a report on their understanding of the assigned article in an appropriate format. [Presidency University Library Link](#)
- **Presentation:** There will be a review presentation (Phase 1, Phase 2, and Phase 3) from among the students' groups, where the students will be given a project, and they have to demonstrate the working and discuss the applications for the same

Textbook(s):

1. Thinking Design by S Balaram. New Delhi [India]: Sage Publications Pvt. Ltd. 2010. eBook. Database: eBook Collection (EBSCOhost)
2. Monk Simon, "Programming Arduino: Getting Started with Sketches", McGraw-Hill Publications, Second Edition
3. Monk Simon "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", Publisher(s): O'Reilly Media, Inc., ISBN: 9781098130923, Fourth Edition.
4. CUDA by Example: An Introduction to General-Purpose GPU Programming. *CUDA by Example: An Introduction to General-Purpose GPU Programming*. Addison-Wesley Professional, 2010.

References:

1. Design Thinking by Clarke, Rachel Ivy. Series: Library Futures, Vol. 4. Chicago: ALA Neal-Schuman. 2020. eBook., Database: eBook Collection (EBSCOhost)
2. Neerparaj Rai, "Arduino Projects for Engineers," BPB Publishers, first edition, 2016.
3. Stewart Watkiss "Learn Electronics with Raspberry Pi" Apress Berkeley, CA. Second edition, 2020. ISBN978-1-4842-6348-8
4. Jo Prusa, "Basics of 3D printing", Prusa Research, 3rd edition.
5. Volker Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi (Series in Sensors)", CRC Press, 1st Edition. 2018.
6. Professional CUDA C Programming. *Professional CUDA C Programming*. Wrox Press, 2014.

Online Resources (e-books, notes, PPTs, video lectures, etc.):

1. Arduino trending Projects - <https://www.projecthub.arduino.cc>
2. Introduction to Arduino - https://onlinecourses.swayam2.ac.in/aic20_sp04/preview
3. Case studies on Wearable technology - <https://www.htciitm.org/wearables>
4. Raspberry Pi Projects - <https://magpi.raspberrypi.com/articles/category/tutorials/>
5. Introduction to internet of things <https://nptel.ac.in/courses/106105166>
6. Getting Started with Jetson Nano - <https://www.youtube.com/watch?v=DVfmw3Ftu3I>

E-content:

1. Tim Brown, "Design Thinking," Harvard Business Review, vol. 86, no. 6, pp. 84–92, Jun. 2008.
2. Rolf Faste, "Ambidextrous Thinking," in Innovations in Mechanical Engineering Curricula for the 1990s, American Society of Mechanical Engineers, 1994, pp. 1–6.
3. M. H. Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, and Pragya Singh, "IoT Based Smart Security System Using Arduino," *Journal of Emerging Technologies and Innovative Research (JETIR)*, vol. 8, no. 8, Aug. 2021.
4. Basil and Eliza Sawant, S. D., "IoT-Based Traffic Light Control System Using Raspberry Pi," in *Proceedings of ICECDS 2017*, 2017. DoI: 10.1109/ICECDS.2017.8389604.
5. Espressif Systems, "ESP32 Series Datasheet," 2024.
6. Josef Průša, "Open-Source 3D Printers and the RepRap Project," *RepRap Magazine*, 2018.

Topics relevant to the development of "SKILL": System design for achieving Sustainable Development Goals.

Catalogue prepared by	Dr. Divyarani M S, Dr. M Manikandan
Recommended by the Board of Studies on	BoS Number:
Date of Approval by the Academic Council	Academic Council Meeting No. ____ dated on _____

Course Code: CSS2280	Course Title: C Programming and Data Structures Type of Course: Theory		L- T-P- C	3	0	0	3
Version No.	2.0						
Course Prerequisites	CSE1004 Problem Solving using C						
Anti-requisites	NIL						
Course Description	C Programming and Data Structures course aims to teach fundamental programming concepts in C, alongside essential data structures for organizing and manipulating data efficiently. The course covers topics from C such as data types, control structures, arrays, pointers, dynamic memory management, and structures. Various data structures such as arrays, linked lists, stacks, queues, trees and graphs with sorting and searching algorithms are also covered. An application of these data structures is AI are also covered at conceptual level.						
Course Objective	The objective of this course is to equip learners with a comprehensive understanding of the fundamental data structures using C. Through theoretical knowledge and practical implementation, students will gain the ability to design, implement, and apply efficient data storage and manipulation techniques to solve computational problems and AI applications effectively. This course aims to develop strong problem-solving skills and a foundation for further studies in computer science.						
Course Outcomes	On successful completion of the course the students shall be able to: C.O.1: Explain the various programming constructs of C [Understand] C.O.2: Implement various linear data structures like arrays, linked lists, stacks, and queues using C to solve specific problems. [Apply] C.O.3: Apply non-linear data structures such as binary trees and graphs in problem solving [Apply] C.O.4: Implement different sorting and searching algorithms in C for efficient data manipulation. [Apply] C.O.5: Explain the role of various data structures in AI applications. [Understand]						
Course Content:							
Module 1	C Programming Constructs	Assignment – Implementation					12 Sessions
Topics: Data Types, Variables, Operators, Expressions and Statements: Conditional and loops, Arrays, Pointers, Dynamic memory management, Structures – array of structures, structure pointers, Functions: call by value, call by reference, functions with pointers and functions with structures, recursive functions.							
Module 2	Linear Data Structures	Assignment					12 Sessions
Topics: Stack -implementation and applications – infix to postfix, expression evaluation, Queue - implementation, applications, intro to Priority Queues, circular queues. Linked list : Singly, Doubly-Linked Lists, Circular Linked List, applications							
Module 3	Non-Linear Data Structures	Assignment					8 Sessions
Topics: Trees, Binary Trees, Tree Traversals, Expression Trees, Binary Search Tree, Graphs: types, representation-adjacency matrix/list, traversals, algorithms, applications							
Module 4	Searching and Sorting	Assignment					8 Sessions

Topics: Searching : Linear Search, Binary Search, Hash search - Hash Functions, Separate Chaining, Open Addressing, Linear Probing, Intro - Quadratic Probing, Sorting: Insertion Sort, Quick Sort, Merge Sort				
Module 5	Data Structures and Algorithms in AI	Assignment		5 Sessions
Topics: Overview of AI, machine learning (ML), deep learning (DL) and reinforcement learning (RL) Role of arrays, matrices and tensors for efficient data management in AI, Applications of graphs in AI – knowledge graphs, social network analysis, path finding – using Dijkstra’s algorithm, graph traversal algorithms in web crawlers Bloom filters and probabilistic data structures – intro, applications in recommendation systems, malware and bot detection.				
Targeted Application & Tools that can be used: Implementation of the concepts using Turbo-C/WSL – Windows subsystem for Linux/VS Code				
Text Book(s): T1: Kanetkar Y, “Let us C”, 20th Ed, BPB Publications, 2024. T2: Kanetkar Y, “Data Structures through C”, 4th Ed, BPB Publications, 2022. T3: Balaguruswamy E, “C Programming and Data Structures”, 4th Ed, Tata McGraw-Hill, 2009.				
Reference(s): R1. A. A. Puntambekar, "C Programming and Data Structures for BE Anna University R21CBCS (III-ECE/EEE - CS3353)", Technical Publications, 2022. R2. Anshuman Mishra, "Data Structures and Algorithms for AI and ML", Asia Pacific, 2025. R3. Amitava Nag, Jyoti Prakash Singh, "Data Structures and Algorithms Using C", S. Chand Publishing, 2011. R3. B.K. Mathan Nagan and T. Mahalakshmi, "Programming in C and Data Structures", Charulatha Publications, 2011. R4. Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures A pseudocode approach using C", Thomson Learning, 2005				
E-Resources/Web Resources 1. EBook: https://presiuniv.knimbus.com/user#/home 2. https://onlinecourses.nptel.ac.in/noc22_cs40/preview 3. https://onlinecourses.swayam2.ac.in/nou23_cs13/preview 4. https://opensa-server.cs.vt.edu/ODSA/Books/vt/cs5040-3777c729-6b55-4f8d-8efd-548985c00deb/fall-2023/CS5040F23/html/index.html 5. Data Structures by Geeta TV, https://ebooks.inflibnet.ac.in/csp01/				

Course Code: CSS2281	Course Title: C Programming and Data Structure Lab Type of Course: Lab	L- T-P- C	0	0	4	2
Version No.	2.0					
Course Prerequisites	CSE1004 Problem Solving using C					
Anti-requisites	NIL					
Course Description	C Programming and Data Structures course aims to teach fundamental programming concepts in C, alongside essential data structures for organizing and manipulating data efficiently. The course covers topics from C such as data types, control structures, arrays, pointers, dynamic memory management, and structures. Various data structures such as arrays, linked lists, stacks, queues, trees and graphs with sorting and searching algorithms are also covered. An application of these data structures is AI are also covered at conceptual level.					
Course Objective	The objective of this course is to equip learners with a comprehensive understanding of the fundamental data structures using C. Through theoretical knowledge and practical implementation, students will gain the ability to design, implement, and apply efficient data storage and manipulation techniques to solve computational problems and AI applications effectively. This course aims to develop strong problem-solving skills and a foundation for further studies in computer science.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the various programming constructs of C [Understand] CO2: Implement various linear data structures like arrays, linked lists, stacks, and queues using C to solve specific problems. [Apply] CO3: Apply non-linear data structures such as binary trees and graphs in problem solving [Apply] CO4: Implement different sorting and searching algorithms in C for efficient data manipulation. [Apply] CO.5: Apply the appropriate data structures in AI applications. [Apply]					
Course Content:						
Module 1	C Programming Constructs	Assignment – Implementation				8 Sessions
1. Write a C program to declare variables of different data types (integer, float, char, double) and perform basic arithmetic operations (+, -, *, /). Display the results with appropriate formatting. 2. Write a C program to determine if a given integer is positive, negative, or zero using if-else statements. 3. Write a C program to find the largest of three numbers entered by the user using nested if-else or if-else if-else statements. 4. Write a C program to print the first n natural numbers using a for loop. 5. Write a C program to calculate the factorial of a given number using a while loop.						

6. Write a C program to calculate the area of a circle using a function that takes the radius as input. 7. Write a program to define swap (int a, int b) to swap the values of 'a' and 'b'. Demonstrate the program using call by value and call by reference. 8. Write a C program to define a function add (int a, int b, int *sum, int*diff) that returns the sum and difference of two integers. Call this function from the main function and display the result. 9. Write a C program to read 5 integer values into an array, find the sum and average of elements and display them. 10. Write a C program to manage employee records using dynamic memory allocation functions with Employee ID, Employee Name, and Salary of N employees. The program should read the number of employees (N) and use malloc () to allocate memory for storing employee records. Accept and display the employee details. The program should then allow the user to add M additional employee records by resizing the existing memory using realloc () . After storing the new records, display all employee details, calculate and display the total salary expenditure, and identify the employee with the highest salary. Finally, release all dynamically allocated memory using free () before terminating the program. 11. Write a C program to create an array of structures to store book details. Pass this array to a function, which searches for a particular book given its id. 12. Write a C program to create a student structure and access its members using a structure pointer. 13. Write a C program that uses a recursive function to determine whether a given number is a palindrome.				
Module 2	Linear Data Structures	Assignment		8 Sessions
14. Write a C program to implement a Stack using an array and perform push, pop, peek, and display operations. 15. Write a menu-driven C program to implement both a Linear Queue and a Circular Queue using arrays. The program should support insertion, deletion, display, and overflow/underflow handling. 16. Write a menu-driven C program to implement a Singly Linked List with the following operations: • Create the list by appending nodes. • Display the list. • Insert at beginning and in a specific position • Delete from beginning, end and specific position • Search for an element 17. Write a C program to implement a Doubly Linked List with the following operations: • Creating the list • Display list 18. Write a C program to implement a Circular Linked List with the following operations: • Creating the list • Display list				
Module 3	Non-Linear Data Structures	Assignment		6 Sessions
19. Write a C program to create a binary tree and perform inorder, preorder, and postorder traversals . The program should display the sequence of node values obtained through each traversal technique. 20. Write a C program to implement a Binary Search Tree (BST) . The program should allow insertion of nodes into the BST and provide an option to search for a specified key. Display an appropriate message indicating whether the key is found in the tree.				

21. Write a C program to represent a graph using both Adjacency Matrix and Adjacency List representations. Implement Breadth First Search (BFS) and Depth First Search (DFS) traversals starting from a specified vertex and display the order of traversal.				
Module 4	Searching and Sorting	Assignment		6 Sessions
22. Write a C program to implement linear search to find a given element in an array. 23. Write a C program to implement binary search to find a given element in a sorted array. 24. Write a C program to implement the insertion sort on a given array of integers. 25. Write a C program to implement the Quick sort algorithm on a given array of integers. 26. Write a C program to implement the Merge sort algorithm on a given array of integers. 27. Write a C program to implement a Hash Table using a suitable hash function and Separate Chaining collision resolution technique. The program should support the insertion of keys into the hash table and display the contents of the table after all insertions 28. Write a C program to perform searching and deletion operations on a Hash Table implemented using Separate Chaining . The program should allow the user to search for a given key, delete a specified key, and display the updated contents of the hash table.				
Module 5	Data Structures and Algorithms in AI	Assignment		2 Sessions
29. Write a C program to represent a weighted graph using an adjacency matrix and implement Dijkstra's Algorithm to find the shortest path from a given source vertex to all other vertices. Display the shortest distance and the corresponding path to each vertex. 30. Write a C program to implement a Bloom Filter using multiple hash functions. The program should support insertion of elements and membership queries, indicating whether an element is possibly present or definitely not present in the set.				
Text Book(s): PROGRAMMING AND DATA STRUCTURES for BE Anna University R21CBCS (III-ECE/EEE - CS3353)" A. A. Puntambekar (Technical Publications, 2022) Data Structures and Algorithms Using C" by Amitava Nag & Jyoti Prakash Singh (S. Chand Publishing) PROGRAMMING IN C AND DATA STRUCTURES" by B.K.Mathan Nagan and T.Mahalakshmi (Charulatha Publications)				

Course Code: CHE7601	Environmental Studies Type of Course: Thoery	L- T- P- C	-	-	-	-
		Contact hours	-	-	-	-
CoursePre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to create awareness towards environment and sustainability. This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with consciousness and knowledge needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers. This course is designed to cater to Environment and Sustainability					
Course Objective	The objective of the course is to " create awareness towards environment and sustainability ".					

Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe the issues related to natural resources, ecosystems and biodiversity 2. Identify environmental hazards affecting air, water and soil quality 3. Discuss the importance of healthy environment and finding the sustainable methods to protect the environment 4. Explain environmental concerns through changes in environmental processes, policies, and decisions			
Course Content:				
Module 1	Understanding Environment, Natural Resources, and Sustainability			
Topics: Classification of natural resources, issues related to Population growth and their overutilization, and strategies for their conservation. Water, air, soil, mineral, energy and food source. Effect of human activities on natural resources. Concept of sustainability- Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs; Sustainable practices in managing resources, including deforestation, water conservation, Desalination – types, energy security, and food security issues, Life Cycle thinking and Circular Economy.				
Module 2	Ecosystems, Biodiversity, and Sustainable Practices			
Topics: Ecosystems and ecosystem services: Various natural ecosystems, Major ecosystem types in India and their basic characteristics; forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. The importance of biodiversity, Types of biodiversity, Biodiversity and Climate Change, the threats it faces, hotspots, and the methods used for it: Strategies for in situ and ex situ conservation, mega conservation.				
Module 3	Environmental Pollution, Waste Management, and Sustainable Development			
Topics: Types of pollution- Chemical, - Biological, Biomedical, noise, air, water, soil, thermal, radioactive and marine pollution, and their impacts on society. Urbanization and Urban environmental problems; effects, and mitigation. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Sustainable Materials and Technologies: Biodegradable and compostable materials, Recycled and reclaimed materials (E-waste management), Sustainable manufacturing processes.				
Module 4	Social Issues, Legislation, and Practical Applications			

Topics: Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Hazardous waste Rule 1989, Biomedical Waste handling 1998, Fly Ash Rule 1999, Municipal Solid Waste Rule 2000, Battery Rules 2001, E- Waste Rules 2011, Plastic waste management Rules 2016, Construction Demolition waste Rules 2016 National Biodiversity Action Plan (NBAP) Major International Environmental Agreements: Convention on Biological Diversity (CBD), The Biological Diversity (Amendment) Act, 2023, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement. Major International organisations and initiatives: United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC).
Targeted Application & Tools that can be used: Application areas are Energy, Environment and sustainability Tools: Online Tools – NPTEL and Swayam.
Project work/Assignment: Assessment Type Online exams (MCQs) will be conducted by the department of Chemistry.
Online Link*: 1) Lecture by Dr. Samik Chowdhury, Dr. Sudha Goel, NPTEL course: Environmental Science, https://nptel.ac.in/courses/109105203, 2024. 2) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024. * Other source links are available in below Resources link.
Text Book 1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA 2. Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co. 3. Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd. 4. Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd. 5. Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press. 6. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press. 7. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books. 8. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press. 9. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed,). Pearson.
Reference Books 1. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022), Conservation through Sustainable Use: Lessons from India. Routledge. 2. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.

Course Code: CSS2264	Course Title: Essentials of AI Type of Course: -Theory Course (ESC)	L-T-P-C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the fundamentals of Artificial Intelligence, AI tools, and prompt engineering techniques. It covers AI applications, evaluation of AI tools, ethical and responsible AI usage, and the social and economic impacts of AI. The course also introduces advanced AI technologies such as chatbots, voice assistants, image recognition, robotics, and intelligent automation through practical activities and case studies.		
Course Objectives	The course aims to introduce the fundamentals and applications of Artificial Intelligence, popular AI tools, and basic prompt engineering techniques. It also helps students evaluate AI tools, understand ethical and responsible AI usage, and gain knowledge of advanced AI technologies through practical examples and case studies.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the fundamentals of Artificial Intelligence, its evolution, types, key concepts, and applications across various domains. [Level 2 – Understand] CO2: Apply basic prompt engineering techniques for generating effective AI responses. [Level 3 – Apply] CO3: Evaluate and compare AI tools based on suitability, functionality, ethical considerations, privacy, and security requirements. [Level 4 – Analyze] CO4: Understand the social, ethical, and economic impacts of AI technologies and their influence on society, industries, and employment. [Level 2 – Understand] CO5: Analyze advanced AI technologies and their real-world applications through case studies and practical scenarios. [Level 4 – Analyze]		
Course Content:			
Module 1	Introduction to Artificial Intelligence	Assignment (Fundamentals and Applications of Artificial Intelligence)	9 Sessions
Topics: Introduction to Artificial Intelligence – Definition and History of AI; Evolution of AI; Goals and Scope of AI; Types of AI – Narrow AI, General AI, Super AI. Key Concepts in AI – Machine Learning, Deep Learning, Neural Networks, Natural Language Processing (NLP), Computer Vision, Generative AI. AI vs Human Intelligence. AI Development Lifecycle. Applications of AI across domains – Healthcare, Education, Finance, Agriculture, Cybersecurity, and E-Commerce.			

Module 2	AI Tools and Effective Prompting Techniques	Practical Assignment (AI Tools and Prompt Engineering Techniques)	9 Sessions
Topics: Introduction to Popular AI Tools – Introduction to AI Tools – Overview of popular AI tools and their applications. AI tools for text generation, image generation, predictive analysis, and chatbot interactions. Prompt Engineering –Introduction to prompts and AI-generated responses. Importance of clear instructions and effective questioning techniques. Understanding how AI interprets prompts.			
Module 3	Suitability and Evaluation of AI Tools	Quiz + Assignment (Evaluation and Ethical Use of AI Tools)	9 Sessions
Topics: Introduction to AI Tool Evaluation, Evaluating Tool Suitability, AI Tools for Different Purposes, Comparison of AI Tools, Ethical Use of AI, Bias and Fairness in AI, Data Privacy and Security, Ethical Guidelines for Responsible AI Use			
Module 4	Social, Ethical, and Economic Impacts of AI	Assignment (Social, Ethical, and Economic Impact Analysis of AI)	9 Sessions
Topics: Social, Ethical, and Economic Effects of AI – Ethical issues in AI, future challenges and opportunities, impact of AI on the economy and employment, and responsible use of AI technologies.			
Module 5	Advanced AI Technologies case study	Mini Project / Case Study (AI Technologies and Real-World Applications)	9 Sessions
AI Technologies – Voice assistants, image recognition applications, AI chatbots, robotic and intelligent automation systems, recommendation systems, and recent advancements and future trends in AI technologies.			
Targeted Application & Tools that can be used: - Implementation of AI-based content generation and chatbot interaction using prompt engineering techniques. Tools: ChatGPT, Google Gemini, Hugging Face - Implementation of image generation and creative AI applications using generative AI tools. Tools: Canva AI, DALL·E, Adobe Firefly - Implementation of predictive analytics and machine learning models for simple real-world datasets. Tools: Google Colab, TensorFlow, Kaggle - Implementation of NLP-based applications such as sentiment analysis, text summarization, and language translation. Tools: NLTK, spaCy, Hugging Face Transformers - Development of AI-based mini projects for solving real-world problems in healthcare, education, finance, agriculture, and cybersecurity. Tools: IBM Watson, Microsoft Azure AI, Teachable Machine			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course Group project on one of the topics mentioned above (Eg. Adversarial search).			
Textbook(s):			

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th Edition, Pearson Education, 2022.
2. Elaine Rich and Kevin Knight, *Artificial Intelligence*, 3rd Edition, McGraw Hill Education, 2009.
3. Tom Taulli, *Artificial Intelligence Basics: A Non-Technical Introduction*, 1st Edition, Apress, 2019.

References:

1. Ethem Alpaydin, *Introduction to Machine Learning*, 4th Edition, MIT Press, 2020.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, 1st Edition, MIT Press, 2016.
3. Melanie Mitchell, *Artificial Intelligence: A Guide for Thinking Humans*, 1st Edition, Farrar, Straus and Giroux, 2019.
4. Pedro Domingos, *The Master Algorithm*, 1st Edition, Basic Books, 2015.
5. Kai-Fu Lee, *AI Superpowers*, 1st Edition, Houghton Mifflin Harcourt, 2018.

Weblinks

[OpenAI](#)

[Google AI](#)

[IBM Artificial Intelligence](#)

[Microsoft AI Learning](#)

[Coursera – AI Courses](#)

[NPTEL – Introduction to Artificial Intelligence](#)

[NPTEL – Artificial Intelligence: Search Methods for Problem Solving](#)

Course Code: CSS2265	Course Title: Essentials of AI Lab Type of Course: Laboratory Course (PCC)	L-T-P-C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces students to the fundamentals and practical applications of Artificial Intelligence through hands-on laboratory exercises. Students will explore AI tools, prompt engineering, generative AI, Natural Language Processing (NLP), basics of Machine Learning, chatbot development, recommendation systems, ethical AI, and voice assistant		

	simulation. The course concludes with the development of AI-based mini projects for real-world applications.
Course Objectives	To develop practical skills in Artificial Intelligence by enabling students to explore AI tools, apply prompt engineering techniques, implement basic NLP and Machine Learning tasks, develop intelligent AI-based applications, and analyze ethical and real-world aspects of AI systems.
Course Outcomes	On successful completion of this course, students will be able to: CO1: Apply AI tools and prompt engineering[Level 3 – Apply] techniques for generating effective AI-based outputs.. CO2: Implement AI-based applications for text[Level 3 – Apply] generation, image generation, and chatbot development. CO3: Apply Natural Language Processing and basic[Level 3 – Apply] Machine Learning techniques for solving simple real-world problems. CO4: Analyze datasets and AI model outputs using[Level 4 – Analyze] preprocessing, visualization, and evaluation techniques. CO5: Analyze ethical issues, bias, and the impact of[Level 4 – Analyze] AI systems in practical applications
Course Content:	
Lab Sheet 1: Introduction to AI Tools • Problem Statement: • Explore different AI platforms such as ChatGPT, Gemini, and Hugging Face, and compare their outputs for various tasks based on relevance and accuracy. Lab Sheet 2: Prompt Engineering Basics • <i>(Using AI tools explored in Lab 1)</i> • Problem Statement: • Design effective prompts for text generation and summarization, and analyze how prompt structure influences AI-generated responses. Lab Sheet 3: Advanced Prompt Engineering • <i>(Continuing Lab 2)</i> • Problem Statement: • Develop role-based and instruction-based prompts to optimize AI outputs for accuracy, detail, and contextual understanding. Lab Sheet 4: AI Content Generation • <i>(Using prompts designed in previous labs)</i> • Problem Statement: • Generate blogs, emails, resumes, and reports using AI tools and improve the outputs through iterative prompt refinement. Lab Sheet 5: AI Image Generation • <i>(Extending prompt engineering concepts)</i> • Problem Statement: • Generate AI-based posters, logos, and advertisements using generative AI tools and compare outputs generated using different prompt styles. Lab Sheet 6: Dataset Collection & Preprocessing • Problem Statement:	

- Collect textual datasets from reviews or social media platforms and perform preprocessing techniques such as tokenization, stemming, and stopword removal.

Lab Sheet 7: Sentiment Analysis using NLP

- *(Using dataset prepared in Lab 6)*
- **Problem Statement:**
- Implement sentiment analysis on textual datasets using NLP libraries and analyze sentiment classification performance.

Lab Sheet 8: Text Summarization & Translation

- *(Continuing NLP tasks from Lab 6 & 7)*
- **Problem Statement:**
- Implement AI-based text summarization and language translation techniques and compare generated outputs with original content.

Lab Sheet 9: Introduction to Machine Learning

- *(Using processed datasets from previous labs)*
- **Problem Statement:**
- Understand supervised and unsupervised learning concepts by loading, splitting, training, and testing datasets using Scikit-learn.

Lab Sheet 10: Data Visualization & Feature Analysis

- *(Continuing Lab 9 using same dataset)*
- **Problem Statement:**
- Visualize datasets using Matplotlib and analyze feature relationships and data distributions using graphical techniques.

Lab Sheet 11: AI Chatbot Development

- *(Using NLP and prompt engineering concepts)*
- **Problem Statement:**
- Develop a rule-based chatbot using Python and integrate contextual AI-generated responses for interactive communication.

Lab Sheet 12: Recommendation System

- *(Using prediction concepts from previous labs)*
- **Problem Statement:**
- Implement a content-based recommendation system and analyze recommendation accuracy using similarity metrics.

Lab Sheet 13: Ethical AI and Bias Analysis

- *(Evaluating outputs generated in previous labs)*
- **Problem Statement:**
- Identify bias, hallucination, and ethical issues in AI-generated outputs and analyze their impact on responsible AI systems.

Lab Sheet 14: Voice Assistant Simulation

- *(Using NLP and chatbot concepts from previous labs)*
- **Problem Statement:**
- Develop a basic voice assistant using Python speech libraries and implement voice commands for search, greetings, and simple automation tasks.

Lab Sheet 15: AI Mini Project

- *(Combining concepts from all previous labs)*
- **Problem Statement:**
- Develop and demonstrate an AI-based application integrating concepts such as NLP, machine learning, chatbot systems, or recommendation systems.

Targeted Application & Tools that can be used:

1. ChatGPT, Gemini, Hugging Face, Canva AI, Python 2. Python IDEs like PyCharm-Jupyter Notebook /Google Collab
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course The course is a lab-based course with all the assessments centrally evaluated. Every experiment consists of two sessions. The first session involves exploring a solution to the problem. The second session involves solving a particular problem.
Textbook(s): 1. Stuart Russel and Peter Norvig. Artificial Intelligence: A Modern Approach. 4th Edition. Pearson Education. 2022. 2. Prateek Joshi and Alberto Artasanchez. Artificial Intelligence with Python. 2nd Edition. Packt. 2020. 3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022
References: 1. Deepak Khemani. <i>A First Course in Artificial Intelligence</i>. 1st Edition. 6th Reprint, 2018. 2. Munesh Chandra Trivedi. <i>A Classical Approach to Artificial Intelligence</i>. 2nd Edition. Khanna Publishers. 2018.

Course Code: CSS1500	Course Title: Computational Thinking using Python Type of Course: Lab Integrated Course (ESC)	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	The course efficiently introduces fundamental ideas including conditionals, loops, functions, lists, strings, and tuples through some inspiring examples. It then discusses dynamic programming like handling exceptions and file usage. In terms of data structures, the course covers Python dictionaries, classes, and objects for constructing user-defined datatypes like linear and binary search.					
Course Objective	To develop computational thinking and problem-solving skills using Python by enabling students to design algorithms, implement programs using core programming constructs and build efficient solutions using data structures and file handling techniques for real-world applications.					
Course Outcomes	On successful completion of this course, students will be able to: CO1: Apply computational thinking principles to design algorithms for solving basic and intermediate computing problems. [Understand] CO2: Implement Python programs using data types, operators, and expressions to perform computational tasks. [Apply]					

	CO3: Develop programs using control structures, functions, and recursion to solve structured problems. [Apply] CO4: Utilize data structures such as lists, tuples, and dictionaries for efficient data representation and manipulation. [Apply] CO5: Design and implement Python programs for file handling and exception management to handle real-world data. [Apply] CO6: Build modular and reusable programs using functions and standard Python libraries to enhance code efficiency and readability. [Apply]	
Course Content:		
Module 1	Computational Thinking And Problem Solving	6 Sessions
Topics: Fundamentals of Computing– Identification of Computational Problems Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi		
Module 2	Datatypes, Expressions, Statements	6 Sessions
Topics: Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
Module 3	Control flow, Functions, Strings	6 Sessions
Topics: Conditionals:Boolean values and operators, conditional (if), alternative (if else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
Module 4	Lists, Tuples, Dictionaries	6 Sessions
Topics: Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing- list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
Module 5	Files	6 Sessions
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).		
List of Practical Tasks		30 Sessions
WEEK 1: Computational Thinking & Algorithms		
Lab Sheet 1: Problem Solving & Algorithm Design		

Level 1: Write an algorithm and Python program to find the minimum element in a list of numbers.

Level 2: Write an algorithm and Python program to insert an element into a sorted list at the correct position.

Lab Sheet 2: Algorithm Strategies (Iteration & Recursion)

Level 1: Write a Python program to guess a number within a given range using iteration.

Level 2: Write a Python program to solve the Tower of Hanoi problem using recursion.

WEEK 2: Data Types & Expressions

Lab Sheet 3: Data Types & Variables

Level 1: Write a Python program to demonstrate different data types (int, float, boolean, string, list).

Level 2: Write a Python program to perform type conversions and display results.

Lab Sheet 4: Expressions & Operators

Level 1: Write a Python program to swap two variables using tuple assignment.

Level 2: Write a Python program to circulate the values of n variables.

WEEK 3: Expressions & Problem Solving

Lab Sheet 5: Mathematical Expressions

Level 1: Write a Python program to calculate the distance between two points.

Level 2: Write a Python program to evaluate complex arithmetic expressions with operator precedence.

Lab Sheet 6: Debugging & Interactive Mode

Level 1: Write a Python program with intentional errors and debug it.

Level 2: Write a Python program to demonstrate interactive mode operations.

WEEK 4: Conditional Statements

Lab Sheet 7: Decision Making

Level 1: Write a Python program to check whether a number is positive, negative, or zero.

Level 2: Write a Python program to find the largest of three numbers using if-elif-else.

Lab Sheet 8: Advanced Conditions

Level 1: Write a Python program to check whether a number is even or odd.

Level 2: Write a Python program to implement a grading system using chained conditions.

WEEK 5: Iteration (Loops)

Lab Sheet 9: Looping Basics

Level 1: Write a Python program to print numbers from 1 to N using a loop.

Level 2: Write a Python program to compute factorial using loops.

Lab Sheet 10: Loop Control

Level 1: Write a Python program demonstrating break and continue.

Level 2: Write a Python program to generate number patterns using nested loops.

WEEK 6: Functions

Lab Sheet 11: Functions Basics

Level 1: Write a Python function to calculate square root of a number.

Level 2: Write a Python function to find GCD of two numbers.

Lab Sheet 12: Recursion & Scope

Level 1: Write a recursive function to calculate exponentiation.

Level 2: Write a Python program demonstrating local and global variables.

WEEK 7: Strings

Lab Sheet 13: String Operations

Level 1: Write a Python program to demonstrate string slicing.

Level 2: Write a Python program to check whether a string is a palindrome.

Lab Sheet 14: String Methods

Level 1: Write a Python program using string functions (upper, lower, replace).

Level 2: Write a Python program to count vowels and consonants in a string.

WEEK 8: Lists

Lab Sheet 15: List Basics

Level 1: Write a Python program to create and display a list.

Level 2: Write a Python program to find the sum of elements in a list.

Lab Sheet 16: List Operations

Level 1: Write a Python program to demonstrate list slicing.

Level 2: Write a Python program to perform linear search on a list.

WEEK 9: Advanced Lists

Lab Sheet 17: List Methods

Level 1: Write a Python program to demonstrate list methods (append, remove).

Level 2: Write a Python program to sort a list.

Lab Sheet 18: List Comprehension

Level 1: Write a Python program using list comprehension to generate squares.

Level 2: Write a Python program to create a histogram of list values.

WEEK 10: Tuples

Lab Sheet 19: Tuple Basics

Level 1: Write a Python program to create and access tuple elements.

Level 2: Write a Python program to demonstrate tuple assignment.

Lab Sheet 20: Tuples as Return Values

Level 1: Write a Python function returning multiple values using tuple.

Level 2: Write a Python program to swap values using tuples.

WEEK 11: Dictionaries

Lab Sheet 21: Dictionary Basics

Level 1: Write a Python program to create and access dictionary elements.

Level 2: Write a Python program to count frequency of elements using dictionary.

Lab Sheet 22: Dictionary Applications

Level 1: Write a Python program to store student marks using dictionary.

Level 2: Write a Python program to generate a retail bill using dictionary.

WEEK 12: Advanced List Processing

Lab Sheet 23: Sorting & Searching

Level 1: Write a Python program to implement simple sorting.

Level 2: Write a Python program to implement binary search.

Lab Sheet 24: Data Processing

Level 1: Write a Python program to generate student marks statement.

Level 2: Write a Python program to analyze list data (min, max, average).

WEEK 13: File Handling Basics

Lab Sheet 25: File Operations

Level 1: Write a Python program to create and write to a text file.

Level 2: Write a Python program to read and display file contents.

Lab Sheet 26: File Processing

Level 1: Write a Python program to count words in a file.

Level 2: Write a Python program to copy contents from one file to another.

WEEK 14: Exceptions & Validation

Lab Sheet 27: Exception Handling

Level 1: Write a Python program using try-except.

Level 2: Write a Python program to handle multiple exceptions.

Lab Sheet 28: Validation Programs

Level 1: Write a Python program to validate voter's age.

Level 2: Write a Python program to validate marks range (0–100).

WEEK 15: Modules & Advanced Concepts

Lab Sheet 29: Modules & Packages

Level 1: Write a Python program to create and use a module.

Level 2: Write a Python program to use built-in modules.

Lab Sheet 30: Command Line Arguments

Level 1: Write a Python program to accept command-line arguments.	
Level 2: Write a Python program to perform operations using command-line inputs	
Project work/Assignment:	
1. Assignment 1 on (Module 1 and Module 2) 2. Assignment 2 on (Module 3 and Module 4 & 5)	
Text Book	
1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021 2. Eric Matthes, Python Crash Course, A Hands-On, Project-Based Introduction to Programming, 3rd Edition, 2023	
References	
1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. 2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.	
Web Resources	
W1. https://onlinecourses.nptel.ac.in/noc20_cs70/preview	
1. Topics relevant to development of "Employability": Data structures using python. 2. Topics relevant to "PROFESSIONAL ETHICS": Naming and coding convention for simple programs using python.	

Program Core Courses

Course Code: EEE2500	Course Title: Network Theory Type of Course: Professional Core & Theory only	L-T- P-C	3	1	0	4
Version No.	1.0					
Course Pre-requisites	MAT1211-Linear Algebra, Differential Equations and Statistical Methods					
Anti-requisites	NIL					
Course Description	This Course aims at obtaining the solutions to problems in electrical networks using various network reduction techniques and theorems. The course is both conceptual and analytical in nature and uses the basic knowledge on mathematics to analyse electrical circuits.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Network Theory and attain Skill Development through Problem Solving methodologies					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 : Apply network reduction techniques and source transformations to simplify electric circuits. CO2: Compute electrical circuit parameters by applying suitable network theorems. CO3: Interpret the transient behavior of RL and RC circuits using differential equations and Laplace transform techniques. CO4: Analyze the frequency response and resonance characteristics of RL and RC circuits. CO5: Determine the parameters of two-port networks (Z, Y, h, ABCD) and their interrelationships. CO6: Calculate voltage, current, and power relations in balanced and					

	unbalanced polyphase circuits.			
Course Content:				
Module1	Module:1 Network Reduction Techniques:	Assignment	Quiz	9L+3T Sessions
Topics: Types of electric circuit elements and sources, Source transformation, mesh analysis, Nodal analysis				
Module2	Module: 2 Network theorems:	Assignment	Simulation	12L+4T Sessions
Topics: Statement of all Network Theorems, Explanation of Super position theorem, Thevenin's theorem, Maximum power transfer theorem and numerical examples on these theorems (DC & AC)				
Module3	Module:3 Transient Analysis and Resonance	Assignment	Programming/Simulation	12L+4T Sessions
Topics: Initial conditions, transient analysis of RL, RC circuits, Laplace transforms of RL, RC circuits with step input, Concept of Resonance and frequency response for sinusoidal input.				
Module4	Module:4 Two port networks	Assignment	Quiz	12L+4T Sessions
Topics: Introduction, Z parameters-parameters, ABCD parameters and h-parameters. Analysis of Poly Phase circuits: Voltage, Current and Power relations in a balanced Star and Delta connected load.				
Targeted Applications and Tools Application Area is Electrical appliances used in residential properties, DC and AC circuits for Power electronic converters, Spark plug in automobiles, Battery Management system in Electric Vehicles. Professionally Used Software: Multisim, MATLAB Simulink.				
Textbooks 1. Ravish.R. Singh, "Electrical Networks", McGraw Hill company, 2009 2. Charles K Alexander and Matthew NO Sadiku "Fundamentals of Electric Circuits (4 th) Edition				
References 1. Van Valkenberg, "Network Analysis", Prentice Hall, 1974. PHI 2. J.A. Edminister, "Theory and Problems of Electric Circuits", Schaum's Outline Series, 4th Edition. Online resources 1. https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&query=Text=electric%20circuit%20analysis 2. https://www.tutorialspoint.com/network_theory/index.htm 3. https://nptel.ac.in/courses/108/105/108105159/ 4. Case Study https://www.scribd.com/document/420348012/Case-Study 5. E book: Electric Circuits: A Primer, Olivier, J. C , 2018 https://presiuniv.knimbus.com/user#/home				
Topics relevant to "SKILL DEVELOPMENT" : Network Reduction Techniques and Source transformation for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in Course Plan.				

Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	21 st BoS, Held on 09/06/2025
Date of Approval by the Academic Council	18 th Academic Council Meeting, dated on 3/8/2022

Course Code: ECE2023	Course Title: Digital Electronics Type of Course: Program Core Theory only	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	EEE1200 - Basics of Electrical and Electronics Engineering					
Anti-requisites	NIL					
Course Description	Digital Electronics: Learning of basics in digital electronic circuits that are used to process the digital signals. The course is designed to be one of the core courses in electronics/ electrical engineering. Successful completion will provide the necessary foundation for more specialist learning in digital microelectronics, computer and communication engineering. The purpose of this course is to support the students to exhibit the Boolean Logic. The course is analytical in nature and needs fair knowledge of Boolean Theorems. The course shields theory and laboratory for Digital Electronics including basic principles, analysis and design. Further it covers the different methods of Boolean function simplification- Study and classification of Digital circuits- Design and Implementations of Digital Logic Circuits. The course also enhances the Design, Implementation and Programming abilities through laboratory assignments. The associated laboratory provides an opportunity to certify the theoretic knowledge.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Electronics and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the concept of number system, conversion, Boolean laws and logic gates. (L2) CO2: Implement simplified Boolean functions using Karnaugh maps and universal gates. (L3) CO3: Design combinational circuits for the given real time application. (L3) CO4: explain the principles of modeling combinational circuits using Hardware Description Languages (HDLs). (L2) CO5: Design synchronous sequential circuits such as counters and shift registers using appropriate flip flops . (L3) CO6: explain the principles of modeling sequential circuits using Hardware Description Languages (HDLs). (L2)					
Course Content:						
Module 1	Fundamentals of Number systems- Boolean algebra and digital logic	Application Assignment	Data Analysis task	10 classes		

Introduction to Number systems, Number base conversions, complement of numbers, Binary Codes, Boolean theorems and Boolean algebra, Boolean functions- canonical and standard forms, Digital logic gates.				
Module 2	Boolean function simplification	Application Assignment	Data Analysis task	9 Classes
Introduction, two variable, three variable, four variable K-Map - Don't care conditions. Quine-McCluskey minimization techniques. NAND & NOR Implementation.				
Module 3	Combinational Logic circuits:	Application Assignment	Programming Task & Data Analysis task	13 Classes
Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Multiplexers-De-multiplexers, Encoders - Decoders, Architecture and implementation of Boolean functions using ROM, PLA and PAL . HDL Models of combinational circuits.				
Module 4	Sequential and Programmable logic circuits:	Application Assignment	Programming Task & Data Analysis task	13 Classes
Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables, characteristic equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines , Registers & Counters, HDL Models of Sequential circuits.				
Text Book(s): 1. Mano, M. Morris and Ciletti Michael D., " <i>Digital Design</i> ", Pearson Education, 6 th edition, 2018. 2. Thomas L. Floyd " <i>Digital Fundamentals</i> ", Pearson Education, 11 th edition, 2018.				
Reference(s): Reference Book(s): R1. Jain, R. P. and Sarawadeka, Kishor " <i>Modern Digital Electronics</i> ", McGraw Hill Education (India), 5 th Edition, 2022. R2. Roth, Charles H., Jr and Kinney Larry L., " <i>Fundamentals of logic Design</i> ", Cengage Learning, 7 th Edition, 2021.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. EBook: https://presiuniv.knimbus.com/user#/home 2. Course Website: https://ece2021-de.netlify.app/ 3. NPTEL COURSE ON : Digital Electronic Circuits, IIT Kharagpur, https://nptel.ac.in/courses/108105132 4. NPTEL COURSE ON : Introduction To Digital Circuits, https://nptel.ac.in/courses/117106086 5. NPTEL COURSE ON : Digital Circuits and Systems, IIT Madras, https://nptel.ac.in/courses/117106114 6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video CircuitVerse - Digital Circuit Simulator online Learn Logisim ➡ Beginners Tutorial Easy Explanation! - Bing video Digital Design 5: LOGISIM Tutorial & Demo				
E-content: 1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168. 2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase2010 13th International Conference on Computer and Information Technology (ICCIT) 3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029. 4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," 2019 IEEE East-West Design & Test Symposium (EWDTS), 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.				

Topics relevant to "SKILL DEVELOPMENT": Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr.G. Muthupandi
Recommended by the Board of Studies on	BOS Meeting NO: 12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16th, Dated 23/10/2021

Course Code: ECE2051	Course Title: Digital Electronics Lab Type of Course: Program Core	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	EEE1200 - Basics of Electrical and Electronics Engineering					
Anti-requisites	NIL					
Course Description	Digital Electronics: Learning of basics in digital electronic circuits that are used to process the digital signals. The course is designed to be one of the core courses in electronics/ electrical engineering. Successful completion will provide the necessary foundation for more specialist learning in digital microelectronics, computer and communication engineering. The purpose of this course is to support the students to exhibit the Boolean Logic. The course is analytical in nature and needs fair knowledge of Boolean Theorems. The course shields theory and laboratory for Digital Electronics including basic principles, analysis and design. Further it covers the different methods of Boolean function simplification- Study and classification of Digital circuits- Design and Implementations of combinational as well as sequential Digital Logic Circuits. The course also enhances the Design, Implementation and Programming abilities through laboratory assignments. The associated laboratory provides an opportunity to certify the theoretic knowledge.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Electronics and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Demonstrate the principles of logic gates and Boolean algebra using standard digital ICs. (L2) CO2: Implement Adders and Subtractors using digital ICs. (L3) CO3: Realize combinational logic circuits for customized specifications. (L3) CO4: Design Counters and Shift Registers using flip-flops. (L3) CO5: Construct combinational logic circuits using Electronic Design Automation tools. (L3) CO6: Simulate sequential logic circuits using Electronic Design Automation tools. (L3)					
Course Content:	Experiment 1: Verify the Logic Gates truth table Level 1: By using Digital Logic Trainer kit Level 2: By using Universal logic gates and Trainer Kit Experiment 2: Verify the Boolean Function and Rules by using Digital Logic Trainer kit Experiment 3: Design and Implementations of combinational logic circuit for specifications					

Level 1: Specifications given in the form of Truth table

Level 2: Specification should be extracted from the given scenario

Experiment 4: Design and Implementations of Half Adder/Full Adder

Level 1: By using basic logic gates and Trainer Kit

Level 2: By using Universal logic gates and Trainer Kit

Experiment 5: Design and Implementations of Half Subtractor/Full Subtractor

Level 1: By using basic logic gates and Trainer Kit

Level 2: By using Universal logic gates and Trainer Kit

Experiment 6: Study of Flip flops – SR, D, JK, T

Experiment 7: Design and Implementations of THREE-bit up counter/Down counter synchronous counter using JK flipflop

Experiment 8: Design and implementation of 4-bit Shift registers using D-Flip Flop - SISO, & PIPO

Experiment 9: HDL coding for basic combinational logic circuit

Level 1: Gate level Modeling

Level 2: Behavioral Modeling

Experiment 10: HDL coding for basic sequential logic circuit

Level 1: Gate level Modeling

Level 2: Behavioral Modeling

Targeted Applications and Tools that can be used:

Application Area	Hands-on Application Problem	Tools & Techniques	Relevant Industry
Basic Digital Circuit Verification	Verification of logic gate truth tables; Boolean function and theorem validation	Digital Logic Trainer Kit, Discrete Components, ICs	Electronics Manufacturing, Embedded Systems
Arithmetic Circuit Design	Design and implementation of half/full adders and subtractors	Basic Gates, Universal Gates, Breadboard Prototyping	Consumer Electronics, Digital Hardware Design
Combinational Logic Implementation	Realization of logic from given specifications; Code converters (BCD to Excess-3, Gray to Binary)	Truth Table Design, Logic Simulation (HDL), Circuit Implementation	Automation, Instrumentation
Sequential Logic Development	Study and implementation of flip-flops; Design of synchronous counters	Waveform Analysis Tools, IC-based Circuits, HDL Simulation	Digital Systems, Robotics

Skill Development Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Boolean Function Implementation	Design logic gates and reduce expressions	Breadboard, ICs, Logic Gates	Digital logic building, truth table mapping
Flip-Flop Operation Study	Test SR, JK, T flip-flops	Breadboard, Timer ICs	Sequential logic behavior
Counters and Shift Register Demo	Design binary counters and shift registers	IC 7490, 74194	Digital timing circuits, bit manipulation

Text Book(s):

1. Mano, M. Morris and Ciletti Michael D., "Digital Design", Pearson Education, Sixth edition, 2018

Reference(s):

Reference Book(s):

1. Jain, R. P., "Modern Digital Electronics", McGraw Hill Education (India), Fourth Edition
2. Roth, Charles H., Jr and Kinney Larry L., "Fundamentals of logic Design", Cengage Learning, Seventh Edition

Online Resources (e-books, notes, ppts, video lectures etc.):

7. EBook: <https://presiuniv.knimbus.com/user#/home>
8. Course Website: <https://ece2021-de.netlify.app/>
9. NPTEL COURSE ON : Digital Electronic Circuits, IIT Kharagpur, <https://nptel.ac.in/courses/108105132>
10. NPTEL COURSE ON : Introduction To Digital Circuits, <https://nptel.ac.in/courses/117106086>

11. NPTEL COURSE ON : Digital Circuits and Systems, IIT Madras, <https://nptel.ac.in/courses/117106114>
12. Lab Tutorial: [Multisim Tutorial for Digital Circuits - Bing video](#)
[CircuitVerse - Digital Circuit Simulator online](#)
[Learn Logisim ➡ Beginners Tutorial | Easy Explanation! - Bing video](#)
[Digital Design 5: LOGISIM Tutorial & Demo](#)

E-content:

1. Z. Xin-Li and W. Hong-Ying, "The application of digital electronics in networking communication," in *Proc. 8th Int. Conf. Measuring Technology and Mechatronics Automation (ICMTMA)*, 2016, pp. 684–687, doi: 10.1109/ICMTMA.2016.168.
2. D. Bhadra, T. A. Tarique, S. U. Ahmed, M. Shahjahan, and K. Murase, "An encoding technique for design and optimization of combinational logic circuits," in *Proc. 13th Int. Conf. Computer and Information Technology (ICCIT)*, 2010.
3. A. Matrosova and V. Provkin, "Applying incompletely specified Boolean functions for patch circuit generation," in *Proc. IEEE East-West Design & Test Symposium (EWDTS)*, 2021, pp. 1–4, doi: 10.1109/EWDTS52692.2021.9581029.
4. A. Matrosova, V. Provkin, and E. Nikolaeva, "Masking internal node faults and Trojan circuits in logical circuits," in *Proc. IEEE East-West Design & Test Symposium (EWDTS)*, 2019, pp. 1–4, doi: 10.1109/EWDTS.2019.8884434.

Topics relevant to "SKILL DEVELOPMENT": Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. G. Muthupandi
Recommended by the Board of Studies on	BOS Meeting held on 07/01/2026
Date of Approval by the Academic Council	Academic Council Meeting, Dated 07/01/2026

Course Code: ENG2030	Course Title: Communication in Practice Type of Course: Integrated	L-T-P-C	1	0	2	2
Version No.	1.0					
Course Pre-requisites	ENG1030– Fundamentals of Communication (Semester I)					
Anti-requisites	NIL					
Course Description	<i>Communication in Practice</i> is the second-semester course in sequence designed for first-year undergraduate students in engineering and computer science programmes. This course puts those foundations under professional pressure. The question is no longer <i>what</i> communication is, but <i>how</i> to deploy it when it counts: in a job interview, a pitch to a client, a negotiation with a colleague, a professional report directed at a real reader, or a leadership communication challenge that affects a team. The course is organised					

	around four modules, each of which explicitly upgrades the work done in semester one. Assessment is 100% Continuous Assessment. There is no end-semester examination. The centrepiece is a capstone Professional Communication Portfolio that the student could realistically share with an employer.			
Course Objective	The course aims to articulate the foundational tenets of professional communicative identity, discourse ethics, and analytical text evaluation and apply them to high-stakes institutional scenarios and complex professional ecosystems. It also focuses on cultivating advanced oral communication strategies and persuasive vocal mechanics, including structured rhetorical delivery and spontaneous adaptive responses, for collaborative, hierarchical, and leadership contexts. Furthermore, it aims to refine technical authorship capabilities and artificial intelligence-mediated workflows to produce precise, highly structured, and audience-centric professional artifacts across formal engineering, computational, and cross-functional corporate domains.			
Course Outcomes	On successful completion of this course the students shall be able to: Explain the principles governing professional communication identity, communicator ethics, and context-sensitive self-presentation across workplace, hierarchical, and digital contexts. Demonstrate advanced vocal, rhetorical, and adaptive strategies across high-stakes spoken communication genres, including interviews, pitches, negotiations, and leadership scenarios. Demonstrate advanced vocal, rhetorical, and adaptive strategies across high-stakes spoken communication genres, including interviews, pitches, negotiations, and leadership scenarios. Execute the production of professional-grade written artifacts across high-demand genres—including formal reports, business proposals, data communications, and advocacy briefs—meeting real-world standards of clarity, structure, and audience appropriateness. Implement AI-assisted communication workflows in professional contexts, including systematic prompt design for high-stakes outputs, validation protocols for synthetic materials, and the application of ethical frameworks at individual and organizational levels.			
Course Content: Communication in Practice				
Module 1	Words that Work: Vocabulary, Register, and Precision	CA1	Register Switching Activity	09 Sessions
The topics will be explored through vocabulary games, role-play activities, communication challenges, case-based tasks, and workplace simulations: - Why Words Matter in Professional and Technical Communication - Choosing the Right Words for Different Situations - Understanding Meaning: Positive, Negative, and Neutral Word Choices - Commonly Confused Words and Miscommunication in Professional Contexts				

- Using Clear, Precise, and Concise Language - Explaining Technical Terms to Non-Technical Audiences - Building and Using Personal/Professional Vocabulary				
Module 2	Listening, Processing, and Structured Response Writing	CA2	Rapid Listening and Response	12 Sessions
The topics will be explored through podcasts, interviews, workplace recordings, collaborative listening tasks, discussions, and real-time writing activities: - Identifying Key Information from Spoken Inputs - Organizing Information from Discussions and Conversations - Converting Spoken Communication into Clear and Structured Written Responses - Writing Summaries from Audio and Discussion Inputs - Writing Follow-Up Responses Based on Spoken Communication - Writing Action Notes, Instructions, and Task Updates from Listening Inputs - Converting Meetings and Discussions into Structured Written Outputs				
Module 3	High-Stakes Spoken Communication	CA	Mock Professional Interview, Pitching an Idea Pitch	12 Sessions
- Speaking as a professional: identity, presence, and the first impression - Vocal authority, physical presence, and communication across hierarchies - Interview communication: structure, composure, and the STAR framework - Pitching ideas: the 3-minute and 10-minute pitch architecture - Negotiation and principled disagreement - Communicating in leadership positions: chairing, facilitating, and giving direction - Managing communication under pressure: hostile questions, silence, and contradiction				
Module 4	Adaptive Communication	CA	Communication Strategy Plan	12 Sessions
The topics will be explored through leadership simulations, AI-assisted scenario practice, ethical debate exercises, case analysis, peer feedback sessions, and reflective portfolio activities: - Communication Strategy: Audiences, Channels, Timing, and Feedback Loops - What Emotional Intelligence Actually Does in High-Stakes Conversations - Reading the Room: Adapting Style Across Personalities, Contexts, and Power Gaps - Giving and Receiving Developmental Feedback as a Professional Practice - Navigating Difficult Conversations: Disagreement, Criticism, and Bad News - Repairing Communication Breakdowns: Apology, Accountability, and Recovery - AI as a Strategic Communication Tool: Capabilities, Limits, and What Professionals Must Decide				
Targeted Application & Tools that can be used: Otter.ai, Microsoft Word/PowerPoint/Teams/Clipchamp/Whiteboard/OneNote/Forms/Copilot, Miro, Padlet, Canva, Mentimeter, AllSides Media Bias Ratings, Ad Fontes Media Bias Chart, Snopes/factcheck.org, Zotero, NotebookLM, Canva, Adobe Express, CapCut, OBS Studio, Claude, ChatGPT, Gemini, DeepSeek, Google Docs				
Project Work / Assignment:				

- 1. Register Switching Activity (Individual):** Students receive a single professional scenario and must communicate the same core message to three different audiences — a peer, a manager, and a non-specialist outsider — switching register, vocabulary, and tone appropriately for each. Delivered live in class. Graded on accuracy of register shift, vocabulary choices, and adaptability under in-the-moment feedback from the assessor.
- 2. Word in the Wild Log (Individual):** Over four weeks, students maintain a running log of 25 words or phrases encountered in professional contexts — podcasts, workplace conversations, news, interviews — that they did not fully understand or could not have used confidently themselves. For each entry, students record the source, the meaning in context, an alternative they might have used, and one original sentence demonstrating precise use. Submitted as a structured document at the end of Module 1. Graded on range, contextual accuracy, and quality of reflection.
- 3. Rapid Listening and Response (Individual):** Students listen to an unedited workplace audio recording — a meeting excerpt, a briefing, or a professional conversation — played once, without transcripts. Under timed conditions, they produce a structured written response that captures key information, identifies the communication purpose, and drafts an appropriate follow-up action note. Graded on accuracy, organisation, and quality of written response.
- 4. Mock Professional Interview (Individual):** Each student undergoes a 10-minute mock professional interview conducted by faculty or a peer panel. No prepared scripts permitted. Graded on composure, structure, vocal authority, and use of the STAR framework. Written self-evaluation of 200 words submitted within 48 hours.
- 5. Idea Pitch (Individual):** Students deliver a 3-minute pitch of a solution to a real or simulated professional problem, to a panel that includes at least one hostile or sceptical questioner. Immediately after the pitch, the panel asks two minutes of unscripted questions. Graded on clarity of argument, persuasive structure, handling of pressure, and vocal presence.
- 6. Difficult Conversation Simulation (Pair):** Pairs of students are assigned roles in a scripted conflict scenario — a performance issue, a missed deadline, a broken professional agreement. Each student must navigate the conversation toward a constructive resolution without a script. Immediately after, both students complete a structured individual debrief identifying what communication choices they made, what they would change, and what they observed in their partner. Graded individually on communication behaviour during the simulation and quality of the debrief.
- 7. Communication Strategy Plan — Presentation and Portfolio Submission (Group):** Students select a real or realistic professional scenario — a team conflict, a stakeholder disagreement, a leadership announcement, or a crisis communication moment. They develop a communication strategy plan that maps the audience, chooses appropriate channels and timing, anticipates likely responses, and identifies where AI tools could assist and where they must not. The plan is delivered as a 5-minute structured presentation to a simulated panel, followed by two minutes of unscripted Q&A. The portfolio submission includes the written plan, a one-page reflection on their communication growth across all four modules, and one piece of evidence from each module that demonstrates that growth. Graded on strategic thinking, clarity of presentation, quality of reflection, and coherence of the portfolio as a whole.

Text Book(s):

- T1. Treasure, J. (2017). *How to be Heard: Secrets for Powerful Speaking and Listening*. Mango Publishing.
- T2. Beebe, S. A., Beebe, S. J., & Ivy, D. K. (2019). *Communication: Principles for a Lifetime* (7th ed.). Pearson.

Reference Book(s):	
R1. Goleman, D. (1995). <i>Emotional Intelligence: Why It Can Matter More Than IQ</i>. Bantam Books. R2. Patterson, K., Grenny, J., McMillan, R., & Switzler, A. (2011). <i>Crucial Conversations: Tools for Talking When Stakes Are High</i> (2nd ed.). McGraw-Hill. R3. Cuddy, A. (2015). <i>Presence: Bringing Your Boldest Self to Your Biggest Challenges</i>. Little, Brown and Company. R4. Fisher, R., Ury, W., & Patton, B. (2011). <i>Getting to Yes: Negotiating Agreement Without Giving In</i> (3rd ed.). Penguin Books. R5. Stone, D., Patton, B., & Heen, S. (2010). <i>Difficult Conversations: How to Discuss What Matters Most</i> (2nd ed.). Penguin Books.	
Web Sources:	
• ted.com/topics/communication • ted.com/topics/leadership • hbr.org (Harvard Business Review — communication and leadership articles) • psychologytoday.com/us/basics/emotional-intelligence • learnprompting.org • unesco.org/en/artificial-intelligence/ethics • yoodli.ai (AI speech coaching) • themuse.com (professional communication and career resources) • mindtools.com (communication skills and workplace tools)	
Topics relevant to "SKILL DEVELOPMENT": Vocabulary building and register awareness; precise and concise language use; explaining technical terms to non-specialist audiences; active listening and information processing; converting spoken inputs into structured written responses; writing action notes and follow-up communications; professional presence and vocal authority; interview communication and the STAR framework; idea pitching and persuasive speaking; negotiation and principled disagreement; chairing and facilitating discussions; managing communication under pressure; communication strategy and audience mapping; emotional intelligence in professional contexts; adapting communication style across personalities and power gaps; giving and receiving developmental feedback; navigating difficult conversations; repairing communication breakdowns; AI as a strategic communication tool; ethics of AI in professional communication.	
Catalogue prepared by	Dr Ajith K and Dr Shahanas Punnilath Shanavas
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2500	Course Title: Signals and Systems Type of Course: Program Core		L-T-P-C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	An understanding of basic concepts of linear circuits as examples of linear systems and a familiarity with complex numbers and calculus, including power series are desirable.						
Anti-requisites	NIL						
Course Description	This is an undergraduate level course that builds a mathematical foundation for understanding and analysing any physical system. This course will teach signal/system properties, sampling, frequency transforms and responses, feedback, control applications as well as computer analysis using MATLAB/Python. The course feeds into several applications, including Data Science, Machine Learning, Communications, Networks and Systems.						
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Classify the continuous-time and discrete-time signals, including operations on signals, periodicity, and energy and power calculations. (L2) CO2: Analyze the fundamental properties of systems such as linearity, causality, time invariance, stability, memory, and system responses. (L4) CO3: Apply convolution techniques to determine the output of LTI systems and evaluate impulse responses, zero-input response, and zero-state response. (L3) CO4: Analyze Fourier series and Fourier transform representations of continuous-time and discrete-time signals for periodic and aperiodic signals, including their properties. (L4) CO5: Analyze continuous-time and discrete-time systems using Laplace transform and Z-transform, including ROC, system stability, and frequency response. (L4) CO6: Analyze FIR and IIR digital filters using pole-zero analysis and spectral methods. (L4)						
Course Content:							
Module 1	Introduction to Signals and Systems	Assignment	Memory Recall based Quizzes			15 Sessions	
Topics: Mathematical Preliminaries, Continuous-time (CT) and Discrete-time (DT) signals, operation on signals, sinusoid and exponential signals, periodicity, power and energy, unit impulse, step, and ramp signals. Basic system properties: systems with and without memory, invertibility and inverse systems, causality, shift-invariance and linearity. Determination of impulse response from step response. Zero-input and zero-state response, unit impulse response, convolution, Graphical method for convolution, stability of systems, Response time and Rise time of system.							
Module 2	Fourier Series and Fourier Transform	Assignment / Quiz	Design and analysis of parameters (simulation)			15 Sessions	
Topics: Linear time invariant systems to complex exponential signals, Fourier series representation of continuous time periodic signals, Convergence and properties of continuous-time Fourier series, Parseval's relation Discrete time Fourier series and its properties, Representation of aperiodic signal, Fourier transform and its properties, Fourier transform of some useful signals, Generalized Fourier series; signals vs vectors. Modulation. System characterization.							

Representation of aperiodic signal, Discrete-time Fourier transform and its properties, power spectral density, Sampling, Duality in discrete-time Fourier series.				
Module 3	Laplace and z-transform and Filter Design	Assignment	Memory Recall based Quizzes	15 Sessions
Topics: Laplace transform, ROC, Inverse Laplace transform, Filter design by placements of poles and zeros of system functions, properties of Laplace transform, analysis and characterization of LTI systems using Laplace transform, Interconnection of LTI systems (cascade and parallel feedback), unilateral Laplace transform. Z- transform, properties of z- transform, Frequency response from pole-zero location, analysis and characterization of LTI systems using z- transform, unilateral z-transform. IIR/ FIR Filters.				
Text Books: 1. Alan V Oppenheim, Alan S Willsky and S. Hamid Nawab, "Signals and systems", Pearson Education, 2nd edition, 2003				
Reference Books: 1. B P Lathi, "Linear Systems and Signals" (The Oxford Series in Electrical and Computer Engineering) 2004 2. Signals and systems, second edition - Simon Haykin, Barry VanVeen, Wiley, Wiley India, 2007 3. J. Proakis and D. Manolakis, DSP: Principles, Algorithms and Applications Prentice Hall 1997.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Signals and Systems MIT OpenCourseWare 2. Signals and Systems Electrical Engineering and Computer Science MIT OpenCourseWare 3. https://presiuniv.knimbus.com/user#/home				
E-content: 1. L. Santhosh and A. Thomas, "Implementation of radix 2 and radix 22 FFT algorithms on Spartan6 FPGA," 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), 2013, pp. 1-4, doi: 10.1109/ICCCNT.2013.6726840. 2. Saeed, Ahmed, et al. "Efficient fpga implementation of fft/fft processor." International Journal of circuits, systems and signal processing 3.3 (2009): 103-110. 3. S. Bouguezel, M. O. Ahmad and M. N. S. Swamy, "An Alternate Approach for Developing Higher Radix FFT Algorithms," APCCAS 2006 - 2006 IEEE Asia Pacific Conference on Circuits and Systems, 2006, pp. 227-230, doi: 10.1109/APCCAS.2006.342373.				
Topics related to development of "EMPLOYABILITY": CTFT, CTFS, DTFT, DTFS, Laplace Transform and Z Transform				
Catalogue prepared by	Mrs. Pallabi Kakati			
Recommended by the Board of Studies on	12th BOS held on 10/08/2021			
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021			

Course Code: ECE2550	Course Title: Signals and Systems Lab Type of Course: Program Core Laboratory	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	An understanding of basic concepts of linear circuits as examples of linear systems and a familiarity with complex numbers and calculus, including power series are desirable.					
Anti-requisites	NIL					
Course Description	This is an undergraduate level course that builds a mathematical foundation for understanding and analysing any physical system. This course will teach signal/system properties, sampling, frequency transforms and responses, feedback, control applications as well as computer analysis using MATLAB/Python. The course feeds into several applications, including Data Science, Machine Learning, Communications, Networks and Systems.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Recognize appropriate MATLAB statements to carry out different arithmetic and logical operations. (L2) CO2: Sketch the Frequency response of fundamental signals and sequences using Fourier transform. (L2) CO3: Apply the properties of Z-Transform and Laplace transform to study fundamental signals. (L3) CO4: Plot Poles and Zeros using Laplace and Z-Transform. (L3) CO5: Demonstrate the convolution operation in time domain using MATLAB. (L3) CO6: Analyze the correlation operation between two signals and sequences in time domain. (L4)					
Course Content:						
List of Laboratory Tasks: Experiment No 1: BASIC OPERATIONS ON MATRICES Level1: Declare a matrix in MATLAB Level2: Do matrix operations and quantify the results. Experiment No 2: GENERATION OF VARIOUS SIGNALS AND SEQUENCES Level1: Draw a time axis and plot a continuous function. Level2: Discretize the continuous function. Experiment No 3: CONVOLUTION BETWEEN SIGNALS AND SEQUENCES Level1: Simulate the convolution of two signals in continuous and discrete time domains. Level2: Use convolution to understand the filtering operation. Experiment No 4: AUTO CORRELATION AND CROSS CORRELATION Level1: Simulate the correlation of signals. Level2: Use correlation operation to detect the signal from a communication perspective. Experiment No 5: FOURIER TRANSFORMS AND INVERSE FOURIER TRANSFORM Level1: Compute the Fourier transform of various functions and plot the amplitude spectra. Level2: Understand the Gibb’s phenomena by increasing the coefficients using a periodic signal.						

Experiment No 6: PROPERTIES OF FOURIER TRANSFORMS Level1: Study the various transform properties and simulate the same in MATLAB. Level2: Apply certain properties to implement filtering, sampling operations. Experiment No 7: LAPLACE TRANSFORMS Level1: Study the Laplace transform and its properties through simulation in MATLAB. Level2: Understand the transient analysis and stability of systems. Experiment No 8: z TRANSFORMS Level1: Study the z transform and its properties through simulation in MATLAB. Level2: Understand the transient analysis and stability of discrete systems.	
Targeted Application & Tools that can be used: Application Area includes signal processing, networks, communication, data science, machine learning, control system design. Professionally Used Software: MATLAB, Simulink	
Text Books: 1. Alan V Oppenheim, Alan S Willsky and S. Hamid Nawab, "Signals and systems", Pearson Education, 2nd edition, 200	
Reference Books: 1. B P Lathi, "Linear Systems and Signals" (The Oxford Series in Electrical and Computer Engineering) 2004 2. Signals and systems, second edition - Simon Haykin, Barry VanVeen, Wiley, Wiley India, 2007 3. Luis F. Chaparro, "Signals and Systems using MATLAB", 2nd Edition, Academic Press. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Signals and Systems MIT OpenCourseWare 2. Signals and Systems Electrical Engineering and Computer Science MIT OpenCourseWare 3. https://presiuniv.knimbus.com/user#/home E-content: 1. L. Santhosh and A. Thomas, "Implementation of radix 2 and radix 22 FFT algorithms on Spartan6 FPGA," 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), 2013, pp. 1-4, doi: 10.1109/ICCCNT.2013.6726840. 2. Saeed, Ahmed, et al. "Efficient fpga implementation of fft/fft processor." International Journal of circuits, systems and signal processing 3.3 (2009): 103-110. 3. S. Bouguezel, M. O. Ahmad and M. N. S. Swamy, "An Alternate Approach for Developing Higher Radix FFT Algorithms," APCCAS 2006 - 2006 IEEE Asia Pacific Conference on Circuits and Systems, 2006, pp. 227-230, doi: 10.1109/APCCAS.2006.342373.	
Topics related to development of "EMPLOYABILITY": CTFT, CTFS, DTFT, DTFS, Laplace Transform and Z Transform	
Catalogue prepared by	Mrs. Pallabi Kakati
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: EEE2504	Course Title: Control Systems Engineering Type of Course: Professional Core and Theory only	L-T-P- C	3	0	0	3
Version No.	3.0					
Course Pre-requisites	ECE2020: Signals and Systems					
Anti-requisites	NIL					
Course Description	The purpose of this course is to explore the importance of control system engineering and to develop the basic abilities of modelling and analyzing the control system. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming and simulation abilities through assignments					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Control Systems Engineering and attain Skill Development through Problem Solving methodologies					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Develop the transfer function for any Electrical and Mechanical systems. 2. Apply Block diagram algebra and Mason’s Gain Formula for the given Block diagram and Signal Flow Graph 3. Examine the time response of second order system for unit step input 4. Analyse the stability of the given system using time domain and frequency domain methods 5. Choose the suitable compensation network for the given system 6. Identify the controllability and observability of the given state model					
Course Content:						
Module 1	System Components and their representation	Assignment	Numerical	10	Sessions	
Topics: Introduction to control systems, mathematical models of physical systems-differential equations of physical systems, Mechanical systems, Electrical systems, Block diagrams and signal flow graphs.						
Module 2	Time Response Analysis, Controllers	Assignment, Quiz	Programming / Simulation	10	Sessions	
Topics: Unit step response of first and second order system, time response specifications, time response specifications of second order systems, steady state errors and error constants. P.PI and PID controllers						
Module 3	Stability Analysis and compensation techniques	Simulation	Programming	15	Sessions	
Topics: Concept of stability, Routh stability criterion, Root locus concept-rules for sketching root locus, Introduction, Frequency domain specifications -Bode diagrams, Stability Analysis from Bode Plots, Concept of relative stability. Introduction to Nyquist stability criteria. Lead, Lag, lead-lag compensating networks						
Module 4	State space model	Case study	Simulation	10	Sessions	
Topics: Concept of State, State variables & State model, Concepts of controllability and observability. Introduction to Nonlinear systems						

Targeted Applications and Tools Control Systems are used in domestic applications, traffic light control, general industry, military and virtually every modern vehicle in the world, robotics. Modern industrial plants utilized robots for manufacturing temperature controls, pressure controls, speed controls, position controls, etc. In chemical process, control field is an area where automations play an important role.

Professionally used tools: MATLAB/Simulink, Scilab, Octave.

Text Book

[1]. Nagrath I. J. and M. Gopal, Control Systems Engineering, New Age International (P) Ltd, 5th ed, 2007.

[2]. K. Ogata, 'Modern Control Engineering', Pearson Education Asia / PHI, 4th Edition.

References

[1] Benjamin Kuo, 'Automatic Control Systems', PHI, 7th Edition.

[2] Hasan Saeed, automatic control Systems with MATLAB programs, S K Kataria and sons, Latest ed.

Online Learning Resources:

1. Ebook: <https://presiuniv.knimbus.com/user#/home>

2. Case study:

https://people.disim.univaq.it/~costanzo.manes/Didattica_Teoria_dei_Sistemi/System_Theory_Web_Resources.html

<https://nptel.ac.in/courses/107/106/107106081/>

Topics relevant to "SKILL DEVELOPMENT": Mathematical modelling, Stability analysis, Compensators **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr Jisha L K
Recommended by the Board of Studies on	BoS No: 17 th BoS held on 06/7/2023
Date of Approval by the Academic Council	21 st Academic Council meeting dated 06/09/2023

Code: ECE2535	Course Title: Linear Integrated Circuits Type of Course: Program Core		L-T-P-C	3	0	0	3
Version No.	3.0						
Course Pre-requisites	Knowledge of passive and active elements, basics of diode – forward and reverse biasing, diode current equation, Transistors - BJT, Rectifiers. Network theorems- KCL, KVL, Voltage divider rule, super position theorem etc.						
Anti-requisites	NIL						
Course Description	The purpose of this course is to enable the students to appreciate the behaviour of operational amplifier based electronic circuits. This course introduces the fundamentals of analog computers. This course emphasizes on the use of operational amplifiers, their characteristics to design various analog circuits. The course also gives a brief idea about operational amplifier based integrated circuits. The associated laboratory provides an opportunity to validate the concepts taught in theory. It also enhances the ability to visualize the real-world problems in order to provide a solution using various simulation tools.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Linear Integrated Circuits and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.						
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the ideal and practical characteristics, configurations, and parameters of an operational amplifier, including the concept of virtual ground. (L2) CO2: Illustrate the open-loop configurations in inverting, non-inverting and differential amplifier circuits with their transfer characteristics. (L3) CO3: Calculate the output of linear operational amplifier circuits including inverting, non-inverting, summing, difference, logarithmic, and antilogarithmic amplifiers. (L3) CO4: Determine the behavior of integrator, differentiator, voltage-to-current, and current-to-voltage converters in given applications. (L3) CO5: Compare the working of nonlinear operational amplifier circuits including comparators, Schmitt triggers, waveform generators, and oscillators. (L4) CO6: Analyze the behavior of IC 555 timer circuits, active filters, voltage regulators, data converters, and phase-locked loop (PLL) circuits. (L4)						
Course Content:							
Module 1	Introduction to op-amp	CA1	Numerical solving				10 Sessions
Topics: Introduction to op-amp, block diagram, op-amp IC, op-amp symbol, equivalent circuit, transfer characteristics and ideal characteristics of op-amp, op-amp parameters, open loop op-amp configurations - inverting, non-inverting and differential mode, concept of virtual ground.							
Module 2	Linear Applications of op-amp	CA2	Numerical solving				17 Sessions
Topics: Non-inverting amplifier, Inverting amplifier, Voltage follower circuit, Summing amplifiers, Average circuit, Difference amplifiers, op-amp as ideal and practical Differentiator circuit, op-amp as ideal and practical Integrator circuit, V to I Converter, I to V Converter, Instrumentation amplifier circuit, AC amplifier, Operational transconductance amplifier (OTA), Sample and hold circuit, Multiplier and Divider using op-amp, Log and antilog amplifiers using op-amp, Precision rectifier.							
Module 3	Special Applications	Quiz or Assignment	Quiz based on numerical solving.				18 Sessions

	of Op-amps and ICs		Assignment based numerical solving.		
Topics: Comparators, Zero crossing detector, Schmitt trigger circuit, Square and Triangular waveform generators, RC phase shift oscillator, Wien bridge oscillator, IC 555 timer - Monostable Multivibrator, Astable Multivibrator, Filters - Low pass filter, high pass filter and bandpass filter, Voltage regulators - Introduction, Series op-amp regulator, 723 general purpose regulator, Converters- Introduction to ADC and DAC, Analysis of 3-bit binary weighted DAC, Analysis of 3-bit R-2R DAC, successive approximation ADC, PLL (IC 565). Targeted Application & Tools that can be used: Targeted Applications: Automotive technologies, personal electronics, consumer appliances etc. This course is useful for placement in core companies, research & development work. Professionally Used Software: NI Multisim, LabVIEW, PSpice etc., device setup in laboratory. Text Books: 1. David A. Bell, "Operational Amplifiers and Linear ICs", 3rd Edition, Oxford University Press, Jan. 2011. Reference Books: 1. Gayakwad A. Ramakant, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson Education, May 2015. 2. L. K. Maheshwari and M. M. S. Anand, "Analog Electronics", Prentice Hall India Learning Private Limited, Jan. 2005. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Document on Integrated Circuit https://www.sciencedirect.com/topics/earth-and-planetary-sciences/integrated-circuit 2. NPTEL Video Lectures on Integrated Circuits, MOSFETs, Op-Amps and their Applications by Prof. Hardik Jeetendra Pandya, IISc, Bengaluru https://nptel.ac.in/courses/108108111 3. Presidency University Library Link: https://presiuniv.knimbus.com/user#/home E-content: 1. Q. He and D. Jiao, "Fast Electromagnetics-Based Co-Simulation of Linear Network and Nonlinear Circuits for the Analysis of High-Speed Integrated Circuits", IEEE Transactions on Microwave Theory and Techniques, vol. 58, no. 12, pp. 3677–3687, Dec. 2010. https://doi.org/10.1109/TMTT.2010.2086590 2. C. Tian, J. Lu, L. Jun, H. Liang, Y. Lu, and M. Yi, "A reconfigurable test method based on LFSR for 3D stacking integrated circuits", Integration, vol. 87, pp. 82–89, Nov. 2022. https://doi.org/10.1016/j.vlsi.2022.06.011 3. A. Lberni, A. Sallem, M. A. Marktani, N. Masmoudi, A. Ahaitouf, and A. Ahaitouf, "Influence of the operating regimes of MOS transistors on the sizing and optimization of CMOS analog integrated circuits", AEU - International Journal of Electronics and Communications, vol. 143, Jan. 2022. https://doi.org/10.1016/j.aeue.2021.154023 4. D. Li, C. Wang, X. Cui, D. Chen, C. Fei, and Y. Yang, "Recent progress and development of interface integrated circuits for piezoelectric energy harvesting," Nano Energy, vol. 94, Apr. 2022. https://doi.org/10.1016/j.nanoen.2022.106938 Topics relevant to "SKILL DEVELOPMENT": Amplifiers, comparators, multivibrators and converters for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.					
Catalogue prepared by	Dr. Mohammed Mujahid Ulla Faiz				
Recommended by the Board of Studies on					
Date of Approval by the Academic Council					

Code: ECE2551	Course Title: Linear Integrated Circuits Lab Type of Course: Lab	L-T-P-C	0	0	2	1
Version No.	2.0					
Course Pre-requisites	Knowledge of passive and active elements, basics of diode – forward and reverse biasing, diode current equation, Transistors - BJT, Rectifiers. Network theorems- KCL, KVL, Voltage divider rule, super position theorem etc.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to appreciate the behaviour of operational amplifier based electronic circuits. This course introduces the fundamentals of analog computers. This course emphasizes on the use of operational amplifiers, their characteristics to design various analog circuits. The course also gives a brief idea about operational amplifier based integrated circuits. The associated laboratory provides an opportunity to validate the concepts taught in theory. It also enhances the ability to visualize the real-world problems in order to provide a solution using various simulation tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Linear Integrated Circuits and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Demonstrate the working of inverting and non-inverting amplifiers using IC 741 with gain verification and saturation avoidance under varying input conditions. (L3) CO2: Demonstrate the working of inverting summing and difference amplifiers using IC 741 for mixed DC and AC inputs while preventing saturation. (L3) CO3: Apply voltage-to-current, current-to-voltage, log and antilog converters using IC 741 to verify their input-output characteristics. (L3) CO4: Illustrate the working of integrator and differentiator circuits using operational amplifiers with square wave response analysis. (L5) CO5: Determine frequency responses of active low-pass and high-pass filters, including cutoff frequency identification and frequency scaling. (L3) CO6: Demonstrate sinusoidal, square, and triangular waveforms using op-amp oscillators and astable/monostable multivibrators using IC 555 timer. (L3)					
Course Content:						
List of Laboratory Tasks:						
Experiment No 1: To setup an Inverting amplifier circuit using OP-AMP 741 IC and observe the waveforms.						
Experiment No. 2: To setup a Non-Inverting amplifier circuit using OP-AMP 741 IC and observe the waveforms.						
Experiment No. 3: To setup an Inverting Summing amplifier circuit using OP-AMP 741 IC and observe the waveforms.						
Experiment No. 4: To setup a Difference amplifier circuit using OP-AMP 741 IC and observe the waveforms.						
Experiment No. 5: To implement Voltage-to-Current and Current-to-Voltage converters using OP-AMP 741 IC and verify their characteristics.						
Experiment No. 6: To implement Log and Antilog amplifiers using OP-AMP 741 IC and verify the logarithmic and exponential relationships.						

Experiment No. 7: Build the circuit of Differentiator and Integrator and observe the waveforms. Experiment No. 8: To obtain the frequency response of active low pass and high pass filters and determine 3dB frequencies of both filters. Experiment No. 9: Generation of sine, square and triangular waveform using op-amp. Experiment No. 10: To set up Astable and Monostable Multivibrator using IC 555.	
Targeted Application & Tools that can be used: Targeted Applications: Automotive technologies, personal electronics, consumer appliances etc. This course is useful for placement in core companies, research & development work. Professionally Used Software: NI Multisim, LabVIEW, PSpice etc., device setup in laboratory.	
Text Books: 1. David A. Bell, "Operational Amplifiers and Linear ICs", 3rd Edition, Oxford University Press, Jan. 2011.	
Reference Books: 1. Gayakwad A. Ramakant, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson Education, May 2015. 2. L. K. Maheshwari and M. M. S. Anand, "Analog Electronics", Prentice Hall India Learning Private Limited, Jan. 2005.	
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Document on Integrated Circuit https://www.sciencedirect.com/topics/earth-and-planetary-sciences/integrated-circuit 2. NPTEL Video Lectures on Integrated Circuits, MOSFETs, Op-Amps and their Applications by Prof. Hardik Jeetendra Pandya, IISc, Bengaluru https://nptel.ac.in/courses/108108111 3. Presidency University Library Link: https://presiuniv.knimbus.com/user#/home	
E-content: 1. Q. He and D. Jiao, "Fast Electromagnetics-Based Co-Simulation of Linear Network and Nonlinear Circuits for the Analysis of High-Speed Integrated Circuits", IEEE Transactions on Microwave Theory and Techniques, vol. 58, no. 12, pp. 3677–3687, Dec. 2010. https://doi.org/10.1109/TMTT.2010.2086590 2. C. Tian, J. Lu, L. Jun, H. Liang, Y. Lu, and M. Yi, "A reconfigurable test method based on LFSR for 3D stacking integrated circuits", Integration, vol. 87, pp. 82–89, Nov. 2022. https://doi.org/10.1016/j.vlsi.2022.06.011 3. A. Lberni, A. Sallem, M. A. Marktani, N. Masmoudi, A. Ahaitouf, and A. Ahaitouf, "Influence of the operating regimes of MOS transistors on the sizing and optimization of CMOS analog integrated circuits", AEU - International Journal of Electronics and Communications, vol. 143, Jan. 2022. https://doi.org/10.1016/j.aeue.2021.154023 4. D. Li, C. Wang, X. Cui, D. Chen, C. Fei, and Y. Yang, "Recent progress and development of interface integrated circuits for piezoelectric energy harvesting," Nano Energy, vol. 94, Apr. 2022. https://doi.org/10.1016/j.nanoen.2022.106938	
Topics relevant to "SKILL DEVELOPMENT": Amplifiers, comparators, multivibrators and converters for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Mohammed Mujahid Ulla Faiz
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2534	Course Title: Digital Signal Processing	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basic concepts of Signals and Systems and their representation and modeling, Concept of Z-Transform and DTFT. Concepts of Matrices.					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts of Digital Signal Processing, including frequency-domain analysis using DTFT and DFT, spectral analysis, and convolution techniques. It covers efficient computation using FFT algorithms and the design and realization of digital filters such as IIR and FIR filters. The course also addresses practical implementation aspects including finite word length effects in digital filters. Students develop the ability to apply DSP techniques for signal analysis and processing.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Signal Processing and attain the SKILL DEVELOPMENT through PROBLEM SOLVING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1.Explain the fundamental concepts of digital signal processing, including discrete Fourier transform and signal convolution. (L2) CO2.Solve DFT and IDFT of discrete signal sequences using FFT algorithms. (L3) CO3.Construct analog IIR filters using Butterworth or Chebyshev approximations and obtain digital IIR filters using impulse invariance and bilinear transformation. (L3) CO4. Construct FIR filters using windowing techniques and frequency sampling methods. (L3) CO5.Solve realization problems of FIR and IIR filters for given transfer functions or difference equations. (L3) CO6. Utilize finite word length concepts and DSP processor features in digital signal processing implementations. (L3)					
Course Content:						
Module 1	Basics of DSP with DFT Convolution	Application Assignment	Data Analysis task	9 Sessions		
Overview and applications of Digital Signal Processing. Sampling theorem and its significance. Introduction and need for signal transformations. Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT). Properties of DFT. Problems on DFT and IDFT. Spectral analysis and spectral leakage. Introduction to convolution. Circular convolution and its computation using concentric circle method and matrix multiplication method. Sectioned convolution. Correlation.						
Module 2	FFT Algorithms	Application Assignment	Data Analysis task	7 Sessions		
Introduction to FFT, Comparison of FFT with Direct evaluation of the DFT, DIT-algorithm and DIF algorithm: Radix-2 DIT-FFT & DIF FFT algorithm and its problems.						
Module 3	IIR Filter Design and Realizations	Application Assignment	Data Analysis task	11 Sessions		
Introduction of filters, Types of filters - IIR filters, Butterworth filters and Chebyshev filters. Design of analog low pass Butterworth and conversion to digital low pass using Impulse Invariance method and Bilinear transformation. Overview of Frequency transformation. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.						

Module 4	FIR Filter Design, Realization and DSP Implementation	Application Assignment	Data Analysis task	18 Sessions
FIR filter design using windows (Rectangular/Hamming/ Hanning window), Frequency sampling method. FIR filter structures - direct form realizations - linear phase structure realizations. Finite word length effects: quantization, truncation and rounding errors, round-off noise, coefficient quantization, limit cycle oscillations. DSP processors: basic architecture and features including MAC unit, pipelining, and applications in real-time signal processing.				
Text Book(s): 1. John Proakis, Dimitris G Manolakis, "Digital Signal Processing Principles, Algorithms and Application", PHI, 3rd Edition (2000). 2. B. Venkataramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TMH, 2002.				
References: Reference Book(s): 1. Li Tan & Jean Jiang " Digital Signal Processing- Fundamentals and Applications" 2nd Edition, 2013 Elsevier Digital Signal Processing 2nd Ed Fundame.pdf 2. Lonnie.C. Ludeman, "Fundamentals of Digital Signal Processing ", John Wiley, 2009 1ST Edition 3. Ganesh Rao "Digital Signal Processing", Pearson Education, 2nd Edition 4. A.V. Oppenheim and R.W. Shafer, "Discrete-Time Signal Processing", PHI, 3rd Edition. Online Resources (e-books, notes, pts, video lectures etc.): 1. Overview Basic SignalRepresentationhttp://users.ece.utexas.edu/~bevans/courses/realtime/lectures/midterm1.html 2. Introduction to FFT Digital Signal Processing Tutorial (tutorialspoint.com) 3. Filter Design and Realizations FOR DSP PRESENTATION (wustl.edu) 4. Introduction to Digital Signal Processing Course MATLAB Helper ® - YouTube 5. Introduction to Signal Processing - YouTube 6. Digital signal processing (slideshare.net)Dsp ppt (slideshare.net) 7. https://presiuniv.knimbus.com/user#/home E-content: 1. L. Santhosh and A. Thomas, "Implementation of radix 2 and radix 22 FFT algorithms on Spartan6 FPGA," <i>2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT)</i>, 2013, pp. 1-4, doi: 10.1109/ICCCNT.2013.6726840. 2. Saeed, Ahmed, et al. "Efficient fpga implementation of fft/fft processor." <i>International Journal of circuits, systems and signal processing</i> 3.3 (2009): 103-110. 3. S. Bouguezel, M. O. Ahmad and M. N. S. Swamy, "An Alternate Approach for Developing Higher Radix FFT Algorithms," <i>APCCAS 2006 - 2006 IEEE Asia Pacific Conference on Circuits and Systems</i>, 2006, pp. 227-230, doi: 10.1109/APCCAS.2006.342373.				
Topics relevant to "SKILL DEVELOPMENT": DFT&IDFT, FFT& IFFT for Skill Development through Problem solving techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr.R. Sekar			
Recommended by the Board of Studies on	12th BOS held on 10/08/2021			
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021			

Course Code: ECE2570	Course Title: Digital Signal Processing Lab	L-T-P-C	0	0	2	1
Version No.	2.0					
Course Pre-requisites	Basic concepts of Signals and Systems and their representation and modeling, Concept of Z-Transform and DTFT. Concepts of Matrices.					
Anti-requisites	NIL					
Course Description	The laboratory aims to reinforce theoretical concepts by providing hands-on experience in the transformation of discrete signals and the design of IIR and FIR filters. Through MATLAB simulation toolboxes, students will gain practical insights into real-world signal processing challenges and develop solutions using computational techniques.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Signal Processing and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Generate MATLAB code for basic discrete-time signal generation, operations, and signal sampling. (L3) CO2: Perform circular convolution of discrete-time sequences using the DFT method. (L3) CO3: Analyze magnitude and phase spectra of signals using FFT algorithms. (L4) CO4: Design an IIR Butterworth and Chebyshev filters for the given specifications. (L3) CO5: Design FIR filters with specified frequency response using windowing and frequency-sampling techniques. (L3) CO6: Implement FIR and IIR filter using DSP processors. (L3)					
List of Laboratory Tasks: Experiment N0 1: Write the Matlab code, to find the Circular convolution of two sequences. Level 1: The input data provided as discrete sequence representation with specific length. Level 2: Data provided as discrete mathematical functional representation. Experiment N0 2: Write the Matlab code, to compute of N point DFT of a give sequence and to plot magnitude and phase spectrum. Level 1: The input data provided as discrete sequence representation with specific length. Level 2: Data provided as discrete Mathematical functional representation. Experiment N0 3: Write the Matlab code, to find Circular convolution of two given sequences using DFT and IDFT. Level 1: Using FFT function Level 2: Using direct formula method. Experiment N0 4: Write the Matlab code, to Construct the Butterworth IIR filter for given specification. Level 1: Specification given directly Level 2: Specification given indirectly-Taking the input signal from real-time sources. Experiment N0 5: Write the Matlab code, to construct the FIR filter by using different windows to meet given specification. Level 1: Specification given directly Level 2: Specification given indirectly-Taking the input signal from real-time sources. Experiment N0 6: Write the Matlab code, to Find $h[n]$ of the difference equation and plot impulse response and pole-zero plots. Level 1: Difference equation is described directly Level 2: Difference equation described indirectly.						

Experiment NO 7: Study of DSP KIT and Code Composer Studio. Level 1: NA Level 2: NA Experiment NO 8: Find Circular convolution of two given sequences on DSP Board with CCS. Level 1: The input data provided as discr Ms. Akshaya M Ganorkarete sequence representation with specific length. Level 2: Data provided as discrete Mathematical functional representation. Experiment NO 9: Computation of N point DFT of a given sequences on DSP Board with CCS. Level 1: The input data provided as discrete sequence representation with specific length. Level 2: Data provided as discrete Mathematical functional representation.	
Targeted Application & Tools that can be used: Application Area includes all modern electronic devices (Music System, cellular phones, computers, digital cameras, high-definition smart televisions, Home Automation, Communication systems). The students will be able to join a profession which involves basics to a high level of digital signal processing and analysis. Professionally Used Software: Matlab/Python / Code Composer Studio/ Octave/SciPy Besides these software tools hardware equipment such as DSP Kits are used for validation purpose.	
Text Book(s): 1. John Proakis, Dimitris G Manolakis, "Digital Signal Processing Principles, Algorithms and Application" , PHI, 3rd Edition (2000). 2. A.V. Oppenheim and R.W. Shafer, "Discrete-Time Signal Processing" , PHI, 3rd Edition	
References: Reference Book(s): 1. Li Tan & Jean Jiang "Digital Signal Processing- Fundamentals and Applications" 2nd Edition, 2013 Elsevier 2. Lonnie.C. Ludeman, "Fundamentals of Digital Signal Processing ", John Wiley, 2009 1ST Edition 3. Ganesh Rao "Digital Signal Processing" , Pearson Education, 2nd Edition Online Resources (e-books, notes, ppts, video lectures etc.): 1. Overview Basic SignalRepresentation http://users.ece.utexas.edu/~bevans/courses/realtime/lectures/midterm1.html 2. Introduction to FFT Digital Signal Processing Tutorial (tutorialspoint.com) 3. Filter Design and Realizations FOR DSP PRESENTATION (wustl.edu) 4. Introduction to Digital Signal Processing Course MATLAB Helper ® - YouTube 5. Introduction to Signal Processing - YouTube 6. Digital signal processing (slideshare.net)Dsp ppt (slideshare.net) 7. https://presiuniv.knimbus.com/user#/home	
E-content: 1. L. Santhosh and A. Thomas, "Implementation of radix 2 and radix 22 FFT algorithms on Spartan6 FPGA," <i>2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT)</i>, 2013, pp. 1-4, doi: 10.1109/ICCCNT.2013.6726840. 2. Saeed, Ahmed, et al. "Efficient fpga implementation of fft/fft processor." <i>International Journal of circuits, systems and signal processing</i> 3.3 (2009): 103-110. 3. S. Bouguezal, M. O. Ahmad and M. N. S. Swamy, "An Alternate Approach for Developing Higher Radix FFT Algorithms," <i>APCCAS 2006 - 2006 IEEE Asia Pacific Conference on Circuits and Systems</i>, 2006, pp. 227-230, doi: 10.1109/APCCAS.2006.342373.	
Topics relevant to "SKILL DEVELOPMENT" : DFT&IDFT, FFT& IFFT for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. G. Muthupandi
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE2521	Course Title: Embedded System Design Using Microcontroller Type of Course: Theory			L-T-P-C	4	0	0	4
Version No.	1.0							
Course Pre-requisites	Basics of Electronics Devices, Logic Design, 8 bit/16 bit Microprocessor Architecture and Assembly Language Programing, Basics of C-Language, Memory types.							
Anti-requisites	NIL							
Course Description	The course provides insights into the fundamentals of microprocessor, microcontroller architecture and instruction set; knowledge for Embedded Systems Design. The course develops programming skills in both assembly language and middle level languages. Peripherals and their programming; Hardware and Software synchronization. Finally, embedded system design applications and some advanced topics will be covered. The comprehensive nature of the course covers assembly language programming using simulation tools.							
Course Objective	This course is designed to improve the learner's <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> Methodologies							
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the fundamental concepts of embedded systems, RISC philosophy, and processor architecture (ARM, RISC-V). (L2) CO2: Illustrate the addressing modes, instruction sets, and stack operations of a microcontroller using assembly language. (L3) CO3: Analyse the functioning and programming of microcontroller peripherals such as Timer, PWM, UART, ADC, and DAC. (L4) CO4: Design interfacing circuits for LEDs, displays, switches, motors, and sensors using Embedded C and simulation tools. (L3) CO5: Examine the embedded system design methodologies and their applicability in Industry 4.0 and biomedical automation. (L4) CO6: Demonstrate a comprehensive embedded application by integrating hardware and software components based on a given case study. (L3)							
Course Content:								
Module 1	Fundamentals of Embedded Systems	Quiz	Memory Recall based Quizzes	15 sessions				
Topics: Embedded Systems: Introduction to Embedded Systems. RISC Design Philosophy. Design Philosophy, Embedded System Hardware, Embedded System Software Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exemptions, Interrupts and Vector Table. Architecture Revisions, ARM Processor families, RISC-V.								
Module 2	Architecture and Programming	Assignment	Programming and Simulation task / Memory Recall based Quizzes	20 sessions				
Topics: Introduction to Architecture. Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions. Stack, I/O Port Interfacing and Programming: Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops - Delay subroutine with simple ALP programs.								

Module 3	Peripherals Interfacing	Assignment using Keil and Proteus	Programming Assignment	10 sessions
Topics: Concepts of Input and Output Ports. Introduction to Embedded C: Conditional statements, loop statements. LPC 2148 Timer Unit, PWM Unit, UART, DAC, ADC				
Module 4	Embedded system designing and applications	Assignment using Keil and Proteus	Interfacing and Programming Assignment	15 sessions
Topics: Interfacing peripherals: Basics of Interfacing Switches, LEDs, seven segment displays. Interfacing Stepper motors and DC motors. Embedded system applications examples and case studies.				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Industry 4.0	Real-time machine monitoring system	Keil, Proteus, STM32CubeIDE	Manufacturing, Robotics	
Biomedical	Heart rate monitoring wearable	ESP32, Arduino IDE	Healthcare, Wearables	
Agricultural Automation	Smart irrigation controller	NodeMCU, Blynk App	Agri-tech, Rural Development	
Smart Cities	IoT-based street light control	Raspberry Pi, MQTT	Urban Infrastructure	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
ALP with Delay Routines	Practice loops and delays	Keil µVision	Assembly coding, delay generation	
UART Communication Test	Implement serial data exchange	Embedded C, Proteus	UART interfacing, debugging	
End-Semester Project	Build real-time application	Keil, Proteus, IoT Platform	Prototype development, integration	
Project Work/Assignment:				
1. Case Study: At the end of the course students will be given a ‘real-world’ application-based on real world embedded system case study. Students will be submitting a report which will include Application Design, sensors used, middleware protocols used and working mechanism etc. in appropriate format				
2 Book/Article review: At the end of the course a literature review of any 05 recent articles from the reputed national and international journal/ conferences will be given by students. They need to refer to tools like Scopus/ Google-Scholar and submit a report on their understanding of the assigned article in appropriate format.				
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to present their review work.				

Text Book(s):

1. Alexander G. Dean, "Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach", ARM Education Media, 2nd Edition
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Designing and Optimizing System Software", Morgan Kaufmann Publishers, 2nd Edition.

Reference(s):**Reference Book(s):**

1. Jonathan W. Valvano, "Embedded Systems: Introduction to Arm® Cortex™-M Microcontroller- Vol 01", CreateSpace Independent Publishing Platform, 1st Edition
2. Jonathan W. Valvano, "Embedded Systems: Real-Time Operating Systems for Arm® Cortex™-M Microcontrollers", CreateSpace Independent Publishing Platform, 1st Edition.
3. ARM Cortex Datasheet available on (<https://www.arm.com/>)

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Free online self-paced course:- <https://bcourses.berkeley.edu>.
2. Online notes: - <https://mitpress.mit.edu/books/internet-things>
3. NPTEL online video content: -
<http://www.digimat.in/nptel/courses/video/106105160/L22.html>
4. Online ppts: - <https://www.upf.edu/prd/en/3376/22580>
5. Online ppts: - <https://www.macs.hw.ac.uk/~dwcorne/Teaching/introdl.ppt>
6. Presidency University Library Link <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Joseph Sifakis, "Embedded systems design - Scientific challenges and work directions 2009 Design, Automation & Test in Europe Conference & Exhibition <https://ieeexplore.ieee.org/document/5090623>
2. Gabor Karsai; Fabio Massacci; Leon Osterweil; Ina Schieferdecker, "Evolving Embedded Systems", Computer, VOL. 43, issue.5 <https://ieeexplore.ieee.org/document/5472888>
3. Sachin P. Kamat," An eye on design: Effective embedded system software", IEEE Potentials, VOL. 29, issue.5 <https://ieeexplore.ieee.org/document/5568178>
4. Ahmed Abdallah; Eric M. Feron; Graham Hellestrand; Philip Koopman; Marilyn Wolf, "Hardware/Software Codesign of Aerospace and Automotive Systems", Proceedings of the IEEE, VOL. 98, issue.4 <https://ieeexplore.ieee.org/document/5440056>

Topics relevant to the: "FOUNDATION SKILLS", ARM Embedded Systems: Introduction to Embedded Systems. RISC Design Philosophy.

Topics related to development of "EMPLOYABILITY": Interfacing peripherals: Basics of Interfacing Switches, LEDs, seven segment displays. Interfacing Stepper motors and DC motors.

Catalogue
prepared by

Mr. Syed Abrar Ahmed

Recommended
by the Board of
Studies on

Date of Approval
by the Academic
Council

Course Code: ECE2571	Course Title: Embedded System Design Using Microcontroller Lab Type of Course: Lab	L-T-P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Understanding of Digital Circuits like Logic Gates, Flip-Flops, Multiplexers, Counters, Registers etc. Basic understanding of microprocessors and microcontrollers (but not mandatory). Simple pseudo instruction of a model microprocessors. Knowledge about real world sensing interfacing. Basic C programming constructs.					
Anti-requisites	NIL					
Course Description	The course provides insights into the architecture of Embedded Systems Design. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real-world problems in order to provide a solution using various simulation tools and hardware interfacing techniques. The course develops programming skills in both assembly language and middle level languages. Peripherals and their programming; Hardware and Software synchronization. The comprehensive nature of the course covers assembly language programming using simulation tools.					
Course Objective	This course is designed to improve the learner's <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> Methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Demonstrate assembly and C programming skills for arithmetic, logic, and data transfer operations on a microcontroller. (L3) CO2: Implement interfacing of basic I/O devices namely LEDs, switches, and push buttons using simulation tools. (L3) CO3: Configure and program Timer, PWM, ADC, and DAC modules for waveform generation and signal conversion. (L3) CO4: Integrate temperature sensor, ultrasonic sensor, LCD display and seven-segment display into a functional embedded system. (L4) CO5: Design a small-scale embedded project combining multiple peripherals and real-time constraints. (L3) CO6: Examine the performance and reliability of an embedded system through case study analysis and documentation. (L4)					
Course Content:						

List of Laboratory Task:

Exp 01:- Level 1- WAP for Data Transfer operations.

Level 2 - WAP to transfer a block of word from Source to destination memory.

Exp 02:- Level 1 - WAP to find addition/Subtraction of two 32-bit numbers

Level 2- WAP to find sum of 'n' 32-bit numbers.

Exp 03:- Level 1- WAP to find multiplication of two 32-bit numbers.

Level 2- WAP to determine the largest and smallest numbers in a given sequence

Exp 04: - Level 1 - WAP to perform Logical operations on two 32-bit numbers.

Level 2 - WAP to sort a sequence of numbers in ascending or descending order

Exp 05:- Level 1- Simulate a program in C for ARM microcontroller to find factorial of a number.

Level 2- Simulate a program in C for ARM microcontroller to demonstrate case conversion of characters from upper to lowercase and lower to uppercase. Exp 06:- Level 1- Interfacing with basic Input / Output Devices LEDs. Level 2- Interfacing with basic Input / Output Devices relay switches. Exp 07:- Interfacing of stepper motors to rotate clockwise and anti-clockwise direction. Exp 08:- Interfacing of DC motors to rotate clockwise and anti-clockwise direction along with speed control. Exp 09:- Pulse Width Modulation (PWM) based Waveform Generation and Timing. Exp 10:- Interfacing of Analog-to-Digital (ADC) and Digital-to-Analog (DAC) Converters. Exp 11:- Interfacing of UART0 to test its Function. Exp 12:- Interfacing a 4x4 keypad read a key from key board and displays it on LCD Display.
Targeted Application & Tools that can be used: Targeted Applications: Industry 4.0, Biomedical and Agricultural automation Professionally Used Software: Keil Version 04/ Proteus
Project Work/Assignment: 1. Case Study: At the end of the course students will be given a ‘real-world’ application-based on real world embedded system case study. Students will be submitting a report which will include Application Design, sensors used, middleware protocols used and working mechanism etc. in appropriate format 2 Book/Article review: At the end of the course a literature review of any 05 recent articles from the reputed national and international journal/ conferences will be given by students. They need to refer to tools like Scopus/ Google-Scholar and submit a report on their understanding of the assigned article in appropriate format. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to present their review work.
Text Book(s): 1. Alexander G. Dean, "Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach", ARM Education Media, 2nd Edition 2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Designing and Optimizing System Software" , Morgan Kaufmann Publishers, 2nd Edition.
Reference(s): Reference Book(s): 1. Jonathan W. Valvano, "Embedded Systems: Introduction to Arm® Cortex™-M Microcontroller- Vol 01" , CreateSpace Independent Publishing Platform, 1st Edition 2. Jonathan W. Valvano, "Embedded Systems: Real-Time Operating Systems for Arm® Cortex™-M Microcontrollers" , CreateSpace Independent Publishing Platform, 1st Edition. 3. ARM Cortex Datasheet available on (https://www.arm.com/) Online Resources (e-books, notes, ppts, video lectures etc.): 1. Free online self-paced course :- https://bcourses.berkeley.edu. 2. Online notes :- https://mitpress.mit.edu/books/internet-things 3. NPTEL online video content:- http://www.digimat.in/nptel/courses/video/106105160/L22.html 4. Online ppts :- https://www.upf.edu/prd/en/3376/22580 5. Online ppts:- https://www.macs.hw.ac.uk/~dwcorne/Teaching/introdl.ppt 6. Presidency University Library Link https://presiuniv.knimbus.com/user#/home E-content:

1. Joseph Sifakis, “ Embedded systems design - Scientific challenges and work directions 2009 Design, Automation & Test in Europe Conference & Exhibition https://ieeexplore.ieee.org/document/5090623 2. Gabor Karsai; Fabio Massacci; Leon Osterweil; Ina Schieferdecker, “Evolving Embedded Systems” , Computer, VOL. 43, issue.5 https://ieeexplore.ieee.org/document/5472888 3. Sachin P. Kamat,” An eye on design: Effective embedded system software”, IEEE Potentials, VOL. 29, issue.5 https://ieeexplore.ieee.org/document/5568178 4. Ahmed Abdallah; Eric M. Feron; Graham Hellestrand; Philip Koopman; Marilyn Wolf, “ Hardware/Software Codesign of Aerospace and Automotive Systems” , Proceedings of the IEEE , VOL. 98, issue.4 https://ieeexplore.ieee.org/document/5440056	
Topics relevant to the: “FOUNDATION SKILLS”, ARM Embedded Systems: Introduction to Embedded Systems. RISC Design Philosophy. Topics related to development of “EMPLOYABILITY”: Interfacing peripherals: Basics of Interfacing Switches, LEDs, Seven segment displays. Interfacing Stepper motors and DC motors.	
Catalogue prepared by	Mr. Syed Abrar
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: EEE2501	Course Title: Electromagnetic Field Theory Type of Course: Professional Core & Theory only	L-T- P- C	3	1	0	4
Version No.	2.0					
Course Pre-requisites	MAT1211-Linear Algebra, Differential Equations and Statistical Methods.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to provide a basic knowledge about Electromagnetic Fields. It uses the mathematical concepts of vector calculus for analysing the fields. The course enhances the ability to visualize the electric and magnetic fields by using simulation tools like MATLAB and Ansys etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electromagnetic Field Theory and attain Skill Development through Problem Solving methodologies					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Identify appropriate coordinate systems and vector calculus for electromagnetic field analysis. 2. Classify electrostatic field problems according to boundary conditions and governing electrostatic laws.					

	3. Calculate electrostatic field vectors using Poisson's and Laplace's equations. 4. Examine magnetic field parameters in current-carrying conductors using magnetostatic laws. 5. Develop methods using Maxwell's equations for wave propagation and power flow in time-varying electromagnetic fields.			
Course Content:				
Module 1	Introduction to vector analysis and coordinate systems	Assignment	Task on choosing the proper coordinate system for Analysis in various applications	12L+4T Sessions
Topics: Sources and effects of electromagnetic fields - Coordinate Systems - Vector fields - Del Operator, Gradient, Divergence, Curl - Differential length, area and volume in different coordinate systems.				
Module 2	Electrostatic fields	Assignment	Virtual lab	12L+4T Sessions
Topics: Coulomb's law, Gauss's law, Electric potential, Electric dipole and flux lines, Energy density in electrostatic field, Boundary conditions, Poisson's and Laplace's equation.				
Module 3	Magneto Static Fields	Project work	Programming Task / Hardware model	12L+4T Sessions
Topics: Lorentz Force, Biot-Savart's Law, Ampere's Circuit Law, Magnetic Potential, Boundary Conditions, Inductor, Magnetic Energy.				
Module 4	Time Varying Electric and Magnetic Fields	Project work	Hardware model	9L+3T Sessions
Topics: Faraday's law, Displacement current, Maxwell's four equations in integral form and differential form. Poynting Vector and the flow of power, Power flow in a co-axial cable, Instantaneous, Average and Complex Poynting Vector. Wave Equation from Maxwell's equation				
Targeted Application & Tools that can be used: Application Area is in the operation of electrical systems, transmission lines, communication systems, Magnetic Levitation Trains, transformers and electrical machines. Professionally Used Software: MATLAB, ANSYS, Vlab.				
Textbooks: 1. Sadiku, Mathew N. O. and Kulkarni, S. V. "Principles of Electromagnetics" , 6th Edition, Oxford University Press, Latest Version. 2. W H Hayt Jr, J A Buck, and M Jaleel Akhtar . "Engineering Electromagnetics Ninth Edition, TMH Publications.				
References: 1. Cheng, David K., "Field & Wave Electromagnetics" , 2nd Edition, Pearson Education, 2014. 2. Pramanik, Ashutosh, "Electromagnetism - Theory and Applications" , 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 2009.				
Online Learning Resources: 1. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/ 2. https://nptel.ac.in/courses/117/103/117103065/ 3. Case study: https://iopscience.iop.org/article/10.1088/1742-6596/1826/1/012081/meta 4. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live				
Topics relevant to "SKILL DEVELOPMENT" : Electric Field Intensity due to different charge distributions, Magnetic field Intensity due to current carrying conductor for Skill Development				

through Problem Solving methodologies. This is attained through assessment component mentioned in Course Plan.	
Catalogue prepared by	Dr Jisha L K
Recommended by the Board of Studies on	21 st BoS, Held on 09/06/2025
Date of Approval by the Academic Council	26 th Academic Council meeting held on 25 th July 2025

Course Code: ECE2533	Course Title: Analog Communication Type of Course: Program Core Theory only	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	EEE1007 Basics of Electrical & Electronics Engineering					
Anti-requisites	NIL					
Course Description	This course provides an introduction to the fundamental principles of analog communication and their significance in modern communication systems. It covers essential concepts such as signal representation, modulation techniques, and transmission of analog signals through communication channels. The course emphasizes amplitude and angle modulation methods, as well as receiver architectures and demodulation techniques used for accurate signal recovery. It also highlights the impact of noise and interference on communication performance and methods used to analyse and improve system reliability. Students will develop the ability to understand, analyse, and evaluate analog communication systems, forming a strong foundation for advanced studies in communication engineering and related technologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analog Communication and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Describe the basic concepts of analog communication systems. (L2) CO2: Use the performance characteristics of amplitude modulation schemes to assess their efficiency and effectiveness. (L3) CO3: Design Frequency Modulator-demodulator, Phase Modulator-Demodulator and their application in transmitter and Receiver. (L3) CO4: Differentiate between Pulse Width Modulation, Pulse Position Modulation and Pulse Amplitude Modulation and their demodulation schemes. (L4) CO5: Apply the principles of time division multiplexing and demultiplexing techniques for wireless communication systems. (L3) CO6: Analyze the effects of noise in analog communication systems. (L4)					
Course Content:						

Module 1	Amplitude Modulation & Demodulation:	Assignment	Memory Recall based Quizzes	13 Sessions
Topics: Amplitude Modulation & Demodulation: Review of Fourier series and Fourier transforms, LTI systems Elements of communication systems: Modulation, Modulation Methods and its Need, Frequency mixer, EM Spectrum and its Applications. Amplitude Modulation & Demodulation: DSB-FC (AM) modulation & its demodulation, Generation of AM signals, sideband and carrier power of AM, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation. Single sideband (SSB) transmission, Generation of SSB signals, Features of Vestigial sideband (VSB) modulation, Comparison of various amplitude modulation techniques, Illustrative Problems.				
Module 2	Angle Modulation & Demodulation:	Assignment / Quiz	Design and analysis of parameters (simulation)	12 Sessions
Topics: Angle Modulation & Demodulation: Concept of instantaneous frequency, generalized concept of angle modulation, Bandwidth of angle modulated waves – Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Phase modulation, Generation of FM waves Indirect method, Direct method. Demodulation of FM, Pre-emphasis & De-emphasis filters, Non-linear effects in FM systems. Illustrative Problems.				
Module 3	Analog pulse modulation	Assignment	Memory Recall based Quizzes	10 Sessions
Topics: Transmitters, Receivers and Pulse Modulation: AM transmitters, FM transmitters, Super heterodyne receiver, Receiver characteristics Introduction to Pulse Modulation (PAM, PWM, PPM), Basics of Sampling Theorem, Multiplexing techniques. Illustrative Problems				
Module 4	Noise	Assignment	Memory Recall based Quizzes	10 Sessions
Topics: Introduction to noise in communication, External Noise-. Noise in Analog Communication,, Types of noise (internal & external), Atmospheric noise, Extra-terrestrial noise, Industrial noise; internal noise- Thermal agitation noise, Shot noise, Miscellaneous noise, noise calculation, noise figure, noise temperature Noise in DSB-SC and SSB, Noise in FM systems, Signal-to-Noise Ratio (SNR) analysis, Illustrative Problems				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
AM/FM Transmission	Design and simulate AM/FM circuits	LTspice, MATLAB Simulink	Broadcast, Defense	
Pulse Modulation	Develop a PAM circuit with multiplexing	Circuit Verse, Proteus	Telecom, Embedded	
Noise Filtering	Noise figure estimation and analysis	MATLAB, Octave	Telecommunication, Aerospace	
Signal Demodulation	Implement demodulation with pre-emphasis	GNU Radio, LabVIEW	Wireless, Automotive	

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
AM signal generation & detection	Explore modulation–demodulation cycle	LTspice, MATLAB	Amplitude modulation
FM transmitter design	Analyze bandwidth & spectral efficiency	Simulink, LabVIEW	Frequency modulation
Noise analysis in receivers	Compare SNR of systems	MATLAB, Octave	Noise analysis
Pulse modulation techniques	Differentiate PAM, PPM & PDM	Proteus, Circuit Verse	Pulse-modulation schemes

Text Books:

- T1. Communication Systems, Simon Haykin, Michael Moher, Fifth Edition John Wiley & Sons 2014,
T2. Modern Digital and Analog Communication Systems, B.P. Lathi, ZhiDing, Fifth edition Oxford University Press 2019.

Reference Books:

- R1. Electronic Communications, Dennis Roddy and John Coolean, Pearson 4th Edition, 2008
R2. Communication Systems (Analog and Digital), Dr. Sanjay Sharma, S.K. Kataria& Sons, 2013.
R3. Introduction to Analog and Digital Communications – Simon Haykin and Michael Moher, Wiley India, 2nd Edition.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://youtu.be/iZM2zgxnEOc>
2. <https://www.sciencedirect.com/topics/engineering/analog-communication>
3. <https://nptel.ac.in/courses/117105143>
4. <https://www.slideshare.net/prestonking948/analog-communication>
5. <https://presiuniv.knimbus.com/user#/home>

E-content:

1. R. Boddada, S. Almonacil, D. R. Arrieta and S. Bigo, "Analog/Digital Converter Requirements for Coherent Optical Satellite Communications," 2022 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), 2022, pp. 1-3, doi: 10.23919/OECC/PSC53152.2022.9850076.
<https://ieeexplore.ieee.org/document/9850076>
2. A. Mezerins and V. Bepal'ko, "Estimation of analog-to-time and time-to-digital conversion efficiency in analog optical communication system testbed," 2015 Advances in Wireless and Optical Communications (RTUWO), 2015, pp. 211-214, doi: 10.1109/RTUWO.2015.7365754.
<https://ieeexplore.ieee.org/document/7365754>
3. Y. Feng et al., "A 20.8-Gbps dual-carrier wireless communication link in 220-GHz band," in China Communications, vol. 18, no. 5, pp. 210-220, May 2021, doi: 10.23919/JCC.2021.05.013.
<https://ieeexplore.ieee.org/document/9444247>
- 4.K. Onohara, J. Nishioka, T. Yoshida and N. Suzuki, "A Study of Multi-Channel Analog-to-Digital Conversion for Beyond-5G Mobile Fronthaul," 2020 Opto-Electronics and

Communications Conference (OECC), 2020, pp. 1-3, doi:
10.1109/OECC48412.2020.9273574.
<https://ieeexplore.ieee.org/document/9273574>

Topics relevant to "SKILL DEVELOPMENT": AM, FM, PM and PAM for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by Mrs. Ashwini B

Recommended by the Board of Studies on 12th BOS held on 10/08/2021

Date of Approval by the Academic Council Meeting No. 16th , Dated 23/10/2021

Course Code: ECE2552	Course Title: Analog Communication Lab Type of Course: Program Core & Laboratory only	L- T-P- C	0	0	2	1
Version No.	2.0					
Course Pre-requisites	EEE1007 Basics of Electrical & Electronics Engineering					
Anti-requisites	NIL					
Course Description	This course will introduce the basic concepts and techniques for analog communications. Applications of analog communication systems will be emphasized. It will help the students to form a strong foundation for the specialization in communication engineering. The course will discuss the requirements for modulation before feeding the message signal to the communication channel from the transmitter. Similarly, the role of demodulation techniques at the receiver side will be discussed. The associated laboratory provides an opportunity to validate the concepts taught in theory as well as enhances the ability to visualize communication scenarios in order to provide a solution using various simulation tools and hardware tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analog Communication and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Demonstrate the working of Amplitude Modulation & Demodulation techniques. (L3) CO2: Estimate improvement in spectrum efficiency using suppressed carrier modulation techniques. (L3) CO3: Apply the concepts of multiplexing and demultiplexing in analog modulation technique. (L3) CO4: Develop angle modulation for communication system. (L3) CO5: Experiment with pulse modulation circuits for communication system. (L3) CO6: Analyze various modulation and demodulation and angle modulation using modern tools. (L4)					
Course Content:						

List of Laboratory Tasks:

Experiment No 1: Study of Amplitude Modulation And Demodulation

Experiment No 2: Simulation of Amplitude Modulation using Matlab/ Simulink.

Experiment No 3: Generate AM-DSB-SC Signal using Ring Modulator

Experiment No 4: Study of AM-SSB-SC modulation and demodulation

Experiment No 5: Study of Frequency Division Multiplexing with DSB-SC

Experiment No 6: Study of Frequency modulation and demodulation

Experiment No 7: Simulation of Frequency Modulation and Demodulation using MATLAB /Simulink, to study time and frequency domain analysis.

Experiment No 8: Design and verify the working of Pre-Emphasis & De-Emphasis circuits to find the normalized gain.

Experiment No 9: Study of Pulse Amplitude Modulation and Demodulation using experimental set up.

Experiment No 10: Study of Pulse Position Modulation and Demodulation using experimental set up.

Experiment No 11: Study of Pulse Width Modulation and their Demodulation using experimental set up.

Experiment No 12: Verification of sampling theorem using experimental setup / MATLAB Simulink

Targeted Application & Tools that can be used:

Targeted Applications: This course is contributed for placement in core companies, research & development work and also useful to know the existing & developing communications. Professionally Used Software: MATLAB, device setup in laboratory.

Text Books:

- T1. Communication Systems, Simon Haykin, Michael Moher, Fifth Edition John Wiley & Sons 2014,
- T2. Modern Digital and Analog Communication Systems, B.P. Lathi, ZhiDing, Fifth edition Oxford University Press 2019.

Reference Books:

- R1. Electronic Communications, Dennis Roddy and John Coolean, Pearson 4th Edition, 2008
- R2. Communication Systems (Analog and Digital), Dr. Sanjay Sharma, S.K. Kataria& Sons, 2013.
- R3. Introduction to Analog and Digital Communications – Simon Haykin and Michael Moher, Wiley India, 2nd Edition.

Online Resources (e-books, notes, ppts, video lectures etc.):

- 1. <https://youtu.be/iZM2zgxnEOc>
- 2. <https://www.sciencedirect.com/topics/engineering/analog-communication>
- 3. <https://nptel.ac.in/courses/117105143>
- 4. <https://www.slideshare.net/prestonking948/analog-communication>
- 5. <https://presiuniv/knimbus.com/user#/home>

E-content:

- 1. R. Boddeda, S. Almonacil, D. R. Arrieta and S. Bigo, "Analog/Digital Converter Requirements for Coherent Optical Satellite Communications," 2022 27th OptoElectronics and

Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), 2022, pp. 1-3, doi: 10.23919/OECC/PSC53152.2022.9850076. https://ieeexplore.ieee.org/document/9850076 2. A. Mezerins and V. Bespal'ko, "Estimation of analog-to-time and time-to-digital conversion efficiency in analog optical communication system testbed," 2015 Advances in Wireless and Optical Communications (RTUWO), 2015, pp. 211-214, doi: 10.1109/RTUWO.2015.7365754. https://ieeexplore.ieee.org/document/7365754 3. Y. Feng et al., "A 20.8-Gbps dual-carrier wireless communication link in 220-GHz band," in China Communications, vol. 18, no. 5, pp. 210-220, May 2021, doi: 10.23919/JCC.2021.05.013. https://ieeexplore.ieee.org/document/9444247 4. K. Onohara, J. Nishioka, T. Yoshida and N. Suzuki, "A Study of Multi-Channel Analog-to-Digital Conversion for Beyond-5G Mobile Fronthaul," 2020 Opto-Electronics and Communications Conference (OECC), 2020, pp. 1-3, doi: 10.1109/OECC48412.2020.9273574. https://ieeexplore.ieee.org/document/9273574 Topics related to development of "FOUNDATION" : Amplitude and angle modulation techniques. Topics related to development of "EMPLOYABILITY" : All modulation techniques. Topics related to development of "ENVIRONMENT AND SUSTAINABILITY" : FM Spectrum and its Applications	
Catalogue prepared by	Dr.Azra Jeelani
Recommended by the Board of Studies on	21st BOS held on 9th June 2025
Date of Approval by the Academic Council	26th Academic Council Meeting held on 25th July 2025

Course Code: ECE2522	Course Title: CMOS VLSI Design Type of Course: Program Core Theory	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Analog electronics, Linear Integrated Circuits, Network Theory.					
Anti-requisites	NIL					
Course Description	This course provides insights into the fundamentals of VLSI Design-based systems. The course develops the knowledge of both hardware and software that leads to the design and implementation of both analogue VLSI circuits. The course emphasizes on CMOS technology, highlighting design methodology, testability, and design verification. The course also demonstrates the use of analog circuit design and layout using cadence virtuoso.					
Course Objective	The objective of the course is to SKILL DEVELOPMENT of students by using PARTICIPATIVE LEARNING techniques.					

Course Outcomes	On successful completion of this Lab the students shall be able to:			
	CO1: Discuss the basic concepts of MOSFET using MOS device models. (L2)			
	CO2: Illustrate MOS inverters to design efficient MOS circuits. (L3)			
	CO3: Use the large-signal model to analyze and comprehend CMOS sub-circuits. (L3)			
	CO4: Examine the functions of MOS amplifiers using small and large signal models. (L4)			
	CO5: Compare the suitability of common source, common drain, cascode, and folded cascode amplifiers for VLSI integration. (L4)			
CO6: Interpret circuit-related issues in RF and Mixed IC design. (L3).				
Course Content:				
Module 1	Device Physics	Assignment/ Quiz	Memory Recall based Quizzes	10 Sessions
MOSFET Structure and Symbols, MOS I/V Characteristics, MOS Device Models: MOS Device Layout, MOS Device Capacitances, MOS Small-Signal Model, MOS SPICE models, NMOS Versus PMOS Devices, Long-Channel Versus Short-Channel Devices- Second-Order Effects. MOS Inverters-Static Characteristics: Introduction, Resistive-Load Inverter, Inverters with N-type MOSFET Load. Introduction SiGe BICMOS Technology.				
Module 2	Sub-Circuits	Assignment/ Quiz	Memory Recall based Quizzes	12 Sessions
CMOS Inverter-stick diagram & layout. Large signal analysis of MOS Devices. MOS Switch, MOS Diode/Active Resistor, Current Sinks and Sources, Current Mirrors Current and Voltage References,				
Module 3	Amplifiers	Assignment/ Quiz	Memory Recall based Quizzes	12 Sessions
Single-Stage Amplifiers: Common Source, Common Drain and Common Drain Amplifier. Cascode Amplifier and Folder Cascode Amplifier, Design of Differential amplifier: large and Small Signal model, Slew Rate and OPAMP: Ideal vs Practical, Compensation of Opamp, Design of Single and 2 Stage opamp.				
Module 4	Design issues and trends	Assignment/ Quiz	Memory Recall based Quizzes	11 Sessions
Basics of data converters; Analog Testing, Floor Planning and Layout issues; Mixed signal design and layout issues; Low Voltage and Low Power Circuits; Introduction to RF Electronics, Introduction to current mode VLSI design.				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Analog Circuit Design	Design of CMOS-based Rectifier Circuits	Cadence Virtuoso	Consumer Electronics	
OpAmp Design	2-stage OpAmp design and simulation	Cadence Virtuoso	Automotive & Biomedical	
Differential Amplifier Tuning	Optimize W/L for Gain, Slew Rate, Bandwidth	Cadence Virtuoso	Communication Systems	
Low Power VLSI	Layout for low voltage, low leakage circuits	Cadence Virtuoso	Wearables and IoT	
Skill Building Through Experiential Learning				

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Differential amplifier design	Achieve required gain, slew rate and bandwidth	Cadence Virtuoso (schematic & layout)	Analog amplifier sizing; AC & transient analysis
Two-stage op-amp implementation	Design a high-performance op-amp circuit	Cadence Virtuoso with parametric sweeps	Op-amp architecture; performance optimisation
CMOS rectifier design	Simulate diode behaviour for energy conversion	Cadence Virtuoso	Power-conversion circuits; MOS-diode modelling
Low-power layout	Minimise power leakage in layout	Cadence Virtuoso layout editor	Low-power layout techniques; leakage reduction

Project work/Assignment:

1. Find the aspect ratio of the Differential Amplifier for the given gain, slew rate and bandwidth and hence design and verify the differential amplifier in cadence virtuoso.
2. Find the aspect ratio of the 2stage OPAMP for the given gain, slew rate and bandwidth and hence design and verify the differential amplifier in cadence virtuoso.
3. Design the CMOS-based rectifier circuits in cadence virtuoso to obtain the constant output of 2 V, if the peak input ac voltage is 3 V at the frequency of 300 Hz and internal resistance is 2Mohm and Internal capacitance is 10 nF.

Text Books:

1. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill 2001
2. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, 2nd edition, Oxford University Press, 1997

Reference(s):

Reference Books

1. B. Razavi, RF Microelectronics, Prentice-Hall, 1998.
2. R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, IEEE Press, 1997.
3. P. R. Gray and R. G. Meyer, Analysis and design of Analog Integrated circuits 4th Edition, Wiley Student Edition, 2001.
4. D. A. Johns and K. Martin, Analog Integrated Circuit Design, Wiley Student Edition, 2002.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Video lectures on "VLSI Devices: Modeling and Simulation" by Prof. Dr. S K Lahiri, IIT KGP <http://www.satishkashyap.com/2013/07/video-lectures-on-vlsi-devices-modeling.html>.
2. VLSI Design, IIT Bombay by Prof. A.N. Chandorkar <https://nptel.ac.in/courses/117/101/117101058/>
3. CMOS Digital VLSI Design by Prof. SudebDasgupta, IIT Roorkee. https://onlinecourses.nptel.ac.in/noc21_ee09/preview

E-content:

1. Konar, Maitraiye, Rashmi Sahu, and Sudip Kundu. "Improvement of the gain accuracy of the instrumentation amplifier using a very high gain operational amplifier." In *2019 Devices for Integrated Circuit (DevIC)*, pp. 408-412. IEEE, 2019. <https://ieeexplore.ieee.org/abstract/document/8783414>
2. Kundu, Sudip, and Pradip Mandal. "ISGP: Iterative sequential geometric programming for precise and robust CMOS analog circuit sizing." *Integration* 47, no. 4 (2014): 510-531. <https://www.sciencedirect.com/science/article/pii/S0167926014000078>
3. Singh, Geetanjali, Srikanta Pal, and Sudip Kundu. "A zero bias highly efficient active diode circuit for piezoelectric energy harvester." *International Journal of Nanoparticles* 14,

no. 2-4 (2022): 106-120. https://www.inderscienceonline.com/doi/abs/10.1504/IJNP.2022.126377	
4. Kundu, Sudip, and Pradip Mandal. "A generic and efficient modeling of phase margin of high performance CMOS OpAmps." In <i>Proceedings of the 2014 IEEE Students' Technology Symposium</i> , pp. 164-169. IEEE, 2014. https://ieeexplore.ieee.org/abstract/document/6808040	
5. Kumar, Vikash, Rishab Mehra, and Aminul Islam. "A 2.5 GHz Low Power, High- Q , Reliable Design of Active Bandpass Filter." <i>IEEE Transactions on Device and Materials Reliability</i> 17, no. 1 (2017): 229-244. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7814293	
5.Presidency University Library Link:- https://presiuniv.knimbus.com/user#/home	
Topics related to the development of "FOUNDATION SKILLS": MOS Transistors, Topics related to the development of "EMPLOYABILITY": Design of Opamp	
Catalogue prepared by	Dr Manikandan T
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2572	Course Title: CMOS VLSI Design Lab Type of Course: Program Core Lab	L- T-P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Analog electronics, Linear Integrated Circuits, Network Theory.					
Anti-requisites	NIL					
Course Description	This course provides insights into the fundamentals of VLSI Design-based systems. The course develops the knowledge of both hardware and software that leads to the design and implementation of both analogue VLSI circuits. The course emphasizes on CMOS technology, highlighting design methodology, testability, and design verification. The course also demonstrates the use of analog circuit design and layout using cadence virtuoso.					
Course Objective	The objective of the course is to SKILL DEVELOPMENT of students by using EXPERIENTIAL LEARNING techniques.					
Course Outcomes	On successful completion of this Lab the students shall be able to: CO1: Characterize MOS transistors and CMOS inverter through experimental analysis. (L4) CO2: Implement CMOS-based universal gates using EDA tools. (L3) CO3: Develop layouts of basic CMOS circuits using EDA tools. (L6) CO4: Examine the functionality of common source and common drain amplifiers based on simulation results. (L4) CO5: Determine the characteristics of differential and operational amplifiers. (L4) CO6: Analye the performance of DAC circuits under different operating conditions using EDA tools. (L4)					
Course Content:						
List of Laboratory Tasks: Familiarization of the Cadence Lab. Lab experiments:						

1. Design a MOS transistor (nmos and pmos) using the cadence tool and obtain its Static Characteristics. Find the relationship between Current ID (Drain current) and VDS` (Drain to Source voltage) for different values of Vgs (Gate to Source voltages). Find ID, Vgs and VDS. In which region is the transistor operating?
2. Design and simulate CMOS schematic Invertor Circuit and verify the following: DC Analysis, AC Analysis and Transient Analysis.
3. Design and simulate CMOS based schematic two input universal gates and verify the following: DC Analysis, AC Analysis and Transient Analysis.
4. Implement CMOS Invertor: Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design.
5. Implement CMOS Two Input Universal Gates: Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design.
6. Design the common source amplifier with given specifications, completing the design flow mentioned below: (a) Draw the schematic and symbol and verify the following: DC Analysis, AC Analysis Transient Analysis (b) Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design-**(b is an optional)**.
7. Design the common drain amplifier with the given specifications, completing the design flow mentioned below: (a) Draw the schematic and symbol and verify the following: DC Analysis, AC Analysis Transient Analysis (b) Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design-**(b is an optional)**.
8. Design the single stage CMOS differential amplifier with the given specifications, completing the design flow mentioned below: (a) Draw the schematic and symbol and verify the following: DC Analysis, AC Analysis Transient Analysis. (b) Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design - **(b is an optional)**.
9. Design an op-amp with given specification using given differential amplifier & Common source amplifier in the library and completing the design flow mentioned below. (a) Draw the schematic and symbol and verify the following: DC Analysis, AC Analysis Transient Analysis. (b) Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design- **(b is an optional)**.
10. Design a 4-bit R-2R based DAC for the given specification and completing the design flow mentioned using given op-amp in the library.(a) Draw the schematic and symbol and verify the following: DC Analysis, AC Analysis Transient Analysis. (b) Draw the Layout and verify the DRC, ERC, Check for LVS, Extract RC and back annotate the same and verify the design- **(b is an optional)**.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools & Techniques Used	Relevant Industries
Analog & Mixed Signal IC	Design of Amplifiers	Cadence Virtuoso	Semiconductors

Custom Layout	Layout of Logic Gates	Virtuoso Layout Editor	EDA Tools
Digital IP Integration	OpAmp & DAC IP Usage	Cadence ADE	ASIC Design
Verification	LVS, DRC, Parasitic Extraction	Assura/Calibre	Foundries

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Differential amplifier design	Tune gain, bandwidth & slew rate	Cadence Virtuoso	Analog amplifier sizing
Two-stage op-amp design	Achieve high gain through IP reuse	Custom IP reuse	Op-amp architecture
CMOS rectifier	Develop voltage-control circuit	Cadence schematic/layout	Power-rectifier design

Project work/Assignment:

1. Find the aspect ratio of the Differential Amplifier for the given gain, slew rate and bandwidth and hence design and verify the differential amplifier in cadence virtuoso.
2. Find the aspect ratio of the 2stage OPAMP for the given gain, slew rate and bandwidth and hence design and verify the differential amplifier in cadence virtuoso.
3. Design the CMOS-based rectifier circuits in cadence virtuoso to obtain the constant output of 2 V, if the peak input ac voltage is 3 V at the frequency of 300 Hz and internal resistance is 2Mohm and Internal capacitance is 10 nF.

Text Books:

1. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill 2001
2. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, 2nd edition, Oxford University Press, 1997

Reference(s):

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1. B. Razavi, RF Microelectronics, Prentice-Hall, 1998.
2. R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, IEEE Press, 1997.
3. P. R. Gray and R. G. Meyer, Analysis and design of Analog Integrated circuits 4th Edition, Wiley Student Edition, 2001.
4. D. A. Johns and K. Martin, Analog Integrated Circuit Design, Wiley Student Edition, 2002.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Video lectures on "VLSI Devices: Modeling and Simulation" by Prof. Dr. S K Lahiri, IIT KGP
2. <http://www.satishkashyap.com/2013/07/video-lectures-on-vlsi-devices-modeling.html>.
3. VLSI Design, IIT Bombay by Prof. A.N. Chandorkar <https://nptel.ac.in/courses/117/101/117101058/>
4. CMOS Digital VLSI Design by Prof. SudebDasgupta, IIT Roorkee. https://onlinecourses.nptel.ac.in/noc21_ee09/preview

E-content:

1. Konar, Maitraiye, Rashmi Sahu, and Sudip Kundu. "Improvement of the gain accuracy of the instrumentation amplifier using a very high gain operational amplifier." In *2019 Devices for Integrated Circuit (DevIC)*, pp. 408-412. IEEE, 2019. <https://ieeexplore.ieee.org/abstract/document/8783414>
2. Kundu, Sudip, and Pradip Mandal. "ISGP: Iterative sequential geometric programming for precise and robust CMOS analog circuit sizing." *Integration* 47, no. 4 (2014): 510-531. <https://www.sciencedirect.com/science/article/pii/S0167926014000078>

3. Singh, Geetanjali, Srikanta Pal, and Sudip Kundu. "A zero bias highly efficient active diode circuit for piezoelectric energy harvester." <i>International Journal of Nanoparticles</i> 14, no. 2-4 (2022): 106-120. https://www.inderscienceonline.com/doi/abs/10.1504/IJNP.2022.126377	
4. Kundu, Sudip, and Pradip Mandal. "A generic and efficient modeling of phase margin of high performance CMOS OpAmps." In <i>Proceedings of the 2014 IEEE Students' Technology Symposium</i> , pp. 164-169. IEEE, 2014. https://ieeexplore.ieee.org/abstract/document/6808040	
5. Kumar, Vikash, Rishab Mehra, and Aminul Islam. "A 2.5 GHz Low Power, High- Q , Reliable Design of Active Bandpass Filter." <i>IEEE Transactions on Device and Materials Reliability</i> 17, no. 1 (2017): 229-244. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7814293	
6. 5.Presidency University Library Link: - https://presiuniv.knimbus.com/user#/home	
Topics related to the development of "FOUNDATION SKILLS" : MOS Transistors, Topics related to the development of "EMPLOYABILITY" : Design of Opamp	
Catalogue prepared by	Dr Manikandan T
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2505	Course Title: Transmission Lines and Waveguides Type of Course: Program Core & Theory only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	The knowledge of vector algebra, basics of electrical engineering, network theory and MATLAB-SIMULINK software tool					
Anti-requisites	NIL					
Course Description	The course focuses on various types of transmission lines used in daily life. The course includes stub impedance matching, transmission and reception of high frequency waves through co-axial cable and waveguide. This course lays a foundation for many communications related courses like satellite communication, mobile communication, analog and digital communication etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Transmission Lines and Waveguides and attain the SKILL DEVELOPMENT through PROBLEM SOLVING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the necessity and working of a transmission line. (L2) CO2: Solve the voltage and current wave equation for a transmission line. (L3) CO3: Analyze the transmission line parameters using analytical and Smith chart methods. (L4) CO4: Infer the various parameter of rectangular wave guide. (L4) CO5: Analyze power transmission and attenuation in rectangular waveguide. (L4)					

	CO6: Illustrate an expression for E and H fields inside a metallic circular waveguide using Bessel functions. (L2)			
Course Content:				
Module 1	Transmission Lines and its parameters	Assignment	Simulation task (transmission lines and its parameters)	16 Session
Topics: Introduction to Transmission lines, transmission line parameters calculation for co-axial cable, Transmission line equations, Concept and numerical on input impedance, Reflection coefficient, VSWR, characteristic impedance, open and short-circuited lines.				
Module 2	Stub impedance matching	Assignment	Simulation task (stub impedance matching parameters)	15 Session
Topics: Introduction to stub impedance matching, single stub impedance matching and numerical, double stub impedance matching and numerical, Smith chart fundamentals, construction of Smith chart, use of Smith chart to solve stub impedance matching problems, Some applications of transmission lines				
Module 3	Waveguides	Assignment	Simulation task	14 Session
Topics: Introduction, properties and characteristics of waveguides, Applications of Waveguides, General approach to solve field inside waveguide, TM wave in rectangular waveguide, various TM modes, waveguide as a high pass filter, Power transmission and attenuation, TE wave in rectangular waveguide, various TE modes, excitation of waveguides, waveguide terminations, introduction to waveguide resonators				
List of Laboratory Tasks: Nil				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
5G/6G Wireless	Design transmission line for RF front-end	MATLAB, HFSS, CST	Telecom, Semiconductor	
Satellite Communication	Stub matching for satellite antenna	Python, Smith Chart Tools	Aerospace, Defence	
Photonics	Analyze wave propagation in dielectric waveguides	COMSOL Multiphysics	Photonics, Optoelectronics	
IoT & Edge Devices	Impedance matching in wearable antenna	Arduino/Raspberry Pi	Healthcare, Consumer Electronics	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
Simulate coaxial line behavior	Visualize wave propagation & impedance	MATLAB, Simulink	Transmission-line simulation	

Stub matching design	Maximize power transfer	Smith Chart Tool, Python	Impedance matching
Identify TE modes	Understand cutoff & propagation modes	HFSS, CST	Waveguide mode analysis
Compare dielectric vs rectangular	Evaluate mm-wave capability	COMSOL, MATLAB	Waveguide comparative study

Text Book(s)

1. K. Giridhar, "Transmission Lines and Wave Guides" , Pooja Publications, India, Fourth Edition.

Reference Book(s):

1. Pramanik, Ashutosh, "Electromagnetism - Theory and Applications" , Prentice-Hall of India Private Limited, Second Edition.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-fall-2005/lecture-notes/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-776-high-speed-communication-circuits-spring-2005/lecture-notes/>
3. <https://presiuniv.knimbus.com/user#/home>

E-content:

1. H. He, B. Li and Y. Sun, "The study of different transmission lines in high-speed optical module," 2014 15th International Conference on Electronic Packaging Technology, 2014, pp. 1052-1055, doi: 10.1109/ICEPT.2014.6922826.
<https://ieeexplore.ieee.org/document/6922826>
2. F. Olyslager, "Properties of and generalized full-wave transmission line models for hybrid (Bi)(an)isotropic waveguides," in IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 11, pp. 2064-2075, Nov. 1996, doi: 10.1109/22.543964.
<https://ieeexplore.ieee.org/document/543964>
3. W. J. Getsinger, "An introduction to microwave transmission lines," [1992] Proceedings of the 35th Midwest Symposium on Circuits and Systems, 1992, pp. 1016-1019 vol.2, doi: 10.1109/MWSCAS.1992.271122.
<https://ieeexplore.ieee.org/document/271122>
4. F. Distler, J. Schür and M. Vossiek, "In-depth characterization of a dielectric waveguide for mmW transmission line applications," 2018 IEEE 22nd Workshop on Signal and Power Integrity (SPI), 2018, pp. 1-4, doi: 10.1109/SaPIW.2018.8401671.
<https://ieeexplore.ieee.org/document/8401671>

Topics relevant to "SKILL DEVELOPMENT" : Transmission line parameters, Reflection coefficient, VSWR, Impedance Matching, Smith Chart, Waveguides for Skill Development through Problem Solving techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Sreenivasappa B V
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE2503	Course Title: Digital Communication. Type of Course: Program Core - Theory only		L-T-P-C	3	0	0	3
Version No.	1.0						
Course Pre-requisites	Basics of analog circuit design, Binary operations in digital electronics, Knowledge of analog communication to highlight its demerits, signals and systems to perform operations on signals and digital signal processing for processing digital signals and for the implementation of digital filters.						
Anti-requisites	NIL						
Course Description	The course deals with the importance and applications of digital communication for data, video, audio, image transmission and reception. The course is conceptual and application oriented. This course acts as a foundation for the future courses in communication domain like mobile communication, antenna and microwave engineering, satellite communication and data communication and networks etc.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Communication and attain Skill Development through Experiential Learning techniques.						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the block diagram and basic signal processing operations of a digital communication system. (L2) CO2: Solve numerical on sampling of low pass signals, quadrature sampling of band pass signals and Hilbert transform. (L3) CO3: Analyze waveform coding techniques namely TDM, PCM, DPCM, and Delta Modulation. (L4) CO4: Infer the concept of Inter Symbol Interference (ISI), Nyquist’s criterion, correlative coding and eye pattern for distortion less baseband transmission. (L4) CO5: Analyze digital modulation techniques namely coherent, non-coherent and quadrature schemes. (L4) CO6: Illustrate the spread spectrum modulation, pseudo noise (PN) sequences and geometric representation of signal. (L3)						
Course Content:							
Module 1	Introduction to Digital Communication	Assignment/ Quiz	Numerical solving Task	10 Sessions			
Block diagram of digital communication, Sampling Principles: Sampling Theorem, Quadrature sampling of Band pass signal, Practical aspects of sampling and signal recovery, Hilbert Transform.							
Module 2	Waveform coding techniques and Inter Symbol Interference	Assignment/ Quiz	Memory Recall based Quizzes	11 Sessions			
TDM, PCM, DPCM and DM, Numerical. ISI, Nyquist’ s criterion for distortion less base-band binary transmission, correlative coding, eye pattern.							
Module 3	Digital Modulation Techniques	Assignment/ Quiz	Memory Recall-based Quizzes	12 Sessions			

Digital modulation formats, coherent binary modulation techniques, coherent quadrature modulation techniques. Non-coherent binary modulation techniques.

Module 4	Spread Spectrum Modulation and Detection and Estimation	Assignment/ Quiz	Numerical solving Task	12 Sessions
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Pseudo noise sequences, notion of spread spectrum, direct sequence spread spectrum, frequency hop spread spectrum, applications, Numerical. Gram-Schmidt orthogonalization procedure, geometric representation of signals, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Wireless Communication	Design and simulate a QPSK system	MATLAB, GNU Radio	Telecom, IoT
Audio/Video Transmission	Implement PCM and DPCM for voice	MATLAB, Simulink	Media, Broadcasting
Secure Communication	Use DSSS for secure transmission	GNU Radio, Python	Defense, Cybersecurity
IoT Systems	Low-power digital modulation simulation	NS-3, MATLAB	Smart Devices, Automation

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
PCM & DPCM simulation	Understand coding methods	MATLAB, Simulink	Quantization & coding
QPSK modulation/ demodulation	Analyze noise performance	GNU Radio	Digital modulation analysis
DSSS implementation	Secure signal transmission	Python, SDR kits	Spread-spectrum techniques
ISI & eye diagram	Visualize channel impairments	MATLAB	Inter-symbol interference analysis

Text Book(s):

1. Simon Haykin, "Digital Communication" , John Wiley Publication, 2003, 2nd Edition.
2. John G. Proakis, "Digital Communication" , TMH Publication, 3rd Edition

Reference Book (s):

1. B. Sklar, "Digital Communication: Fundamentals and Applications" , Pearson Edition, 2nd Edition.
2. Sam Shanmugam, "Digital & Analog Communication K." , John Wiley Publication, 2nd Edition.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://presiuniv.knimbus.com/user#home>
2. MIT OPEN COURSE: <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/>
3. MIT PRINCIPLES OF DIGITAL COMMUNICATIONS: <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-1-introduction/>
4. MIT PRINCIPLES OF DIGITAL COMMUNICATIONS : <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-6-quantization/>
5. MIT PRINCIPLES OF DIGITAL COMMUNICATIONS : <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-15-modulation-demodulation/>

Topics relevant to "SKILL DEVELOPMENT": Learning concepts of different pulse code modulations helps in Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course plan.

Catalogue prepared by	Dr. Sreenivasappa B V
Recommended by the Board of Studies on	19 th BOS held on 3 rd July 2024
Date of Approval by the Academic Council	24 th Academic Council Meeting held on 03/08/2024.

Course Code: ECE2553	Course Title: Digital Communication Lab Type of Course: Program Core, Lab	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Basics of analog circuit design, Binary operations in digital electronics, Knowledge of analog communication to highlight its demerits, signals and systems to perform operations on signals and digital signal processing for processing digital signals and for the implementation of digital filters.					
Anti-requisites	NIL					
Course Description	The laboratory experiments provide an opportunity for the students to validate the concepts learned in theory through experiments and motivate the students to extend such laboratory experiments to real life applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Communication and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					

Course Outcomes	On successful completion of this Lab the students shall be able to: CO1: Analyze the sampling theorem for analog signals using MATLAB/SIMULINK and laboratory trainer kits for all the three sampling cases. (L4) CO2: Demonstrate Time Division Multiplexing (TDM) of multiple band-limited signals using MATLAB/SIMULINK and hardware modules. (L3) CO3: Illustrate Pulse Code Modulation (PCM) and signal reconstruction using MATLAB/SIMULINK and trainer kits. (L3) CO4: Design coherent digital modulation and demodulation schemes using MATLAB/SIMULINK and trainer kits/discrete components. (L3) CO5: Design non-coherent digital modulation and demodulation schemes using MATLAB/SIMULINK and trainer kits/discrete components. (L3) CO6: Demonstrate PN sequence generation and Direct Sequence Spread Spectrum. (L3)	
Course Content:		
List of Laboratory Tasks:		
S. No	Name of the Experiment/Exercise	Sessions
1	Experiment No 1: Verify Sampling theorem Level 1: Verify sampling theorem for the given analog signal using MATLAB/SIMULINK Level 2: Verify sampling theorem for the given analog signal using trainer kit	2
2	Experiment No 2: Time Division Multiplexing Level 1: Setup the module of TDM of four band limited signals to verify different signals in different time slots can be transmitted using a single channel using MATLAB/SIMULINK Level 2: Setup the module of TDM of four band limited signals to verify different signals in different time slots can be transmitted using a single channel using trainer kit	2
3	Experiment No 3: Pulse Code Modulation and Demodulation Level 1: Setup the modulation and demodulation of PCM to obtain binary bits for the given analog signal and from the binary bits reconstruct the analog signal using MATLAB/SIMULINK Level 2: Setup the modulation and demodulation of PCM to obtain binary bits for the given analog signal and from the binary bits reconstruct the analog signal using trainer kit	2
4	Experiment No 4: Modulation and demodulation of ASK and BPSK Level 1: Implement the circuit to verify modulation and demodulation of ASK and BPSK for the given binary data and calculate the bit error rate (BER) using MATLAB/SIMULINK Level 2: Design and implement the circuit to verify	2
	Level 2: Verify the modulation and demodulation of ASK for the given binary data using discrete components	2
5	Experiment 5: Modulation and demodulation of FSK Level 1: Verify the modulation and demodulation of FSK for the given binary data using MATLAB/SIMULINK Level 2: Verify the modulation and demodulation of FSK for the given binary data using trainer kit	2

6	Experiment 6: Modulation and demodulation of DPSK Level 1: Verify the modulation and demodulation of DPSK for the given binary data using MATLAB/SIMULINK Level 2: Verify the modulation and demodulation of DPSK for the given binary data using trainer kit	2
7	Experiment 7: Modulation and demodulation of QPSK Level 1: Verify the modulation and demodulation of QPSK for the given binary data using MATLAB/SIMULINK	2
8	Experiment 8: Modulation and demodulation of GMSK Level 1: Verify the modulation and demodulation of GMSK for the given binary data using MATLAB/SIMULINK	2
9	Experiment 9: Generation of PN sequence and DSSS Level 1: Generation of Pseudo-Noise (PN) Sequence and Implementation of Direct Sequence Spread Spectrum (DSSS) Using MATLAB/Simulink	2

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
IoT Communication	Transmit sensor data via PCM	Arduino, ADC	Smart Agriculture, Smart Homes
Voice Transmission	PCM implementation for voice	MATLAB, DSP Kit	Telecom, Assistive Tech
Digital Healthcare	ECG data compression using DM	Raspberry Pi	Healthcare, Bio-medical
Secure Data	Line coding & transmission	Logic ICs, Arduino	Cybersecurity, IT

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Sampling & quantization	Digitize analog signals	MATLAB/SIMULINK	Sampling theory & quantization
PCM system integration	Build full digital chain	MATLAB/SIMULINK	Signal-chain integration
Line coding	Explore encoding schemes	MATLAB/SIMULINK	Bandwidth-efficient coding
Delta modulation	Compare efficiency vs PCM	MATLAB/SIMULINK	Adaptive modulation

Text Book(s):

1. Digital Communication Laboratory Manual.

Topics relevant to "SKILL DEVELOPMENT": Performing suitable experiments to perform pulse code modulation for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course plan.

Catalogue prepared by	Dr. Sreenivasappa B V
Recommended by the Board of Studies on	19 th BOS held on 3 rd July 2024
Date of Approval by the Academic Council	24 th Academic Council Meeting held on 03/08/2024.

Course Code: CSS2257	Course Title: Computer Organization and Architecture Type of Course: Theory Course (PCC)	L-T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the core principles of computer architecture and organization from basic to intermediate level. This theory based course emphasizes on understanding the interaction between computer hardware and software. It equips the students with the intuition behind assembly-level instruction set architectures. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.					
Course Objective	To develop a comprehensive understanding of computer system organization by enabling students to analyze processor architecture and instruction execution, explore memory hierarchy and cache mechanisms, examine input/output organization and interfacing and evaluate system performance and optimization techniques.					
Course Outcomes	On successful completion of this course, students will be able to: CO1: Describe the fundamental components of a computer system and their interconnections. [Remember] CO2: Explain the concepts of Instruction Set Architecture (ISA) and memory organization. [Understand] CO3: Apply techniques to perform arithmetic and logical operations in computer systems. [Apply] CO4: Explain the organization and functioning of processor and memory subsystems. [Understand] CO5: Analyze the design and performance aspects of computer architecture components for efficient system operation. [Analyze]					
Course Content:						
Module 1	Basic Structure of Computer					12 Sessions
Topics: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Computer systems RISC & CISC, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Arithmetic Operations on Signed numbers. Instructions and Instruction Sequencing, Instruction formats, Memory Instructions.						
Module 2	Instruction Set Architecture and Memory Unit					12 Sessions
Topics: Instruction Set Architecture: Addressing Modes, Stacks and Subroutines. Memory System: Memory Location and Addresses, Memory Operations, Semiconductor RAM Memories, Internal Organization of Memory chips, Cache memory mapping Techniques.						
Module 3	Arithmetic And Input/output Design					10 Sessions
Topics: Arithmetic: Carry lookahead Adder, Signed-Operand Multiplication, Integer Division, and Floating-point operations. Input/output Design: Accessing I/O Devices, I/O communication, Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits						
Module 4	BPU and Pipelining					11 Sessions

Topics: Basic Processing Unit: Fundamental Concepts, Single Bus organization, Control sequence, Execution of a Complete Instruction, Multiple Bus Organization. Pipelining: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Hazards.
Targeted Application & Tools that can be used: Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc. Tools: Virtual Lab, IIT KGP Tejas – Java Based Architectural Simulator, IIT Delhi
Project work/Assignment: Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments
Textbook(s): 1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", Sixth Edition, McGraw-Hill Higher Education, 2023 reprint. 2. William Stallings, "Computer Organization & Architecture – Designing for Performance", 11th Edition, Pearson Education Inc., 2019.
References 1. David A. Patterson & John L. Hennessy, "Computer Organization and Design MIPS Edition- The Hardware/Software Interface", 6th Edition, Morgan Kaufmann, Elsevier Publications, November 2020. 2. Web References: 3. NPTEL Course on "Computer architecture and organization" IIT Kharagpur By Prof. Indranil Sengupta, Prof. Kamalika Datta. https://nptel.ac.in/courses/106105163 4. NPTEL Course on "Computer Organization", IIT Madras By Prof. S. Raman. 5. https://nptel.ac.in/courses/106106092 6. https://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to "SKILL DEVELOPMENT": Generation of Computers, CISC and RISC processors, Bus Arbitration, Collaboration and Data collection for Term assignments and Case Studies for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: ECE2524	Course Title: Data Communication and Networking Type of Course: Program Core	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Network Theory , Elements of Electronics Engineering, Digital Communication					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the student to the basics of computer communications. Data communications and networking includes long haul network hardware, circuit and packet switching, interfaces between computer and network hardware, and performance issues. The course develops technical as well as debugging skills. The course enables the students to build various networks among different distributed networks.					
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Illustrate the concepts of data communication, internet protocols, OSI and TCP/IP models, and circuit-switched networks. (L2) CO2: Apply framing, flow control, and error control techniques using noiseless and noisy channel protocols such as Simplest Protocol, Stop-and-Wait, Stop-and-Wait ARQ, and Go-Back-N ARQ for reliable data communication. (L3) CO3: Apply CSMA, controlled access, and channelization techniques such as FDMA, CDMA, and TDMA in wired and wireless LAN systems. (L3) CO4: Examine IPv4 and IPv6 addressing techniques, including classful and classless addressing, in internet communication networks. (L4) CO5: Compare UDP and TCP transport protocols for efficient and reliable network communication. (L3) CO6: Demonstrate the application of DNS, cryptography, and IP security mechanisms in internet communication. (L3)					
Course Content:						
Module 1	Network Models & Physical Layer	Quiz	Memory Recall based Quizzes		10 Session	
Topics: Introduction-Data Communications, Networks, internet, Protocols and Standards, layered tasks, The OSI Model layers, TCP/IP Protocol Suite, Network Models, Circuit switched networks						
Module 2	Data Link Layer	Assignment	Design oriented		12 Session	
Topics: Framing, Flow and Error control, Protocols for Noiseless and noisy channels-Simplest Protocol, Stop and wait protocol, Stop and wait automatic repeat request, Go-Back-N automatic repeat request, HDLC, Random access, ALOHA, CSMA, Controlled access, channelization, wired LAN, Wireless LAN. FDMA, CDMA, TDMA						
Module 3	Network and Transport Layer	Assignment	Design Analysis		13 Session	
Topics: IPv4 Addresses - spaces, notation, classful and classless addressing; IPv6 Addresses - structure, address space, internet protocols - Headers, IPv4, IPv6, Transport protocols-UDP-user datagram, check sum, operation and uses, TCP-services, features, segment, TCP connection.						

Module 4	Application layer and Security	Assignment	Application based analysis	10 Session
Topics: Domain name system-Name space, Domain name space, DNS in Internet, resolver, Overview of Cryptography and IP Security.				
List of Laboratory Tasks: NIL				
Targeted Application & Tools that can be used: Application Area are, companies like CISCO, IBM, TCS, Infosys, where network routing and maintenance of computer networks are handled. Professionally Used Software: Network simulator tools like NS2, NS3, GNS3, Cisco Packet Tracer, Putty, Microsoft Visio, Secure CRT.				
Project work/Assignment:				
1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link. 2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 3. Assignment: (a) Create a simple network model with multiple scenarios, collect statistics on network performance through the use of simulation tools, analyse statistics and draw conclusions on network performance. (b) Performance analysis of layer 1 and layer 2 (physical and data link layer) devices in LAN.				
Text Book(s): Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw-Hill, 2012.				
Reference(s): Reference Book(s): - James F. Kurose, Keith W. Ross, "Computer Networks", 2nd Edition, Pearson education 2003. - Wayne Tomasi, "Introduction to Data communication and Networking", Pearson education, 2007. W. Stallings, "Data and Computer Communications", 8th edition, Pearson Prentice Hall, 2013. Online Resources (e-books, notes, ppts, video lectures etc.): https://www.cs.vu.nl/~ast/CN5/ https://open.lib.umn.edu/exploringbusiness/chapter/15-5-data-communications-networks/ https://www.ibm.com/in-en/cloud/learn/networking-a-complete-guide https://www.youtube.com/watch?v=mYWslbszYQ https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=129584&printable=1 - Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home				
E-content: - Agrawal D. and Zeng, Q. Introduction to Wireless and Mobile Systems. Pacific Grove, CA, NJ: Brooks/Cole Thomson Learning, 2003. - Couch, L. Digital and Analog Communication Systems. Upper Saddle River, NJ: Prentice Hall, 2000. - Gast, M. 802.11 Wireless Network. Sebastopol, CA: O'Reilly, 2000. Garcia, A. and Widjaja, I, Communication Networks. New York, NY: McGraw-Hill, 2003. - Halsall, F. Multimedia Communication. Reading, MA: Addison-Wesley, 2001. Hamming, R. Coding and Information Theory. Upper Saddle River, NJ: Prentice Hall, 1980.				
Topics related to development of "FOUNDATION" : Layered Computer Network Models. Topics related to development of "EMPLOYABILITY" : IPv4 and TCP protocols. Topics related to development of "ENTREPRENEURSHIP" : Computer Networks and Domain names.				

Catalogue prepared by	Dr Rakesh Chowdhury
Recommended by the Board of Studies on	BOS Meeting NO: 15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th , Dated 03/08/2022

Course Code: ECE2523	Course Title: Digital VLSI Design Type of Course: Program Core, Theory only	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Low Power VLSI Design, Foundations for VLSI Design					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand the fundamentals of Digital and embedded systems. The course insights into the various methodology and models for real-world circuits and enhances student’s abilities to implement programmable logic devices for specific chip design. The course emphasizes on memory types with error detection and correction techniques and also demonstrates the use of Hardware Description Language (HDL) to develop designs for high level synthesis and simulation.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques using open-source Design Tools.					
Course Outcomes	On successful completion of the course students shall be able to: CO1: Explain the basics of HDLs, VLSI design flow, and Verilog language elements (modules, ports, data types, operators, system tasks) for understanding how Verilog is used in digital design. (L2) CO2: Apply gate-level and dataflow modelling in Verilog for designing and simulating simple combinational circuits like adders, Subtractor, multiplexers, decoders, and comparators. (L3) CO3: Develop behavioral models in Verilog using always/initial blocks, loops, tasks, and functions for describing flip-flops, shift registers. (L6) CO4: Use behavioral models to build FSMs for simulating complex sequential circuits. (L3) CO5: Design arithmetic circuits and simple memories in Verilog for building efficient hardware units. (L6) CO6: Implement digital systems using programmable logic devices (ROM, PLA, PAL) for creating flexible hardware designs. (L3)					
Course Content:						
Module 1	Introduction to Verilog	Quiz	Memory Recall based Quiz	10 Session		
Topics: Introduction to HDLs, VLSI Design flow, importance and trends in Verilog. Verilog language elements: Modules, ports, data types, operators, lexical conventions, system tasks, Compiler Directives. Difference between System tasks and Functions.						

Module 2	Data flow and gate level modelling	Assignment	Design and Simulation Based	09 Session
Topics: Gate Level modelling, gate primitives, delays, Data flow Modelling, continuous assignment statement, delay specification, Combinational and simple sequential circuits. Adders, Subtractor, Mux, Demux, Encoder and Decoder, Comparator circuits				
Module 3	Behavioral modelling	Project	Simulation and small hardware based	13 Session
Topics: Behavioral modelling (always, initial, blocking/non-blocking), Conditional statement, Multiway branching, loops, sequential and parallel blocks. Difference between task and functions, Sequential circuits. Flip Flops, Shift Registers, Counters, FSMs (Mealy and Moore)				
Module 4	Designing with programmable Logic Devices	Project	Software design based	13 Session
Topics: Read only memories, Programmable Logic Arrays, Programmable Array Logic, Other sequential programmable Logic Devices (PLDs), Generics, Generate statements. Design of Networks for Arithmetic Operations: Design of serial Adder with Accumulator, Design of Binary Multiplier, Implementation on memories (RAM and ROM)				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Professionally Used Software: Xilinx-VIVADO or modelsim/MATLAB Targeted Application: 1. Fuzzy Based PID Controller Devices using VHDL in Transportation. 2. Design and Implementation of a Real-time Traffic Light Control 3. Design and VLSI implementation of anti-collision robot processor using RFID technology 4. Various sensor and Biomedical Health Monitoring gadget implementation.				
Project work/Assignment/Quiz:				
1. Students will be made into group and given the programming assignment at the end of each module. Students need to use VERILOG for these assignments. Sample Assignment 1: Design a cyclic redundancy Checker using Verilog. Compare the power and area consumption for the code using two different approaches. Design and implement in Xilinx-VIVADO. Also perform debugging using the available tools. Sample Assignment 2: How to interface a mouse with Basys 3 FPGA in Verilog Sample Assignment 3: Design a real time traffic control system using Verilog. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format Presidency University Library Link . 3. Presentation: There will a group presentation on the programming assignment or any course related self-study topic/research related topic they had done.				
Text Book(s): T1 Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition. T2 Fundamentals of Logic Design” , Charles H Roth Jr. & Barry L Kinney, Cengage learning, 2010				

Reference(s):**Reference Book(s):**

1. Ming-Bo Lin, "Digital System Designs and Practices: Using Verilog HDL and FPGAs", Wiley, 2008
2. Donald E. Thomas, Philip R Moorby, 'The Verilog Hardware Description Language', Springer, Fifth edition.
3. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition.
4. Donald E. Thomas, Philip R Moorby, 'The Verilog Hardware Description Language', Springer Science+Business Media, LLC, Fifth edition.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [Introduction to Hardware Modeling using verilog by IIT KHARAGPUR - Bing video](#)
2. [Introduction to VERILOG LANGUAGE FEATURES PART 1 by IIT KHARAGPUR - Bing video](#)
3. [System Design Through VERILOG - Course \(nptel.ac.in\)](#)
4. [VERILOG MODELING OF THE PROCESSOR PART 1 using Verilog by IIT KHARAGPUR - YouTube](#)
5. [Hardware Design Representation by IIT KHARAGPUR - YouTube](#)

E-content: (Presidency University E-resources)

1. [Verilog HDL based FPGA design | IEEE Conference Publication | IEEE Xplore](#)
2. [Implementation of Smart Home through FPGA using Verilog Hardware Descriptive Language | IEEE Conference Publication | IEEE Xplore](#)
3. <https://presiuniv.knimbus.com/openFullText.html?DP=http://182.72.188.196/LocalGuru>

Topics related to development of "FOUNDATION": Digital Systems and Embedded Systems, Real-World Circuits, Models, Design Methodology

Topics related to development of "EMPLOYABILITY": Programmable Logic Devices, Packaging and Circuit boards, Interconnection and Signal integrity

Topics related to development of "ENTREPRENEURSHIP": I/O Interfacing

Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": Methods of Error Detection and Correction.

Catalogue
prepared by

Ms. Kehkeshan Jalall S

Recommended
by the Board of
Studies on

10th BOS held on 17/01/2020

Date of Approval
by the Academic
Council

Meeting No. 16th , Dated 23/10/2021

Course Code: ECE2573	Course Title: Digital VLSI Design Lab Type of Course: Program Core Lab	L- T-P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Basic concepts of simple circuit design involving diode and Transistor, their interconnections and current and voltage levels. Basics of logic gates and implementation of Digital Logic Circuits using gates, flip-flops, registers, multiplexers, decoders etc					
Anti-requisites	NIL					
Course Description	This course provides insights into the fundamentals of VLSI Design-based systems. The course develops the knowledge of both hardware and software that leads to the design and implementation of digital VLSI circuits using Verilog .					
Course Objective	The objective of the course is to SKILL DEVELOPMENT of students by using EXPERIENTIAL LEARNING techniques.					
Course Outcomes	On successful completion of the course students shall be able to: CO1: Develop basic Verilog modules and test benches for simulating simple combinational gates and circuits in Xilinx Vivado. (L6) CO2: Implement combinational circuits (multiplexer, demultiplexer, adder, Subtractor, comparator, encoder, decoder) using gate-level and dataflow modelling for verifying their functionality through simulation. (L3) CO3: Design sequential circuits (flip-flops, shift registers, counters) using behavioral modelling for observing clocked behavior and reset functionality in waveforms. (L6) CO4: Model finite state machines (Mealy and Moore) in Verilog for detecting sequences and controlling state transitions with proper test bench verification. (L6) CO5: Create arithmetic circuits (serial adder with accumulator, binary multiplier) using behavioral Verilog for simulating correct numerical operations. (L6) CO6: Design simple memory (RAM or ROM)using verilog for data storage applications. (L6)					
Course Content:						
List of Laboratory Tasks: Lab 0: Familiarization of Vivaldo Tools. Lab experiments: (All the experiment given below must use test benches to verify the results) Experiment 1: Introduction to Verilog & Vivado Level1: Write and simulate a simple Verilog module for 2-input AND, OR, and NOT gates using all three modelling styles. Create testbench observe waveforms in Vivado. Level2: Write and simulate a simple Verilog module for half adder and half Subtractor gates using all three modelling styles. Create testbench and observe waveforms in Vivado. Experiment 2: Dataflow Modelling Level1: Design and simulate a 4:1 Multiplexer and 1:4 Demultiplexer using continuous assignment (dataflow style) with delay specification. Verify all select lines. Level2: Design and simulate a 8:1 Multiplexer and 1:8 Demultiplexer using continuous assignment (dataflow style) with delay specification. Verify all select lines. Experiment 3: Gate-Level Modeling Level1: Implement a 4-bit Ripple Carry Adder using gate primitives with propagation delay. Simulate and check carry/borrow output. Level2: Implement a 4-bit Subtractor using gate primitives with propagation delay. Simulate and check carry/borrow output. Experiment 4: Combinational Circuit Design Level1: Design a BCD to 7-Segment Decoder using dataflow/gate-level modeling. Simulate all input combinations. Level2: Design a 2-bit BCD to 7-Segment Decoder using dataflow/gate-level modeling. Simulate all input combinations.						

Experiment 5: Encoder & Decoder

Level1: Implement a 8-to-3 Priority Encoder using dataflow style. Add testbench to verify priority logic.

Level2: Implement a 3-to-8 Decoder using dataflow style. Add testbench to verify priority logic.

Experiment 6: Behavioral Modeling – Sequential Circuits

Level1: Design and simulate D Flip-Flop, JK Flip-Flop and T Flip-Flop using always block with blocking. Include reset.

Level2: Design and simulate D Flip-Flop, JK Flip-Flop and T Flip-Flop using always block with non-blocking assignments. Include reset.

Experiment 7: Shift Registers & Counters

Level1: Write behavioral Verilog code for 4-bit SIPO Shift Register. Simulate and observe the output.

Level2: Write behavioral Verilog code for 4-bit Up/Down Counter. Simulate and observe the output.

Experiment 8: Finite State Machine (FSM)

Level1 Design a Mealy FSM for sequence detector (detect "1011") using behavioral modeling. Write complete testbench and verify states.

Level 2 Design a Moore FSM for sequence detector (detect "1011") using behavioral modeling. Write complete testbench and verify states.

Experiment 9: Arithmetic Circuits

Level1: Design a Serial Adder with Accumulator, Write the test bench and simulate with different values

Level2: Design 4-bit Array Multiplier using behavioral style. Write the test bench imulate with different input values.

Experiment 10: Memory & Programmable Logic

Level1: Implement a 16×8 Synchronous RAM using Verilog (with generics). Simulate read/write operations and synthesize on FPGA`

Level2: Implement a 16×8 Synchronous 8×8 ROM using Verilog (with generics). Simulate read/write operations and synthesize on FPGA`

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Memory Design	SRAM/DRAM simulation & layout	Verilog HDL	Embedded Automation
Arithmetic Circuits	Adders, subtractors, MUX/DEMUX	Xilinx Vivado	Digital Electronics, Embedded Systems
Traffic Control	Flip-flop based control FSM		

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Gate verification using bulb-switch logic	Understand gate operations at system level	Verilog, simulation tools	Logic verification; circuit debugging
4-bit ripple-carry adder	Develop hierarchical Verilog modelling	Vivado + FPGA board	Combinational logic design; hierarchical modelling
Traffic-light FSM	FSM design for real-time applications	Verilog, case statements, FPGA	Finite-state machine design; real-time control

Project work/Assignment:

1. Write a Verilog code to design a Mealy Finite State machine without overlap to detect given and sequence & verify its output
2. Design a 8*8 RAM memory using Verilog

Text Books:

T1 Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson

Education, Second Edition. T2 Fundamentals of Logic Design” , Charles H Roth Jr. & Barry L Kinney, Cengage learning, 2010	
Reference(s): Reference Books 1. Ming-Bo Lin, "Digital System Designs and Practices: Using Verilog HDL and FPGAs", Wiley, 2008 2. E. Thomas, Philip R Moorby, 'The Verilog Hardware Description Language", Springer, Fifth edition. 3. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Introduction to Hardware Modelling using verilog by IIT KHARAGPUR - Bing video 2. Introduction to VERILOG LANGUAGE FEATURES PART 1 by IIT KHARAGPUR - Bing video 3. System Design Through VERILOG - Course (nptel.ac.in) 4. VERILOG MODELING OF THE PROCESSOR PART 1 using Verilog by IIT KHARAGPUR - YouTube 5. Hardware Design Representation by IIT KHARAGPUR - YouTube E-content: 1. Verilog HDL based FPGA design IEEE Conference Publication IEEE Xplore 2. Implementation of Smart Home through FPGA using Verilog Hardware Descriptive Language IEEE Conference Publication IEEE Xplore 3. https://presiuniv.knimbus.com/openFullText.html?DP=http://182.72.188.196/LocalGuru/	
Topics related to the development of “FOUNDATION SKILLS” : Topics related to the development of “EMPLOYABILITY” :.	
Catalogue prepared by	Ms. Kehkeshan Jalall S
Recommended by the Board of Studies on	10 th BOS held on 17/01/2020
Date of Approval by the Academic Council	Meeting No. 16 th , Dated 23/10/2021

Course Code: ECE2504	Course Title: Microwave Antenna and Wave Propagation Type of Course: Program Core	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of Cartesian, cylindrical and spherical coordinate systems. Differential length (dl), surface (ds) and volume (dv). Line, surface and volume integrals. Divergence and curl operations. Fundamentals of static electric and magnetic fields which includes electric field density and intensity, magnetic field density and intensity, Maxwell ’ s equations, boundary conditions.					
Anti-requisites	NIL					
Course Description	This course will introduce the basics of electromagnetic radiation and propagation and also deals with how VHF and UHF antennas are used in microwave communication. This course gives a comprehensive coverage of a wide variety of antennas and propagation techniques related to numerous					

	communication systems. This course provides an opportunity to validate the concepts of mathematical modeling behind the antenna design.		
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of student by using <u>PARTICIPATIVE LEARNING</u> techniques		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the propagation of electromagnetic waves with Maxwell's Equations, wave equations and Boundary conditions. (L2) CO2: Describe the concepts of wave equations and polarization emphasizing its significance in horizontal and vertical polarization scenarios. (L2) CO3: Interpret the linear wire antenna performance parameters namely return loss, radiation efficiency, bandwidth, gain, directivity and far fields. (L3) CO4: Examine the performance of antenna arrays to improve beam steering, directivity and radiation efficiency. (L3) CO5: Analyze the performance of Aperture antennas using return loss, radiation efficiency, bandwidth, gain, directivity and far fields. (L4) CO6: Calculate the parameters namely Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance for communication in ground, sky and space wave modes. (L4)		
Course Content:			
Module 1	Electromagnetic Field Theory Fundamentals	Memory Recall based Quizzes	10 Sessions
Topics: Introduction: Maxwell's Equations using potentials, Scalar Potentials, The Magnetic Vector Potential, Boundary Conditions for the Electromagnetic Field (electric field and magnetic field), Time-Harmonic Representation, Wave Equation, Plane Electromagnetic Wave in free space, Poynting Theorem, Plane Electromagnetic Waves in Lossy Dielectrics, Plane Electromagnetic Waves in Good Conductors, Wave Polarization (Vertical, Horizontal and Elliptical)			
Module 2	Basic Antennas and Arrays	Design and analysis of parameters (simulation)	13 Sessions
Topics: Basic antenna parameters: Introduction, Dipole Antenna (Hertzian, Half Wave Dipole), Loop antenna Dipole (Electric and Magnetic), Near field and far field equations, expression for radiated power, Radiation Resistance, Antenna Radiation Patterns, Radiation Intensity and Average Radiation Intensity, Antenna Directivity, Antenna Gain and Radiation Efficiency, Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Uniform Linear Arrays – Broadside Arrays, End fire Arrays. Array of linear wire elements - Yagi Uda Antenna			
Module 3	Microwave Antennas	Memory Recall based Quizzes	12 Sessions
Topics: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas. Design Equations of Microstrip Patch antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors. Geometry, Pattern Characteristics Scattering Matrix: Definition of Scattering Parameters Contents, Meaning of S-Parameters.			
Module 4	Wave Propagation	Memory Recall based Quizzes	10 Sessions
Topics: Introduction, Definitions, Categorizations and General Classifications of Different Modes of Wave Propagation, Ground Wave Propagation, Space and Surface Waves, Space Wave Propagation –Duct Propagation, Scattering Phenomena, Tropospheric Propagation. Sky Wave			

Propagation – Introduction, Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
5G/6G Communication	Design reconfigurable antennas for mmWave	CST, HFSS, MATLAB	Telecom, IoT
Satellite Systems	Simulate high-gain reflector antennas	MATLAB, GRASP	Aerospace
Microwave Imaging	Model antennas for breast cancer detection	COMSOL, CST	Healthcare
IoT & Smart Devices	Integrate compact microstrip antennas	ADS, KiCAD	Consumer Electronics

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Design and simulate a patch antenna	Validate antenna parameters	HFSS or CST	Antenna modelling; simulation & parameter validation
Reconfigurable antenna prototype	Address multi-band communication	Fabrication tools; vector network analyser	Prototyping & testing reconfigurable antennas
Propagation loss estimation (LOS/NLOS)	Analyse wave behaviour in urban/rural environments	MATLAB; terrain maps	Path-loss modelling; propagation analysis
Build and test a Yagi-Uda antenna	Study directional properties	Antenna kit; spectrum analyser	Antenna construction; radiation-pattern measurement

Project work/Assignment:

Designing/simulate a practical antenna (Reconfigurable antennas are preferable) from own specifications.

Text Books:

1. Antenna and Wave Propagation, Fourth Edition, John D Kraus. Sixteenth reprint 2015 McGraw Hill Education

Reference Books:

1. Antenna Theory and Applications, Fourth Edition, Constantine A. Balanis. WILEY
2. Antenna and Wave Propagation, Kamal Kishore. Dreamtech Press Distributed by WILEY

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://youtube.com/playlist?list=PL3UZlXOnyu9CRoBFsG5x-VqYeC69FmMZT>
2. <https://www.sciencedirect.com/topics/engineering/radio-wave>
3. <https://www.sciencedirect.com/topics/physics-and-astronomy/wave-propagation>
4. <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Zhe Chen, Xiao-Ting Yuan, Jian Ren, Tao Yuan, An ultra-wideband MIMO antenna for 5G smartphone, AEU - International Journal of Electronics and Communications, Volume 154, 2022, 154301, ISSN 1434-8411,
<https://doi.org/10.1016/j.aeue.2022.154301>.
2. Jian Ren, Zheng-Yu Xiong, Jing-Ya Deng, Jia-Yuan Yin, Yin Zhang, Li-Xin Guo, A compact single-layer filtering patch antenna with wide harmonic suppression and enhanced bandwidth, AEU - International Journal of Electronics and Communications, Volume 145, 2022, 154083, ISSN 1434-8411,
<https://doi.org/10.1016/j.aeue.2021.154083>.
3. Jian Ren, Zheng-Yu Xiong, Jing-Ya Deng, Jia-Yuan Yin, Yin Zhang, Li-Xin Guo, A compact single-layer filtering patch antenna with wide harmonic suppression and enhanced bandwidth, AEU - International Journal of Electronics and Communications, Volume 145, 2022, 154083, ISSN 1434-8411,
<https://doi.org/10.1016/j.aeue.2021.154083>.
4. Xiaokun Yang, Linwei Cui, Zhao Ding, Zhengping Zhang, A 5G filtering antenna simultaneously featuring high selectivity and band notch, AEU - International Journal of Electronics and Communications, Volume 153, 2022, 154299, ISSN 1434-8411,
<https://doi.org/10.1016/j.aeue.2022.154299>.

Topics relevant to "SKILL DEVELOPMENT": Radiation Pattern, wave propagation for **Skill Development** through **Participative Learning** techniques. This is attained through assignment/quiz component mentioned in course handout.

Topics relevant to development of "FOUNDATION" : VHF and UHF Antenna design and wave propagation.

Topics relevant to development of "ENVIRONMENT AND SUSTAINABILITY" : Wave Propagation

Catalogue prepared by	
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2554	Course Title: Microwave Antenna and Wave Propagation Lab Type of Course: Program Core	L-T- P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Basic concepts of Cartesian, cylindrical and spherical coordinate systems. Differential length (dl), surface (ds) and volume (dv). Line, surface and volume integrals. Divergence and curl operations. Fundamentals of static electric and magnetic fields which includes electric field density and intensity, magnetic field density and intensity, Maxwell' s equations, boundary conditions.					
Anti-requisites	NIL					

Course Description	This course will introduce the basics of electromagnetic radiation and propagation and also deals with how VHF and UHF antennas are used in microwave communication. This course gives a comprehensive coverage of a wide variety of antennas and propagation techniques related to numerous communication systems. This course provides an opportunity to validate the concepts of mathematical modeling behind the antenna design.
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of student by using <u>PARTICIPATIVE LEARNING</u> techniques
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the principles of amplitude modulation/demodulation, antenna radiation mechanisms, and electromagnetic wave propagation through experimental observation. (L2) CO2: Apply laboratory instruments such as function generators, RF measurement systems, and Vector Network Analyzers (VNA) to measure antenna parameters, signal characteristics, and microwave components. (L3) CO3: Analyze the radiation patterns, gain, beamwidth, coupling characteristics, and propagation effects of different antennas and microwave devices. (L4) CO4: Implement practical setups to study ground wave, space wave, and sky wave propagation, and interpret their behaviour using measured signal parameters. (L4) CO5: Evaluate the performance of dipole, Yagi-Uda, microstrip patch, and horn antennas based on experimental measurements such as return loss, bandwidth, gain, and radiation pattern. (L4) CO6: Design and fabricate basic antenna structures and RF circuits, including dipole antennas, microstrip patch antennas, directional couplers, and microwave oscillator/amplifier systems. (L5)
Course Content:	
List of Lab Experiments: Experiment No 1: Study of Amplitude Modulation and Demodulation Level 1: Use function generator and lab setup to perform AM modulation and demodulation. Level 2: Design your own message signal circuit and perform modulation. Experiment No 2: Radiation Pattern of Dipole Antenna Level 1: Measure radiation pattern using lab setup. Level 2: Fabricate dipole antenna and analyze pattern. Experiment No 3: Yagi-Uda Antenna Design and Analysis Level 1: Analyze antenna parameters using standard models. Level 2: Construct and test Yagi-Uda antenna. Experiment No 4: Microstrip Patch Antenna Design Level 1: Design patch antenna and analyze key parameters. Level 2: Fabricate patch antenna and test return loss. Experiment No 5: Ground and Space Wave Propagation Level 1: Study signal attenuation over distance. Level 2: Set up RF link and analyze field strength. Experiment No 6: Sky Wave Propagation Study Level 1: Analyze ionospheric parameters and MUF. Level 2: Collect shortwave signal data and compare. Experiment No 7: Directional Coupler Characteristics Level 1: Measure coupling and isolation using lab tools. Level 2: Analyze directional coupler using design models. Experiment No 8: Microwave Oscillator and Amplifier Study Level 1: Study frequency response and gain characteristics.	

Level 2: Build and test oscillator or amplifier circuit.

Experiment No 9: Antenna Parameter Measurement using VNA

Level 1: Measure return loss and bandwidth of antenna.

Level 2: Compare performance of different antenna designs.

Experiment No 10: Horn Antenna Design and Testing

Level 1: Study gain and beamwidth of horn antenna.

Level 2: Construct and test a basic horn antenna

Targeted Application & Tools that can be used:

This course is contributed for placement in core companies, research & development work and also useful to know the existing & developing communications.

Project work/Assignment:

Designing/simulate a practical antenna (Reconfigurable antennas are preferable) from own specifications.

Text Books:

1. Antennas and wave propagation - John D. Kraus and Ronald J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 5th Ed., (special Indian Edition), 2017
2. Antenna Analysis and Design, Constantine A. Balanis, Wiley Publications, 4th Ed, 2016.

Reference Books:

1. Antenna Theory and Design, Warren L. Stutzman, Gary A. Thiele, Wiley Publications, 3rd Edition.
2. Electromagnetic Waves and Radiating Systems - E.C. Jordan and K.G. Balmain, PHI, 2nd ed., 2000.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://youtube.com/playlist?list=PL3UZlXOnyu9CRoBFsG5x-VqYeC69FmMZT>
2. <https://www.sciencedirect.com/topics/engineering/radio-wave>
3. <https://www.sciencedirect.com/topics/physics-and-astronomy/wave-propagation>
4. <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Zhe Chen, Xiao-Ting Yuan, Jian Ren, Tao Yuan, An ultra-wideband MIMO antenna for 5G smartphone, AEU - International Journal of Electronics and Communications, Volume 154, 2022, 154301, ISSN 1434-8411, <https://doi.org/10.1016/j.aeue.2022.154301>.
2. Jian Ren, Zheng-Yu Xiong, Jing-Ya Deng, Jia-Yuan Yin, Yin Zhang, Li-Xin Guo, A compact single-layer filtering patch antenna with wide harmonic suppression and enhanced bandwidth, AEU - International Journal of Electronics and Communications, Volume 145, 2022, 154083, ISSN 1434-8411, <https://doi.org/10.1016/j.aeue.2021.154083>.
3. Jian Ren, Zheng-Yu Xiong, Jing-Ya Deng, Jia-Yuan Yin, Yin Zhang, Li-Xin Guo, A compact single-layer filtering patch antenna with wide harmonic suppression and enhanced bandwidth, AEU - International Journal of Electronics and Communications, Volume 145, 2022, 154083, ISSN 1434-8411, <https://doi.org/10.1016/j.aeue.2021.154083>.
4. Xiaokun Yang, Linwei Cui, Zhao Ding, Zhengping Zhang, A 5G filtering antenna simultaneously featuring high selectivity and band notch, AEU - International Journal of Electronics and Communications, Volume 153, 2022, 154299, ISSN 1434-8411, <https://doi.org/10.1016/j.aeue.2022.154299>.

Topics related to development of “FOUNDATION” : VHF and UHF Antenna design and wave propagation.

Topics related to development of “ENVIRONMENT AND SUSTAINABILITY” : Wave Propagation

Catalogue prepared by	
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE2527	Course Title: MOBILE COMMUNICATION Type of Course: Discipline Elective Data Transfer Technologies & Theory only		L- T-P- C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Analog Communication Digital Communication						
Anti-requisites	NIL						
Course Description	This course provides an in-depth introduction to the fundamentals of mobile communication systems. It covers cellular concepts, signal propagation mechanisms, multiple access techniques, and the architecture and features of mobile technologies such as GSM, GPRS, and LTE. Emphasis is placed on understanding medium access control, network layer protocols, and mobility management including Mobile IP and Ad-hoc networks. These concepts will enable the students to carry out their research and development activities, placement opportunities and foundation to design the cellular architecture						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the principles of wireless communication systems and cellular network concepts. (L2) CO2: Utilize radio propagation mechanisms and spread spectrum techniques to analyze wireless signal behavior in communication systems. (L3) CO3: Demonstrate the operation of multiple access techniques in Cellular Networks. (L3) CO4: Apply the cellular architecture and functions to upgrade Mobile Networks. (L3) CO5: Illustrate agent discovery, registration, tunneling, and encapsulation in Mobile IP for packet delivery. (L3) CO6: Employ DSDV and DSR routing protocols to establish routes in Mobile Ad hoc Networks (MANETs). (L3)						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Wireless Communication and Networks and attain Employability Skills through Participative Learning.						
Course Content:							
Module 1	INTRODUCTION TO MOBILE COMMUNICATION	Assignment	System Representation task	12 Classes			
Topics: Basics of communication system, Wired and wireless network, Cellular Concepts- cell structure, frequency reuse, cell splitting, channel assignment, capacity power control, Interference,							

handoff, interference, signal propagation-reflection, refraction, diffraction, path loss of radio signal, multipath propagation, spread spectrum.				
Module 2	MEDIUM ACCESS CONTROL	Seminar/Presentation	Participation skills	10 Classes
Topics: MAC- hidden and exposed terminals, near far terminal, FDM, SDM, TDM, CDM, Multiple Access Scheme –SDMA – FDMA – TDMA – CDMA – Aloha- classical, slotted, CSMA methods - comparison of SDMA/TDMA/FDMA/CDMA.				
Module 3	GSM and GPRS (2G, 3G and 4G)	Quiz	Memory Recall based Quizzes	12 Classes
Topics: Evolution of 1g/2g/2.5g/3g,4G, GSM- services and features, architecture, traffic channel, control channel, localization and calling, GPRS and LTE- features and architecture.				
Module 4	MOBILE NETWORK LAYER	Problem Solving	Analysis on routing methods	11 Classes
Mobile IP – Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation. Mobile Adhoc-Network -Routing, DSDV, Dynamic Source Routing.				
Targeted Application & Tools that can be used: Application Area is Communication, connection of devices by BLUETOOTH, Accessing the Internet, Locating and Tracking-GPS, security systems, television remote control, computer-interface devices, Wi-Fi.				
Text Book(s) T1: Jochen Schiller, “ <i>Mobile Communications</i> ”, Pearson Education, second edition, 2008. T2 : <u>Theodore S. Rappaport.</u> , “ <i>Wireless Communications: Principles and Practice</i> ”, Pearson Education ,2nd Edition, 2009				
Reference Book(s) R1. William Stallings, “ <i>Wireless Communications and Networks</i> ”, Pearson Education, second edition, 2002 R2. C.K. Toh, “ <i>AdHoc Mobile Wireless Networks</i> ”, Pearson Education, first edition, 2015.				
Online Resources 1. EBook: https://presiuniv.knimbus.com/user#/home 2. Seminar: https://nptel.ac.in/courses/117104099 3. Case Study: http://kcl.digimat.in/nptel/courses/video/117104099/117104099.html				
Topics relevant to “SKILL DEVELOPMENT”: Signal propagation, Multiple Access Scheme, Medium Access Control and Evolution of 1G to 4 G - for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr. M. VanithaLakshmi			
Recommended by the Board of Studies on	21st BOS held on 9th June 2025			
Date of Approval by the Academic Council	26th Academic Council Meeting held on 25th July 2025			

DISCIPLINE ELECTIVES

GENERAL BASKET

Course Code: ECE3200	Course Title: Measuring Instruments and Sensors Type of Course: Discipline Elective Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	[1] Linear Integrated circuits-ECE 3001 Concepts of Instrumentation amplifier, signal conditioning circuits, Oscillators, Behavior of components of Electrical Engineering. [2] Digital Electronics-ECE2002 Concepts of digital system, Combinational circuits					
Anti-requisites	NIL					
Course Description	This course deals with measuring instruments used for indicating, measuring and recording quantities. It is essential to learn its usefulness in the design of automatic process control, home automation systems, large integrated computer-based system and their calibrations. Application of measurement and instrument helps students to calibrate industrial equipment' s, design instruments for various application in Bio medical, Electrical, Mechanical fields and enhances the ability to visualize the real-world problems in order to provide a solution using various simulation tools and hardware interfacing techniques. It also provides a practice to the construction of testing and measuring set up for electronic systems and to have a deep understanding about instrumentation concepts that will result in basic process control in industry to manufacture quality products.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Measuring Instruments and Sensors and attain EMPLOYABILITY SKILLS through _PARTICIPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Calculate the static characteristics of instrumentation systems using measured data. (L3) CO2: Determine measurement errors using statistical analysis techniques for instrument calibration. (L3) CO3: Explain bridge circuit principles for measuring resistance, capacitance, and inductance. (L2) CO4: Describe the operation of digital measuring instruments and waveform generators for electrical measurements. (L2) CO5: Illustrate the operating principles of displacement, pressure, temperature and proximity sensors for physical parameter measurement. (L2) CO6: Determine the physical parameters using displacement, pressure, temperature, and proximity sensors. (L3)					
Course Content:						
Module 1	Measurements and Measuring Systems, Error in measurement and their statistical Analysis	Assignment/quiz	Programming Task	13 Sessions		
Topics: Significance of measurements, Methods of Measurement- Direct and Indirect Methods, True Value, Static Error, Static Correction, Error Calibration Curve, Accuracy and Precision, Static Sensitivity, Linearity. Hysteresis, Dead Time, Dead Zone, Resolution or Discrimination, Types of Errors, Arithmetic Mean, Range, Deviation, Average Deviation, Standard Deviation (S.D.), Variance.						

Module 2	Storage and display devices	Assignment/quiz	Data collection and simulation task	12 Sessions
Topics: D.C. and A.C. Bridges (Measurement of resistance, capacitance and Inductance), Digital Voltmeter (DVM), Digital Multimeter (DMM), Square and pulse generator, Relaxation oscillat				
Module 3	Sensors and Transducers	Assignment/quiz	Data collection and simulation task	15 Sessions
Topics: Basic Principles of Operation, Different types of transducers, Resistive, Capacitive, Linear Variable differential transducer (LVDT), piezoelectric transducer, Temperature transducers, Pressure Transducers, Proximity Sensor.				
Targeted Application & Tools that can be used: Application Area is AWA-Biosensor BOD analyser, bio medical field, Analog devices, Automatic process control, chemical sensors and analytical instruments Professionally Used Software: MATLAB/ Lab VIEW NI Lab-VIEW NI ELVIS II+ Workstation, NI myDAQ				
Text Book(s): 1. A. K. Sawhney, "Electronics and Electrical Measurements" , Dhanpat Rai and Sons. 4 th Edition, 2017.				
References 1. David A. Bell, "Electronic Instrumentation and Measurements" , Oxford University Press / PHI. 2 nd Edition, 2006. 2. H. S. Kalsi, "Electronic Instrumentation" , McGraw Hill., 4 th Edition, 2018. 3. Online videos of lab-VIEW compatible NI devices., 2 nd Edition, 2019.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Video lectures on measuring instruments and sensors - https://nptel.ac.in/courses/108/105/108105153/ 2. Coursera - https://www.coursera.org/learn/sensors-circuit-interface 3. Udemy - https://www.udemy.com/course/electronic-measurements-and-instrumentation/				
E-Content: 1. H. Liu, W. Sun, Q. Chen and S. Xu, "Thin-Film Thermocouple Array for Time-Resolved Local Temperature Mapping," in <i>IEEE Electron Device Letters</i> , vol. 32, no. 11, pp. 1606-1608, Nov. 2011, doi: 10.1109/LED.2011.2165522. 2. S. F. Ali and N. Mandal, "Design and Development of an Electronic Level Transmitter Using Inter Digital Capacitor," in <i>IEEE Sensors Journal</i> , vol. 19, no. 13, pp. 5179-5185, 1 July1, 2019, doi: 10.1109/JSEN.2019.2903296. 3. S. F. Ali, P. Maurya and N. Mandal, "Development of PLC Based Reluctance type Target Flow Control System," <i>2020 IEEE International Conference for Innovation in Technology (INOCON)</i> , 2020, pp. 1-5, doi: 10.1109/INOCON50539.2020.9298292. 4. B. Mondal, R. Sarkar and N. Mandal, "Design and Implementation of an RF-Based Wireless Displacement Transmitter," in <i>IEEE Sensors Journal</i> , vol. 20, no. 3, pp. 1383-1392, 1 Feb.1, 2020, doi: 10.1109/JSEN.2019.2947318.				
Topics relevant to "EMPLOYABILITY SKILLS" : Methods of Measurement, types of error, resolution for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout. Topics related to development of "FOUNDATION SKILLS" : Direct and Indirect Methods, Digital voltmeter, digital Multimeter, cathode ray oscilloscope, Resistive, capacitive transducers, LVDT, Single and Multi-channel DAS, Amplifiers, Timers, Familiarization with virtual instrumentation using Lab VIEW Software				
Catalogue prepared by	Dr. Ajit Kumar			
Recommended by the Board of Studies on	12th BOS held on 10/08/2021			
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021			

Course Code: ECE3201	Course Title: Bio-Medical Instrumentation		L- T-P- C	3	0	0	3
	Type of Course: : Discipline Elective-Signal Processing Basket						
Version No.	2.0						
Course Pre-requisites	[1] Linear Integrated Circuits, 2] Measuring Instruments and Sensors						
Anti-requisites	NIL						
Course Description	The purpose of this course is to enable the students to appreciate the need for Biomedical Instrumentation and Role of engineers in biomedical field. The course is conceptual in nature which allows the students to understand the application of various engineering concepts used in biomedical for diagnosis, treatment and prevention of diseases.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Bio-Medical Instrumentation and to improve the <u>Employability Skills</u> of student by using <u>Participative Learning</u> techniques.						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the fundamental blocks of biomedical instrumentation systems, including transducers, signal conditioning units, processing units, display devices, and recording systems. (L2) CO2: Describe the operating principles, characteristics, and applications of biomedical transducers for physiological parameter measurement. (L2) CO3: Demonstrate the working principles of patient monitoring systems used for cardiovascular parameter measurement, including blood pressure, blood flow, pulse rate, and oxygen saturation.(L3) CO4: Discuss the working principles of patient monitoring systems used for respiratory parameter measurement, including lung volume and lung capacity measurement. (L2) CO5: Discuss the working of ECG, EEG, EMG, and EOG recording systems through bioelectric signal propagation and electrode configurations. (L2) CO6: Differentiate the principles and system components of medical imaging modalities including X-ray, CT, ultrasound, and MRI for medical diagnosis. (L4)						
Course Content:							
Module 1	Introduction to Biomedical Instrumentation system	Assignment	A short note on instruments used in medical field for diagnosis, treatment and prevention of diseases			08 Sessions	
Topics: Role of Technology in Medicine, Physiological Systems of the Body, Basic Medical Instrumentation System, Wireless Connectivity in Medical Instruments, Classification of Transducers, Optical Fibre Sensors, Biosensors, Smart Sensors, A basic recording system, Types of preamplifiers. Basic components of BMI systems, Classification of Transducers, Potentiometric transducer, variable capacitance, variable inductance, Piezo-electric Transducer, Strain gauge pressure transducer, Thermocouple, Thermistor, A basic recording system, General consideration for signal conditioners, Types of preamplifiers, differential, instrumentation amplifiers, isolation amplifier, chopper amplifiers. Biotelemetry							
Module 2	Patient Monitoring System	Case Study	Any one state of art patient monitoring systems			09 Sessions	

Topics: Introduction to patient monitoring system, Types of patient monitoring system, Blood pressure measurement: Direct and Indirect method of blood pressure measurement, Phonocardiograph (PCG) for heart sound measurement, Blood Flow meter: Electromagnetic blood flow meters, Ultrasound, Dye dilution, thermal dilution method etc. Spirometer for lung volume and lung capacity measurement. Pulse rate measurement using IR principle.				
Module 3	Bioelectric Recorders	Assignment	Different types of electrodes, its features and specific application	10 Sessions
Topics: Origin of bioelectric signals, polarization, depolarization, hyperpolarization. Propagation of bioelectric potentials. Electrode tissue interface, surface and deep-seated Electrodes. ECG: Function of heart, conduction path way, placement of electrodes, lead configurations. Block Diagram of an Electrocardiograph. EEG: Introduction to EEG, 10-20 system of placement of electrodes, Block Diagram of Electroencephalograph, EMG: Introduction to EMG, Block Diagram of EMG recording, Introduction to EOG.				
Module 4	Modern Imaging System	Case study	Trends and recent research projects based on medical images	8 Sessions
Topics: Introduction to medical imaging, Methods of Monitoring Foetal Heart Rate, Monitoring Labour Activity, Oximeters, Blood Flow Measurement, Methods of blood Cell Counting, Safety Codes for Electromedical Equipment, Introduction to medical imaging, Basics of diagnostics radiology, X-ray: Production of X-ray, X-ray Machine, application X-ray, CT: Basic Principle, CT Scan system components, Ultrasound: Principle of Ultrasound, Application of ultrasound in biomedical. MRI: Basic Principle, MRI Scan system components.				
Targeted Application & Tools that can be used: Multisim for simulating the signal conditioners used in BMI. MATLAB, LabVIEW for preprocessing the raw data and extraction of features using signal and image processing. Any microcontrollers and FPGA for developing embedded systems for Biomedical Field for processing, displaying recording and transmitting the real time data.				
Textbook(s): 1. R S Khandpur, "Handbook of Biomedical Instrumentation", McGraw Hill Education, 3rd edition, 2014. 2. J. Webster, "Medical Instrumentation: Applications and Design", John Wiley and Sons, 4th edition, 2009.				
References 1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall India Learning Private Limited, 1st edition, 1990. 2. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation", Prentice Hall India Learning Private Limited, 1st edition, 2013.				
Digital References 1. NPTEL - https://nptel.ac.in/courses/108/105/108105101/ 2. Coursera - https://www.coursera.org/learn/bioengineering 3. Udemy - https://www.udemy.com/course/biomedical-engineering-instrumentation-course-rahbme216-rahsoft/				
E-Contents 1. Karthick, R., R. Ramkumar, Muhammad Akram, and M. Vinoth Kumar. "Overcome the challenges in bio-medical instruments using IOT-A review." <i>Materials Today: Proceedings</i> 45 (2021): 1614-1619. 2. Fedtschenko, Tatjana, Alexander Utz, Alexander Stanitzki, Andreas Hennig, Andre Lüdecke, Norbert Haas, and Rainer Kokozinski. "A new configurable wireless sensor system for biomedical applications with ISO 18000-3 interface in 0.35 μm CMOS." <i>Sensors</i> 19, no. 19 (2019): 4110.				

3. Vavrinský, Erik, Martin Daříček, Martin Donoval, Karol Rendek, František Horínek, Martin Horniak, and Daniel Donoval. "Design of EMG wireless sensor system." In <i>2011 International Conference on Applied Electronics</i> , pp. 1-4. IEEE, 2011. 4. Rendek, K., M. Daříček, E. Vavrinský, M. Donoval, and D. Donoval. "Biomedical signal amplifier for EMG wireless sensor system." In <i>The Eighth International Conference on Advanced Semiconductor Devices and Microsystems</i> , pp. 251-254. IEEE, 2010.	
Topics relevant to “EMPLOYABILITY SKILLS” : Wireless Connectivity in Medical Instruments, Phonocardiograph (PCG) for heart sound measurement, Basics of diagnostics radiology, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Ajit Kumar
Recommended by the Board of Studies on	BOS Meeting NO: 19th BOS held on 06/07/2024
Date of Approval by the Academic Council	Academic Council Meeting No. 24th, Dated 03/08/2024

Course Code: ECE3203	Course Title: Printed Circuit Board Design Type of Course Discipline Elective-General Basket			L-T-P-C	3	0	0	3
Version No.	1.0							
Course Pre-requisites	Basic electronics concepts							
Anti-requisites	NIL							
Course Description	This course will teach teams of students how to design and fabricate PCB for prototyping as well as in Industrial Production environment. This will help students to innovate faster with electronics technology.							
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.							
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand basics of PCB designing. 2. Apply advance techniques, skills and modern tools for designing and fabrication of PCBs. 3. Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB. 4. Understand concepts of Packaging.							
Course Content:								
Module 1	Introduction	Quiz	Memory Recall based Quizzes	7 session				
Topics: Need for PCB, Types of PCBs Single and Multilayer, Technology: Plated Through Hole, Surface Mount, PCB Material, Electronic Component packaging, PCB Designing, Fabrication, Production, Electronic Design Automation Tools: Proprietary tools like Eagle, Ultiboard, Orcad and Opensource tools like KiCad, Design Issues: Transmission line, Cross talk and Thermal management.								
Module 2	PCB Design	Assignment / Quiz	Design and Simulation task	12 session				

Topics: Introduction to KiCad, Schematic entry / drawing, netlisting, layering, component foot print library selection & designing, design rules, component placing: Manual & automatic, track routing: automatic & manual, rules: track length, angle, joint & size, Autorouter setup. IPC standards for schematic, designing, material and documentation				
Module 3	PCB Prototyping and Production	Assignment	Analysis and Verification	16 sessions
Topics: PCB Prototyping: CNC Machine, Photo-Lithography process, Screen Printing process and chemical etching. PCB Mass Manufacturing Process: Gerber Generation, CAM, panelization, cleaning, drilling, plating, screen printing, etching, automated optical inspection, tinning, solder resist, legend printing, PCB testing				
Module 4	PCB design for EMI/EMC		Case study	10 sessions
Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards,.				
Targeted Application & Tools that can be used: Application: Printed circuit board (PCB) design brings your electronic circuits to life in the physical form. Using layout software, the PCB design process combines component placement and routing to define electrical connectivity on a manufactured circuit board The students will be able to find career opportunities in various domains such as: PCB design engineer PCB layout engineer. Application engineers technical support. Professionally Used Software: Altium., Fusion 360., Altium 365, NI Multisim, Autodesk EAGLE, KiCad EDA, Ansys RedHawk, EasyEDA.				
Project Work/Assignment: 1. Case Studies: At the end of the course students will be given a PCB-HISTORY * TYPES * APPLICATIONS * ADVANTAGES * DIS-ADVANTAGES * TOP PCBs MANUFACTURERS IN INDIA * MATERIALS USED IN MANUFACTURING PCBs * MANUFACTURING PROCESS * SOLDER RESIST * TEST * PROTECTION AND PACKAGING as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. using PCB 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 4. Project Assignment: Assignment 1: Implement simple analog circuits using KiCad. Assignment 2: Assignment Each student was assigned a unique schematic to be drafted using MultiSim's schematic capture feature. You should create an error-free net list, import it into the PCB feature of Ultiboard, then design a proper laid-out and routing. Designs should be no bigger than 6"x6"				
Text book: 1. Printed circuit board design, fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006				
Reference(s): Reference Book(s): Online Resources (e-books, notes, ppts, video lectures etc.): Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002 2. R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill 2001 3. Mark Madou, Fundamentals of Microfabrication, CRC Press, ISBN: 0-8493-9451-1 4. Elaine Rhodes, Developing Printed Circuit Assemblies: From Specifications to Mass Production, 2008 5. C. Robertson. PCB Designer's Reference. Prentice Hall, 2003 6. C. Coombs, Printed Circuits Handbook, McGraw-Hill Professional, 6 editions, 2007				

7. V. Shukla, Signal Integrity for PCB Designers, Reference Designer, 2009
8. D. Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall, 2003
9. B. Archambeault, J. Dreuiawniak, PCB Design for Real-World EMI Control, Springer, 2002
10. RS Khandpur, Printed Circuit Board, Tata McGraw Hill Education Pvt Ltd., New Delhi
11. S D Mehta, Electronic Product Design Volume-I, S Chand Publications
12. Open source EDA Tool KiCad Tutorial: <http://kicad-pcb.org/help/tutorials/>
13. PCB Fabrication user guide page: <http://www.wikihow.com/Create-Printed-Circuit-Boards> , http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/ , http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself
14. PCB Fabrication at home(video): <https://www.youtube.com/watch?v=mv7Y0A9YeUc>, <https://www.youtube.com/watch?v=imQTCW1yWk>

E-content:

1. Andres H. Rodriguez; Daniel J. Gonzalez; Mark C. Lesak " Design of a Printed Circuit Board (PCB) for Electrical Integration on the Agile Ground Robot (AGRO)." in 2020 IEEE MIT Undergraduate Research Technology Conference (URTC).
<https://ieeexplore.ieee.org/document/9668875>.
2. [Rémy Caillaud](#); [Cyril Buttay](#); [Roberto Mrad](#); [Johan Le Leslé](#); [Florent Morel](#); [Nicolas Degrenne](#); [Stefan M.](#) "Design, manufacturing and characterization of printed circuit board embedded inductors for power applications" in 2018 IEEE International Conference on Industrial Technology (ICIT).
<https://ieeexplore.ieee.org/document/8352262>
3. [Ali Toprak](#); [Ali Rifat Boynuegri](#) "Printed Circuit Board Rapid Prototyping with Three-Dimensional Printer" in 2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT)
<https://ieeexplore.ieee.org/document/9254998>
4. <https://presiuniv.knimbus.com/user#/home>

Topics related to development of "FOUNDATION": Need for PCB, Types of PCBs Single and Multilayer, Technology

Topics related to development of "EMPLOYABILITY": PCB DESIGN

Topics related to development of "ENTREPRENEURSHIP": PCB Prototyping and Production

Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": PCB design for EMI/EMC.

Topics related to development of "HUMAN VALUES AND PROFESSIONAL ETHICS": Application of PCB design.

Catalogue prepared by	Ms Srilakshmi K H
Recommended by the Board of Studies on	BOS Meeting NO: 19th BOS held on 06/07/2024
Date of Approval by the Academic Council	Academic Council Meeting No. 24th, Dated 03/08/2024

Course Code: Cece2019	Course Title: Electronic Controlled Converter Type of Course: Discipline Elective, General Basket Theory only		L-P-C	3	0	3
Version No.	1.0					
Course Pre-requisites	The knowledge of analog electronics and microcontroller are needed to design the power converter and associated control circuit; and network theorems for voltage and current calculation in power converter topologies.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to learn about the basics of power semiconductor devices, design of variety of power electronic converters and associated control algorithms for the control and conversion of one form of energy into another form of energy. The nature of the course is application oriented. The course benefits the students through assignment projects based on practical implementation of various power converters which will be useful in domestic and industrial applications					
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques using MATLAB/Simulink or PSpice Tools.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the features, principles and characteristics of power semiconductor devices. (L2) CO2: Examine the working of AC to DC controlled power converters. (L3) CO3: Illustrate the operation of DC-to-DC power converters. (L3) CO4: Design DC to AC power converters for uninterruptible power supplies (UPS) and electric vehicles (EVs). (L3) CO5: Demonstrate the working of AC-to-AC power converters. (L3)					
Course Content:						
Module 1	Introduction to power electronics	Assignment	Control characteristics of power semiconductor devices	06 session		
Topics: Introduction to power electronics (definition, block diagram, applications), various power semiconductor devices, control characteristics of power semiconductor devices, peripheral effects of power electronics						
Module 2	AC to controlled DC power converters	Assignment	Simulation of AC to controlled DC power converter (Full bridge controlled)	10 sessions		
Topics: Introduction to AC to controlled DC converter, single phase full bridge-controlled converter using single silicon-controlled rectifier, gating pulse generation, isolation and gate drive circuits						
Module 3	DC to DC power converter	Assignment	Simulation of DC-to-DC	10 sessions		

			power converter	
Topics: Introduction to DC-to-DC converter, Buck converter, Boost converter, class C type bi-directional dc-dc converter, Fly-back converter, PWM pulses generation, isolation and gate drive circuits, Numerical Examples				
Module 4	DC to AC power converter	Assignment	Simulation of DC to AC power converter	09 session
Topics: Introduction to DC to AC converter, single phase full-bridge inverter, single pulse width modulation and sine pulse width modulation, filter selection, isolation circuit and gate drive circuits, Numerical Examples				
Module 5	AC to AC power converter	Assignment	Simulation of AC-to-AC power converter	09 session
Introduction to AC to AC converter, single phase bi-directional AC voltage controller using TWO Thyristors / single TRIAC, gating signal generation, isolation and gate drive circuits, Numerical Examples.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: Application Area is solar, wind, automotive, domestic and industrial etc. Professionally Used Software: Arduino/Raspberry Pi /MATLAB/SIMULINK/Python (Anaconda / Jupiter Notebook)/PSpice				
Project Work/Assignment:				
1. Case Studies: At the end of the course students will be given a 'real-world' application-based topics like controlled rectifiers, choppers, inverters etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 4. Project Assignment: Software/Hardware implementation of few important power converters studied in this course Assignment-1: AC to Controlled DC power converter using SCR and display the output DC voltage on LCD using Arduino controller Assignment-2: Fixed DC to Variable DC power converter (Step-down DC-DC converter) using IGBT and associated components and display the input DC voltage and output DC voltage on LCD using Arduino controller Assignment-3: Fixed DC to Variable DC power converter (Step-up DC-DC converter) using IGBT and associated components and display the input DC voltage and output DC voltage on LCD using Arduino controller Assignment-4: Fixed DC to DC to multiple DC power converter (Isolated Fly-back converter) using Power MOSFET and associated components and display the input DC voltage and output DC voltage on LCD using Arduino controller				

Assignment-5: AC to Controlled AC power converter (Bidirectional AC voltage controller) using TRIAC and associated components and display the output AC voltage on LCD using Arduino controller

Assignment-6: Fixed DC to AC power converter (Full Bridge Inverter) using power MOSFET and associated components and display the input DC voltage and output AC voltage on LCD using Arduino controller

Text Book(s):

1. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Prentice Hall of India Pvt. Ltd., /Pearson (Singapore -Asia) New Delhi, 2nd Edition, 2002
2. Ned Mohan, T. M. Undeland, W. P. Robbins "Power Electronics: Converters, Applications and Design", John-Wiley, 3rd Edition, 2007

Reference(s):

Reference Book(s):

1. M. D. Sing and Khanchandani K. B, "Power Electronics", TMH Publishing Company Limited, 2001
2. Cyril W. Lander, "Power Electronics", McGraw Hill, 3rd Edition, 1993

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/lecture-notes/>

E-content:

1. D. Fewson, "Introduction to power electronics," in IEEE Power Engineering Review, vol. 19, no. 9, pp. 44-44, Sept. 1999, doi: 10.1109/MPER.1999.785806.
<https://ieeexplore.ieee.org/document/785806>
2. P. Nicolae, I. Nicolae and M. Motocu, "Behavior of a fully controlled rectifier from a power group," Proceedings of 14th International Power Electronics and Motion Control Conference EPE-PEMC 2010, 2010, pp. T11-99-T11-106, doi: 10.1109/EPEPEMC.2010.5606513.
<https://ieeexplore.ieee.org/document/5606513>
3. B. Kim, E. Boulaud, E. Boisaubert, S. Am and P. Chrin, "Study of the Control of a New AC Voltage Stabilizer using Linear Controller with Reference Frame Transformation," 2020 22nd European Conference on Power Electronics and Applications (EPE'20 ECCE Europe), 2020, pp. P.1-P.7, doi: 10.23919/EPE20ECCEEurope43536.2020.9215637.
<https://ieeexplore.ieee.org/document/9215637>
4. R. Bououd and L. Sbita, "An overview of chopper topologies," 2017 International Conference on Green Energy Conversion Systems (GECS), 2017, pp. 1-7, doi: 10.1109/GECS.2017.8066207.
<https://ieeexplore.ieee.org/document/8066207>
5. R. Billmeyer, M. Lu, B. Johnson and S. Dhople, "Modeling and Simulation of Power-Electronic Inverters in Analog Electronic Circuit Simulators," 2021 IEEE International Symposium on Circuits and Systems (ISCAS), 2021, pp. 1-5, doi: 10.1109/ISCAS51556.2021.9401268.
<https://ieeexplore.ieee.org/document/9401268>

Topics related to development of "FOUNDATION SKILLS": Various power semiconductor devices and Power Converters.

Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": Power Converters.

Catalogue prepared by

Dr. Sreenivasappa B V

Recommended by the Board of Studies on

BOS Meeting NO: 12th, Dated BOS 10/08/2021

Date of Approval by the Academic Council

Academic Council Meeting No. 16th, Dated 23/10/2021

Course Code: ECE3205	Course Title: Industrial Automation and Control Type of Course: Discipline Elective- General Basket	L - T-P - C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Digital Control Systems (ECE3005) Concepts of analog to digital and digital to analog conversions. To know about time response specifications of second order systems and Proportional-Integral-Derivative (PID) controllers.					
Anti-requisites	Nil					
Course Description	The purpose of this course is to enable the students to appreciate the need for Industrial Automation and control which play a key role in modern industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn the basics of automation and working of systems. The course will be supported by various simulation assignments, which will enhance the student’ s abilities to become a good Industrial Automation and Control engineer.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Industrial Automation and Control and develop <u>Employability Skills</u> of the student by <u>Participative Learning</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Explain the need for industrial automation and basic automation components 2) Analyze industrial process parameters and control system types 3) Explain PLC and SCADA architecture and operation 4) Develop PLC programs using ladder logic for industrial applications 5) Illustrate the concepts, configuration and integration of DCS 6) Explain IoT and IIoT concepts and their industrial applications					
Course Content:						
Module 1	Introduction to Industrial Automation	Assignment / Quizzes	Data Collection and Analysis		14 Classes	
Automation components: Need for process control, Pressure to Current (P/I), current to pressure (I/P) converters, basic Control elements, open loop and closed loop control systems. Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and SCADA, Different Systems in SCADA like Field Instrumentation, Remote terminal unit (RTU), Master Terminal Unit (MTU).						
Module 2	Programmable logic controllers and Relay Ladder Logic	Assignment / Quizzes	Programming and Simulation task		11 Sessions	

Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries. Relay Ladder Logic and Programming.				
Module 3	Distributed Control System	Assignment	Programming and Simulation task	06 Sessions
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.				
Module 4	Industrial Internet of Things	Assignment	System Design Task and Analysis	08 Sessions
Introduction to Internet of Things - Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (IIoT - Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IoT, Understanding System Design for IoT, Design Model for IoT.				
Targeted Application & Tools that can be used Application Area: Industrial automation is the technological enhancement of systems and machinery used for industries like manufacturing and production. The goal is to limit procedures performed by human workers. Industrial automation technology helps businesses enhance safety, save time, boost quality production, reduce monitoring, and lower costs. All of these benefits lead companies to higher productivity, greater efficiency, and more profitability. Professionally Used Software: MATLAB/ SIMULINK, SIMATIC STEP 7-TIA Portal, CODESYS, LabVIEW etc.				
Text Book(s):				
1. Industrial Instrumentation and Control by S.K. Singh The McGraw Hill Companies. 2. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2013. 3. The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, Lucas. Darnell, 2016. Jaico Publishing House, 2013.				
References				
1) Programmable logic controller, Dunning, Delmar. 2) Process Control Instrumentation Technology by. C.D. Johnson, PHI 3) Industrial control handbook, Parr, Newnem. 4) D. Patranabis, 'Principles of Industrial Instrumentation' , Tata McGraw Hill Publishing Company Ltd., 1996. 5) Joe Biron& Jonathan Follett, Foundational Elements of an IoT Solution - The Edge, The Cloud and Application Development, Oreilly,1st Edition, 2016. Online Resources (e-books, notes, ppts, video lectures etc.): 1. NPTEL: Electrical Engineering - Industrial Automation and Control 2. What is a PLC? PLC Basics Pt1 - Bing video 3. What is DCS? (Distributed Control System) - Bing video 4. https://onlinecourses.nptel.ac.in/noc21_cs17/preview 5. https://presiuniv.knimbus.com/user#/home E-content: 1. Haijian Wang; Xinyue Liang; Menggao He; Xuefeng Li; Shuyuan Fu Analysis of Application of PLC Technology in Automation Control of Electrical Engineering. 2020 IEEE Conference on Telecommunications, Optics and Computer Science (TOCS) https://ieeexplore.ieee.org/document/9339623 2. Michel de Mattos Fernandes; Jeferson André Bigheti; Ricardo Pasquati Pontarolli; Eduardo Paciencia Industrial Automation as a Service: A New Application to Industry 4.0. IEEE Latin America Transactions (Volume: 19, Issue: 12, December 2021) https://ieeexplore.ieee.org/document/9480146				

3.	Y. L. Cai, Q. He, J. Duan and Z. Y. Gao, "Full-order observer-based output regulation for linear heterogeneous multi-agent systems under switching topology", <i>Journal of Artificial Intelligence and Systems</i> , vol. 1, pp. 20-42, 2019. https://ieeescience.org/jpapers/20
4.	Zhao Zining, Fu Yongling and Chen Luxi, "System design of linear position tracking experimental device based on PLC", <i>Machine Tool and Hydraulics</i> , vol. 45, no. 13, pp. 99-104, 2017. https://www.researchgate.net/publication/337447159_Design_and_Implementation_of_PLC-Based_Monitoring_and_Sequence_Controller_System
5.	G. Madhan, G. R. Kandhasamy and S. Muruganand, "Design and Implementation of PLC based Computerized Monitoring in Dip Coating System", <i>International Journal of Computer Applications</i> , Vol. 57, No 16, 2012. https://www.ijcaonline.org/archives/volume57/number16/9197-3720 .
6.	Bruno Cunha INESC TEC, Porto, Portugal and Cristóvão Sousa CIICESI-ESTG, Politécnico do Porto, Felgueiras, Portugal, "On the Definition of Intelligible IIoT Architectures" https://ieeexplore.ieee.org/document/9476342 .
Topics relevant to "EMPLOYABILITY SKILLS" : Modelling of PLC using Ladder diagram & Sequential flow chart. Building a PLC system using programming, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Syed Abrar Ahmed Mr. Tony Aby Varkey M
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3206	Course Title: Linear Algebra for Communication Engineering Type of Course: Discipline Elective from General Basket & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	To succeed in this course the student should be comfortable with vectors, matrices and their operations.					
Anti-requisites	NIL					
Course Description	The course emphasizes on the applications of linear algebra in communication engineering. This course finds applications in various fields of engineering, like Signal Processing, Coding Theory, Machine Learning, Computer Graphics and Computer Vision. The course provides insights into the methods for reducing the problem from many areas of engineering into one in linear algebra extended to multi-dimensional spaces. The course also deals with techniques to solve problems analytically.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Linear Algebra for Communication Engineering and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the fundamentals of linear algebra, including matrix operations, Gaussian elimination, and the four fundamental subspaces. (L2) CO2: Use least squares approximation and projection matrices to solve systems of linear equations. (L2) CO3: Employ eigenvalue and eigenvector computations to diagonalize matrices. (L3)					

	CO4: Examine symmetric and positive definite matrices to determine their properties and applications in optimization. (L3) CO5: Assess the role of Singular Value Decomposition (SVD) in linear transformations and data analysis. (L3) CO6: Solve linear programming problems using geometric and simplex methods, including duality principles. (L3)				
Course Content:					
Module 1	Matrices and Gaussian Elimination	Assignment		Programming (Curve Fitting) Task	10 Sessions
Topics: Introduction, the geometry of linear equations, elimination with matrices, multiplication and inverse matrices, factorization, column space and null space, Solution to homogenous equations, Row reduced form, Independence, Basis and Dimensions, the four fundamental sub-spaces, matrix spaces.					
Module 2	Least squares, Determinants and Eigenvalues	Assignment		Programming Task	10Sessions
Topics: Orthogonal vectors and subspaces, projection onto subspaces, projection matrices and least squares, orthogonal matrices and Gram-Schmidt, properties of determinants, determinant formulas and cofactors, Cramer’s rule, eigenvalues and eigenvectors, diagonalization and powers, differential equations, Fourier Series.					
Module 3	Positive Definite Matrices and Applications	Project Assignment		Programming and Simulation Task	14Sessions
Topics: Symmetric matrices and positive definiteness, positive definite matrices and minima, Linear transformations and their matrices, change of basis, Singular Value Decomposition, Fourier Transform, similar matrices and Jordan form.					
Module 4	Optimization	Programming Task		11 sessions	
Topics: Matrix Games, Linear Programming—Geometric Method, Linear Programming—Simplex Method, Duality					
Targeted Applications and Tools					
Application Area	Hands-on Application Problem	Tools Utilised		Relevant Industries	
Signal Processing	Noise reduction using projection methods	MATLAB, NumPy		Telecom, Audio Engineering	
Coding Theory	Error correction using orthogonal matrices	MATLAB, Python		Telecommunications, Data Storage	
Machine Learning	Principal Component Analysis (PCA) using SVD	Python, TensorFlow, Scikit-learn		AI & ML, FinTech, HealthTech	
Computer Vision	Face recognition using eigenfaces	OpenCV, Python, TensorFlow		Surveillance, AR/VR, Robotics	
Computer Graphics	Transformation of objects using linear maps	Blender, MATLAB, OpenGL		Gaming, Animation, Simulation	
Data Science	Dimensionality reduction using SVD and matrix factorization	Python, Jupyter Notebook		Analytics, Finance, Healthcare	
Skill Building Through Experiential Learning					

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Curve Fitting using Least Squares	Understand over-determined systems and data fitting	Python (NumPy, Matplotlib), MATLAB	Curve fitting, system over-determination handling
Eigenface Generation	Apply eigenvalue decomposition for image compression and recognition	Python (OpenCV, Scikit-learn), MATLAB	Image compression, pattern recognition
Orthogonalization via Gram-Schmidt	Demonstrate vector projection and basis generation	MATLAB, Python (SymPy)	Orthogonal basis construction, projection operations
Diagonalization of Matrices	Analyze linear systems and matrix powers for communication models	MATLAB, Python	Matrix analysis, eigenvalue computation
Channel Modeling in MIMO Systems	Model and simulate multi-antenna systems using linear algebra	MATLAB Simulink	MIMO simulation, channel estimation

Textbook(s):

David C. Lay, "Linear Algebra and Its Applications", (6th Edition), Pearson (2020)

References:

1. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition-Wellesley Cambridge Press (2016).
2. Ron Larson, David C. Falvo, "Elementary Linear Algebra", 8th Edition- Brooks Cole (2016).
3. D.C. Lay, S.R. Lay, J.J. McDonald, "Linear algebra and its applications"

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [Linear Algebra | Khan Academy](#)
2. [Linear Algebra | MIT OpenCourseWare](#)

E-content

1. Hansen Anders C. 2010 "Infinite-dimensional numerical linear algebra: theory and applications", Proc. R. Soc. A. 4663539–3559, <http://doi.org/10.1098/rspa.2009.0617>
2. Calvetti, D., Reichel, L., Sgallari, F. (1999). Applications of Anti-Gauss Quadrature Rules in Linear Algebra. In: Gautschi, W., Opfer, G., Golub, G.H. (eds) Applications and Computation of Orthogonal Polynomials. International Series of Numerical Mathematics, vol 131. Birkhäuser, Basel. https://doi.org/10.1007/978-3-0348-8685-7_3

Presidency University Library Link

<https://presiuniv.knimbus.com/user#/home>

Topics relevant to "EMPLOYABILITY SKILLS": Cramer's rule, Fourier Transform for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Topics relevant to development of "FOUNDATION SKILLS": Solution to homogenous equations, Basis and Dimensions, the four fundamental sub-spaces.

Topics relevant to development of "EMPLOYABILITY": Linear transformations and their matrices, Singular Value Decomposition.

Catalogue prepared by	Dr. Robin Rohit Vincent
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE3207	Course Title: Fuzzy Logic and its Engineering Applications Type of Course: : Discipline Elective-Signal Processing Basket	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Fuzzy Logic is an advanced topic, so the students opting for this subject should have preliminary knowledge of Set Theory, Logic, and Engineering Mathematics					
Anti-requisites	NIL					
Course Description	The course is specially designed for candidates dealing with electrical, electronics, and communications engineering. The candidates can engage in the fuzzy systems theory concepts and gain an in-depth understanding of its usage in multiple domains. The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. It will cover the basics of fuzzy set theory and presents different problems where one can apply this concept. In this course, students will learn how to implement fuzzy logic for problems involving uncertainties and vagueness. This course will act as a foundation course for the researchers working in different areas of science and engineering.					
Course Description	The objective of the course is to familiarize the learners with the concepts of Fuzzy Logic and its Engineering Applications to improve the learners' <u>Employability Skills</u> by using <u>Participative Learning</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to CO1 Explain the concepts of Fuzzy sets, their operations and properties. CO2 Illustrate Fuzzification and Defuzzification with appropriate membership functions CO3 Utilize membership functions, input output variables and connectives to fuzzy rule-based systems. CO4 Categorize the real-time data based on Fuzzy equivalence relations CO5 Make use of c-means clustering techniques to optimize data samples CO6 Design fuzzy logic controllers for real-time applications					
Course Content:						
Module 1	Introduction to Fuzzy Sets Theory	Quiz	Memory Recall based Quizzes	10 Sessions		
Topics: Introduction, The Utility of Fuzzy Systems, Uncertainty and Information, Fuzzy sets and membership, Chance Versus Fuzziness, Fuzzy Set Operations, Properties of Fuzzy Set Operations						
Module 2	Membership Functions, Fuzzification and De-fuzzifications	Assignment	Comprehension based Quizzes and assignments; simulation with MATLAB	10 Sessions		
Topics: Features of Membership function, Various Forms, Fuzzification, De-fuzzification to Crisp Sets, De-fuzzification to Scalars, Fuzzy (Rule-based) Systems						
Module 3	Fuzzy Classification	Assignment	Comprehension based Quizzes and assignments; simulation with MATLAB	10 Sessions		
Topics: Classification by Equivalence Relations, Crisp Analysis, c-Means Clustering, Fuzzy c-means clustering, Classification metric, Hardening the Fuzzy c-Partition						

Module 4	Fuzzy Control System	Assignment	System Design Task and Analysis	10 Sessions
Topics: Control System Design Problem, Control(Decision) Surface, Assumption in a fuzzy control system design, Simple Fuzzy logic controllers, Fuzzy engineering process control, Fuzzy statistical process control				
Targeted Application & Tools that can be used: Fuzzy logic-based speech recognition, Fuzzy image search, Handwriting recognition, Fuzzy set modeling of decision making, Trainable fuzzy systems for idle speed control, Control of automatic exposure in video cameras, Humidity control in a clean room, Air conditioning systems, Washing machine timing, Microwave ovens, Vacuum cleaners, Altitude control of spacecraft, Satellite altitude control, Flow and mixture regulation in aircraft deicing vehicles, Decision-making support systems Professionally Used Software: MATLAB				
Text Book(s): 1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley				
Reference Book(s) 1. George J. KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995 2. S. Rajasekaran, G.A. Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Fuzzy Sets, Logic and Systems & Applications By Prof. Nishchal Kumar Verma, IIT Kanpur (NPTEL)- https://onlinecourses.nptel.ac.in/noc20_ee03/preview 2. A Beginner's course on Fuzzy Logic and it's Application (Udemy)- https://www.udemy.com/course/fuzzylogic/ 3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley E-book http://home.iitk.ac.in/~avrs/ManyValuedLogic/FuzzyLogicforEngineers.pdf 4. E-book "Fuzzy Logic with Engineering Applications" , http://home.iitk.ac.in/~avrs/ManyValuedLogic/FuzzyLogicforEngineers.pdf 5. E-book "Fuzzy logic: a practical approach" , https://books.google.co.in/books?hl=en&lr=&id=3jGjBQAAQBAJ&oi=fnd&pg=PP1&dq=fuzzy+logic&ots=m2Jb2THX_r&sig=XaRwJHUguly1M8OFqXGAN02knTo&redir_esc=y#v=onepage&q=fuzzy%20logic&f=false 6. An Introduction to Fuzzy Logic Applications in Intelligent Systems https://books.google.co.in/books?hl=en&lr=&id=xbDSBwAAQBAJ&oi=fnd&pg=PA1&dq=ebook+fuzzy+logic&ots=ObXPuLUPEs&sig=ch4Wn_n9RA90TfOQH14ThtwM-3I#v=onepage&q=ebook%20fuzzy%20logic&f=false 7. E-content on Fuzzy Logic https://www.geeksforgeeks.org/fuzzy-logic-introduction/ 8. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home				
E-content: 1. Bastian, S. Tano, T. Oyama and T. Arnould, "FATE: fuzzy logic automatic transmission expert system," <i>Proceedings of 1995 IEEE International Conference on Fuzzy Systems.</i>, 1995, pp. 5-6 vol.5, doi: 10.1109/FUZZY.1995.410015. https://ieeexplore.ieee.org/document/410015 2. Bastian, "Influencing the nonlinearity at the transition between fuzzy logic rules," <i>Proceedings of 1995 IEEE International Conference on Fuzzy Systems.</i>, 1995, pp. 1413-1418 vol.3, doi: 10.1109/FUZZY.1995.409865. https://ieeexplore.ieee.org/document/409865 3. C. Wong, "Realization of linear defuzzified output via mixed fuzzy logics," [<i>Proceedings 1993</i>] <i>Second IEEE International Conference on Fuzzy Systems</i>, 1993, pp. 1167-1172 vol.2, doi: 10.1109/FUZZY.1993.327349. https://ieeexplore.ieee.org/document/327349 4. R. L. de Mantaras and L. Godo, "From fuzzy logic to fuzzy truth-valued logic for expert systems: a survey," [<i>Proceedings 1993</i>] <i>Second IEEE International Conference on Fuzzy Systems</i>, 1993, pp. 750-755 vol.2, doi: 10.1109/FUZZY.1993.327536. https://ieeexplore.ieee.org/document/327536				

Topics relevant to “EMPLOYABILITY SKILLS” : Fuzzy Classification, Machine learning using Fuzzy Logic and Pattern Recognition, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Arvind Kumar
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Signal Processing Basket

Course Code: ECE3400	Course Title: Speech Signal Processing Type of Course: Discipline Elective Theory only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Signals and Systems (ECE2003), Digital Signal Processing (ECE3161) Basic concepts like Energy, Magnitude, Zero Crossing rate, Autocorrelation function, pole zero analysis, DFT and some basic mathematical concepts.					
Anti-requisites	NIL					
Course Description	Speech signal processing is highly relevant for engineering graduates as it equips them with essential skills for developing modern applications such as voice-enabled systems, intelligent assistants, biometrics, and human-computer interaction technologies. This course provides a comprehensive theoretical and practical understanding of speech production, perception, and processing for human-computer interaction, covering speech sound classification, speech recognition and verification algorithms, system limitations, and hands-on analysis through assignments and quizzes.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Speech Signal Processing to improve the learners' <u>Employability Skills</u> by using <u>Participative Learning</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the basic mechanisms of human speech production and perception and their relevance to speech signal processing systems. (L2) CO2: Implement fundamental signal processing techniques like sampling, framing, and feature extraction for processing of speech signal. (L3) CO3: Examine speech signals in time and frequency domains to identify characteristics of voiced, unvoiced, and silent segments. (L4) CO4: Analyze different speech models and algorithms for speech recognition and speaker verification systems. (L4) CO5: Apply speech analysis tools to process, visualize, and interpret real-world speech data. (L3) CO6: Investigate the performance, limitations, and challenges of speech processing systems in human-computer interaction applications. (L4)					
Course Content:						
Module 1	Fundamentals of Human Speech Production	Quiz	Memory Recall based Quizzes and assignments/simulation task		11 Sessions	

Topics:
Introduction to Speech, The Mechanism of speech production, Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates

Module 2	Discrete time speech signals	Assignment	Comprehension based Quizzes and assignments; simulation with MATLAB	12 Sessions
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Topics:
Introduction, Time dependent processing of speech, short time energy and average magnitude, short time Average zero crossing rate, Speech vs. silence discrimination using Energy and Zero Crossings, Pitch period estimation using parallel processing

Module 3	Frequency domain methods for speech processing	Assignment	Comprehension based Quizzes and assignments; simulation with MATLAB	12 Sessions
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Topics:
Introduction, definitions and properties: Fourier Transforms interpretation and Z transform interpretation, sampling rates in time and frequency, filter bank Summation method for short time Synthesis, Spectral estimation of speech using the discrete Fourier Transform

Module 4	The Cepstrum and Homomorphic Speech Processing	Assignment	System Design Task and Analysis	10 Sessions
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Topics:
Introduction, Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All Pole Models, Cepstrum Distance Measures.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Speech Recognition	Design voice assistant for Indian languages	Kaldi, Python, Azure	Consumer Electronics, AI
Speech Enhancement	Noise reduction in call center audio	Audacity, MATLAB	BPO, Telecom
Speaker Verification	Authenticate user with voiceprint	MATLAB, Praat	Security, Banking
Speech Synthesis	Build a text-to-speech system	Festival, Tacotron	Assistive Tech, Media

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Short-time Energy Analysis	Detect voiced/unvoiced speech	MATLAB	Voicing classification, temporal analysis
Cepstrum Computation	Identify pitch and formants	MATLAB / Python	Pitch detection, spectral formant extraction
Spectrogram Analysis	Visualize speech features	Audacity / Python	Spectral representation, time-frequency analysis
Design Speaker ID System	Build speaker verification model	Kaldi / Deep Learning	Speaker modeling, ML classification

Text Book(s):

1. Lawrance Rabiner and Ronald Schafer, "Digital Speech Processing: Theory and Applications", Pearson, 1st Edition

2. Theory and Applications of Digital Speech Processing 2011 . Rabiner and Schafer, Pearson Education,2 Reference Book(s) 1. Thomas F. Quatieri, "Discrete Time Speech Signal Processing: Principles and Practice", Pearson, 2002 2. S. K. Mitra, "Digital Signal Processing: A computer-Based Approach", Tata McGraw Hill, 4th Edition Online Resources (e-books, notes, ppts, video lectures etc.): 1. Digital Speech Processing By Prof. Shyamal Kumar Das Mandal (IIT Kharagpur) - NPTEL - https://onlinecourses.nptel.ac.in/noc22_ee117/preview 2. Digital Speech Processing courses on Udemy - https://www.udemy.com/course/digital-speech-processing/ 3. Build automated speech systems with Azure Cognitive Services by Microsoft on Coursera - https://www.coursera.org/projects/build-automated-speech-systems-with-azure-cognitive-services 4. Automatic Speech Recognition e-book https://link.springer.com/book/10.1007/978-1-4471-5779-3 5. Fundamentals of Speech Recognition https://books.google.co.in/books/about/Fundamentals_of_Speech_Recognition.html?id=XEVqQgAACAAJ&redir_esc=y 6. Deep Learning for NLP and Speech Recognition https://link.springer.com/book/10.1007/978-3-030-14596-5 7. ASRoIL: a comprehensive survey for automatic speech recognition of Indian languages https://link.springer.com/article/10.1007/s10462-019-09775-8 8. Government projects on ASR (CDAC) https://www.cdac.in/index.aspx?id=mc_st_Speech_Recognition E-content: 1. G. Potamianos, "Audio-visual automatic speech recognition and related bimodal speech technologies: A review of the state-of-the-art and open problems," <i>2009 IEEE Workshop on Automatic Speech Recognition & Understanding</i>, 2009, pp. 22-22, doi: 10.1109/ASRU.2009.5373530. - https://ieeexplore.ieee.org/document/5373530 2. M. Wolfel, "Predicted walk with correlation in particle filter speech feature enhancement for robust automatic speech recognition," <i>2008 IEEE International Conference on Acoustics, Speech and Signal Processing</i>, 2008, pp. 4705-4708, doi: 10.1109/ICASSP.2008.4518707. - https://ieeexplore.ieee.org/document/4518707 3. R. King, "New challenges in automatic speech recognition and speech understanding," <i>TENCON '97 Brisbane - Australia. Proceedings of IEEE TENCON '97. IEEE Region 10 Annual Conference. Speech and Image Technologies for Computing and Telecommunications (Cat. No.97CH36162)</i>, 1997, pp. 287 vol.1-, doi: 10.1109/TENCON.1997.647313. - https://ieeexplore.ieee.org/document/647313 4. J. Droppo and A. Acero, "Experimenting with a global decision tree for state clustering in automatic speech recognition systems," <i>2009 IEEE International Conference on Acoustics, Speech and Signal Processing</i>, 2009, pp. 4437-4440, doi: 10.1109/ICASSP.2009.4960614. - https://ieeexplore.ieee.org/document/4960614 Topics relevant to "EMPLOYABILITY SKILLS": Speech vs. silence discrimination using Energy and Zero Crossings, Pitch period estimation using parallel processing approach, Fourier Transforms interpretation and Z transform interpretation of speech signal, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Aruna M Ms. Anupama Sindgi Mr. Arvind Kumar
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3401	Course Title: Digital Image Processing Type of Course: Discipline Elective	L-T- P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	The various signal processing operations are used as a tool for variety of basic image processing operation. Since DIP is a subfield of signal processing, a good knowledge of Fourier Transform and its properties would help in image analysis. The course needs a fair knowledge of Mathematics and Computational logic.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to appreciate the fundamental concepts of Digital Image Processing. The course is both conceptual and analytical which imparts knowledge on designing algorithms for real-world applications. The course also enhances the programming abilities through assignments. This course will help the students to get jobs in various areas where Image processing is needed, like the film industry, news channels, video mixing, social media platforms, YouTube, animation industry and so on. The lab sessions and Programming assignments provides an opportunity to validate the concepts taught as well as enhances the ability to visualize the real-world problems in order to provide a solution using various MATLAB simulation with required tool boxes.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Digital Image Processing to improve the learners' <u>Employability Skills</u> by using <u>Experiential Learning</u> techniques					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Apply pixel-based mathematical operations to perform image analysis in real-world imaging applications. (L3) CO2: Apply image enhancement techniques, to improve image quality and feature extraction in digital imaging applications. (L3) CO3: Apply image restoration and image segmentation techniques to enhance image quality and extract meaningful information for imaging applications. (L3) CO4: Apply image compression techniques to optimize data storage and transmission while balancing information preservation and data reduction in imaging applications. (L3) CO5: Analyze color image processing and multiresolution techniques to extract and interpret image features at different scales in imaging applications. (L4)					

	CO6: Analyze morphological operations to enhance image structures and support effective digital image interpretation in imaging applications. (L4)			
Course Content:				
Module 1	Fundamentals Of Image Processing	Application Assignment	Data Analysis task	10session
Topics: Fundamentals Of Image Processing: Introduction – Steps in image processing systems –Image Sensing and acquisition – Image formation Model-Sampling and Quantization - Representation of Digital Images –Pixel relationships –Mathematical tools used in Digital Image processing.				
Module 2	Image Enhancement	Assignment	Simulation and data analysis task	12 sessions
Topics: Image Enhancement: Introduction to two dimensional orthogonal & unitary transforms- Two-dimensional discrete Fourier transform - Properties of unitary transforms- Spatial Domain Gray level Transformations – Histogram processing – Image enhancement in the Frequency Domain filters – Smoothing and sharpening filters – Homomorphic Filtering				
Module 3	Image Analysis	Assignment	Data Collection and Analysis	10session
Topics: Image restoration process- Fundamentals of Image Compression - Image Compression Model-Huffman coding. Fundamentals of Image Segmentation - Point, Line and Edge detection. Introduction to Unsupervised learning models used for feature extraction				
Module 4	Color And Morphological Image Processing	Assignment	Simulation/Data Analysis	07 classes
Topics: Introduction –Basics and fundamentals of Color Image Processing and Color models-Pseudo color Image Processing-Wavelets and Multiresolution Processing - Image Pyramids-Subband Coding- Introduction to Morphological Image Processing. Introduction to Supervised learning models to Image detection and classification.				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilized	Relevant Industries	
Medical Imaging	Extract tumor boundaries from MRI scans using segmentation	MATLAB, Python (OpenCV)	Healthcare, Diagnostics	
Surveillance & Security	Motion detection and object tracking in CCTV footage	MATLAB, Python, Deep Learning	Security, Law Enforcement	
Autonomous Vehicles	Lane and sign detection in road images	Python, TensorFlow	Automotive, Robotics	
Media & Entertainment	Face detection and feature enhancement in selfies	OpenCV, Keras	Social Media, AR/VR	

Remote Sensing	Satellite image classification and road extraction	MATLAB, PyTorch	Urban Planning, Defense
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Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Image Acquisition and RGB Manipulation	Extract and manipulate image color channels	MATLAB	Image channel analysis, metadata extraction
Logical Operations and Watermarking	Apply logical operators and implement watermarking	MATLAB	Digital watermarking, logical image operations
Histogram Computation and Equalization	Analyze and enhance contrast	MATLAB	Histogram processing, contrast enhancement
Image Restoration	Remove noise and reconstruct images	MATLAB	Noise filtering, image restoration

Test Book(s):

- Gonzalez, R. C. & R. E. Woods, "Digital Image Processing" , Pearson Education, 3rd edition. 2009

Online Resources (e-books, notes, ppts, video lectures etc.):

Reference(s):

Reference Book(s):

- Y. Wang, J. Ostermann, and Y.Q. Zhang, "Video Processing and Communications," Prentice Hall, First Edition
- David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach," Prentice Hall; First Edition
- Richard Hartley, Andrew Zisserman, "Multiple View Geometry in Computer Vision," Cambridge University Press, Second Edition

Online Resources (e-books, notes, ppts, video lectures etc.):

- Online notes
<https://web.eecs.umich.edu/~justincj/teaching/eecs442/WI2020/syllabus.html#>
- NPTEL online video content:- https://onlinecourses.nptel.ac.in/noc21_ee23/preview
- Online ppts :- <http://www.wu.ece.ufl.edu/courses/eee6512f16/index.htm>
- Online ppts:
<https://staff.fnwi.uva.nl/r.vandenboomgaard/PCV20172018/20172018/syllabus.html>
- Video lectures on "Digital Image Processing" by Prof. Dr. P K Biswas, IIT Kharagapur.
<https://freevideolectures.com/course/2316/digital-image-processing-iit-kharagpur>
- <https://www.coursera.org/learn/digital>
- <https://nptel.ac.in/courses/117/105/117105135/>

E-content:

- K. Rasool Reddy; K. Hari Priya; N. Neelima, " Object Detection and Tracking -- A Survey 2015 International Conference on Computational Intelligence and Communication Networks (CICN) _ <https://ieeexplore.ieee.org/document/7546127>
- Hammad Naeem; Jawad Ahmad; Muhammad Tayyab , " Real-time object detection and tracking", IEEE International Conference on Multi Topic-INIMC, December 2013
<https://ieeexplore.ieee.org/document/6731341>
- Vijeta Sharma; Manjari Gupta; Ajai Kumar; Deepti Mishra , " Video Processing Using Deep Learning Techniques: A Systematic Literature Review ", IEEE Access , VOL. 9
<https://ieeexplore.ieee.org/document/7322178>

4. Sahar Movaghati, Alireza Moghaddamjoo, Ahad Tavakoli, " Road Extraction From Satellite Images Using Particle Filtering and Extended Kalman Filtering IEEE Transactions on Geoscience and Remote Sensing , VOL. 48, issue.7 https://ieeexplore.ieee.org/document/5439693	
Topics relevant to "EMPLOYABILITY SKILLS": Representation of Digital Images, Image operation, Image segmentation, Image Analysis, Color And Morphological Image Processing, for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr K BhanuRekha, Annapurna.H.S
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3403	Course Title: Adaptive Signal Processing Type of Course: Discipline Elective / Signal Processing Basket and Theory Only		L- T-P- C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Digital Signal Processing Signal and Systems						
Anti-requisites	NIL						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Adaptive Signal Processing to improve the learner's <u>Employability Skills</u> of student by using <u>Participative Learning</u> techniques						
Course Description	The course aims to develop a mathematical theory of linear adaptive filters. The course discusses the adaptation techniques of the filter to achieve the desired output. Such adaptive algorithms are frequently encountered in many signal processing and machine learning algorithms. The adaptive signal processing course will be aided by simulations, which will enable the students to validate their theoretical findings.						
Course Outcomes	On successful completion of this course the students shall be able to: 1. Recognize the importance of signal processing in non-stationary environment. 2. Discuss the role of adaptive signal processing in communication systems. 3. Apply the various mathematical models to adaptive signal processing. 4. Use of Wiener filter for given applications.						
Course Content:							
Module 1	Introduction/Stationary Processes and Model	Assignment/QUIZ	Memory Recall based quiz				10 Sessions
Topics:							

INTRODUCTION: The filtering problem, Adaptive filters, linear filter structures, approaches to the development of linear adaptive filter algorithms, real and complex forms of adaptive filters, nonlinear adaptive filters, Applications.

STATIONARY PROCESSES AND MODELS: Partial characterization of a discrete time stochastic process, mean ergodic theorem, correlation matrix, correlation matrix of sine wave plus noise, stochastic models, Wold decomposition, asymptotic stationarity of an auto regressive process. Yule-Walker equations

Module 2	WIENER FILTERS	Assignment	Simulation task	10 Sessions
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Topics:
WIENER FILTERS: Linear optimum filtering problem statement, principle of orthogonality, minimum mean squared error, Wiener Hopf equations, error performance surface. Channel equalization. Linearly constrained minimum variance filter, generalized side lobe cancellers.

Module 3	Linear Prediction	Assignment	Simulation task	10 Sessions
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Topics:
LINEAR PREDICTION: Forward Linear Prediction, backward Linear Prediction, Levinson-Durbin algorithm, properties of prediction error filters, Schur-Cohntest, auto regressive modeling of a stationary stochastic process. Method of steepest descent: Steepest descent algorithm, stability of the Steepest descent algorithm.

Module 4	Applications of Adaptive signal processing	Assignment	Simulation task	10 Sessions
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Topics: Adaptive modeling of a multi-path communication channel, adaptive model in geophysical exploration, Inverse modeling, Adaptive interference canceling: applications in Bio-signal processing.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Smart Communication Systems	Adaptive Channel Equalization	MATLAB, Python	Telecom, 5G/6G
Audio Processing	Noise Cancellation	Librosa, Audacity	Consumer Electronics
Biomedical Signal Processing	ECG/EEG Denoising	Python, MATLAB	Healthcare Devices
IoT & Smart Devices	Signal Cleaning in IoT Sensors	MATLAB, PyTorch	Embedded Systems

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
LMS Filter Design	Understand gradient-based adaptive learning	Python / MATLAB	LMS convergence and step-size tuning
Wiener Filter Simulation	Noise reduction in speech signals	MATLAB Toolbox	Minimum error estimation
AR Modeling	Analyze stochastic processes	Python (statsmodels)	Stochastic modeling, AR coefficient estimation
EMD-based Filter	Explore modern decomposition techniques	PyEMD Library	Signal decomposition, noise separation

Text Book(s):

1. Simon Haykin, "Adaptive Filter Theory", Pearson Education, 2003

2. Ali H. Sayed, Fundamentals of Adaptive Filtering, John Wiley, 2003 References 1. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing" , Person Education, 2005. 2. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive Filters" , Prentice-Hall of India, 2002 3. S. Thomas Alexander, "Adaptive Signal Processing - Theory and Application" , Springer-Verlag. 4. James V. Candy, Signal Processing: A Modern Approach, McGraw-Hill, International Edition. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Video lectures on "Adaptive Signal Processing" by Prof. Mrityunjay Chakraborty, IIT KGP https://nptel.ac.in/courses/117105075 2. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home E-content: 1. D.Morgan, "Adaptive signal processing" IEEE Trans. on Acoustics, Speech, and Signal Processing Vol 34, (4) 1986) DOI: 10.1109/TASSP.1986.1164869. 2. Alexander Voznesensky; Dmitrii Kaplun , "Adaptive Signal Processing Algorithms Based on EMD and ITD", IEEE Access (Volume: 7), DOI: 10.1109/ACCESS.2019.2956077. 3. B. Widrow; E. Walach Adaptive signal processing for adaptive control" , DOI: 10.1109/ICASSP.1984.1172527. 4. Alexander Voznesensky ; Dmitrii Kaplun , " Adaptive Signal Processing Algorithms Based on EMD and ITD", IEEE Access Vol 7,2019 DOI: 10.1109/ACCESS.2019.2956077 Topics relevant to "EMPLOYABILITY SKILLS" : WIENER FILTERS, Linear optimum filtering problem statement, Adaptive filters, Channel equalization, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr Dharmesh Kumar Srivastava
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3402	Course Title: Biomedical Signal Processing Type of Course: Discipline Elective Theory only		L- T- P- C	3	0	0	3
Version No.		2.0					
Course Pre-requisites	Basic concepts and techniques for processing of discrete-time signals, systems and transforms. Understanding of FIR and IIR Filters; Discrete Fourier Transform (DFT) and Fast Fourier transform (FFT) techniques and their applications; Implementation of DSP algorithms on DSP processors.						

Anti-requisites	NIL				
Course Description	The course describes the origin and characteristics of biomedical signals collected from humans. This course imparts knowledge of signal processing methods to analyze the health status of individuals in order to differentiate between a healthy and an unhealthy person. The course also develops critical thinking to choose and apply a signal model for a specific set of physiological disorders. The comprehensive nature of the course covers a number of quizzes and signal processing assignments using various tools to enhance students' abilities to become an independent biomedical engineer.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Biomedical Signal Processing and to improve the <u>Employability Skills</u> of student by using <u>Participative Learning</u> techniques.				
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the origin, characteristics, and physiological significance of biomedical signals including ECG, EEG, and EMG. (L2) CO2: Describe the principles and functioning of bioelectrical signal acquisition systems and their clinical relevance. (L2) CO3: Apply analog and digital filtering techniques for noise and artifact removal in biomedical signals. (L3) CO4: Analyze biomedical signals using time-domain methods for feature extraction and event detection. (L4) CO5: Analyze biomedical signals using frequency-domain methods and spectral estimation techniques. (L4) CO6: Evaluate and compare parametric signal models (AR, ARMA) for biomedical system modeling. (L5)				
Course Content:					
Module 1	Biosignals and its Origin	Quiz		Memory Recall based Quizzes	12 Classes
Introduction to biosignals: Human anatomy and physiology, Electrical activities of a Cell, Origin and dynamics of Biomedical signals, Electrocardiography (ECG) signal origin and characteristics. Electroencephalography (EEG) signal and its characteristic. Electromyography (EMG) signal and its characteristic. Other Biomedical signals – Blood Pressure, Respiration, Electrooculogram (EOG) etc.					
Module 2	Noise Removal and Processing of Biosignals	Assignment / Quiz		Programming and Simulation task	12 Classes
Review of Discrete time signals and systems, Analog filters, Digital filters. Time domain filtering - Synchronized Averaging, Moving Average etc., Frequency Domain Filtering, The Weiner Filter, Adaptive Filtering, Adaptive interference cancellation. Filtering of physiological signals.					
Module 3	Analysis of Biosignals	Assignment		Memory Interfacing Task and Analysis	15 Classes
Practices followed for data collection from opposite gender patients. Feature Extraction and Event Detection from ECG (P, QRS and T Waves detection, Pan Tompkins Algorithm for QRS Detection), EEG and EMG signals. Time-domain Analysis – Biosignal Morphologies, Signal length, Envelop Extraction, Amplitude demodulation, The Envelopgram, Activity Analysis etc. Frequency-domain Analysis – Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniell's Spectral Estimator, and Measures derived from Power Spectra Density.					

Module 4	Modelling of Biomedical Signals and Systems	Assignment	System Design Task and Analysis	06 Classes
Parametric Modelling of Biomedical Systems, Various Signal models like Autoregressive, Autocorrelation method, ARMA model etc., Random signals and their processing, Overview of Advanced Topics.				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Cardiac Monitoring	QRS Detection from ECG	Python, MATLAB	Healthcare Devices	
Brain-Computer Interface	EEG Signal Processing	MNE, LabVIEW	Neurotech	
Wearables	PPG Feature Extraction	Python (NeuroKit2)	Consumer Health	
IoMT	Remote Biosignal Transmission	MATLAB, SciPy	Digital Health	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
ECG Feature Extraction	Identify PQRST segments	Pan-Tompkins Algorithm (MATLAB)	ECG signal segmentation and feature labeling	
EEG Classification	Detect epileptic seizure	Wavelet + SVM (Python)	EEG pattern classification using ML	
Denoising EMG	Remove noise from EMG signals	ICA (MATLAB/Python)	Artifact removal, clean signal reconstruction	
PPG Analysis	Estimate heart rate variability	NeuroKit2 Toolkit	HRV analysis, PPG interpretation	
Textbook(s):				
1. Sörnmo L. and Laguna P, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", Academic Press, 1st edition, Elsevier, 2005.				
2. Willis J. Tompkins "Biomedical Digital Signal Processing", 2nd edition, IEEE, PHI, 2004.				
Reference(s):				
1. Devasahayam S. R., "Signals and Systems in Biomedical Engineering: Signal Processing and Physiological Systems Modeling", Kluwer Academic/Plenum Publishers, 5 th edition, New York, 2000.				
2. Reddy D. C., "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005.				
3. Rangayyan R. M. "Biomedical Signal Analysis: A case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002.				
Online Resources (e-books, notes, ppts, video lectures etc.):				
1. MIT Open Course Ware Lecture Notes on "Biomedical Signal and Image Processing". https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/pages/lecture-notes/				
2. Prof. Sudipta Mukhopadhyay NPTEL Lecture Notes and Videos: https://nptel.ac.in/courses/108105101				
3. Fatemeh Hadaeghi Lecture Notes (from Jacobs University Bremen): https://www.ai.rug.nl/minds/teaching/courses/t2018biomed/				

4. Dr. Kunal Pal's Video lectures on "Biomedical Signal Processing" from NIT Rourkela: <https://www.youtube.com/watch?v=XKoGk99ktf8>
5. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-content:

1. M. L. Ahlstrom and W. J. Tompkins, "Digital Filters for Real-Time ECG Signal Processing Using Microprocessors," in *IEEE Transactions on Biomedical Engineering*, vol. BME-32, no. 9, pp. 708-713, Sept. 1985, doi: 10.1109/TBME.1985.325589. <https://ieeexplore.ieee.org/abstract/document/4122146>
2. Coté, Gerard L., Ryszard M. Lec, and Michael V. Pishko. "Emerging biomedical sensing technologies and their applications." *IEEE Sensors Journal* 3, no. 3 (2003): 251-266. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.415.7820&rep=rep1&type=pdf>
3. James, Christopher J., and Christian W. Hesse. "Independent component analysis for biomedical signals." *Physiological measurement* 26, no. 1 (2004): R15. <<https://iopscience.iop.org/article/10.1088/0967-3334/26/1/R02/meta>> Available at Link: https://www.academia.edu/download/49895521/0967-3334_2F26_2F1_2Fr0220161026-21959-1bfp9y3.pdf
4. Addison, Paul S. "Wavelet transforms and the ECG: a review." *Physiological measurement* 26, no. 5 (2005): R155. https://people.uwec.edu/walkerjs/primer/Papers/Addison_EEG_Review.pdf
5. Moraes, Jermana L., Matheus X. Rocha, Glauber G. Vasconcelos, José E. Vasconcelos Filho, Victor Hugo C. De Albuquerque, and Auzuir R. Alexandria. "Advances in photoplethysmography signal analysis for biomedical applications." *Sensors* 18, no. 6 (2018): 1894. <https://www.mdpi.com/1424-8220/18/6/1894/pdf>

Topics relevant to "EMPLOYABILITY SKILLS": Analysis of ECG / EMG / EEG signals, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Natya.S
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE3404	Course Title: Multimedia Signal Processing Type of Course: Discipline Elective from Signal Processing Basket & Theory only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	A fair knowledge in digital signal processing and basic concepts of frequency transformations is desirable.					
Anti-requisites	NIL					
Course Description	This is an undergraduate level course that deals multimedia presentations (text, graphics, speech, audio, image, video) and their standards for coding, processing and compression. The subject shall provide an introduction to our perception of speech, audio, music, image and video to be able to understand advanced techniques, algorithms and concepts for digital processing of multimedia presentations. The course enables to know					

	the principles and technologies of several important standards and their typical application scenarios.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Multimedia Signal Processing to improve the learner's <u>Employability Skills</u> by using <u>Participative Learning</u> Methodologies.				
Course Outcomes	On successful completion of this course the students shall be able to: 1) Discuss the fundamentals behind multimedia signal processing and compression. (Comprehension) 2) Explain the basic principles behind existing multimedia compression and communication standards. (Comprehension) 3) Apply the acquired knowledge to specific multimedia related problems and projects at work. (Application)				
Course Content:					
Module 1	Basic Digital Signal Processing	Assignment		Programming Task, Data Analysis task	12 classes
Topics: Digital Processing Basics, Multimedia Processing and Communications, Compression and Networking as Cornerstones, Information Theory Basics, Lossless Source Coding, Huffman/arithmetic Codes, LZW, Text/graphics Compression, Quantization (scalar/vector). Ethical practices to be observed while using multimedia techniques.					
Module 2	Model Based Signal Processing	Assignment		Programming Task, Data Analysis task	10 classes
Topics: Waveform, Transform, Model-based Coding, Performance Criteria, Perception, Human Visual System Models, Still Image Compression, JPEG, JPEG2000, Wavelet/Sub-band/Fractal, Perceptually-based Coders, 2 nd Generation Image Coding					
Module 3	Multimedia Communication Standards	Project		Programming Task, Data Analysis task	11 classes
Topics: Audio Compression, MPEG-1/2, Dolby AC-2 and AC-3, Compression of Stereo and Surround Sound, Video Compression Basics, Overview of Multimedia Communication Standards H.323 and H.324, Video Compression Standards H.261, H.263, Video Compression Standards MPEG-1, MPEG-2, and HDTV, MPEG-4, MPEG-7, Multimedia Transmission, Error Resilience and Concealment, Multimedia over IP					
Module 4	Applications of DSP to Multimedia	Assignment		Programming Task, Data Analysis task	12 classes
Topics: Music Signal Processing and Auditory Perception, Speech Processing, Acoustic Theory of Speech-The Source-filter Model, Speech Models and Features, Speech Enhancement, Echo Cancellation					
Targeted Applications and Tools					
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries		
Video Streaming	Live encoding of H.264 video	FFmpeg, OpenCV	OTT Media, Surveillance		
Speech Enhancement	Noise reduction for VoIP	MATLAB, Python	Telecom, Assistive Tech		

Image Compression	JPEG2000 encoder design	Python (PyWavelets)	Medical Imaging, Drones
Music Processing	Spectral separation of instruments	Librosa, Jupyter	Music Tech, DSP

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Implement Huffman & LZW	Understand lossless coding	Python, custom scripts	Entropy coding, data compression
Design MPEG-4 Encoder	Comprehend video compression	FFmpeg, OpenCV	Video coding pipeline setup
Speech Enhancement Filter	Reduce ambient noise	MATLAB, SciPy	Signal filtering, speech enhancement
Build JPEG Compressor	Master image compression	Python, PIL, PyWavelets	JPEG compression, wavelet analysis

Textbook(s):

1. Saeed V. Vaseghi, "Multimedia Signal Processing: Theory and Applications in Speech, Music and Communications", Wiley.

References:

1. Ralf Steinmetz and Klara Nahrstedt, "Multimedia Systems", Springer
2. Iain E.G. Richardson, "H.264 and MPEG-4 Video Compression", John Wiley

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [Multimedia Signal Processing | University of Illinois](https://courses.engr.illinois.edu/ece417/fa2020/)
<https://courses.engr.illinois.edu/ece417/fa2020/>
2. [Multimedia Signal Processing | Norwegian University of Science and Technology](https://www.ntnu.edu/studies/courses/TTT4135)
<https://www.ntnu.edu/studies/courses/TTT4135>

E-Content:

1. Presidency University Library Link <https://presiuniv.knimbus.com/user#/home>
2. Efficient and Low-Complexity Surveillance Video Compression Using Backward-Channel Aware Wyner-Ziv Video Coding, IEEE Transactions on Circuits and Systems for Video Technology (Volume: 19, Issue: 4, April 2009)
<https://ieeexplore.ieee.org/document/4801602>
3. Sparse Music Representation With Source-Specific Dictionaries and Its Application to Signal Separation, IEEE Transactions on Audio, Speech, and Language Processing (Volume: 19, Issue: 2, February 2011) <https://ieeexplore.ieee.org/document/5444999>

Topics relevant to "EMPLOYABILITY SKILLS" : Audio and video compression Standards, Digital Processing Basics for Multimedia Processing and Communications; Audio and Video Compression Basics, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Pallabi Kakati
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3405	Course Title: Wavelets and Filter Banks			L- T- P- C	3	0	0	3
	Type of Course: Theory Only							
Version No.	1.0							
Course Pre-requisites	Digital Signal Processing; Matlab; Linear Algebra.							
Anti-requisites	NIL							
Course Description	The course mainly involves the theories of multirate filter banks (FBs) and wavelet, in addition, and their applications. It falls into two sections: FBs and wavelet. The first section begins with the design of filter, and then introduces the fundamental concepts, properties and theory of multirate FBs. Furthermore, several types of FBs, such as cosine-modulated FBs, linear phase FBs, time varying FBs, 2-dimmmensional FBs, directional FBs, are analyzed. In the end of this section, the applications of FBs in communication are introduced.							
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques using AI & IOT.							
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand the terminologies that are used in the wavelet's literature. 2. Understand the concepts and theory behind wavelets constructions from an interdisciplinary perspective that unifies harmonic analysis (mathematics), filter banks (signal processing), and multiresolution analysis (computer vision). 3. Be familiar with the modern signal processing using signal spaces, bases, operators and series expansions. 4. Apply wavelets and multiresolution techniques to a problem at hand, and justify why wavelets provide the right tool. 5. Research, present, and report a selected project within a specified time. 6. Think critically, ask questions, and apply problem-solving techniques.							
Course Content:								
Module 1	Introduction and filter design techniques	Quiz	Memory Recall based Quizzes	12 Sessions				
Topics: Multirate system fundamentals, Multirate filter design techniques: IFIR and FM approach, Design of two-channel linear-phase/low-delay filter banks, Two band filter banks with FIR and IIR filters, <i>M</i> -channel maximally decimated filter banks, <i>M</i> -channel near-perfect-reconstruction cosine-modulated filter banks, <i>M</i> -channel perfect reconstruction cosine modulated filter banks.								
Module 2	Non-uniform filter banks	Assignment/Quiz	Theoretical Understanding	10 Sessions				
Topics: <i>M</i> -channel linear phase filter banks, Multiresolution analysis and wavelet theory, Comparison of wavelet and Fourier transform,								
Module 3	Filter banks and discrete wavelet transform	Assignment/Quiz	Theoretical Understanding	11 Sessions				
Topics: Wavelet with FIR and IIR filters I, Wavelet with FIR and IIR filters II, <i>M</i> -band wavelet, Wavelet design based on cosine modulated filter banks, Wavelet transform application: de-noising and compression, Matching wavelet.								
Targeted Application & Tools that can be used:								

- Audio and Image Compression, Quantization Effects, Digital Communication and Multicarrier Modulation, Trans multiplexers, Text-Image Compression: Lossy and Lossless,
 - Medical Imaging and Scientific Visualization, Edge Detection and Feature Extraction, Seismic Signal Analysis,
 - Geometric Modelling, Matrix Preconditioning, Multiscale Methods for Partial Differential Equations and Integral Equations.
- Professionally Used Software:
- MATLAB® Wavelet Toolbox, Software for Filter Design, Signal Analysis, Image Compression, PDEs,
 - Wavelet Transforms on Complex Geometrical Shapes.

Project work/Assignment:

1. Case Studies: At the conclusion of each module, we will have a 'case-based' discussion session for approximately half the class period. Cases will be from lecture / journal article content by considering a 'real-world' scenario where the course concepts can be applied. We will post the case one week in advance. For each case, each student from each group formed will write a 1-2-page executive summary outlining their understanding, including relevant analyses, schematics, and graphs. Guidelines on report format will be provided with the first case.
2. Book/Article review: At the end of each module, a book or an article will be given to each student. They need to visit the library and write a report on their understanding about the assigned article for 1 page. [Presidency University Library Link](#).
3. Presentation: There will a group presentation on latest trends and advancements in Wavelets & Filter banks

Text Book(s):

1. P. P. Vaidyanathan, Multirate Systems and Filter Banks. Prentice-Hall. Englewood Cliffs, NJ: 1993.
2. G. Strang and T. Q. Nguyen, Wavelets and Filter Banks. Wellesley-Cambridge Press, Wellesley, MA, Revised Edition, 1998.
3. Stephane Mallat, A Wavelet Tour of Signal Processing. San Diego: Academic Press, 1999.

Reference(s):

1. M. Vetterli and J. Kovacevic, Wavelets and Subband Coding, Prentice Hall, Englewood Cliffs, NJ, 1995.
2. Fusheng Yang, Engineering Analysis and Applications of Wavelet Transform. Science Press, BJ:1999.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [NPTEL :: Electrical Engineering - NOC:Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis](#)
2. [Lecture Notes | Wavelets, Filter Banks and Applications | Mathematics | MIT OpenCourseWare](#)
3. [Introduction to Wavelet.ppt \(live.com\)](#)

E-content:

1. P. P. Vaidyanathan, "Multirate digital filters, filter banks, polyphase networks, and applications: a tutorial", *Proc. IEEE*, vol. 78, no. 1, pp. 56-93, January 1990.
2. P. P. Vaidyanathan, "Theory and design of M -channel maximally decimated quadrature mirror filters with arbitrary M , having the perfect reconstructions property," *IEEE Trans. Acoust., Speech, Signal Processing*, vol. 35, no. 4, pp. 476-492, April 1987.
3. R. D. Koilpillai and P. P. Vaidyanathan, "Cosine-Modulated FIR Filter Banks Satisfying Perfect Reconstruction," *IEEE Trans. Signal Processing*, vol. 40, no. 4, April 1992.
4. T.Q. Nguyen, "Near Perfect Reconstruction Pseudo-QMF Banks," *IEEE Trans. Signal Processing*, vol. 42, no. 1, pp. 65-76, January 1994.
5. T. Q. Nguyen, "A tutorial on Filter Banks and Wavelets," *In Proc. IEEE International Conference on Digital Signal Processing*, Cypress, June 1995.
6. Y. P. Lin and P. P. Vaidyanathan, "Linear Phase Cosine Modulated Maximally Decimated Filter Banks with Perfect Reconstruction," *IEEE Trans. Signal Processing*, vol. 42, no. 11, November 1995.

Catalogue prepared by	Ms. Swetha G
Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3406	Course Title: Probabilistic Systems analysis Type of Course: Discipline Elective- Signal Processing Basket	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	A college-level course in calculus and statistics is desirable. The students should be aware of double integrations and methods for solving partial differential equations.					
Anti-requisites	NIL					
Course Description	This course provides insights into the modeling and analysis of real-world random phenomena and processes, including the basics of statistical inference. The course introduces the relevant models, skills and tools, by combining mathematics with conceptual understanding and intuition. The assignment-based practices in this course lay a firm foundation for building probabilistic models in various application domains.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques using open-source Design Tools.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Discuss the basics of probability, sample space, events, statistics and apply them to real life problems 2) Distinguish probability density and distribution functions for single and multiple random variables and calculate the statistical parameters for random variables 3) Apply the concept of random processes along with its parameters in estimating the correlation, covariance and PSD.					
Course Content:						
Module 1	Probability Theory and Probability Statistics	Assignment	Problem Solving Task	7 Sessions		
Topics: Probability models and axioms, Conditioning and Bayes' rule, Independence, Counting						
Module 2	Random Variables	Assignment	Problem Solving Task	10 Sessions		
Topics:						

Discrete random variables; probability mass functions; expectations, Discrete random variable examples; joint PMFs, Multiple discrete random variables: expectations, conditioning, independence, Continuous random variables, Multiple continuous random variables				
Module 3	Distribution Functions and Random Processes	Assignment	Problem Solving Task	11 Sessions
Topics: Continuous Bayes rule; derived distributions, Derived distributions; convolution; covariance and correlation, Iterated expectations; sum of a random number of random variables, Bernoulli process, Poisson process, Markov chains, Weak law of large numbers, Central limit theorem, Bayesian statistical inference, Classical statistical inference				
Module 4	Detection, estimation and filtering	Assignment	Problem solving task	17 sessions
Statistical decision theory - Bayes' criterion (Binary hypothesis, M-ary hypothesis), minimax criterion, Neyman-Pearson criterion, sequential detection, Estimation-maximum likelihood estimation, generalized likelihood ratio test, Bayes' estimation (minimum mean-square error estimate, minimum mean absolute value of error estimate, maximum a posteriori estimate), Cramer-Rao Inequality, Multiple Parameter Estimation, least-square estimation, Filtering-Wiener filter, Kalman filter				
Targeted Application & Tools that can be used: Application Areas: Exploratory decision making, Machine Learning, Artificial Intelligence and Data analysis, computer vision, natural language processing, computational biology, Statistics and Statistical Signal Processing Domain. TOOLS: Python and R programming.				
Project work/Assignment:				
Assignment 1: Problem solving assignment on probability theory Assignment 2: Problem solving assignment on random variables Assignment 3: Problem solving assignment on random processes Assignment 4: Problem solving assignment on queuing theory				
Textbook(s): 1. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition, Wiley, 2016 2. Mourad Barkat, "Signal detection and estimation", 2e, Artech House, 2005				
References: 1. Bertsekas, Dimitri, and John Tsitsiklis. Introduction to Probability. 2nd ed. Athena Scientific, 2008. ISBN: 9781886529236. 2. Athanasios Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", 4th edition, PHI, 2002. 3. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing", 3rd edition, Pearson Education, 2009				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Probabilistic Systems Analysis and Applied Probability (amser.org) 2. Introduction To Applied Probability Udemy 3. Probability Theory and Stochastic Processes with Applications 4. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home				
E-content 1. https://www.researchgate.net/publication/309793344 Reliability sensitivities with fuzzy random uncertainties using genetic algorithm 2. https://www.researchgate.net/publication/333449747 Methodologies for Assessing Risks of Accidents in Chemical Process Industries 3. https://www.researchgate.net/publication/226742073 Modelling Technologies and Applications 4. https://www.researchgate.net/publication/327826061 Modelling Technologies and Applications Nanotechnologies and Electronics Packaging				

Topics relevant to development of “Foundation Skills” : Probability models and axioms; probability mass functions; expectations.	
Topics relevant to development of “Employability” : Markov chains; Central limit theorem, Bayesian statistical inference.	
Catalogue prepared by	Dr. Sumantra Chaudhuri
Recommended by the Board of Studies on	12 th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3407	Course Title: Video Processing and Computer Vision Type of Course: : Discipline Elective- Signal Processing Basket	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Digital Image Processing, Signals and Systems, Transforms and Techniques					
Anti-requisites	NIL					
Course Description	This course aims to introduce students to a wide range of video processing and computer vision techniques. The purpose of this course is to familiarize the students with the fundamental ideas and problems in computer vision and video processing as well as the main solutions. An introduction to computer vision is provided in this course, along with advanced ideas like motion estimation and tracking, image classification, scene understanding, object categorization and tracking, image fusion, image registration, etc.					
Course Objective	This course is designed to improve the learner's <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> Methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Know the fundamental techniques for video processing, and computer vision 2) Understand the basics of analog and digital video: video representation and transmission 3) Understand the basics of computer vision 4) Familiarize himself/herself with computer vision algorithms and applications					
Course Content:						
Module 1	Introduction to Video Processing	Quiz	Memory Recall based Quizzes	09 session		

Topics: Video data, video acquisition, video representation, Video data representation, sensors for video acquisition, working of digital camera (block diagram), camera resolution and color conversion, types of video cameras general mathematical operations for video processing, Color perception and specifications, color representation, video formats (NTSC, SECAM, PAL, VGA, HD), video storage requirements, video indexing				
Module 2	Video Processing	Assignment / Quiz	Programming and Simulation task / Memory Recall based Quizzes	12 session
Topics: Sampling in spatial and temporal domains, sampling conversion, video to frames and frames to video Pre-filter in video cameras, interpolation filter in video displays, Fourier analysis of video sequence, spatial frequency, temporal frequency, temporal frequency caused by motion.				
Module 3	Introduction to Computer Vision and Algorithms	Assignment	Programming Assignment	12 session
Topics: Introduction to Computer Vision, Image Processing VS Computer Vision, Color Vision, Camera and Epipolar Geometry, Auto-calibration Motion estimation: - Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.				
Module 4	Applications of Computer Vision	Assignment	Programming Assignment	12 session
Topics: Object detection and tracking various scenarios, Pattern Analysis, Face recognition and Tracking, Applications of computer vision in robotics and Autonomous Vehicles (ADAS)				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: Security and Surveillance, ADAS, Industry 4.0 Professionally Used Software: Python/ MATLAB/ SCILAB				
Project Work/Assignment:				
1. Case Study: At the end of the course students will be given a ‘real-world’ application-based on Computer Vision and Video Processing as a case study. Students will be submitting a brief report in appropriate format 2 Article review: At the end of the course a literature review of any 01 recent articles from the reputed national and international journal/ conferences will be given by students. They need to refer to tools like Scopus/ Google-Scholar and submit a report on their understanding of the assigned article in appropriate format. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to present their review work.				
Text Book(s): 2. AL BOVIK, “Handbook of Image and Video Processing,” Elsevier Science, 2 nd Edition. 3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011, 1st Edition.				

Topics relevant to the: "FOUNDATION SKILLS", Introduction to Computer Vision, , Image Processing VS Computer Vision	
Topics related to development of "EMPLOYABILITY": Object detection and tracking various scenarios, Pattern Analysis, Face recognition and Tracking, Applications of computer vision in robotics and Autonomous Vehicles (ADAS)	
Catalogue prepared by	Mr. Kiran Dhanaji Kale
Recommended by the Board of Studies on	BOS Meeting NO: 15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No.18th , Dated 03/08/2022

VLSI Basket

Course Code: ECE3408	Course Title: IC Fabrication Technology Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	VLSI Design, design and implementation of VLSI circuits for complex digital and analog systems, NMOS and CMOS fabrication steps, design for testability and design verification.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand the basics of IC fabrication technology. This course aims to foster knowledge of Integrated circuit technology and fabrication techniques. This course introduces the various manufacturing methods and their underlying scientific principles in the context of technologies used in VLSI chip fabrication and Microcontrollers. This course also discusses the complexities and challenges associated with VLSI chip fabrication and different Microcontrollers. The course gives clear understanding about entire Chip fabrication.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of IC Fabrication Technology and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain semiconductor crystal growth and wafer preparation processes used in the production of semiconductor substrates for integrated circuit fabrication. (L2) CO2: Classify oxidation, lithography, etching techniques and their roles in pattern formation during integrated circuit manufacturing. (L2) CO3: Illustrate the use of diffusion and ion implantation mechanisms for controlling dopant profiles in semiconductor devices. (L3)					

	CO4: Illustrate the influence of metallization, packaging, testing, and yield enhancement processes on the performance and reliability of integrated circuits. (L3) CO5: Analyze the complete VLSI fabrication flow from wafer preparation to packaging and determine the significance of each process step in integrated circuit manufacturing. (L4) CO6: Examine fabrication challenges and process parameters and their effects on semiconductor device quality, yield, and reliability. (L4)				
Course Content:					
Module 1	Crystal Growth	Quiz		Memory Recall based Quizzes	12 Session
Topics: Introduction, electronic-grade silicon, czochralski crystal growing-crystal structure, crystal growing theory, crystal growing practise, shaping operations, etching, process considerations.					
Module 2	Oxidation and lithography	Assignment		Theoretical Understanding	12 Session
Topics: Growth mechanics and kinetics, thin oxides, oxidation techniques and systems, optical lithography-optical resists, electron lithography-resists, mask generation, X-ray lithography-resists, ion lithography					
Module 3	Diffusion and Implantation	Assignment		Theoretical Understanding	14 Session
Topics: Models of diffusion in solids, one dimensional diffusion equations, atomic diffusion mechanisms, measurement techniques, Ion implantation-range theory-ion stopping, range distribution, Furnace Annealing, high energy implantation, Metallization applications, choices, physical vapour deposition, metallization problems, introduction to packaging, package types					
	List of Laboratory Tasks: Nil				
Targeted Applications and Tools					
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries		
Facility Manager	Cleanroom management simulation	ATHENA, TCAD	Semiconductor Manufacturing		
Process Engineer	Etch rate analysis and simulation	SILVACO	VLSI Industry		
Process Development Designer	Design of process flow for CMOS	SYNOPSIS	Electronics R&D		
Facility Engineer	Layout-to-process mapping	VISUAL TCAD	IC Design Facilities		
Skill Building Through Experiential Learning					
Activity / Task	Objective	Tools / Technologies Used	Skills Developed		
Simulate oxidation thickness under varied temperature	Understand oxidation kinetics	ATHENA / TCAD	Process simulation, oxide growth modeling		
Ion implantation profile analysis	Assess depth and concentration variation	SILVACO Tools	Implant depth prediction, doping profile visualization		

Mask design for lithography	Evaluate layout vs. fabrication patterning	Photomask design tools	Photolithography planning, layout mapping	
Yield estimation through defect analysis	Analyze process impact on yield	Statistical modeling in SYNOPSIS	Yield estimation, defect modeling	
Text Book 1. S.M. Sze, "VLSI technology", Tata McGraw Hill, Second Edition, 2017.				
Reference(s): Reference Books 1. S. K. Ghandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", John Wiley and Sons Inc., New York, 1983. 2. Plummer J. D., Deal M. D. and P. B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Pearson/PHI, 2001. 3. Plummer J. D., Deal M. D. and P. B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Pearson/PHI, 2001. 4. James Plummer, M. Deal and P. Griffin, "Silicon VLSI Technology", Prentice Hall, Electronics and vLSI series, 2000. Online Resources (e-books, notes, ppts, video lectures etc.): 1. NPTEL - https://onlinecourses.nptel.ac.in/noc21_mm26/preview 2. Udemy - https://www.udemy.com/course/pcb-design-and-fabrication-for-everyone/ 3. Coursera - https://www.coursera.org/lecture/leds-semiconductor-lasers/introduction-to-semiconductor-fundamentals-3zejs 4. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home E-content: 1. William Cheng-Yu Ma;Yan-Jia Huang;Po-Jen Chen;Jhe-Wei Jhu;Yan-Shiuan Chang;Ting-Hsuan Chang , "Impacts of Vertically Stacked Monolithic 3D-IC Process on Characteristics of Underlying Thin-Film Transistor" , IEEE Journal of the Electron Devices Society 2020 , https://ieeexplore.ieee.org/document/9141258 2. NEGIN ZARAEI 1, BOYOU ZHOU 1, KYLE VIGIL 2, MOHAMMAD M. SHAHJAMALI 3, AJAY JOSHI 1, AND M. SELIM ÜNLÜ, "Gate-Level Validation of Integrated Circuits with Structured-Illumination Read-Out of Embedded Optical Signatures", IEEE,2020, https://ieeexplore.ieee.org/document/9063443 3. IN-GON LEE1 , WON-SEOK OH2 , YOON JAE KIM2 , AND IC-PYO HONG, "Design and Fabrication of Absorptive/ Transmissive Radome Based on Lumped Elements Composed of Hybrid Composite Materials" , IEEE Access 2020, https://ieeexplore.ieee.org/document/9141287				
Topics relevant to "SKILL DEVELOPMENT": Growth mechanics and kinetics, oxidation techniques and systems, packaging design considerations -for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Ms. Akshaya M Ganorkar			
Recommended by the Board of Studies on	12th BOS held on 10/08/2021			
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021			

Course Code: ECE3409	Course Title: Sensor Technology		L- P- C	3	0	3
Type of Course:	Discipline Elective: VLSI and Embedded Systems Basket, Theory only					
Version No.	2.0					
Course Pre-requisites	Knowledge of basic measurement systems and its functionalities, Knowledge of passive and active elements, network theorems					
Anti-requisites	NIL					
Course Description	The purpose of this course is to provide an understanding of sensor technologies from physics to fabrication and to circuits. This course covers the fundamental physics of typical sensors, circuits associated with the system design, and micro fabrication technologies associated with the sensors.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Sensor Technology and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Utilize sensor characteristics and dynamic models for sensor selection and performance evaluation. (L3) CO2: Illustrate physical sensing mechanisms governing sensor operation in sensing systems. (L2) CO3: Describe the operating principles of sensors used for measuring non-electrical quantities. (L2) CO4: Determine non-electrical quantities using appropriate sensing techniques for physical parameter measurement. (L3) CO5: Implement signal conditioning and communication techniques for sensor interfacing. (L3) CO6: Explain the processing techniques used in sensor fabrication and packaging. (L2)					
Course Content:						
Module 1	Sensor Fundamentals	Quiz/Seminar				07 Sessions
Topics: Measurement system, Sensors, Sensor classification, Sensor Characteristics – Static, Dynamic, Environmental, Dynamic model of sensor elements						
Module 2	Physical Properties	Quiz/Seminar				09 Sessions
Topics: Resistance, Capacitance, Inductance, Magnetism, Piezoelectricity, Pyro electricity, Hall effect, Thermoelectricity, Photo electricity						
Module 3	Non-electrical quantity Sensors	Quiz/Seminar				13 Sessions
Topics: Displacement, Pressure, Flow, Level, Thickness, Vibration, Temperature, Humidity, Light, Sound, Radiation						
Module 4	Sensor Interfacing	Quiz/Seminar				11 Sessions
Topics: Circuits - Amplifiers, Converters, Filters, Excitation, Isolation, Communication protocol - Wired, Wireless, Batteries for Low-Power Sensors						
Module 5	Sensor Fabrication	Quiz/Seminar				04 Sessions
Topics: Wafer cleaning, Oxidation, Diffusion, Deposition, Etching, Packaging						

List of Laboratory Tasks: Nil

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Automotive	Sensor-based fuel control and emission monitoring	Arduino, CAN protocol analyzers	Tata Motors, Bosch
Medical	Wearable temperature and ECG monitoring sensors	Flex sensors, MATLAB, BLE modules	Siemens Healthineers, GE Healthcare
Manufacturing	Smart vibration monitoring of rotating machinery	NI LabVIEW, MEMS accelerometers	Siemens, Honeywell
IoT & Consumer	Smart home temperature and light sensors	ESP32, Node-RED, MQTT	Samsung, Havells

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Displacement sensor using Hall/Inductive sensors	Measure and compare accuracy of different sensors	Arduino + Hall/Inductive sensors	Sensor calibration and accuracy testing
Cold junction compensation for thermocouples	Enhance temperature measurement precision	Multisim, OpAmp circuits	Compensated temperature measurement
Smart boiler monitoring system	Real-time temperature display and heater control	NTC sensor, ESP32, OLED	Embedded control and display integration
Gesture-based control using IR sensors	Develop touchless input interface	IR Proximity sensors, Arduino	Gesture recognition and interfacing

Project work/Assignment:

1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. [Presidency University Library Link](#).
2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

Project Assignment: Design and develop a system that will sense temperature of water in a boiler in real-time and produce and output in a display. The sensor must have a feedback mechanism to control the operation of the heater.

Assignment 1: Develop a displacement measurement system with an inductive sensor and hall effect sensor

Assignment 2: Design a cold junction compensation while using a thermocouple. Build the circuit in Multisim and simulate it.

Text Book(s):

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", Springer, 2004
2. I.R. Sinclair, "Sensors and Transducers", Newnes Oxford, Third Edition, 2001

References

1. A.K. Sawhney, "A Course on Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai & Co., 2011
2. Jon. S. Wilson, "Sensor Technology Hand Book," Elsevier, 2011.
3. John G Webster, "Measurement, Instrumentation and sensor Handbook," CRC Press, 2014.

4. Ramon Pallas-Areny and John G Webster, "Sensors and Signal Conditioning," Wiley India, 2012.	
Digital References 1. NPTEL - https://nptel.ac.in/courses/108106193 2. Coursera - https://www.coursera.org/learn/pressure-force-motion-humidity-sensors 3. Udemy - https://www.udemy.com/course/exploring-sensors-and-actuators-theory-and-practice 4. Presidency University Library Link - https://presiuniv.knimbus.com/user#/home	
E-Content: 1. M.I. Hossain et al., "Development of electrochemical sensors for quick detection of environmental (soil and water) NPK ions," RSC Advances, Vol. 14, pp. 9137-9158, 2024. https://doi.org/10.1039/D4RA00034J 2. Obradovic, Dragan, Henning Lenz, and Markus Schupfner. "Fusion of sensor data in Siemens car navigation system." <i>IEEE Transactions on Vehicular Technology</i> Vol. 56, pp. 43-50, 2007. https://ieeexplore.ieee.org/abstract/document/4067135 3. P. Jia et al., "Self-powered flexible battery pressure sensor based on gelatin," Chemical Engineering Journal, Vol. 479, pp. 147586, 2024. https://doi.org/10.1016/j.cej.2023.147586 4. H.J. Pandya et al., "Toward a Portable Cancer Diagnostic Tool Using a Disposable MEMS-Based Biochip," IEEE Transactions on Biomedical Engineering, Vol. 63, pp. 1347-1353, 2016. https://doi.org/10.1109/TBME.2016.2535364	
Topics relevant to "SKILL DEVELOPMENT": Various sensor characteristics, designing sensors, and application of sensing principles and electronic circuits through Participatory learning techniques. This is attained through the Assignments/Seminars, as mentioned in the assessment component.	
Catalogue prepared by	Dr. Noel Prashant Ratchagar
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE3410	Course Title: MEMS and Nanotechnology Type of Course: Discipline Elective Theory	L- T- P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Analog Electronics					
Anti-requisites	NIL					
Course Description	The course deals with Micro electro mechanical systems (MEMS), devices and technologies. The course also discusses Micro-machining and microfabrication techniques, including planar thin- film processing, silicon etching, wafer bonding, photolithography, deposition and etching. The course also includes Transduction mechanisms and modelling in different energy domains. The course emphasizes on analysis of micromachined capacitive, piezoresistive and thermal sensors/actuators and applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of MEMS and Nanotechnology and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Illustrate MEMS sensors, microfabrication techniques, and actuation mechanisms for microsystem applications. (L2) CO2: Utilize micromachining processes and actuation methods for MEMS device realization. (L3) CO3: Implement deposition techniques, microstereolithography processes, and simulation methods for MEMS fabrication and design. (L3) CO4: Explain MEMS switch operation, actuation mechanisms, and design considerations for RF and microwave systems. (L2) CO5: Describe MEMS-based RF filters, phase shifters, and micromachined antennas for RF and microwave systems. (L2) CO6: Describe MEMS inductors and capacitors for RF and microwave circuits. (L2)					
Course Content:						
Module 1	Introduction and Fundamentals MEMS Device Physics	Assignment/ Quiz	Memory Recall based Quizzes			12 Sessions
Topics: Historical background development of microelectronics, evolution of micro sensors, MEMS, emergence of micro machines. Micro sensors: Introduction, thermal sensors, mechanical sensors, flow sensors and Introduction to SAW DEVICES. Microfabrication of MEMS: Surface Micromachining, Bulk Micromachining, LIGA Process: Introduction, Basic Process and Application, micromachining of polymeric MEMS devices. Actuation: Electrostatic Actuation, Piezoelectric Actuation, Thermal Actuation, Magnetic Actuation, Mechanical Vibrations, The single degree of Freedom System, The many Degrees of freedom system						
Module 2	MEMS Materials and fabrication process Modelling	Assignment/ Quiz	Memory Recall based Quizzes			8 Sessions
Topics:						

Metals, semiconductors, thin films for MEMS and their deposition techniques, materials for polymer MEMS. Microstereolithography: Introduction, Scanning Method, Projection Method, Applications. Solid modeling: Numerical Simulation of MEMS, Mechanical Simulation, Electrostatic Simulation.					
Module 3	MEMS Switches and RF Applications	Assignment/ Quiz	Memory Recall based Quizzes		12 Sessions
Topics: Switch parameters, basics of switching, Switches for RF and microwave applications, actuation mechanisms for MEMS devices, dynamics of switch operation, MEMS switch design considerations, Microwave Considerations, Material Consideration, Mechanical Considerations modeling and evaluation. MEMS based RF and Microwave circuits: RF Filters, Micromachined Phase shifters, and Micromachined antenna.					
Module 4	MEMS Inductors and Capacitors	Assignment/ Quiz	Memory Recall based Quizzes		8 Sessions
Topics: MEMS Inductors: self and mutual inductance, micromachined inductors, modelling and design issues of planar inductors, variable inductor and polymer-based inductor. MEMS Capacitors: MEMS gap tuning capacitor, MEMS area tuning capacitor, Dielectric Tunable capacitors.					
Targeted Application & Tools that can be used: Applications in various fields such as biomedical, optical, wireless networks, aerospace, and consumer products.					
Text Book(s): T1: Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture," McGraw-Hill, 1st edition, ISBN: 0072393912. T2: RF MEMS: Theory, Design, and Technology, Gabriel M. Rebeiz, John Wiley & Sons, 2003.					
Reference(s): Reference Book(s): R1 RF MEMS & Their Applications by Vijay K. Varadan, K. J. Vinoy and K. A. Jose John Wiley & Sons, 2003 R2 Introduction to Microelectromechanical Microwave Systems (2nd Edition) by Hector J. De Los Santos, Artech house. R3 Mems Mechanical Sensors Microelectromechanical system series Srephen Beeby/Artech House Online Resources (e-books, notes, ppts, video lectures etc.): 1. NPTEL Video lectures on "MEMS and Microsystems" by Prof. Santiram Kal, IIT Kharagpur https://nptel.ac.in/courses/117/105/117105082/ 2. Video lectures on "Micro and Smart systems" by Prof. Sudip Misra", IISc Bangalore. https://nptel.ac.in/courses/112/108/112108092/ 3. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home e-learning materials – 1. Liao, Meiyong. "Progress in semiconductor diamond photodetectors and MEMS sensors." Functional Diamond 1, no. 1 (2022): 29-46. 2. Xu, Rui-Jia, and Yu-Sheng Lin. "Actively MEMS-based tunable metamaterials for advanced and emerging applications." Electronics 11, no. 2 (2022): 243. 3. Liu, Hua-Feng, Zhi-Cai Luo, Zhong-Kun Hu, Shan-Qing Yang, Liang-Cheng Tu, Ze-Bing Zhou, and Michael Kraft. "A review of high-performance MEMS sensors for resource exploration and geophysical applications." Petroleum Science (2022). 4. Zhang, Shenghai, Shaohua Luo, Shaobo He, and Hassen M. Ouakad. "Analog circuit implementation and adaptive neural backstepping control of a network of four Duffing-type MEMS resonators with mechanical and electrostatic coupling." Chaos, Solitons & Fractals 162 (2022): 112534.					

Topics relevant to "EMPLOYABILITY SKILLS": Micro sensing for MEMS, Numerical Simulation of MEMS, MEMS switch design considerations, MEMS Inductors and MEMS Capacitors - for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Puneeth S B Dr. Pritam Keshari Sahoo Dr. Ashutosh Anand
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE3411	Course Title: Photonic Integrated Circuits Type of Course: Elective Theory.	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	A background in silicon photonics, fiber optics, or semiconductors is recommended, but not required. Proficiency in linear algebra and calculus will enhance understanding of design concepts. The course emphasizes on How to model photonic devices, working, analysis and design of photonic devices and also to create compact models for them. Additionally, this course will create a foundation for future courses such as advanced photonics.					
Anti-requisites	NIL					
Course Description	Photonic integrated circuits has evolved into a key technology with transformative impact on a wide variety of applications, ranging from high-speed data transmission to further quantum optics and optical computing.					
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of the student by using <u>PARTICIPATIVE LEARNING</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1: Apply advanced techniques and tools of sensing and computation to solve multi-disciplinary challenges in industry and society. 2: Strong cognizance in the area of high-speed data transmission. 3: To learn how to develop photonic devices. 4: Evaluate the gap between theoretical basics and high-impact applications by combining a lecture with a hands-on design.					
Course Content:						
Module 1	Introduction and review	Quiz		Memory Recall based Quizzes	8 sessions	
Topics: Optical communications: short-reach, long-haul, and data centers communications. Economic drivers towards photonic integration. Interaction of optical waves with dielectric and metal interfaces. Boundary conditions, total internal reflection. Review of silicon PN-and PN-junctions. Junction diode static and transient characteristics.						
Module 2	Fundamentals of Silicon photonics	Assignment/Quiz		Theory	7 sessions	

Topics:
Symmetric dielectric waveguides. Asymmetric dielectric waveguides. Rectangular waveguides. Computational methods for integrated photonics, design and fabrication of silicon waveguide structures. Waveguide loss, scattering, absorption, radiation.

Module 3	Photonic systems	Assignment	Memory Recall based Quizzes	7 sessions
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Introduction to photonic systems for short-reach and long-haul optical communications. Modulation formats, receiver and transmitter characteristics, optical link budget, BER and penalties. Introduction to data center optical networks. Optical switching. Optical switches.

Module 4	Photonic Crystal Structures	Assignment	Comprehension based Quizzes and assignments	8 sessions
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Introduction to physics of 1D period structures Photonic crystal waveguides and bends Photonic crystal integrated circuits Waveguide couplers Add/Drop filters, Mach-Zehnders Delay lines.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
High-speed Optical Communication	Design of silicon photonic modulator and demodulator	Lumerical, Ansys	Telecom, Data Centers
Optical Sensing	Simulate waveguide-based biosensors	COMSOL Multiphysics	Healthcare, Environmental Monitoring
Quantum Photonics	Model single-photon sources using photonic crystals	Photon Design, MATLAB	Quantum Computing
Photonic Switching Networks	Design and simulate an optical switch fabric	VPIphotonics	Data Centers, High-performance Computing

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Design a silicon photonic waveguide	Understand fabrication parameters and optical losses	Lumerical MODE / FDTD	Waveguide modeling, loss analysis
Simulate a photonic crystal cavity	Analyze field confinement and Q-factor	Photon Design or COMSOL	Optical confinement simulation, resonance evaluation
Build a Mach-Zehnder Interferometer model	Explore phase shifting and interference	MATLAB, OptiSystem	Interferometric signal control
Test photonic modulator circuits	Evaluate modulation depth and response	VPIphotonics, Ansys	Modulator behavior characterization

Project work/Assignment:

1.Design a project based on analysis, design and testing of the silicon photonic circuits.

Text Book(s):

S.L. Chuang, Physics of Photonic Devices, second edition, Wiley, New York, 2009.

B. Saleh and M.C. Teich, Fundamentals of Photonics, 2nd ed., Wiley, 2007.

References

G.P Agrawal, Fiber Optic Communication Systems, Wiley, ISBN 0470505117

R.G feller and U. Bapst. Wireless in-house communication via diffuse infrared radiation, SPIE Press

S. Hranilovic. Spectrally Efficient Signalling for Wireless Optical Intensity Channels. PhD thesis, Dept. of Elec. & Comp. Engineering, University of Toronto, 2003.

Online Resources & E-content(e-books, notes, ppts, video lectures etc.):

Digital Content:

1. NPTEL - https://onlinecourses.nptel.ac.in/noc21_mm26/preview
2. EDX - <https://www.edx.org/course/silicon-photonics-design-fabrication-and-data>
3. COURSERA - <https://www.coursera.org/specializations/optical-engineering>.

E - Learning materials:

4. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6833068&isnumber=6832912>
5. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6990118&isnumber=6988061>
6. Presidency University Library Link <https://presiuniv.knimbus.com/user#/home>

Research Papers

1. 1P. Qiao, G. Su, Y. Rao, C. J. Chang-Hasnain and S. L. Chuang, "Modeling of long-wavelength high contrast grating VCSELs and comparison with experiment," *CLEO: 2013*, 2013, pp. 1-2.
2. Guan-Lin Su, Pengfei Qiao, C. -Y. Lu, D. Bimberg and S. L. Chuang, "Low-threshold dielectric-cavity microlasers," *2014 Conference on Lasers and Electro-Optics (CLEO) - Laser Science to Photonic Applications*, 2014, pp. 1-2.
3. Weik, M.H. (2000). integrated fiber optic communications system. In: Computer Science and Communications Dictionary. Springer.https://doi.org/10.1007/1-4020-0613-6_9232
4. Weik, M.H. (2000). fiber optic communications system. In: Computer Science and Communications Dictionary. Springer. https://doi.org/10.1007/1-4020-0613-6_9221

Topics Relevant to development of “Foundation skills” : Non linear Optics

Topics Relevant to development of “Employability” : Development of Silicon photonics

Catalogue prepared by	Dr Balaji ka
Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3412	Course Title: Mixed Signal Circuit Design Type of Course: VLSI Basket Theory		L- T-P- C	3	0	0	3
Version No.	1.0						
Course Pre-requisites	Basic Concepts of Operational Amplifiers, the parameters of Op-Amps, open loop and closed loop configurations of Op-Amps, inverting and non-inverting Operational Amplifier and Applications of Op-Amp. Modelling and operation of MOSFET, biasing of MOSFET.						
Anti-requisites	NIL						
Course Description	The purpose of the course is to provide the exposure to students about the mixed signal circuits by integrating various analog and digital circuits. The course helps students to learn how to design and implement product level design blocks for various VLSI applications. The course is designed with considering the need of VLSI design industry. This course encourages students to choose career as Analog or Mixed circuit design Engineer.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Mixed Signal Circuit Design and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.						
Course Outcomes	On successful completion of this course the students shall be able to: 1) Understand the concepts of MOS Operational Amplifiers. 2) Describe the concepts of Switched Capacitor Circuits and realize the concepts of PLL. 3) Memorize the modeling and architecture of data converters and Oversampling Converters. 4) Relate the concepts of Phase Locked Loop and Voltage Controlled Oscillator.						
Course Content:							
Module 1	Operational amplifiers and Comparators	Assignment / Quiz	Memory recall-based Quiz	14 Sessions			
Topics: Operational amplifiers: Basic two stage MOS Operational amplifier-Characteristic parameters, two stage MOS Op-Amp with Cascode. MOS Folded Cascode Op-amp. Fully differential folded Cascode op-amp. Current feedback op-amps. Stability and frequency compensation of op-amps. Phase margin and noise in op-amps. Comparators: Op-Amp Based Comparators, Charge Injection Errors - Latched Comparators - CMOS and BiCMOS Comparators.							
Module 2	Switched capacitor circuits and PLL	Assignment / Quiz	Implementation using Simulation Tools	13 Sessions			
Topics: Switched capacitor circuits: Basic building blocks, basic operation and analysis, inverting and non-inverting integrators, signal flow diagrams, first order filter. Sample and hold circuits - Performance requirements, MOS sample and hold basics, clock feed through problems, S/H using transmission gates, high input impedance S/H circuits. Phase locked loops: Basic loop architecture. PLLS with charge pump phase comparators - dynamics of PLLS. Voltage controlled oscillators, characteristics of PLLS. Applications of PLLS.							
Module 3	Fundamentals and Classification of Convertors	Assignment / Application	Implementation using Simulation Tools	12 Sessions			
Topics: Data converter fundamentals: Performance characteristics, ideal D/A and A/D converters, quantization noise. Nyquist rate D/A converters: Decoder based converter, binary-scaled converters. Thermometer code converters. Nyquist rate A/D Converters: Integrated converters - successive approximation converters, cyclic A/D converters, Flash or parallel converters. Oversampling Converters: Noise shaping modulators, Decimating filters and Interpolating filters, Higher order modulators.							

List of Laboratory Tasks: Nil

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Mixed Signal ICs	Design folded cascode Op-Amp with target PSRR and phase margin	LTSpice, Cadence	Semiconductor, Consumer Electronics
Switched Capacitor Filters	Design switched-capacitor low pass filter	MATLAB, LTSpice	Healthcare, Signal Processing
PLL Design	Simulate and optimize a Charge Pump PLL for given lock-in range	Cadence, Simulink	Telecommunications, Automotive
Data Converters	Model and analyze SAR ADC and DAC non-linearity	MATLAB, Cadence Virtuoso	IoT Devices, Embedded Systems

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Op-Amp Based Data Converter	Build ADC/DAC with Op-Amp interfacing	LTSpice, Cadence Virtuoso	Signal conversion, analog-digital interfacing
Comparator Design	Simulate mixed-signal comparator circuit	Cadence, Ngspice	Thresholding logic, transient analysis
Noise Analysis of Analog Front-End	Evaluate performance under noisy conditions	Spectre Simulator, MATLAB	SNR computation, spectral filtering

Textbook(s):

- T1. Paul.R. Gray & Robert G. Major, Analysis and Design of Analog Integrated Circuits, John Wiley & sons, 5th Edition 2004.
T2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, 2nd Edition.
T3. . R. Jacob Baker, "CMOS Mixed-Signal Circuit Design", Wiley Second Edition.

Reference(s):

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Second Edition.
2. Rudy Van De Plassche, "CMOS Integrated Analog-to- Digital and Digital-To-Analog Converters", Kluwer Academic Publishers, Second Edition.
3. Richard Schreier, "Understanding Delta-Sigma Data converters", Wiley Second Edition.

Online Resources (e-books, notes, video lectures etc.):

1. Video lectures on CMOS Mixed Signal VLSI design by IIT Professors, Bombay
<https://www.youtube.com/playlist?list=PLLDC70psjvq5vtrb0EdII4xIKA15ec-Ij>
2. Video lectures on mixed signal design by Satish Kayshap
<http://www.satishkashyap.com/2012/08/video-lectures-on-mixed-signal.html>
3. Video and e-transcripts on CMOS Analog VLSI design
<https://nptel.ac.in/courses/117/101/117101105/>
4. Video and e-transcripts on CMOS Digital VLSI design
<https://nptel.ac.in/courses/108/107/108107129/>
5. Presidency University Library Link: <https://presiuniv.knimbus.com/user#/home>

E-Content:

1. M. Chanda, S. Jain, S. De and C. K. Sarkar, "Implementation of Subthreshold Adiabatic Logic for Ultralow-Power Application," in IEEE Transactions on Very Large-Scale Integration (VLSI) Systems, vol. 23, no. 12, pp. 2782-2790, Dec. 2015. <https://ieeexplore.ieee.org/document/7018053>
2. R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in sub-micron CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi: 10.1109/NEWCAS.2008.4606334. <https://ieeexplore.ieee.org/document/4606334>
3. Gopalaiah, S. V., A. P. Shivaprasad, and Sukanta K. Panigrahi. "Design of low voltage low power CMOS OP-AMPS with rail-to-rail input/output swing." In 17th International Conference on VLSI Design. Proceedings., pp. 57-61. IEEE, 2004. <https://ieeexplore.ieee.org/document/1260903>.
4. R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in sub-micron CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi:10.1109/NEWCAS.2008.4606334. <https://ieeexplore.ieee.org/document/4606334>.

Topics relevant to "SKILL DEVELOPMENT" : Phase locked loops, Nyquist rate D/A converters, Nyquist rate A/D Converters, Oversampling Converters - for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. R Anusha
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3413	Course Title: Low Power VLSI Design Type of Course: Discipline Elective and theory only	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of digital circuits like gates, flip-flops, registers, multiplexers, decoders. Fundamentals of Analog and Digital VLSI design					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand the fundamentals of low power VLSI architectures and systems. The course insights into the various methods used to confront the low power issue VLSI system from circuit level to system level of abstraction. This course enhances student's abilities to develop a low power design architecture and analysis of various parameters.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Low Power VLSI Design and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Identify the sources of power dissipation in CMOS integrated circuits. (L3) CO2: Illustrate different approaches of Low power design at circuit level.(L3) CO3: Summarize issues in Low Power Design at circuit levels. (L3) CO4: Examine different encoding and computation logic to design and optimize low-power VLSI digital circuits. (L4)					

	CO5: Explain leakage sources and reduction techniques. (L2) CO6: Analyze low power clock distribution networks for power efficient VLSI design. (L4)			
Course Content:				
Module 1	Device & Technology Impact on Low Power	Assignment/Quiz	Designing and Analysis task	10 Sessions
Topics: Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.				
Module 2	Power analysis	Assignment/Quiz	Simulation and analysis task	10 Sessions
Topics: Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.				
Module 3	Low Power Design at circuit and logic level	Assignment/Quiz	Design Analysis	10 Sessions
Topics: Low Power Design Circuit Level: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library. Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.				
Module 4	Leakage Power minimization Approaches, Adiabatic switching, Memory Design	Assignment/Project	Data Analysis	10 Sessions
Topics: Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components. Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network. Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.				
List of Laboratory Tasks: Nil				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Microprocessors	Optimize logic blocks for lower power	Xilinx ISE, Cadence Virtuoso	Semiconductor	
DSPs	Reduce switching activity using low power arithmetic	LT-Spice, EDA Playground	Consumer Electronics	
IoT Devices	Design energy-efficient memory units	Microwind, VIVADO	IoT & Embedded Systems	

Wearables	Battery-aware system design	VLSI Lab Tools	Health Tech
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Skill Building Through Experiential Learning			
Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Power Gating Logic Simulation	Minimize standby leakage	Cadence Virtuoso	Sleep transistor control, leakage mitigation
Clock Tree Synthesis	Design low-skew clock network	Innovus, PrimeTime	Clock optimization, timing closure
Multi-Vt Implementation	Analyze power-performance trade-offs	Synopsys Design Compiler	Vt selection, static power estimation

Textbook(s):

1. Kaushik Roy, Sharat Prasad, “Low Power CMOS VLSI circuit design” , John Wiley & Sons Inc., 2000. 1st Edition

References:

Reference Book(s):

1. G.K. Yeap, Farid N. Najm, “Low Power VLSI design and technology” , World Scientific Publishing, 1996. (1st Edition)
2. Soudris, Dimitrios, Christrian Pignet, Goutis, Costas, “Designing CMOS circuits for low power,” Springer International, 2004. (1st Edition)
3. Ajit Pal, —Low-Power VLSI Circuits and Systems || , Springer, 2015. (1st Edition)
4. A. P. Chandrakasan, R.W. Brodersen, “Low Power Digital VLSI Design” , IEEE Press, 1998. (1st Edition)
5. Gary K. Yeap, “Practical Low Power Digital VLSI Design” , Kluwer Academic Press, 1998. (1st Edition)
6. Jan M. Rabaey, Massoud Pedram, “Low power Design methodologies” , Kluwer Academic Press, 1996. (1st Edition)
7. Michael Keating, David Flynn “Low Power Methodology Manual for System-On-Chip Design” Springer Publication 2007. (1st Edition)

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Lecture videos for Low Power VLSI Circuits & Systems by Prof. Ajit Pal, IIT Kharagpur - NPTEL <https://nptel.ac.in/courses/106/105/106105034/>
2. PPT on Low Power VLSI Design, Link : <https://nijwmwary.com/low-power-vlsi-circuits-systems/>
3. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Shanbhag, Naresh R. "Algorithms transformation techniques for low-power wireless VLSI systems design." *International Journal of Wireless Information Networks* 5, no. 2 (1998): 147-171. <https://link.springer.com/article/10.1023/A:1018869519651>
2. H. O. Elwan and A. M. Soliman, "Low-voltage low-power CMOS current conveyors," in *IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications*, vol. 44, no. 9, pp. 828-835, Sept. 1997, doi: 10.1109/81.622987.
3. C. Park, Y. A. Tavares, J. Lee, J. Wo and M. Lee, "5th-Order Continuous-Time Low-Pass Filter Achieving 56 MHz Bandwidth 30.5 dBm IIP3 With a Novel Low-Distortion Amplifier," in *IEEE Transactions on Circuits and Systems II: Express Briefs*, vol. 68, no. 6, pp. 1768-1772, June 2021, doi: 10.1109/TCSII.2020.3039247.
4. Carvajal, R., Torralba, A., Tombs, J. et al. Low Voltage Class AB Output Stage for CMOS Op-Amps Using Multiple Input Floating Gate Transistors. *Analog Integrated Circuits and Signal Processing, springer*, 36, 245-249 (2003). <https://doi.org/10.1023/A:1024774506261>

Topics relevant to “EMPLOYABILITY SKILLS” : Probability & frequency, probabilistic power analysis techniques - for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Akshaya M Ganorkar
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3414	Course Title: CAD for VLSI Type of Course: Discipline Elective VLSI Basket Theory Only	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of Digital Electronics, VLSI design flow, VLSI circuits implementation for complex digital and analog systems.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students; the fundamentals techniques and algorithms used in Computer-Aided Design tools. Modelling, analysis of digital VLSI systems, computer-aided design (CAD) algorithms for various design specifications will be covered. The course develops design skills and could enable students to apply algorithms related to physical design of VLSI circuits.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of CAD for VLSI and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe various graph algorithms and their applications in VLSI design automation. (L2) CO2: Define computational complexity concepts and their implications for the efficiency and limitations of physical design algorithms. (L2) CO3: Apply partitioning, placement, and floorplanning algorithms to optimize VLSI layouts. (L3) CO4: Illustrate the use of routing algorithms and routing models in interconnection planning for integrated circuits. (L3) CO5: Analyze logic synthesis techniques and their role in transforming behavioral descriptions into optimized digital circuits. (L4) CO6: Analyze CAD tools and physical design methodologies with respect to the VLSI design automation flow. (L4)					
Course Content:						
Module 1	Design methodologies and CAD tools	Quiz		Memory Recall based Quizzes	10 classes	
Topics: Design domains, design actions, design methods and technologies, VLSI Design automation tools, data structure for graph representation, Graph algorithms: depth first search, breadth first search, Dijkstra’ s algorithm and prim’ s algorithm.						
Module 2	Computational complexity and layout compaction	Assignment		Design Analysis	9 classes	
Topics:						

Combinatorial optimization problems, decision problems, Complexity classes, NP completeness and NP hardness, symbolic layout, applications of compaction, informal problem formulation, maximum distance constraints, and algorithms for constraint graph compaction. A Longest-path Algorithm for DAGs, the Liao Wong Algorithm and the Bellman-Ford Algorithm.

Module 3	Placement, Partitioning and Floorplanning	Assignment		Design Analysis	9 classes
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Topics:
Wire length estimation, Types of placement problem, placement algorithms-constructive placement, iterative improvement, KL partitioning algorithm, floor planning concepts-terminology, representation and problems, shape functions and floor plan sizing.

Module 4	Routing and Logic Synthesis	Assignment		Programming and simulation	9 classes
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Topics:
Area routing, channel routing-models, vertical and horizontal constraint graphs, left edge algorithm, channel routing algorithms, introduction to combinational logic synthesis, Binary decision diagrams: ROBDD principles, implementation, construction and manipulation and two level logic synthesis. . Variable Ordering, Applications to Verification and Applications to Combinatorial Optimization. Testing: Fault Models, Simulation, Basic test generation.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Computational Circuit Analysis	Implement graph algorithms for path optimization	Python, NetworkX	EDA, Semiconductor
VLSI Circuit Design	Design custom layout using floorplanner	Vivado, Cadence Innovus	Semiconductor, IoT
Timing Verification	Build delay estimation tools	Synopsys PrimeTime	Automotive, Aerospace
Design and Layout Generation	Generate layout from netlist using P&R	Cadence, Tanner Tools	VLSI, Foundries

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Netlist to Layout Flow	Convert HDL to physical layout	Cadence Innovus	Digital backend design, PNR flow
RC Extraction and Parasitic Analysis	Simulate post-layout behavior	Calibre, QRC	Parasitic modeling, IR drop prediction

Project work/Assignment:

Project Assignment:

- Develop a heuristic algorithm for finding a maximum bipartite subgraph in circle graphs.
- Suggest modifications to the Kernighan-Lin algorithm to speed up the algorithm.
- Design an efficient heuristic algorithm based on maze routing to simultaneously route two 2-terminal nets on a grid graph. Compare the routing produced by this algorithm with that produced by Lee's maze router by routing one net at a time.
- Implement the approximation algorithm for finding a k -independent set-in circle graphs. Experimentally evaluate the performance of the algorithm by implementing an exponential time complexity algorithm for finding a k -independent set.

Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and

write a report on their understanding about the assigned article in appropriate format.
[Presidency University Library Link](#) .

Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

Text Book(s):

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
2. M. L. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed- Signal VLSI circuits", Kluwer, 2001.

Reference(s):

1. Stephen Trimberger, "Introduction to CAD for VLSI" , Kluwer Academic publisher, 2002.
2. Naveed Shervani, "Algorithms for VLSI physical design Automation" , Kluwer Academic Publisher, 2nd edition.
3. G. Hachtel and F. Somenzi, "Logic Synthesis and Verification Algorithms" , Kluwer, 1998.
3. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation" , Kluwer Academic Publishers; 3rd ed., 1999.

Online and Web resource (s):

1. <https://nptel.ac.in/courses/106/106/106106088/>
2. <https://cse.ucsd.edu/faculty-research/vlsicad-computer-aided-design>
3. <http://www.facweb.iitkgp.ac.in/~isg/CAD/>
4. <https://www.youtube.com/watch?v=hJTK5nj1iq8>
5. <https://www.youtube.com/watch?v=WLdbujc-aH4>
6. <https://www.youtube.com/watch?v=zKFRfmySFOw>

E-Content:

1. H. Martin Bucker and Christian Sohr Bucker "Reformulating a Breadth-First Search Algorithm on an Undirected Graph in the Language of Linear Algebra" in IEEE 2014 International Conference on Mathematics and Computers in Sciences and in Industry, 33-35. doi:10.1109/MCSI.2014.40
<https://ieeexplore.ieee.org/abstract/document/7046157>
2. Farnaz Towhidi, Arash Habibi Lashkari "Binary Decision Diagram (BDD)" in IEEE 2009 International conference on future computer and communication, 03-05 April 2009, doi:10.1109/ICFCC.2009.31 <https://ieeexplore.ieee.org/abstract/document/5189833>.
3. Archana K Rajan, Deepika Bhaiya "VLSI partitioning using parallel kernighan lin algorithm" in IEEE 2017 International Conference on Communication and Signal Processing (ICCSP)-CHENNAI, India (2017.4.6-2017.4.8)doi:10.1109/ICCSP.2017.8286727 <https://ieeexplore.ieee.org/abstract/document/8286727>.
4. Groeneveld R" Physical design challenges for billion transistor chips " in IEEE International Conference on Computer Design-Freiberg, Germany (16-18 Sept. 2002), 78–83. doi:10.1109/ICCD.2002.1106751.
<https://ieeexplore.ieee.org/abstract/document/1106751>.

Topics relevant to "EMPLOYABILITY SKILLS" : Graph algorithms, algorithms for constraint graph compaction floor planning concept, Binary decision diagrams - for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. R Anusha
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3415	Course Title: Design for Testability Type of Course: Discipline Elective	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basic concepts of Digital Logic Circuits using gates, flip-flops, registers, multiplexers, decoders etc. Basic electronic Circuits and Mathematics and Fundamentals of VLSI Design-based systems.					
Anti-requisites	NIL					
Course Description	This course provide an in-depth theory and practice of fault analysis, test generation, and design for testability for digital VLSI circuits and systems. Design and manufacturing defect models introduced. In addition, test generation and fault simulation algorithms targeting the different fault models. Both combinational and sequential logic testing are covered and different synthesis for testability schemes such as BIST (Built-In-Self-Test), scan path design, and Core based testing introduced.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> techniques using VLSI testing tools.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the importance of VLSI testing, test generation and test technology. CO2: Determine the controllability and observability of VLSI circuits through testability measures for reliability of testing. CO3: Use scan designs and scan architectures to improve the testability of VLSI circuits. CO4: Apply fault models, fault classes, and test pattern generation techniques for testing VLSI techniques. CO5: Examine test generation algorithms to identify faults in digital circuits. CO6: Employ Built-In Self-Test (BIST) techniques to improve system reliability.					
Course Content:						
Module 1	Introduction to DFT	Assignment/Quizzes	Memory Recall based Quizzes		10 Sessions	
Topics: Testing importance in VLSI, VLSI Development process, electronic system manufacturing process, system level operation, Challenges, levels of abstraction, review of VLSI test technology, overview of AI-assisted semiconductor testing and automated defect prediction technique						
Module 2	Testability Analysis	Assignment	Simulation and analysis task		12 Sessions	
Topics: Introduction, SCOAP testability analysis (combinational and sequential controllability and observability calculation), Design for testability approaches, Scan cell designs, Scan architectures, Scan design rules, Scan design flow, ML-assisted controllability and observability estimation, intelligent scan insertion techniques for reducing test power and test time.						
Module 3	Test Generation	Assignment/Quizzes	Design Analysis		13 Sessions	
Topics:						

Fault models, Fault classes, ATPG algorithms for combinational circuits (path sensitization, Boolean difference, Kohavi algorithm, D-Algorithm, PODEM, Sequential ATPG, neural-network-based fault classification and automatic test pattern generation.

Module 4	Logic Built in Self-Test (BIST)	Assignment/Project	Data Analysis	10 Sessions
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Introduction, BIST Design rules, test pattern generation, output response analysis, Logic BIST architectures, Intelligent test response analysis

Targeted Application & Tools that can be used:

Application Area – Hardware design Engineer, DFT engineer, VLSI design Engineer.

Professionally Used Software: Cadence-Modus, Tessent

Project work/Assignment:

1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. [Presidency University Library Link](#).

2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

3. Project Assignment:-

Project 1. The emphasis on online education is increasing now-a-days, based on the current scenario, one organization designs a prototype for smooth and interactive learning platforms, consider the design with following functions embedded:

1.Locking of meeting after 10 minutes

2.Control over the class by the instructor

You are free to add functions. Enlist the test cases and pattern you will use to test the design.

Assignment 1. A block level design is given as a project to design engineer, it is given for DFT engineer for testing, he/she needs to insert scan and generate patterns, to get the required test coverage. What will be your approach for the same?

Assignment 2. ALU is the heart of the processors, The basics ones start with 4 bit and beyond. Analyze the test patterns for 4 bit ALU in HDL environment and use test patterns for testing the design.

Textbook(s):

1. Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, "VLSI Test Principles and Architectures" The Morgan Kaufmann, 2013
2. N N Biswas, " Logic design theory", Prentice Hall

References:

Reference Book(s):

1. Z.Navabi, "Digital System Test and Testable Design", Springer, 2011.
2. Laung-Terng Wang, Charles E. Stroud, Nur A. Toubia, System-on-Chip Test Architectures: Nanometer Design for Testability, Morgan Kaufmann, First Edition, 2010.
3. Huertas JL, (editor), "Test and design-for-testability in mixed-signal integrated circuits", The Netherlands: Kluwer Academic; 2004.

Online Resources (e-books, notes, ppts, video lectures etc.):

4. Lecture videos for design for testability: https://onlinecourses.nptel.ac.in/noc20_ee76

5. PPT on Design for Testability, Link : <https://eecs.ceas.uc.edu/~jonewb/DFTnew.pdf>
6. <https://www.youtube.com/watch?v=MgCFUO2BrkQ>
7. <https://www.youtube.com/watch?v=MEaMm423t0w&list=PLZjIBaHNchvOFBWBAtAP9exwQgYpKqsO4>
8. <https://www.geeksforgeeks.org/design-for-testability-dft-in-software-testing/>
9. https://web.stanford.edu/class/archive/ee/ee371/ee371.1066/lectures/lect_14.2up.pdf
10. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-Content

1. Bukovjan, Peter, Meryem Marzouki, and Walid Maroufi. "Design for testability reuse in synthesis for testability." *Proceedings. XII Symposium on Integrated Circuits and Systems Design (Cat. No. PR00387)*. IEEE, 1999.
2. Williams, Thomas W. "Design for Testability: The Path to Deep Submicron." *14th Asian Test Symposium (ATS'05)*. IEEE, 2005.
3. Williams, Thomas W. "Design for testability: today and in the future." *VLSI Design, International Conference on*. IEEE Computer Society, 1997.
4. Williams, Thomas W., and Kenneth P. Parker. "Design for testability—A survey." *Proceedings of the IEEE* 71.1 (1983): 98-112.
5. Ghosh, Indradeep, Niraj K. Jha, and Sujit Dey. "A low overhead design for testability and test generation technique for core-based systems-on-a-chip." *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems* 18.11 (1999): 1661-1676.

Topics related to development of "FOUNDATION SKILLS": Introduction to DFT and Fundamentals of DFT Topics related to development of "EMPLOYABILITY": Projects based on Various design for testability recently published research articles. Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": If chips are tested for any defects then the wastage of chips discarded due to defects will be reduced.

Catalogue prepared by	Ms Akshaya M Ganorkar
Recommended by the Board of Studies on	BOS NO: 15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th , Dated 03/08/2022

Embedded Systems Basket

Course Code: ECE3467	Course Title: Software for Embedded System Type of Course: Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Before attempting this course, the student should have prior knowledge of Digital Logic and Operators, some understanding of Microprocessors and/or Microcontrollers, Assembly Language Programming of any Microprocessors and/or Microcontrollers, Prior C Programming knowledge (would be an added advantage but not compulsory).					
Anti-requisites	NIL					
Course Description	This course focuses on the development of software for real-world embedded systems. Students will be exposed to various techniques for writing efficient codes for embedded products. The course will begin by giving an overview of controlling hardware systems using C programming language. In the next level use of Integrated Development Environment (IDE) tools will be undertaken for building and managing efficient programs and design. Installation of software tools as well as virtual machines, controlling of hardware kits etc. will be the key elements. To augment the learning process for independent software development students will be trained in compilation and make process by using various open-source compilers and tools such as GNU toolchain GNU, Git version control, Linux, Virtual Machines etc. Additionally, concepts like memory management; device driver development, compilers and debuggers, timers and interrupt systems, interfacing of devices, communications and networking in embedded systems will make students ready for industry.					
Course Objective	The objective of the course is to familiarize the learners with the software for embedded systems and attain <u>SKILL DEVELOPMENT</u> through <u>PARTICIPATIVE LEARNING</u>					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the core principles of embedded software development process, encompassing safety, security and quality. (L2) CO2: Demonstrate the use of Context Diagrams and Finite State Machines (FSMs) to represent the structure and logic of embedded systems. (L3) CO3: Apply C programming principles for ARM microcontrollers utilizing control flow, pointers, and data structures. (L3) CO4: Apply debugging tools of single stepping and breakpoints to verify C programs utilizing variables, pointers, and complex data structures. (L3) CO5: Examine embedded memory organization distinguishing stack, heap, and code segments and integrate tested memory manipulation routines. (L3) CO6: Implement embedded Linux configurations by compiling custom kernels, writing system scripts, and integrating Device drivers. (L3)					
Course Content:						
Module 1	Introduction to Embedded Systems Software Development	Quiz	Memory Recall based Quizzes	7 session		
Topics:						

Review of Embedded Systems and Application Areas, Fundamentals of Software Engineering and Development Processes, Embedded Software - Safety, Security and Quality, Introduction to Embedded Software Modelling, Context Diagrams, State Charts / Finite State Machines (FSMs),.				
Module 2	C-Programming for Embedded Systems	Assignment / Quiz	Programming	8 session
Topics: Review of modeling languages for Embedded Software development, C-Programming Review, Programming ARM Controllers using C – Conditional Statements, Loop Statements, debugging, single stepping, breakpoints, pointers and data structures, variables, numbers and parameter passing.				
Module 3	Memory Management and Device Driver Concepts	Assignment	Analysis and Verification	17 session
Topics: Introduction to Memory Organization, Memory Architectures, Memory Segments, Data Memory, Special Keywords (Const, Extern & Static), The Stack, The Heap, Code Memory, Practice on Memory Manipulation Software, Incorporate Memory Manipulation Software into the build system and Evaluation of some Test Functions. Linux - Scripting and Configuration, Kernel Building, Building Libraries and Utilities, Generic Device Driver Development Concepts, Linux Device Drivers.				
Project Work/Assignment:				
1. Case Studies: At the end of the course students will be given 'real-world' application-based circuits like traffic light controller, LCD display, DC motor etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer to the library resources and write a report on their understanding about the assigned article in an appropriate format. Presidency University Library Link. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 4. Project Assignment: Assignment 1: Recently there have been lot of controversies over use of Electronic Voting Machine (EVM) Systems in elections. You have been asked to design an "EVM System" to be used in elections. The system will have additional facility to webcast the voting process live to a central station using Wi-Fi/3G/4G connection by using a high-resolution camera and/or tablet (as of now avoid VVPAT facility). Draw a FSM diagram considering various states, inputs and Outputs. Assignment 2: Consider the figure shown below showing the layout of an Embedded System to be designed using the TM4C123x/129x microcontroller. Write a device driver for the individual modules shown such as for stepper motor control, dc motor control, timer and sensing inputs both digital as well as analog.				
Text Book(s):				
1. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors," 3rd Edition, Newnes.				
Reference(s):				
Reference Book(s):				
1. Michael Barr and Anthony Massa, "Programming Embedded Systems with C and GNU Development Tools," O'Reilly.				
2. Haring D.D. et al., "Embedded Software Development With C," Springer.				
3. Jane W S Liu, "Real – Time Systems", Prentice Hall, 2000.				
4. Class Notes (CN).				

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Video lectures on "Embedded System using Arm" by Prof. Dr.Indranil Sen Gupta, IIT KGP [Lecture 01: Introduction to Embedded Systems - YouTube](#)
2. Lecture series on Embedded Systems by Dr. Santanu Chaudhury, Dept. of Electrical Engineering, IIT Delhi. For more details on NPTEL visit <http://nptel.ac.in>

E-content:

1. Camposano, R., & Wilberg, J. (1996). Embedded system design. *Design Automation for Embedded Systems*, 1(1), 5-50. [Embedded system design | SpringerLink](#)
2. Ryu, S., & Kim, S. C. (2020). Embedded identification of surface based on multirate sensor fusion with deep neural network. *IEEE embedded systems letters*, 13(2), 49-52.
3. [Embedded Identification of Surface Based on Multirate Sensor Fusion With Deep Neural Network | IEEE Journals & Magazine | IEEE Xplore](#)

Topics relevant to "SKILL DEVELOPMENT": Introduction to Embedded Systems, C-Programming for Embedded Systems. Memory management concepts for C programming for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Aruna Dore
Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3416	Course Title: REAL TIME SYSTEMS Type of Course: Discipline Elective VLSI and Embedded Systems Basket Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Microcontroller Applications, Proficiency with ANSI-C and C++ is required. Familiarity with Microcontroller-Based systems along with relevant open-source tools.					
Anti-requisites	NIL					
Course Description	The course provides insights into theory, algorithms, protocol concepts, mechanisms and implementation of real-time computer systems. The course deals with the design and applications of all real time aspects of various system components, like OS, memory, communication and an introduction to reliability evaluation methods. The course emphasizes on the basic concepts of real-time programming and also lays a foundation for development of small projects addressing the critical aspects of a modern software development life cycle.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Real Time Systems and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.					

Course Outcomes	On successful completion of this course the students shall be able to: (1) Describe Real time systems. (2) Understand the concepts of computer control, operating system and computer hardware (3) Discuss the components of Operating Systems. (4) Apply suitable methodologies to design and develop Real-Time Systems.				
Course Content:					
Module 1	Introduction to Real-Time Systems & Concepts of Computer Control	Assignment/Quiz		Memory Recall based Quizzes	06 classes
Topics: Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Issues in Real Time Computing, Examples of real-time applications, Time Constraints, Classification of Programs. Concepts of Computer Control: Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control.					
Module 2	Languages for Real-Time Applications	Assignment / Quiz		Programming task	10 classes
Topics: General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Standard Interface. Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Compilation of Modular Programs, Data types, Control Structures, Co-routines, Interrupts and Device Handling, Real-time Support, Overview of Real-Time Languages.					
Module 3	Operating Systems Concepts	Assignment/Quiz		System Design Task and Analysis	10 classes
Topics: Operating systems and hardware support for real-time applications. Posix real-time extensions; features of well-known real-time operating systems; Real-Time Multi-Tasking OS, Scheduling Strategies, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Task Co-Operation and Communication					
Module 4	RTS Development Methodologies & Intertask Communication	Assignment/Quiz		System Design Task and Analysis	10 classes
Topics: Foreground/Background System. Yourdon Methodology, Ward and Mellor Method, Hatelly and Pirbhai Method, Buffering data - Time relative Buffering- Ring Buffers - Mailboxes - Queues - Critical regions - Semaphores - other Synchronization mechanisms - deadlock - priority inversion - process stack management - run time ring buffer .					
List of Laboratory Tasks: Nil					
Targeted Applications and Tools					
	Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
	Embedded Systems	Design a real-time system for sensor data logging	Code Composer Studio, Keil	IoT, Medical Devices	

Smart Home Automation	Develop a smart lighting control system	Arduino IDE, Python	Consumer Electronics
Automotive Systems	Real-time dashboard for vehicle diagnostics	MATLAB, Simulink	Automotive
Industrial Control	Real-time monitoring for assembly lines	LabVIEW, RTOS	Manufacturing

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Rate Monotonic Scheduling Lab	Implement static priority scheduling	FreeRTOS, Python Simulators	Task prioritization, schedulability analysis
Interrupt Handling in RTOS	Simulate ISR behavior under deadline constraints	ARM Keil, STM32	Real-time response, latency evaluation

Text Book(s):

1. Stuart Bennet, "Real-Time Computer Control" , 2nd Edn. Pearson Education.
2. "Real time Systems" by I.A.Dhotre Technical publications, 1st Edition.

Reference(s)

- 1: C.M. Krishna, Kang G. Shin, "Real -Time Systems" , McGraw -Hill International Editions.
- 2: Phillip. A. Laplante, "Real-Time Systems Design and Analysis" , second edition, PHI.
- 3: Raj Kamal, "Embedded Systems" , Tata McGraw Hill, India, third edition

Online and Web resource (s):

1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs98/preview
2. Udemey: <https://www.udemy.com/course/real-time-systems>
3. <https://www.notesforgeeks.in/2021/08/ec8791-embedded-and-real-time-systems-syllabus-2017-regulation.html>
4. <https://nielit.gov.in/chennai/sites/default/files/Chennai/ED500-Syllabus.pdf>
5. <https://www.rejinpaul.com/2021/06/ec8791-embedded-and-real-time-systems.html>
6. <https://www.cse.iitb.ac.in/~krithi/courses/684/ts-Sep-2004.pdf>
7. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-Content:

1. Control and Communication Challenges in Networked Real-Time Systems by J. Baillieul and P. J. Antsaklis, "Control and Communication Challenges in Networked Real-Time Systems," in *Proceedings of the IEEE*, vol. 95, no. 1, pp. 9-28, Jan. 2007, doi:10.1109/JPROC.2006.887290 <https://ieeexplore.ieee.org/document/4118454>
2. Controller Area Network (CAN) schedulability analysis: Refuted, revisited and revised Davis, R.I., Burns, A., Bril, R.J. al. Controller Area Network (CAN) schedulability analysis: Refuted, revisited and revised. *Real-time Syst* 35, 239 - 272 (2007). <https://doi.org/10.1007/s11241-007-9012-7> <https://link.springer.com/article/10.1007/s11241-007-9012-7>
3. Weakly hard real-time systems G. Bernat, A. Burns and A. Liamosi, "Weakly hard real-time systems," in *IEEE Transactions on Computers*, vol. 50, no. 4, pp. 308-321, April 2001, doi: 10.1109/12.919277 <https://ieeexplore.ieee.org/document/919277>
4. Scheduling real-time applications in an open environment Deng and J. W. . -S. Liu, "Scheduling real-time applications in an open environment," *Proceedings Real-Time Systems Symposium*, 1997, pp. 308-319, doi: 10.1109/REAL.1997.641292. <https://ieeexplore.ieee.org/document/641292>
5. Design and Operation of ETA, an Automated Ellipsometer P. S. Hauge and F. H. Dill, "Design and Operation of ETA, an Automated Ellipsometer," in *IBM Journal of Research and Development*, vol. 17, no. 6, pp. 472-489, Nov. 1973, doi:10.1147/rd.176.0472. <https://ieeexplore.ieee.org/document/5391322>

Topics relevant to “EMPLOYABILITY SKILLS” : Data Transfer Techniques, Compilation of Modular Programs, Operating systems and hardware support for real-time applications, Priority Structures and Task Management - for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. ANNAPURNA.H.S
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3417	Course Title: DSP Processors Type of Course: Discipline Elective- Signal Processing Basket	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of simple high school math on trigonometry, complex numbers, signals and systems, Digital signal Processing algorithm computations, and a little familiarity with programming especially numerical computation.					
Anti-requisites	NIL					

Course Description	This course provides insights into the fundamentals of DSP processors. The course imparts the knowledge of basic DSP concepts and number systems to be used, different types of conversion errors. The course emphasizes the architectural differences between DSP and General-purpose processor.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of DSP Processors to improve the learners' <u>Employability Skills</u> by <u>Participative Learning</u> .			
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the fundamentals of digital signal processing, DFT/FFT, digital filters and numerical effects in DSP systems. 2. Illustrate the architectural features and building blocks of commercial DSP Processor. 3. Illustrate addressing modes, peripherals, interrupts and pipelining of TMS320C54xx processor. 4. Demonstrate FIR and IIR filters on DSP Processors. 5. Examine FFT algorithms on DSP Processor with proper scaling and overflow management. 6. Employ memory and I/O interfacing techniques for efficient data transfer in DSP processors.			
Course Content:				
Module 1	Introduction To Digital Signal Processing	Quiz	Memory Recall based Quizzes	12 session
Topics Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Review of Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors				
Module 2	Architectures for Programmable DSP Devices and Pipelining	Assignment / Quiz	Programming and Simulation task	14 session
Topics: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Memory space, Program Control, instructions and Programming, On-Chip Peripherals, Interrupts, Pipeline Operation.				
Module 3	Implementations of Basic DSP Algorithms	Assignment	Analysis and Verification	10 session
The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX				
Module 4	Interfacing Memory And I/O Peripherals	Assignment	Analysis and Verification	9 session
Topics: Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface, programmed I/O, interrupts and I/O, direct memory access (DMA).				

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Audio Signal Processing	Real-time equalizer/filtering	Code Composer Studio, MATLAB	Consumer Electronics
Biomedical Signal Processing	ECG/EEG feature extraction	MATLAB, STM32	Healthcare
Communications	FFT-based spectrum sensing	Python, C, DSP board	Telecommunications
Edge AI Systems	Voice command recognition	CMSIS-DSP, TensorFlow Lite	IoT and Smart Devices

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
FFT Optimization	Speed up FFT algorithm for DSP chip	Code Composer Studio	Assembly tuning, fixed-point accuracy
IIR/FIR Filter Realization	Implement filters in hardware	TMS320C67x	Signal filtering, hardware constraints handling

Text Book(s):

3. Avtar Singh and S. Srinivasan, Digital Signal Processing Thomson Publications, 1st Edition, 2004
4. .B. Ventakaramani, M. Bhaskar, Digital Signal Processors Architecture Programming and Applications || , Tata

Reference(s):

Reference Book(s):

3. Jonatham Stein, Digital Signal Processing || , John Wiley, 1st Edition, 2000. 2. Sen M. Kuo & WoonSergGan,
4. Digital Signal Processors Architectures, Implementation and Application || , Pearson Practice Hall, 1st Edition, 2013
5. Digital Signal Processing -Principles, Algorithms Applications by J.G. Proakis & D.G. Manolakis, PHI, 2005

Online Resources (e-books, notes, ppts, video lectures etc.):

6. Lecture series on Embedded Systems by Dr.Santanu Chaudhury, Dept. of Electrical Engineering, IIT Delhi <http://nptel.iitm.ac.in>
2. TMS320C54XX data sheet, product information and support <https://www.ti.com/>
3. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-content:

4. Gustavo Ruiz, Juan A. Michell, Design and Architectures for Digital Signal Processing. 2013, <https://www.intechopen.com/books/3158>
5. "Quad DSP board gives processor-hungry applications a performance boost", Aircraft Engineering and Aerospace Technology, Vol. 71 No. 5. <https://doi.org/10.1108/aeat.1999.12771ead.002>
<https://www.emerald.com/insight/content/doi/10.1108/aeat.1999.12771ead.002/full/html>

Topics relevant to "EMPLOYABILITY SKILLS": Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mrs. KEHKESHAN JALALL S
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3418	Course Title: FPGA Design for Embedded Systems Type of Course: Discipline Elective & Theory only	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basics of Digital logic and Digital design					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand the basics of FPGA. This course aims to build knowledge on understanding programmable architectures and configuring them for different applications. The course also help student learn about the Verilog programming structures and modelling types which can be used for digital system design and help in building of an over-all concept for an application which can be tested on FPGA interfaced with various other hardware' s.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques using FPGA Board					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand the basic concepts of FPGA. 2. Apply embedded system concepts with appropriate FPGA based on applications 3. Write Verilog code for combinational and sequential logics CO4: Students can design a communication module using Verilog. 4. Design a motor control module using Verilog					
Course Content:						
Module 1	FPGA Architecture And Overview	Quiz		Memory Recall based Quizzes	9 Sessions	
Topics:						

Embedded system design flow - Robot Control System - Digital Design Platforms - Microprocessor based Design - Single-chip Computer/Microcontroller-based Design - Application Specific Standard Products (ASSPs) - Design Using FPGA - robotic rover application - FPGA Devices - FPGA and CPLD - Architecture of a SPARTAN-3ETM FPGA - Floor Plan and Routing - Timing Model for a FPGA - FPGA Power Usage.

Module 2	Embedded System Design	Assignment		Theoretical Understanding	10 Sessions
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Topics:
FPGA-based Embedded Processor - Design Re-use Using On-chip Bus Interface - Creating a Customized Microcontroller - Robot Axis Position Control - FPGA-based Signal Interfacing and Conditioning - Motor Control Using FPGA- Case Studies for Motor Control -Prototype Using FPGA- FPGA Design Test Methodology

Module 3	Verilog Constructs	Assignment		Theoretical Understanding	10 Sessions
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Topics:
VLSI Design flow- behavioral style, the dataflow style, and structural style - Data types - Constants - Assignment Statement - Operators - Conditional Expressions - Statement types - Vector operations - Bit selects - Functions - Gate level modeling.

Module 4	Verilog Modeling Building FPGA projects	Assignment		Programming assignment	13 Sessions
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Topics:
Design and test a Binary Coded Decimal Adder, Design and test a PWM Circuit, with verification by simulation. Design and test an ADC circuit, using Quartus Prime built-in tools to verify your circuit design. Enhance and test a working design, using most aspects of the Quartus Prime Design Flow and the NIOS II Software Build Tools (SBT) for Eclipse.

List of Laboratory Tasks: Nil

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Video Imaging	Design image filters using FPGA	Verilog, Quartus Prime	Media, Surveillance
Automotive Computing	Motor control system implementation	Verilog, Xilinx	Automobile
Aerospace Applications	Sensor fusion logic design	MATLAB, FPGA Board	Aerospace
Medical Devices	Signal acquisition from sensors	NIOS II, Verilog	Healthcare

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
PWM Controller Design	Develop PWM-based embedded logic	Vivado, VHDL	PWM generation, embedded timing
AXI-based Peripheral Integration	Connect peripherals with AXI interface	Zynq Board, Vivado IP Integrator	Bus protocols, SoC design

Project work/Assignment:

1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. [Presidency University Library Link](#).
2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.
3. Project Assignment- Implement various digital circuits in Verilog and verify the same on FPGA board., Write a report on the research article given., Explore the robotic application of embedded system with a research article and verify the coding done in the same.

Text Book

1. Rahul Dubey, "Introduction to Embedded System Design Using Field Programmable Gate Arrays" Springer-Verlag London Limited, 2009
2. John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, Asia, III Edition, 2003.

References

1. Blaine Readler, "Verilog by Example: A Concise Introduction for FPGA Design", Full Arc Press, 2011.
2. J. Bhasker, "A Verilog HDL Primer, Third Edition Hardcover", Star Galaxy Publishing; 3rd edition, 2005.
3. Bhasker, "Verilog HDL Synthesis, A Practical Primer", Star Galaxy Publishing; 3rd edition, 1998.

Online Resources (e-books, notes, ppts, video lectures etc):

1. NPTEL - https://onlinecourses.nptel.ac.in/noc22_cs46/preview
2. Udemy - <https://www.udemy.com/course/fpga-embedded-design-verilog/>
3. Coursera - <https://www.coursera.org/learn/intro-fpga-design-embedded-systems>
4. Online Notes - <https://ieeexplore.ieee.org/document/6186912>
5. Online Notes - <https://ieeexplore.ieee.org/document/6472742>

E-content:

1. Carlos Leopoldo Carreón-Díaz De León ;Sergio Vergara-Limón; ,” Parameter Identification of a Robot Arm Manipulator Based on a Convolutional Neural Network” , IEEE Access (Volume: 10) 2022 , <https://ieeexplore.ieee.org/document/9780143>
2. Swapna Chintakunta, Raghavendra Rao Kanchi, Ramanjappa Thogata, “Designing an introductory FPGA - Based embedded system laboratory” ,American Journal of Embedded Systems and Applications ,2022
https://www.researchgate.net/publication/297717116_Designing_an_Introductory_FPGA-Based_Embedded_System_Laboratory
3. Wendell F.S. Diniz Vincent Fremont, “An FPGA-based architecture for embedded systems performance acceleration applied to Optimum-Path Forest classifier” ,Microprocessor and Microsystems, 2017 ,
<https://reader.elsevier.com/reader/sd/pii/S0141933116302290?token=EAEF66D704C273BA8004F8BFD5C95E49BB56FF0D4ACB324649EE1124C866FFB6B952BEC1BF49CD6F6BD5E180F07F18CF&originRegion=eu-west-1&originCreation=20220719080055>

Topics Relevant to development of "FOUNDATION SKILLS": VLSI Design flow- behavioral style, the dataflow style, and structural style

Topics Relevant to development of "EMPLOYABILITY": Design Using FPGA - robotic rover application - FPGA Devices - FPGA and CPLD

Topics related to development of "ENTREPRENEURSHIP": Robot Control System, Stepper motor control, servo motor control.

Topics Relevant to development of "ENVIRONMENT AND SUSTAINABILITY": Robot Control System - Digital Design Platforms

Catalogue prepared by

Mrs Anupama Sindgi

Recommended by the Board of Studies on	BOS NO: 10th. BOS held on 17/01/2020
Date of Approval by the Academic Council	Academic Council Meeting No. 16, Dated 23/10/2021

Course Code: ECE3419	Course Title: Developing Secure Embedded Systems Type of Course: Discipline Elective Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic understanding of Microprocessor 8085, Microcontroller 8051. Basic knowledge of VLSI, Assembly language programming and c programming.					
Anti-requisites	NIL					
Course Description	The course focuses on design, implementation and explore hardware and software security measures design using appropriate techniques and tools and to develop an ability to understand comprehensively the technologies and techniques underlying in building an embedded solution in a trustful and secure environment.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> methodologies of secure embedded systems.					
Course Outcomes	On successful completion of this course the students shall be able to: (1) Explain the origin and characteristics of Embedded Systems. (2) Apply various techniques to secure an Embedded Systems. (3) Demonstrate various security vulnerabilities and its solutions (4) Employ various techniques to deploy and secure Embedded systems.					
Course Content:						
Module 1	Embedded System Primer	Quiz		Memory Recall based Quizzes	10 Classes	
Topics: Embedded system processor- PIC, ARM- Programming input and output, Components for embedded system, Models of program, Assembly, linking, loading, Compilation techniques, Program optimization.						
Module 2	Layers of embedded system	Assignment / Quiz		Simulation Based	10 Classes	
Topics: Embedded Design life cycle, Embedded System modelling, Layers of an Embedded System - hardware layer - Application layer - Software Layer - middleware. EDLC Approaches, Interfaces to the external world. FPGA- The Role of FPGAs, FPGAs types, FPGAs vs Custom VLSI, Fine - Grained and Course - Grained Reconfigurable Architecture, Case Studies.						

Module 3	Introduction to security and tools	Assignment		Simulation Based	12 Classes
Topics: Security properties (confidentiality, integrity and availability), security vulnerabilities, threats and attacks, security models, policies and mechanisms, Encryption Techniques, Basic notions of security protocol. Block Ciphers - DES, AES, Blowfish, modes of operation, Stream Ciphers-RC4, Linear and Differential cryptanalysis					
Module 4	Security in Embedded Systems	Assignment		Design Based	08 Classes
Topics: Cryptography, Trusted computing, FPGA Flexibility, Trusted -untrusted zone isolation, Physical attack protection, Access control mechanism, Incentive based Trust model deployment for securing Embedded system and prevention of DDoS.					
Project work/Assignment:					
Project Assignment: 1. A systematic review of future trends in security and trust models in IoT. 2. Secure WEB-Deployment using Embedded Systems 3. Presentation: There will a group presentation on the programming assignment or any course related self-study topic/research related topic they had done. 4. Students will be made into group and given the programming assignment at the end of each module. Students need to use Embedded Development Kits for these assignments. Tools: 1. Kiel C5 2. Raspberry Pi					
Textbook(s): 1. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1st edition, Press, 2016. 2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1 st edition, Packt Publishing Ltd, 2016. Reference Books: 3. Shibu, K. V. Introduction to embedded systems, 1st edition, Tata McGraw-Hill Education, 2009. Vahid, Frank, and Tony D. Givargis. Embedded system design: a unified hardware/software introduction, 1 st edition, John Wiley & Sons, 2006. 4. Zhu Y. Embedded Systems with ARM® Cortex-M3 Microcontrollers in Assembly Language and C. E-Man Press; 2014. 5. Wolf W. FPGA-based system design. Pearson education; 2004 Jun 15. E-content: 6. SEnSE – An Architecture for a Safe and Secure Integration of Safety-Critical Embedded Systems https://ieeexplore.ieee.org/document/8555740 7. Design and Implementation of Secure Embedded Systems Based on Trustzone https://ieeexplore.ieee.org/document/4595549 8. High-Security System Primitive for Embedded Systems https://ieeexplore.ieee.org/document/5368926 9. Design and implementation of embedded secure web server for ARM platform https://ieeexplore.ieee.org/document/6022952 Online Resources (e-books, notes, ppts, video lectures etc.): 1. Free online self-paced course :- https://bcourses.berkeley.edu. 2. Online notes :- https://mitpress.mit.edu/books/internet-things					

3. NPTEL online video content:- http://www.digimat.in/nptel/courses/video/106105160/L22.html 4. Online ppts :- https://www.upf.edu/prs/en/3376/22580 5. Online ppts:- https://www.macs.hw.ac.uk/~dwcorne/Teaching/introdl.ppt 6. https://www.udemy.com/course/embedded-electronics-bootcamp-from-bit-to-deep-learning/ 7. https://nptel.ac.in/courses/106105159 8. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home	
Topics relevant to development of “EMPLOYABILITY” : Security and Trust implementation in Embedded Systems. Topics related to development of “SKILL” : Leading skills for Embedded system design, networking and security.	
Catalogue prepared by	Nipun Sharma
Recommended by the Board of Studies on	10 th BOS held on 17/01/2020
Date of Approval by the Academic Council	Meeting No. 16 th , Dated 23/10/2021

Course Code: ECE3420	Course Title: Introduction to Embedded Machine Learning Type of Course: General Basket Theory only	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Comprehension of concepts/logics in Machine and Deep Learning Algorithms. Basics of Embedded Systems. Basics of Python programming for Machine and Deep Learning Algorithms.					
Anti-requisites	NIL					
Course Description	This course aims at provide introduction of an emerging field embedded machine learning. This course gives best possible insight of deploying machine learning applications on embedded systems using TinyML.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Introduction to Embedded Machine Learning and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Understand the various ML model based upon the input data. (L2) CO2: Develop various ML techniques based on embedded systems. (L3) CO3: Compare difference in RISC vs CISC architectures with example. (L2) CO4: Categorize instruction set of Cortex M controllers in TinyML. (L3) CO5: Experiment DL workflow using TinyML . (L3) CO6: Examine application built for TinyML. (L3)					
Course Content:						
Module 1	Overview of Machine Learning Algorithms	Quiz	Memory Recall based Quizzes			14 session

Supervised Learning, Regression- Linear Regression, Ridge Regression, LASSO, and Classifications of Supervised Learning: K-NN, Decision Tree, Naive Bayes, Support-Vector Machines, Perceptron, Logistic Regression, Unsupervised Learning- K-means Clustering, and PCA.					
Module 2	Overview of Embedded Devices for Machine Learning Algorithms	Assignment / Quiz	Programming and Simulation task		12 sessions
RISC and CISC Architectures, Introduction to ARM® Architecture and ARM® Cortex™-M TM4C123X processor, Comparing ARM® Cortex™-M TM4C123X processor with TM4C129X architecture, FPGA.					
Module 3	TinyML	Assignment	Programming		19 sessions
Fundamentals of TinyML, Need of TinyML, Advantages, Deploying TinyML, Factors to be considered while deploying TinyM.					
Targeted Application & Tools that can be used: JOBS- • Execute a lead role for the design, development, and verification of real-time machine learning algorithms for innovative power tools. • A state-of-the-art field that brings the performative power of ML to shrink deep structured earning networks to fit on tiny hardware. • Implement machine learning algorithms in embedded environments. • Manage the development of data collection methods, test plans/procedures and test cases for training, evaluation, and verification of machine learning algorithms. TOOLS- Python (NumPy, Pandas, sklearn, xgboost, TensorFlow, keras, etc.) MySQL, Snowflake, GCP/AWS and Tableau Java.					
Text Book(s): 1. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Designing and Optimizing System Software", Morgan Kaufmann Publishers, 2nd Edition. 2. Pete Warden, Daniel Situnayake, "TinyML", 1st Edition, O'Reilly Media, Inc. Reference Book(s): 1. Mano, M. Morris and Ciletti Michael D., "Digital Design", 5th Edition, Pearson Education, 2020. 2. Oliver Theobald , "Machine Learning For Absolute Beginners: A Plain English Introduction", 2nd Edition, The author, 2017. Bert Moons, Daniel Bankman, Marian Verhelst, Embedded Deep Learning Algorithms, Architectures and Circuits for Always-on Neural Network Processing", First Edition, Springer Link					
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Harward University Course on "TinyML" https://pll.harvard.edu/course/fundamentals-tinyml?delta=0 2. NPTEL Course on "An Introduction to Artificial Intelligence" by Prof. Mausam, IIT Delhi https://onlinecourses.nptel.ac.in/noc22_cs56/preview 3. NPTEL Course on "Deep Learning" by Prof. Sudarshan Iyengar & Prof.Mitesh M. Khapra , IIT Madras, https://onlinecourses.nptel.ac.in/noc19_cs85/preview 4. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home E-content: 1. Ahmad Shawahna, Sadiq M. Sait, and Aiman El-Maleh, "FPGA-Based Accelerators of Deep Learning Networks for Learning and Classification: A Review", IEEE Access, Volume 7, 2019, pp:7823-7859. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8594633 2. Mohammed Elnawawy , Assim Sagahyroon , and Tamer Shanableh, "FPGA-Based Network Traffic Classification Using Machine Learning", IEEE Access, Volume 8, 2020, pp: 175637-175650. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9205799 3. Tarek Belabed, Maria Gracielly F. Coutinho , Marcelo A. C. Fernandes , Carlos Valderrama Sakuyama , and Chokri Souani, "User Driven FPGA-Based Design Automated Framework of Deep Neural Networks for Low-Power Low-Cost Edge Computing", IEEE					

Access, Volume	9,	2021,	pp:	89162 –	89180.
https://ieeexplore.ieee.org/document/9458248					
4.	Shuai Li, Yukui Luo, Kuangyuan Sun, Nandakishor Yadav, and Kyuwon Ken Choi, "A Novel FPGA Accelerator Design for Real-Time and Ultra-Low Power Deep Convolutional Neural Networks Compared With Titan X GPU", IEEE Access, Volume 8, 2020, pp: 105455 – 105471. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9108269				
Topics relevant to "EMPLOYABILITY SKILLS": Classifications of Supervised Learning: K-NN, Decision Tree, Naive Bayes, Support-Vector Machines, TM4C123X processor, Deploying TinyML - for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.					
Catalogue prepared by		Ms. Natya.S			
Recommended by the Board of Studies on		15th BOS held on 28/07/2022			
Date of Approval by the Academic Council		Meeting No. 18th, Dated 03/08/2022			

Course Code: ECE3421	Course Title: Deep Learning using FPGA Type of Course: Program Core Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Comprehension of concepts/logics in Machine and Deep Learning Algorithms. Basics of VHDL code for Digital Logic Circuits using EDA tools. Basics of Python programming for Machine and Deep Learning Algorithms.					
Anti-requisites	NIL					
Course Description	This course aims at the real time implementation of Machine Learning and Deep Learning Algorithms using the FPGA device. The course penetrates into the fundamentals of Artificial Intelligence concepts and the logical representation of the ML and DL algorithms. This course motivates towards the development of synthesizable VHDL code for classification, identification and regression using the ML and DL algorithms. The course provides the opportunity for FPGA based Real time implementable AI applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Machine Learning and Deep Learning using FPGA and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Distinguish between Machine Learning and Deep Learning algorithms for classification, regression and identification. 2. Demonstrate the importance of VHDL in real time applications. 3. Apply the concept of ML and DL algorithms for classification and Identification using the developed synthesizable VHDL code. 4. Analyze the developed artificial intelligence based VHDL code for power, area and delay using the FPGA device					
Course Content:						

Module 1	Introduction to Machine Learning	Quiz	Memory Recall based Quizzes	11 sessions
Topics: Supervised Learning, Regression- Linear Regression, Ridge Regression, LASSO, and Classifications of Supervised Learning: K-NN, Decision Tree, Naive Bayes, Support-Vector Machines, Perceptron, Logistic Regression, Unsupervised Learning- K-means Clustering, PCA.				
Module 2	Digital Circuit Design	Assignment / Quiz	Programming and Simulation task	12 sessions
Topics: Introduction to VHDL Programming, Modeling styles in VHDL, Importance of Behavioral Modeling in Machine Algorithm, Development of Decision Tree Algorithm using VHDL, Validation of Synthesizable code for Machine Learning, Machine Learning based Data classification using VHDL, Machine Learning based Regression using VHDL				
Module 3	Deep Learning	Assignment	Analysis and Verification	10 sessions
Topics: History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks, Representation Power of Feed forward Neural Networks, Back propagation, Compensation Code for neural network using VHDL, Neural Network based Classification and Regression using VHDL, Real time application using Neural Network in FPGA.				
Module 4	Implementable Neural Networks	Project	Application	7 session
Topics: Application of Neural network in Stuck-at Fault analysis of Digital Circuits, Recurrent Neural Network for Power Converters Switching Faults, Neural Network for Image Classification, EDA tools used for Neural Network based Applications				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Image Processing	Object and character recognition using CNN	Vivado, Python, TensorFlow	Healthcare, Surveillance	
IoT & Edge AI	Low-power model for real-time prediction	PYNQ-Z2, Vitis AI	Smart Cities, Automation	
Fault Diagnosis	Predictive maintenance of circuits	ModelSim, Vivado	Automotive, Aerospace	
Communication Systems	Signal classification using RNN	Python, MATLAB	Telecom, Satellite	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	

Implement ML classification using VHDL	Develop logic for binary classification	Vivado, ModelSim	Logic design, synthesizable coding, binary classification
Simulate Feedforward NN on FPGA	Apply DL in digital circuits	Python, VHDL	Feedforward networks, digital inference, signal mapping
Build real-time image classifier	Deploy CNN on FPGA	PYNQ Board, OpenCV	FPGA deployment, CNN inference, vision pipeline
Analyze power and delay	Optimize VHDL-based AI code	Vivado Power Analysis	Resource profiling, energy-delay optimization

Text Book(s):

5. Deisenroth, Faisal and Ong, “Mathematics for Machine Learning” , Cambridge University Press, 1st Edition, 2020. Link: <https://mml-book.github.io/book/mml-book.pdf>
6. Volnei A. Pedroni, “Circuit Design with VHDL” , Third Edition, MIT press, 2020
<https://www.penguinrandomhouse.com/books/657983/circuit-design-with-vhdl-third-edition-by-volnei-a-pedroni/>

Reference(s):

Reference Book(s):

1. Mano, M. Morris and Ciletti Michael D., “*Digital Design*” , 5th Edition, Pearson Education, 2020.
2. Oliver Theobald , “*Machine Learning For Absolute Beginners: A Plain English Introduction*” , 2nd Edition, The author, 2017.
3. Andrew W. Trask, “*Grokking Deep Learning*” , 1st Edition, Manning Publications, 2019.
4. Jayaram Bhasker, “*A VHDL Primer*” , 3rd Edition, AT&T Publications, 2003.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. NPTEL Course on “Digital System design with PLDs and FPGAs” by Prof. Kuruvilla Varghese <https://www.digimat.in/nptel/courses/video/117108040/L01.html>
2. NPTEL Course on “An Introduction to Artificial Intelligence” by Prof. Mausam, IIT Delhi https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3. NPTEL Course on “Deep Learning” by Prof. Sudarshan Iyengar & Prof. Mitesh M. Khapra , IIT Madras, https://onlinecourses.nptel.ac.in/noc19_cs85/preview
4. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>
E-content:

1. Ahmad Shawahna , Sadiq M. Sait , and Aiman El-Maleh, “FPGA-Based Accelerators of Deep Learning Networks for Learning and Classification: A Review” , IEEE Access, Volume 7, 2019, pp:7823-7859. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8594633>
2. Mohammed Elnawawy , Assim Sagahyroon , and Tamer Shanableh, “FPGA-Based Network Traffic Classification Using Machine Learning” , IEEE Access, Volume 8, 2020, pp: 175637-175650. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9205799>
3. Tarek Belabed, Maria Gracielly F. Coutinho , Marcelo A. C. Fernandes , Carlos Valderrama Sakuyama , and Chokri Souani, “User Driven FPGA-Based Design Automated Framework of Deep Neural Networks for Low-Power Low-Cost Edge Computing” , IEEE Access, Volume 9, 2021, pp: 89162 - 89180. <https://ieeexplore.ieee.org/document/9458248>
4. Shuai Li, Yukui Luo, Kuangyuan Sun, Nandakishor Yadav, and Kyuwon Ken Choi, “A Novel FPGA Accelerator Design for Real-Time and Ultra-Low Power Deep Convolutional Neural Networks Compared With Titan X GPU” , IEEE Access, Volume 8, 2020, pp: 105455 - 105471. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9108269>

Topics relevant to “EMPLOYABILITY SKILLS” : K-NN, Decision Tree, Naive Bayes, Support-Vector Machines, Machine Learning based Regression using VHDL, Neural Network based Classification and Regression using VHDL -for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Joseph Anthony Prathap,
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Communication Basket

Course Code: ECE3423	Course Title: Information Theory and Coding Type of Course: Discipline Basket	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of simple Applied Statistics [MAT1003], Digital Communication [ECE3007] Mean and variance of discrete random variables, Joint probability, Probability theory Basic communication block diagram and its working, Channels					
Anti-requisites	NIL					
Course Description	The course is designed for undergraduate level students to learn about information coding in communication. The main objective of the course is to understand the basics of error control coding in the information. This course will be foundation for advanced signal processing and network security. The research potential of the subject can make students to learn and develop algorithm. This course provides an introduction to the concept of Entropy, rate of information and various source encoding algorithms. Discrete & continuous communication channels are included to get the knowledge of numerical computations in the development of communication system without any error.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Information Theory and Coding and attain the SKILL DEVELOPMENT through PROBLEM SOLVING.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Discuss the concept of dependent and independent source, measure of information, Entropy, rate of information and order of a source along with an introduction to AI. 2. Compare the codes generated by employing Shannon, Shannon Fano and Huffman encoding algorithms with AI generated codes.					

	3. Analyse the continuous and discrete communication channels using input, output and joint probabilities and AI based channel models. 4. Perform the error correction occurred in the received vector using syndrome matrix and AI based methods.			
Course Content				
Module 1	Introduction to Information Theory	Assignment/Quiz	Numerical/ Memory recall based	10 Classes
Topics Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Introduction to AI. Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources.				
Module 2	Information Coding	Assignment	Numerical	9 Classes
Topics Source coding theorem, Kraft McMillan Inequality property – KMI, Encoding of the Source Output, Shannon’s Encoding Algorithm, Shannon Fano Encoding Algorithm, Huffman codes, Extended Huffman coding. AI driven source coding- neural compression VS classical coding.				
Module 3	Information Channel	Quiz/ Assignment	Memory recall based / Numerical	10 Classes
Topics Communication Channel block diagram, Channel Matrix, Joint probability Matrix, Mutual Information, Channel Capacity, Channel Capacity of : Binary Symmetric Channel, Binary Erasure Channel, Muroga,s Theorem, Continuous Channels: Shannon’s Hartley law and its numerical. AI based channel modelling.				
Module 4	Error Control Coding	Quiz/ Assignment	Memory recall based / Numerical	10 Classes
Topics Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. AI enhanced error detection- neural decoders.				
List of Laboratory Tasks: NA				
Targeted Application & Tools that can be used: Application area of Information Theory and Coding in Network Security and Computer Communication System. Professionally used software : MATLAB				
Text Book(s): 1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996. 2. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007				
Reference(s): 1. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058. 2. Information Theory and Coding-by <u>Dr. J. S. Chitode</u> Technical Publications,First edition 2021.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Video lectures on” Source coding theorem” by Prof: SN Merchant, IIT Bombay https://nptel.ac.in/courses/117101053				

2. Videos on Entropy, Mutual Information, Conditional and Joint Entropy <https://www.digimat.in/nptel/courses/video/108102117/L02.html>
3. Presidency University Library Link <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Ye Liu, Justin P. Coon "Mitigating Bit-Synchronization Errors in Huffman-Coding-Aided Index Modulation" IEEE Communications Letters (Volume: 23, Issue: 3, March 2019) <https://ieeexplore.ieee.org/document/8588988/authors#authors>
2. Shigeaki Kuzuoka, Shun Watanabe "An Information-Spectrum Approach to Weak Variable-Length Source Coding With Side-Information" IEEE Transactions on Information Theory (Volume: 61, Issue: 6, June 2015) Page(s): 3559 – 3573. <https://ieeexplore.ieee.org/document/7089269>
3. Distributed Source Coding Using Abelian Group Codes: A New Achievable Rate-Distortion Region, Dinesh Krithivasan; S. Sandeep Pradhan, IEEE Transactions on Information Theory Year 2011, Volume: 57, Issue: 3, Journal Article, Publisher: IEEE Cited by: Pages (44) <https://ieeexplore.ieee.org/document/5714261>
4. Aleksandar Radonjic "Integer Codes Correcting Single Errors" IEEE Communications Letters (Volume: 22, Issue: 1, January 2018, Page(s): 17 - 20 <https://ieeexplore.ieee.org/document/8055561>

Topics relevant to "SKILL DEVELOPMENT": Information content of message, Markov Statistical Model, Source Coding, Channel Capacity, Error Control Coding for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by

Ms. Akshatha K

Recommended by the Board of Studies on

12th BOS held on 10/08/2021

Date of Approval by the Academic Council

Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3424	Course Title: Satellite Communication Type of Course: Discipline Elective & Theory Only.	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	[1] Analog Communication, [2] Digital Communication, 3] Antenna and wave propagation Basic concepts of Digital modulation, antenna and wave propagation, SNR and CNR					
Anti-requisites	NIL					
Course Description	The course introduces the students to the basic concept in the field of satellite communication. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The satellite services like broadcasting are also studied thoroughly. The course also provides the student with the thorough understanding of the fundamental principles when designing global satellite systems for communication purpose, unique challenges of designing, developing, fielding, maintaining, and operating satellite communications systems payload.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Satellite Communication and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.					

Course Outcomes	On successful completion of this course the students shall be able to: CO1: Demonstrate the selection of an appropriate launch vehicle for a given satellite mission based on payload mass and orbit type. (L3) CO2: Analyze the performance of a satellite communication link using Kepler's laws, EIRP, and transmission losses. (L4) CO3: Demonstrate the concepts of link power budget, system noise, uplink and downlink C/N ratio, and rain attenuation for characterizing the performance of a Ku-band satellite communication link under heavy rainfall conditions in a coastal region. (L3) CO4: Examine the performance of the power supply unit, attitude control, station keeping, thermal control, TT&C, transponders, and antenna subsystem in a geostationary satellite used for emergency communication during a cyclone disaster scenario. CO5: Apply satellite access techniques for a case study of establishing reliable communication in a remote island region using INTELSAT/INSAT/VSAT networks. (L3) CO6: Illustrate the integration of GSM and GPS technologies for location tracking in mobile communication systems. (L3)			
Course Content:				
Module 1	Introduction to Satellite systems	Quiz	Memory Recall based	10 Sessions
Topics: Introduction History, The Indian Scenario, INTELSAT, Frequency Allocation, List of present satellites with their features, Basic Satellite System, Satellite Orbit, Geostationary Orbit, Orbital Parameter & Perturbations, Launching Procedures - launch vehicles and propulsion				
Module 2	Orbits & Link Budget Calculation:	Case Study	Simulation	10 Sessions
Topics: Introduction: Kepler's Laws, Space Link:, EIRP, Transmission losses, Link Power Budget, System Noise, CNR, Uplink, Downlink, Effects of Rain, Combined CNR				
Module 3	Space Segment	Assignment	Simulation	10 Sessions
Topics: Introduction: Power Supply Unit, Attitude Control, Station Keeping, Thermal Control, TT &C, Transponders, Antenna Subsystem				
Module 4	Satellite Communication Services	Assignment	Modeling Task	12 Sessions
Satellite Access, SPADE System, Spread Spectrum Transmission & Application, GPS & its application. INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).				
Targeted Application & Tools that can be used: Application Areas in Weather forecasting ,Radio and TV broadcast satellites, Military satellites. Navigation, Global telephone backbones, Connections for remote or developing areas, Global mobile communication. Professionally Used Software: Matlab and Satellite Communication Simulators.				
Project work/Assignment/Quiz:				
Case Study: Identify the position of the HD Dish antenna placed over the building roof, analyse the orientation part of the dish antenna, its operating frequency bands and the Video signal				

processing through the setup box. Also justify why the downlink frequency should be lower than the uplink frequency bands.

Assignment1:

In most satellite TV receivers, the first IF band is converted to a second, fixed IF. Why is this second frequency conversion required?

Assignment2:

A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 hours. Given that the eccentricity is 0.002, calculate the semimajor axis. The earth's equatorial radius is 6378.1414 Km.

Text Book:

1. Dennis Roddy, Satellite Communication, 2006, 4th Edition, McGraw Hill Publication.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://nptel.ac.in/courses/117101055/>
2. Online notes: - <https://mitpress.mit.edu/books/satellite> communication
3. Free online self-paced course :- <https://bcourses.berkeley.edu>.
4. <https://www.cl.cam.ac.uk/teaching/0809/satellite> communication/InfoTheoryLectures.pdf
5. <https://www.slideshare.net/nitmittal/satellite-comm-trans-ece>
6. <https://www.accessengineeringlibrary.com> > content > book
7. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9210567>
8. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-Content

1. Technology trends and challenges of antennas for satellite communication systems Y Rahmat-Samii, AC Densmore - IEEE Transactions on 2014 <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6945379>
2. Broadband LEO satellite communications: Architectures and key technologies Y Su, Y Liu, Y Zhou, J Yuan, H Cao... - ... Communications, 2019
3. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8700141>
4. Development and future applications of satellite communications E Lutz, H Bischl, H Ernst, F David, M Holzbock Awa
5. https://link.springer.com/chapter/10.1007/0-387-23072-6_15
6. A new broadband magic tee design for Ka-band satellite communications VS Kumar, DG Kurup - IEEE Microwave and Wireless ...,019 <https://ieeexplore.ieee.org/abstract/document/8602357>

References

1. T. Pratt, C. Bostian, J. Allnutt, Satellite Communication, Wiley Publication
2. W. L. Pitchand, H. L. Suyderhou, and R. A. Nelson, "Satellite Communication Systems Engineering," Pearson Education

Topics related to "EMPLOYBILITY": Design of spade systems, space link budget estimation and design of pico satellite for developing EMPLOYBILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr.M.S Divya Rani Mrs. Annapurna
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3425	Course Title: Wireless Communication and Networks Type of Course: Discipline Elective, Data Transfer Technologies Basket Theory Only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Analog Communication, Digital Communication, Wireless Networks, Basic concepts of communication system, modulation, demodulation, well acquainted with terms such as evolution of wireless standards-1G to 4G and PAN technologies.					
Anti-requisites	NIL					
Course Description	The objective of this course is building an understanding of the core issues encountered in the design of wireless networks. The course includes the fundamentals of wireless communication and provides an overview of existing and emerging wireless communication networks. It covers fundamentals of cellular communications, multiple access technologies and various wireless networks including past and future generation networks. Further, the students will understand the basic concept of wireless system design and get familiar with various wireless networks. They will get the idea from the fundamentals of wireless communication and the evolution of wireless networks from first generation to LTE and LTE advanced after completion of this course.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> techniques using open-source Design Tools.					
Course Outcomes	On successful completion of the course students shall be able to: CO1: Explain the basic components and limitations of wireless communication systems. (L2) CO2: Apply the concept of cellular structure and frequency reuse to reduce interference in mobile networks. (L3) CO3: summarise channel assignment strategies and capacity enhancement techniques in cellular systems. (L3) CO4: Demonstrate multiple access techniques for efficient wireless communication. (L3) CO5: Use MIMO and diversity techniques to improve wireless system performance. (L3) CO6: Compare WLAN and WPAN standards with respect to network topology and MAC protocols for wireless communication applications. (L3)					
Course Content:						
Module 1	An Introduction to Wireless Communication and Cellular Concept	Quiz	Memory Recall based Quiz	10 Session		
Topics: Communication Systems, Types of Wireless Communication Systems, Classification of modern wireless systems. Limitations of wireless networks.: Introduction to cell structure, hexagonal cell geometry, concept of frequency reuse.						
Module 2	Capacity Enhancement and Multiple Access Techniques	Assignment	Case Study Based	12 Session		
Topics: Channel assignment strategies, Capacity enhancement techniques, Interference and system capacity, Handoff, Trunking and grade of service. Introduction to multiple access, Frequency division multiple access, Time division multiple access, Code division multiple access and Spread spectrum multiple access.						
Module 3	Multiple Antenna Techniques	Project	Small hardware based	08 Session		

Topics: MIMO systems, spatial multiplexing, System model, Pre-coding, Beam forming, transmitter diversity, receiver diversity, Channel state information-capacity in fading and non-fading channels.				
Module 4	Wireless Networks	Project	Small hardware based	09 Session
Topics: Introduction to wireless Networks, Advantages and disadvantages of Wireless Networks, OSI model, WLAN topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a, b, and g standards, WPAN technologies.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Professionally Used Software: Arduino, Matlab integration with GSM receiver, integrate the GSM device with any microcontroller, the embedded programming, SMS gateway simulator which can be used for testing purpose. Targeted Application: Communication, connection of devices by BLUETOOTH, Television and Radio Broadcasting, Radio Frequency Identification (RFID), Mobile Telephone System (Cellular Communication), Radar, Infrared Communication etc. Accessing the Internet, Locating and Tracking-GPS, security systems, television remote control, computer-interface devices, Wi-Fi, wireless power transfer and many projects based on mobile communications are applications of mobile communication. Enhance Security: The different types of wireless communication can enhance security. For example, walkie-talkies transmit and receive radio signals				
Project work/Assignment/Quiz:				
Bluetooth based Garage Door Opening, Smart Card Technology-based Security System Assignment 1: Election Day results are out. Everyone wants to congratulate the winner. Suppose the cell phone for everyone displays "G" on its top right corner of screen. Identify the technology standard. Draw its architecture and explain the main blocks. Assignment 2: Distinguish various multiple access techniques along with area of its application Assignment 3: Given codes are $C_1 = [-1, -1, -1, -1]$, $C_2 = [1, -1, -1, 1]$, $C_3 = [-1, 1, 1, 1]$, $C_4 = [-1, 1, 1, -1]$, Considering these codes, Show that whether CDMA can be applied with these codes. Determine total no. of users in this system and give reason for your answer. Comment on capacity of CDMA. Why CDMA is called as Spread Spectrum Technology? Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format Presidency University Library Link.				
Text Book(s): T1 Peter J. Ashenden, "Digital Design: An Embedded Systems Approach Using VERILOG", Elsevier, 2010 T2 Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.				
Reference(s): Reference Book(s): R1 Wireless Telecom System and Networks, Mullet: Thomson Learning 2006. R2 Fundamentals of wireless communication, David Tse, Pramod Viswanath, Cambridge 2005. Online Resources (e-books, notes, ppts, video lectures etc.): 1. https://www.coursera.org/lecture/healthcare-it/module-3-wearables-w1ayK 2. https://www.coursera.org/lecture/introduction-to-digital-health/mobile-applications-and-wearable-technologies-FnyjT 3. https://nptel.ac.in/courses/112/105/112105249/ 4. https://www.intechopen.com/chapters/66880 5. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home				

E-content: (Presidency University E-resources) 1. https://presiuniv.knimbus.com/openFullText.html?DP=http://www.intechopen.com/books/advanced-trends-in-wireless-communications 2. https://www.intechopen.com/books/5408 3. https://jwcn-eurasipjournals.springeropen.com/articles/10.1186/s13638-022-02110-w 4. https://www.ksp.kit.edu/site/books/m/10.5445/KSP/1000051989/ 5. https://www.mdpi.com/books/pdfview/book/1088	
Topics related to development of "FOUNDATION": Beyond 5G Architecture Topics related to development of "EMPLOYABILITY": Capacity enhancement techniques, LTE-A architecture, OFDM, MIMO and Cognitive radio. Topics related to development of "ENTREPRENEURSHIP": OFDM, MIMO and Cognitive radio Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": Capacity enhancement techniques, Interference and system capacity, Handoff, Trunking and grade of service.	
Catalogue prepared by	Ms. Maitraiye Konar
Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3426	Course Title: Radar Engineering Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basic concepts of analog modulation and demodulation schemes and probability theory					
Anti-requisites	NIL					
Course Description	This is an advanced research-oriented course designed for undergraduate students. This course will enable students' knowledge towards detection and tracking of radar signals. The course emphasizes on working, analysis and design of Radar wireless communication system. Additionally, this course will create a foundation for future courses such as optical Communication and Free Space Wireless Communication system.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Radar Engineering and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the fundamental principles of radar systems, including electromagnetic wave propagation, the radar equation, and core system components. (L2) CO2: Apply the radar range equation and power budget calculations to determine key system performance parameters for different radar configurations. (L3) CO3: Calculate the CW, pulsed, and FMCW radar waveforms and their range resolution, velocity measurement, and ambiguity function characteristics for system configurations. (L3) CO4: Determine the matched filtering, pulse compression, Doppler processing, and MTI techniques for target detection and clutter rejection. (L3) CO5: Design antenna arrays and beamforming networks for phased array radar, optimizing gain, beamwidth, and sidelobe levels. (L3)					

	CO6: Examine the optimal radar system configurations for applications such as weather surveillance, air traffic control, and defense, by integrating propagation effects, target characteristics, and system constraints. (L4)			
Course Content:				
Module 1	Basics of Radar	Quiz	Memory Recall based Quizzes	10 Sessions
Topics: Basics of Radar: Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse waveform - PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar.				
Module 2	The Radar Equation	Assignment / Quiz	Comprehension based Quizzes and assignments	9 Sessions
Topics: The Radar Equation: Prediction of Range Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Probability of Detection, Radar Cross Section of Targets.				
Module 3	MTI and Pulse Doppler Radar	Assignment	Comprehension based Quizzes and assignments; simulation with MATLAB	10 Sessions
Topics: MTI and Pulse Doppler Radar: Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MTI Radar with – Power Amplifier				
Module 4	Tracking Radar	Assignment	Project implementations in software, batch wise presentations	10 Sessions
Topics: Tracking Radar: Role of the radar tracker, -Plot to track association, Track initiation, Track maintenance, Track smoothing Types of Tracking Radar Systems- Lobe switching, conical scan, Alpha-beta tracker, Kalman filter, Multiple hypothesis tracker (MHT), Interacting multiple model (IMM)				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: Data analytics, Automatic machine translation, object detection etc. Professionally Used Software: Anaconda/ pytorch or google colab, Jupyter Notebook on cloud/ MATLAB Deep Learning Toolbox				
Project Work/Assignment:				
1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. <u>Presidency University Library Link</u> :https://puniversity.informaticsglobal.com/login 2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 3. Project Assignment: - Implementation of various concepts in from Radar Engineering using Python/ MATLAB				

Text Books:

- T1. M.I. Skolnik, Introduction Radar Systems, 2nd Edn, Mc Graw Hill Book Co.,1981
T2. F.E. Terman, Radio Engineering, Mc Graw Hill Book Co, 4th Edn. 1955
T3. Simon Kingsley And Shaun Quegan, Understanding Radar Systems, Mcgraw Hill Book Co.,

Reference Book(s):

1. Nathanson, F E, "Radar Design Principles" Scitech Publishing.
2. Hovanessian, S.A., "Radar System Design And Analysis", Artech House
3. D.K. Barton, Modern Radar Systems Analysis, Artech House, 1988.
4. B, Edde, Radar: Principles, Technology, Applications, Prentice Hall, 1993

Online Resources (e-books, notes, ppts, video lectures etc.):

1. NPTEL - <https://nptel.ac.in/courses/108/105/108105154/>
2. COURSERA - <https://www.coursera.org/specializations/optical-engineering>.
3. <https://doi.org/10.1175/BAMS-88-11-1753>.
4. [https://doi.org/10.1175/1520-0426\(1997\)014<1502:DADOAP>2.0.CO](https://doi.org/10.1175/1520-0426(1997)014<1502:DADOAP>2.0.CO).
5. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E contents:

1. Zhang, G. F., R. J. Doviak, D. S. Zrnić, R. Palmer, L. Lei, and Y. Al-Rashid, 2011; Polarimetric phased-array radar for weather measurement: A planar or cylindrical configuration. J. Atmos. Oceanic Technol.
<https://www.semanticscholar.org/paper/Polarimetric-Phased-Array-Radar-for-Weather-A-or-Zhang-Doviak/537ca7fc87fd73f07da2f7044f1020d795eef77d>
2. Wurman, J., Y. Richardson, C. Alexander, S. Weygandt, and P. F. Zhang, 2007; Dual-Doppler analysis of winds and vorticity budget terms near a tornado. Mon. Wea. Rev.
<https://www.semanticscholar.org/paper/Dual-Doppler-Analysis-of-Winds-and-Vorticity-Budget-Wurman-Richardson/2257f06925d8c069b27726e800307340e1313b93>
3. Zhang, Yiming; Zhang, Shuai; Pedersen, Gert Frølund, 2020; A Simple and Wideband Decoupling Method for Antenna Array Applications.
<https://vbn.aau.dk/ws/files/320484972/manuscript.pdf>
4. Said Mikki, dept. of ECECS, University of New Haven, West Haven, CT, USA, 2018; Quantum Antenna Theory for Secure Wireless Communications.
[file:///C:/Users/Admin/Downloads/Quantum Antenna Theory EuCap2020 %20\(1\)%20\(1\).pdf](file:///C:/Users/Admin/Downloads/Quantum%20Antenna%20Theory%20EuCap2020%20(1)%20(1).pdf)

Topics relevant to "EMPLOYABILITY": Tracking Radar, Applications of Radar, Power and operating frequency for developing EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.

Catalogue
prepared by

Ashwini B

Recommended
by the Board of
Studies on

15th BOS held on 28/07/2022

Date of Approval
by the Academic
Council

Meeting No. 18th, Dated 03/08/2022

Course Code:
ECE3427

Course Title: RF Engineering

Type of Course: Discipline Elective

L-T-P-C

3

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3

	Data Transfer technology Basket & Theory only					
Version No.	2.0					
Course Pre-requisites	To succeed in this course the student should be comfortable with basic concepts of Analog and Digital Communication courses. The basic analog and digital modulation techniques needed to translate signal from original frequency to a specified RF frequency. Multiple Access techniques are used to extend the RF communication for accommodating multiple users.					
Anti-requisites	NIL					
Course Description	The course is designed for undergraduate students to introduce components and architecture with applications. This course will enable the students to classify different active and passive components with design and noise considerations. This will also enable the students to seek employment opportunities, research and development activities InDesign of RF control circuit and various system architectures.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of RF Engineering and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Discuss the importance of RF design and its applications. 2) Classify active RF devices and noise considerations. 3) Apply the concepts of RF engineering in RF control circuits. 4) Summarize various radio frequency architectures.					
Course Content:						
Module 1	RF system-Basic architecture	Assignment		Programming and simulation Task	9 Sessions	
Topics: Introduction, Importance of using Radio frequency design, Applications. RF behavior of passive Components-Resistors, Capacitors, Inductors. Transmission line analysis Parallel RLC tank, Series RLC networks, Impedance Matching, Pi match, T match.						
Module 2	Active RF components	Assignment		Programming and Simulation Task	10 Sessions	
Topics: RF diodes, Bipolar junction transistors, RF Field Effect transistor, Metal Oxide Semiconductor Transistors, High Electron Mobility Transistors, Semiconductor Technology Trends						
Module 3	RF Transistor amplifier and Mixer Design	Project Assignment		Programming Task	9 Sessions	
Topics: Amplifier power relations, Broadband High power and Multistage Amplifiers. Basic Characteristics of Mixers, Frequency domain considerations, Single ended Mixer design, Single and double balanced mixer, Integrated active mixer, Image reject Mixer						
Module 4	TRANSCEIVER ARCHITECTURES	Assignment		Data collection and analysis	10 Sessions	
Receiver Architectures: Basic Heterodyne Receivers, Modern Heterodyne Receivers, Direct-Conversion Receivers, Transmitter Architectures: Direct-Conversion Transmitter, Modern Direct-Conversion Transmitters, Heterodyne Transmitters, OOK Transceivers						
Targeted Applications and Tools						
	Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries		

	5G Communication	Design an RF front-end for mmWave bands	MATLAB, Simulink, ADS	Telecom, Semiconductor
	IoT Systems	Low-power RF interface for home automation	GNU Radio, USRP	Home Automation, Smart Cities
	Radar Systems	Design and simulate radar transceiver	MATLAB, LTSpice	Defense, Automotive
	Satellite Communication	Compare satellite-based navigation RF systems	MATLAB, Simulink	Aerospace, Navigation
Skill Building Through Experiential Learning				
	Activity / Task	Objective	Tools / Technologies Used	Skills Developed
	Design a microstrip patch antenna	Learn high-frequency antenna design concepts	HFSS, ADS	Antenna tuning, radiation pattern analysis
	Simulate RF filters for communication circuits	Understand filter behavior at RF frequencies	LTSpice, MATLAB	Filter design, frequency response simulation
Project work/Assignment:				
1. Case Studies: At the end of the course students will be given a 'real-world' application as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link. 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. Project Assignment: Design a user friendly interface for the fast access to control high voltage electrical circuit operations using RF technology. Assignment 1: Design, Visualize and compare matching network for one port load using Simulink. Assignment 2: Implement RF metal oxide semiconductor device model on Matlab for different parameters. Assignment 3: If the RF signal and the output IF is 2 MHz, determine all frequencies up to third-order harmonics that are generated by the mixer. Assignment 4: Compare different Radio navigation systems with accuracy of position, Velocity Accuracy and Range of operation.				
Textbooks: - Behzad Razavi, "RF Microelectronics", Pearson Education, 6th Edition - Reinhold Ludwig, GeneBogdanov, "RF Circuit design, Theory and Applications", Pearson India, 2011, 2nd Edition Digital Reference(s) 3. ebook: https://www.atnf.csiro.au/people/Tasso.Tzioumis/sms2014/presentations/Clegg(RF_Engineering).pptx. 4. ebook: https://www.ti.com/lit/ml/slap127/slap127.pdf				
References: - Kai Chang, "RF and Microwave Wireless system", Pearson Education edition, 2015, 1st Edition. W. H. Hayt, McGraw "Engineering Electromagnetics"-Hill Book Company, 8th Edition. Online Reference(s)				

NPTEL: https://nptel.ac.in/courses/117/102/117102012/# NPTEL: https://nptel.ac.in/content/syllabus_pdf/117102012.pdf Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home E-content: 1. Ajinkya C Bapat ¹ , Sonali U Nimbhorkar, Department of Computer Science and Engineering, G.H. Raisoni College of Engineering, Nagpur, RFID Based Object Tracking System Using Collaborative Security Protocol, DOI 10.4010/2016.943 ISSN 2321 3361 © 2016 IJESC, Research article, Volume 6, Issue no.4 https://ieeexplore.ieee.org/abstract/document/8465897 2. Jasmine Jose Department of Electronics and Telecommunication Engineering, Don Bosco Institute of Technology, Mumbai, India, Sherin George; Lydia Bosco; Juliet Bhandari; Freda Fernandes; Ashwini Kotrashetti, A review of RF energy harvesting systems in India, International Conference on Technologies for Sustainable Development (ICTSD), 2015 https://ieeexplore.ieee.org/document/7095838 3. John Walker; Daniel Myer; Frederick Raab; Chris Trask, Classic Works in RF Engineering: Combiners, Couplers, Transformers, and Magnetic Materials, Artech https://ieeexplore.ieee.org/document/9100964		
Topics relevant to "EMPLOYABILITY": Transceiver Architectures for developing EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.		
Catalogue prepared by		Mrs AKSHATHA K
Recommended by the Board of Studies on		15th BOS held on 28/07/2022
Date of Approval by the Academic Council		Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3428	Course Title: Wireless Adhoc Networks Type of Course: Discipline Elective	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Wireless Communication and Networks, Wireless topologies and protocols					
Anti-requisites	NIL					
Course Description	This course is an advanced research-oriented course designed for under graduate students with computer and wireless networks background. The course will act as foundation for Mobile Ad Hoc Networks (MANETs), Wireless Sensor Networks (WSNs) and Wireless Mesh Networks (WMNs). The course examines wireless cellular, ad hoc and sensor networks, covering topics such as medium access control, network and transport protocols, unicast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>PROBLEM SOLVING</u> techniques using open-source Design Tools.					

Course Outcomes	On successful completion of the course students shall be able to: CO1: Explain the architecture of IOT and WSN systems (L2) CO2: Classify various middleware protocols for building IOT and WSN applications. (L3) CO3: Illustrate real time applications of IOT and WSN to make smart world. (L3) CO4: Demonstrate competence in programming for IoT Applications. (L3) CO5: Analyze and classify the range of peer-to-peer communication protocols that facilitate the development of IoT and WSN applications. (L3) CO6: Examine synchronous deployment scenarios of IoT and WSN frameworks that facilitate the emergence of intelligent global systems. (L4)		
Course Content:			
Module 1	MAC Protocols	Assignment / Quiz	10 Sessions
Topics: Introduction, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention – Based Protocols, Contention – Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.			
Module 2	Routing Protocols	Assignment	09 Sessions
Topics: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.			
Module 3	Transport Layer Protocols	Assignment	10 Sessions
Topics : Issues in designing a transport layer protocol for ad hoc wireless network, transport layer solutions Security in ad hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks			
Module 4	Quality of Service and Energy Management in Ad-hoc Wireless Networks	Project	10 Sessions
Topics: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.			
List of Laboratory Tasks: Nil			
Targeted Application & Tools that can be used: Professionally Used Software: Network simulator2/OPNET/Matlab, Arduino Targeted Application: Wireless Adhoc Network in Ultra wide band radio communication- Wireless fidelity systems. Accessing the Internet, Locating and Tracking-GPS, security systems, television remote control, computer-interface devices, Wi-Fi, wireless power transfer and many projects based on mobile communications are applications of mobile communication. Enhance Security: The different types of wireless communication can enhance security. For example, walkie-talkies transmit and receive radio signals			
Project work/Assignment/Quiz:			
Project Assignment: Consider a wireless network where the transmission is going on between nodes A & B that are separated by a distance d and the transmission range of each node is R. Assignment 1: Collect the data for a network traffic and calculate the percentage of packet drop and packets delivered successfully. Assignment 2: Calculate the probability of data packet collision in the MACA protocol. Assume that T_c is the control packet transmission propagation delay, T_w is the optimal maximum			

back-off time, β is the percentage of ready nodes, & R is the transmission range of each node. Assignment 3: Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination? Assignment 4: Calculate the probability of data packet collision in the MACA protocol. Assume that T_c is the control packet transmission propagation delay, T_w is the optimal maximum back-off time, β is the percentage of ready nodes, & R is the transmission range of each node. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format Presidency University Library Link.	
Text Book(s): 1. C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education India; 1st edition 2006, PHI.	
Reference(s): 1. Roy Blake, "Wireless Communication Technology", First Edition CENGAGE, 2012 2. Jagannathan Sarangapani, "Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control" Second Edition CRC Press. 3. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007. 4. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004. 5. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002	
Online and Web resource (s): 1. Archive.cone.informatik.uni-freiburg.de/.../lecture/.../MANET-01.ppt 2. www.rimtengg.com/coit2007/proceedings/pdfs/122.pdf 3. people.cs.vt.edu/~irchen/6204/.../lecture4-mobile-ad-hoc-networks 4. https://nptel.ac.in/courses/106/105/106105160/ 5. https://www.coursera.org/lecture/internet-of-things-history/sensor-networks-n-to-1-iOmzK 6. Presidency University Library Link :- https://presiuniv.knimbus.com/user#/home	
E-Content: 1. Wireless Sensor Network as a Mesh: Vision and Challenges by Zhanserik Nurlan, Tamara Zhukabayeva, Mohamed Othman, Aigul Adamova, And Nurkhat Zhakiyev, Digital Object Identifier 10.1109/ACCESS.2021.3137341. 2. Using Overhearing and Rateless Coding in Disseminating Various Messages in Vehicular AdHoc Networks by Mostafa Nozari, Faramarz Hendessi, Nadia H. Khiadani, And Maryam Ataei Kachooei, Digital Object Identifier 10.1109/ACCESS.2021.3110945. 3. Reliability-Aware Multi-Objective Optimization-Based Routing Protocol for VANETs Using Enhanced Gaussian Mutation Harmony Searching by Sami Abduljabbar Rashid1, Mohammed Alhartomi, Lukman Audah and Mustafa Maad Hamdi, Digital Object Identifier 10.1109/ACCESS.2022.3155632 4. Adaptive Routing Design for Flying Ad Hoc Networks Min Zhang, Chao Dong, Peng Yang, Ting Tao, Qihui Wu and Tony Q. S. Quek, IEEE Communications Letters, Vol. 26, NO. 6, June 2022 https://Ieeexplore.Iee.org/Document/9716929.	
Topics related to development of "FOUNDATION": MAC Protocols, Energy Management in Ad-hoc Wireless Networks Topics related to development of "EMPLOYABILITY": Security in ad hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks Topics related to development of "ENTREPRENEURSHIP": Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes Topics related to development of "ENVIRONMENT AND SUSTAINABILITY": MAC Protocols that use Directional Antennas, LAN's, Wi-Fi, Wi-Max.	
Catalogue prepared by	Ms. Maitraiye Konar

Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3429	Course Title: Optical Communication Type of Course:: Discipline Elective- Data Transfer Technologies Basket	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basic concepts of electronic devices, digital modulation and demodulation schemes, analog modulation and demodulation schemes, probability theory.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to learn the basic principle of optical fiber communication and also understand the transmission characteristics and losses in a wireless communication system. The course will act as a harbinger for exponentially growing modern communication systems. The course emphasizes on working, analysis and design of wireless communication system. Additionally, this course will create a foundation for future courses such as Radar Communication and Free Space Communication etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Optical Communication and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1 Explain basic concepts of OWC systems including wireless access schemes. (L2) CO2 Explain the safety regulations and environmental factors affecting the deployment of OWC systems. (L2) CO3 Analyze the working principles and performance parameters of optical sources (LEDs and LASERs) and detectors (PIN and APD). (L4) CO4 Apply suitable analog and digital modulation techniques to optical wireless communication systems. (L3) CO5 Analyze the application areas such as LiFi, underwater communication, and vehicle-to-vehicle (V2V) systems. (L4) CO6 Employ complete optical wireless communication systems by integrating components, modulation schemes, and performance optimization techniques (L3)					
Course Content:						
Module 1	Introduction to optical wireless communication systems	Quiz	Memory Recall based Quizzes	10 Sessions		
Topics:						

Wireless Access Schemes, Brief History of OWC, OWC/Radio Comparison, WC Application Areas, Safety and Regulations, OWC Challenges.				
Module 2	Optical Sources & Detectors	Assignment	Design oriented	13 Sessions
Optical Sources : LED & LASERS: Internal & External Quantum Efficiency, Power Efficiency, Luminous Efficiency, Modulation Bandwidth Optical Detectirs : PIN & APD Photo Detectors, Direct & Coherent Detection Techniques Detection Noise				
Module 3	Modulation Techniques	Assignment	Design Analysis	12 Sessions
Topics Introduction, Analogue Intensity Modulation, Digital Baseband Modulation Technique Pulse Position Modulation, On-Off Keying, Multi carrier modulation (MCM) techniques				
Module 4	Use Cases	Assignment	Application based analysis	10 Sessions
Module 4: Use Cases Visible Light Communication: System Design, SNR Analysis, MIMO VLC, WiFi/LiFi Co-existence, Under Water Communication, V2V Communication.				
Targeted Application & Tools that can be used: Tools: MATLAB				
Project work/Assignment: Project/Assignment:. 1. Performance Analysis of OOK, PPM and OFDM Modulation Techniques for VLC 2. Comparative Performance Analysis of PIN and APD Photodetectors. 3. Compare the Bit Error Rate for various weather conditions.				
Text Book T1: Ghassemlooy Z, Popoola, Rajbhandari. "Optical Wireless Communication System and Channel Modelling With MATLAB", CRC Press (Taylor & Francis Group) 2013				
References R1. Ramirez R, M Sevia. "Optical Wireless Communications IR for Wireless Connectivity)", CRC Press (Taylor & Francis Group) 2008 R2 H Steve N. Wireless Optical Communication System. Springer, 2005. Online Resources & E-content(e-books, notes, ppts, video lectures etc.): NPTel - https://onlinecourses.nptel.ac.in/noc23_ee61/preview ResearchPapers : 1. D. Karunatilaka, F. Zafar, V. Kalavally, and R. Parthiban. <i>LED Based Indoor Visible Light Communications: State of the Art</i>. In: IEEE Communications Surveys & Tutorials, vol. 17, no.3,pp.1649–1678,2015.DOI:10.1109/COMST.2015.2471304. 2. H. Elgala, R. Mesleh, and H. Haas. Indoor Optical Wireless Communication: Potential and State-of-the-Art. IEEE Communications Magazine, vol. 49, no. 9, pp. 56–62, Sept. 2011. DOI: 10.1109/MCOM.2011.6011734				

Topics relevant to "EMPLOYABILITY": Fiber Optic Communication Systems for developing EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Nishant Sharan
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Wearable Technologies Basket

Course Code: ECE3431	Course Title: Fundamentals of Wearable Sensing Type of Course: Program Core & Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic knowledge in Wireless Communication					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand measurement and instrumentation systems that are used in wearable sensors. This course is analytical in nature and provides a good knowledge about the construction of testing and measuring setup for wearable sensing systems. The course is beneficial in the design of resistive sensors, reactive sensors and self-generating sensors and its applications in real life scenarios that would be worn on body. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance, using both hardware and simulation tools.					
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of student by using <u>PARTICIPATIVE LEARNING</u> techniques using virtual testing through simulation in ANSYS software/Matlab/CCS Studio.					
Course Outcomes	On successful completion of the course students shall be able to: CO1: Explain the principles, components, and sources of error in measurement systems used for biomedical sensing applications. (L2) CO2: Apply the working principles of resistive sensors such as potentiometers, strain gauges, RTDs, thermistors, LDRs, hygrometers, and gas sensors in wearable monitoring applications. (L3) CO3: Discuss the concepts of integrated and smart sensors, IEEE 1451 standards, and Transducer Electronic Datasheets (TEDs). (L2)					

	CO4: Illustrate the working principles and applications of smart sensors, MEMS sensors, flexible sensors, and structural health monitoring sensors. (L2) CO5: Explain the role, attributes, and classifications of wearable devices used in healthcare and assistive technologies. (L2) CO6: Apply wearable sensor concepts for physiological monitoring, body movement analysis, food intake characterization, and sensing inside and outside the human body. (L3)			
Course Content:				
Module 1	Resistive and Reactive Sensors	Assignment	Case study based	08 Classes
Topics: Overview of Measurement System, Instruments and errors in sensing systems. Resistive sensors- Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), thermistors, magneto- resistors, light dependent resistor (LDR), resistive hygrometers, resistive gas sensors. Wearable applications: Strain sensor for monitoring Physiological signals, body movement.				
Module 2	Smart Sensors and Applications	Project	Small hardware based	09 Classes
Topics: Integrated and Smart sensors, IEEE 1451 standard & Transducer Electronic Datasheets (TEDs), Overview of various smart sensors: Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22, FC28), IR sensor (FC51), Gas sensor (MQ2,MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335), etc, Structural health monitoring sensors, Introduction to MEMS and Flexible sensors.				
Module 3	Scope of Wearable Devices	Assignment	Small hardware based	08 Classes
Topics: Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Wearable and non-invasive assistive technologies, Detection and Characterization of food intake by wearable sensors, Wearing sensors inside and outside of the Human body for early detection of diseases.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: : 1. Fabrication of interdigitated (IDE) electrodes. 2. Piezoresistive sensors for cuffless blood pressure measurement. 3. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring. 4. Smart textile for neurological rehabilitation system (NRS) 5. Epidermal electronics system (EES) 6. 3D imaging and motion capture 7. safety and security, navigation, Enhancing sports media, Automatic digital diary 8. AI for respiratory diagnostics and clinical trials. Professionally Used Software: python/C, C++, Virtual testing through simulation in ANSYS software.				
Project work/Assignment/Quiz:				

1. Case Studies: At the end of the course students will be given a 'real-world' Wearable application-based devices etc. as a case study. Students will be submitting a report which will include Block/Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format.

2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. [Presidency University Library Link](#).

3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

Text Book(s):

1 "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, Academic Press/Elsevier, ISBN 978-0124186620, Edward Sazonov, Michael R. Neuman (editors), 2nd edition.

Reference(s):

Reference Book(s):

- 1 "Wearable Electronics Sensors-For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015
- 2 M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
- 3 "Environmental, Chemical and Medical Sensors", by Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://www.coursera.org/lecture/healthcare-it/module-3-wearables-w1ayK>
2. <https://www.coursera.org/lecture/introduction-to-digital-health/mobile-applications-and-wearable-technologies-FnyjT>
3. <https://nptel.ac.in/courses/112/107/112107289/>
4. <https://nptel.ac.in/courses/112/105/112105249/>
5. <https://www.intechopen.com/chapters/66880>
6. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

E-Content: (Presidency University E-resources)

1. <https://presiuniv.knimbus.com/openFullText.html?DP=http://www.intechopen.com/books/advanced-trends-in-wireless-communications>
2. <https://www.intechopen.com/books/5408>
3. <https://jwcn-eurasipjournals.springeropen.com/articles/10.1186/s13638-022-02110-w>
4. <https://www.ksp.kit.edu/site/books/m/10.5445/KSP/1000051989/>
5. <https://www.mdpi.com/books/pdfview/book/1088>

Topics related to development of "EMPLOYABILITY": Textiles and clothing, Social Aspects: Interpretation of Aesthetics, Adoption of Innovation, Health monitoring sensors. Students will learn various sensors and their broad applications from employability skills.

Catalogue prepared by

Mrs. Amrutha V Nair

Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3432	Course Title: Flexible Electronics And Sensors Type of Course: Discipline Elective- AI and Wearable Technologies Basket	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Measuring Instruments and Sensors.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to provide an overview of flexible electronics technology and issues related material processing for thin film electronics. This course exposes the students for the materials selection and patterning methods for thin film electronics development. This course describes the process involved in transferring the flexible electronics from foils to textiles and also the challenges, opportunities and the future of wearable devices. It exposes the students to the design, challenges of wearable sensors employed for sensing the physical and biological parameters. A review on the process involved in the conversion of conducting and semiconducting fibers to smart textiles.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Flexible Electronics and Sensors and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the evolution of flexible electronics, the materials and technologies used in flexible electronic systems. (L2) CO2: Describe the principles of low-temperature electronic device fabrication and the fundamentals of wearable technologies, including wearable haptic and tactile display systems. (L2) CO3: Describe the material considerations and functional characteristics of semiconductors, dielectrics, and conductors employed in flexible electronics. (L2) CO4: Demonstrate the use of jet-printing and related print-processing approaches for patterning and fabricating flexible electronic devices. (L3) CO5: Illustrate the principles of printing, lithography, multilayer patterning, and surface engineering techniques used in flexible electronics fabrication. (L2) CO6: Demonstrate the selection of suitable fabrication and patterning techniques for the development of flexible electronic devices such as					

	displays, sensors, MEMS, lab-on-a-chip systems, and solar panels. (L3)			
Course Content:				
Module 1	Overview of flexible electronics technology	Case study / quiz	flexible electronics technology	10session
History of flexible electronics - Materials for flexible electronics: degrees of flexibility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-to Roll processing - Additive printing.				
Module 2	Amorphous and nano-crystalline silicon materials and Thin film transistors and Wearable haptics	Case study / quiz	World of wearables	10session
Topics: Fundamental issues for low temperature processing - low temperature amorphous and nanocrystalline silicon - characteristics of low temperature dielectric thin film deposition - low temperature silicon nitride and silicon oxide characteristics - Device structures and materials processing - Device performance - Contacts for the device - Device stability. World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic and tactile display.				
Module 3	Materials and Novel patterning methods for flexible electronics	Case study / quiz	Print processing	12 session
Materials considerations for flexible electronics: Overview, Inorganics semiconductors and dielectrics, organic semiconductors and dielectrics, conductors - Print processing options for device fabrication: Overview, control of feature sizes of jet printed liquids, jet printing for etch mask patterning, methods for minimizing feature size, printing active materials.				
Module 4	Flexible electronics from foils to textiles & Wearable Bio, Chemical and Inertial sensors	Case study / quiz	Jet Printing	12session
Ink-jet printing, gravure, imprint lithography, spray pyrolysis, surface energy effects, multilayer patterning, design rule considerations. Displays, sensor arrays, memory devices, MEMS, lab-on-a-chip, and flexible solar panels				
Targeted Application & Tools that can be used:				
Project Assignment:				
1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .				
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				

4. Project Assignment: -Printed electronics has the potential to revolutionize many industries. Some of the most interesting possibilities are in the areas of textiles and clothing. With electronics printed onto a substrate that is then applied to fabrics, we can add sensors, displays or other elements to existing clothing designs, or create entirely new items that take advantage of added features. Do survey on wearable sensors for monitoring patient health care system.

Text Book(s):

1. Michael J. McGrath, Clíodhna Ni Scanail, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 201, 1st Edition, Apress Media LLC, New York.
2. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.

Reference(s):

1. Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, 1st Edition, Academic Press, Cambridge.
2. Kate Hartman, "Make: Wearable Electronics: Design, prototype, and wear your own interactive garments", 2014, 1st Edition, Maker Media, Netherlands.
3. Guozhen Shen, Zhiyong Fan, "Flexible Electronics: From Materials to Devices", 2015, 1st Edition, World Scientific Publishing Co, Singapore.
4. Yugang Sun, John A. Rogers, "Semiconductor Nanomaterials for Flexible Technologies: From Photovoltaics and Electronics to Sensors and Energy Storage (Micro and Nano Technologies)", 2011, 1st Edition, William Andrew, New York.

Online and Web resource (s):

1. <https://nptel.ac.in/courses/108/108/108108147/>
2. <https://www.coursera.org/learn/freeform-electronics>
3. <https://presiuniv.knimbus.com/user#/home>

E-Content:

1. Mario Caironi, Yong-Young Noh "Latest Advances in Substrates for Flexible Electronics in Journal of the Society for Information Display, First published: 16 January 2015, <https://doi.org/10.1002/9783527679973.ch10>.
2. Panpan Wang, Mengmeng Hu, Hua Wang, Zhe Chen, Yuping Feng, Jiaqi Wang, Wei Ling, Yan Huang "The Evolution of Flexible Electronics: From Nature, Beyond Nature, and To Nature" in First Advanced Sciences published: 28 August 2020 <https://doi.org/10.1002/advs.202001116> <https://onlinelibrary.wiley.com/doi/full/10.1002/advs.202001116>.
3. Marc Aliqué, Claudia Delgado Simão, Gonzalo Murillo, Ana Moya "Fully-Printed Piezoelectric Devices for Flexible Electronics Applications" in Advanced Materials Technologies First published: 25 January 2021. <https://doi.org/10.1002/admt.202001020> <https://onlinelibrary.wiley.com/doi/abs/10.1002/admt.202001020>,

Topics relevant to "EMPLOYABILITY SKILLS": World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Srilakshmi K H Dr. K Bhanu Rekha
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3433	Course Title: Wearable Devices and its Applications Type of Course: Discipline Elective &Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Fundamentals of Wireless Communication					
Anti-requisites	NIL					
Course Description	The objective of this course is to make the students to understand the need for development of wearable devices and it simplications on various sectors. It will also comprehend the design and development of various wearable inertial sensors and wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications. The course will enable the students to become acquainted with various wearable locomotive sensors as assistive devices for tracking and navigation. This course also helps in carrying out research and development activities or employment opportunities in the area of wearable devices.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Wearable Devices and its Applications and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING					
Course Outcomes	On successful completion of the course students shall be able to: CO1: Explain the evolution, attributes, and classification of wearable devices including types of wearable sensors (invasive and non-invasive) and their applications. (L2) CO2: Classify wearable inertial sensors including accelerometers, gyroscopic sensors, and magnetic sensors based on their modality of measurement. (L2) CO3: Illustrate the applications of wearable inertial sensors in fall risk assessment, fall detection and gait analysis. (L3) CO4: Analyze the role of wearable cameras in safety and security, navigation, sports and smart-watch applications. (L4) CO5: Explain the principles of MEMS microphones and bio-acoustics, and their integration with AI for respiratory diagnostics and clinical trials. (L2) CO6: Analyze wearable assistive devices and their applications including devices for vision, hearing, touch sensation, and various body-worn assistive technologies. (L4)					
Course Content:						
Module 1	Introduction to Wearable Devices	Quiz	Memory Recall based Quiz	09 Classes		
Topics: Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors’ overview–sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety.						
Module 2	Wearable Inertial Sensors	Assignment	Case study based	08Classes		
Topics:						

Wearable Inertial Sensors-Accelerometers, Gyroscopic sensors and Magnetic sensors; Modality of Measurement- Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications: Fall Risk Assessment, Fall Detection, Gait Analysis, Quantitative Evaluation of Hemiplegic and Parkinson's Disease patients. Physical Activity monitoring: Human Kinetics, Cardiac Activity, Energy Expenditure measurement: Pedometers, Altigraphs.				
Module 3	Wearable Cameras and Microphones for Navigation	Project	Small hardware based	14Classes
Topics: Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bio acoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist, fore arm and-feet, vests and belts, head-mounted devices.				
Module 4	Other Applications	Assignment	Small hardware based	08 Classes
Topics: Wearables for life in space: Life on Moon and Mars, Optical cardiovascular Monitoring, Bioimpedance systems for home care monitoring using BSNs: the IPANEMA BSN , Fatigue monitoring techniques: Methods and wearables.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: 1. Fabrication of interdigitated (IDE) electrodes. 2. Piezoresistive sensors for cuffless blood pressure measurement. 3. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring. 4. Smart textile for neurological rehabilitation system (NRS) 5. Epidermal electronic system (EES) 6. 3D imaging and motion capture 7. safety and security, navigation, Enhancing sports media, Automatic digital diary 8. AI for respiratory diagnostics and clinical trials. Professionally Used Software: ANSYS software, python/C, C++				
Project work/Assignment/Quiz:				
1. Students will be made into groups and given programming assignments at the end of each module. Students need to use MULTISIM for these assignments. 2. Book Review/ Article review: A chapter of a book or an article will be given to each student. They need to visit the library and write a report on their understanding about the assigned article for 1 page. 3. Presentation: There will be a group presentation on the programming assignment or any course related self-study topic/research related topic they had done.				
Text Book(s): 1 "Seamless Healthcare Monitoring", Toshiyo Tamura and Wenxi Chen, Springer 2018, 1st edition 2 "Wearable Sensors-Fundamentals, Implementation and Applications", by Edward Sazonov and				

Michael R. Neuman, Elsevier Inc., 2014, 2nd edition

Reference(s):

Reference Book(s):

- 1 "Wearable Electronics Sensors-For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015
- 2 M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Application to the Mining Industry," Energies, vol. 11, p. 547, 2018.
- 3 "Environmental, Chemical and Medical Sensors", by Shantanu Bhattacharya, A. K. Agarwal, Nripen Chanda, Ashok Pandey and Ashish Kumar Sen, Springer Nature Singapore Pte Ltd. 2018
4. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Application to the Mining Industry," Energies, vol. 11, p. 547, 2018.

Online Lectures:

1. <https://www.coursera.org/lecture/healthcare-it/module-3-wearables-w1ayK>
2. <https://www.coursera.org/lecture/introduction-to-digital-health/mobile-applications-and-wearable-technologies-FnyjT>
3. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

Website:

1. <https://nptel.ac.in/courses/112/107/112107289/>
2. <https://nptel.ac.in/courses/112/105/112105249/>
3. <https://www.intechopen.com/chapters/66880>

E-Content: (Presidency University E-resources)

1. <https://jwcn-eurasipjournals.springeropen.com/articles/10.1186/s13638-022-02110-w>
2. <https://www.ksp.kit.edu/site/books/m/10.5445/KSP/1000051989/>
3. <https://www.mdpi.com/books/pdfview/book/1088>

Topics relevant to "EMPLOYABILITY": Design and development of various wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications, Wearable devices with Global Positioning System (GPS) integration for tracking and navigation, Wearable Optical Sensors EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Amrutha V Nair
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3434	Course Title: Embedded Platforms for Wearables Type of Course: Wearable Technologies, Theory only	L-T-P-C	3	0	0	3
Version No.	2.0					

Course Pre-requisites	Microprocessor, Microcontroller, Fundamentals of Wearable Sensing				
Anti-requisites	NIL				
Course Description	The objective of this course is to introduce concepts of wearable embedded system design and the insight of various ARM Cortex architectures and its applications in various areas of wearable computing and to introduce the I/O interfacing with ARM Cortex architectures.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Embedded Platforms for Wearables and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING				
Course Outcomes	On successful completion of this course the students shall be able to: 1) Understand design issues of wearable embedded system design 2) Explore various ARM processor architectures for wearable applications 3) Program ARM Cortex architecture using assembly and C programming 4) Interface I/O peripherals with ARM Cortex				
Course Content:					
Module 1	Introduction to Wearable Embedded Systems	Quiz	Memory Recall based Quizzes		06session
Topics: Introduction to wearable embedded systems, Challenges in the design of wearable embedded system design, Design Methodology for wearable embedded systems, Selection criteria of embedded processor for wearable embedded systems, Application areas of wearable embedded systems.					
Module 2	Wearable Embedded Architectures	Assignme nt / Quiz	Programming and Simulation task / Memory Recall based Quizzes		10 sessions
Topics: Features of ARM Cortex Series, Comparison of ARM Cortex-M and Cortex-A architectures, addressing modes, ARM instruction set for ARM Cortex.					
Module 3	Programming Embedded Architecture and Interfacing	Assignme nt / Quiz	Programming and Simulation task / Memory Recall based Quizzes		12 sessions
Topics: Assembly language Programming, Embedded C Programming, Code Density and Thumb Mode in ARM, Power Control in ARM, Interrupt structure of ARM Cortex architecture, Interfacing with ARM Cortex: - LED, LCD, Keypad, PWM Programming, Communication Protocols: - Bluetooth, USB, CAN BUS, MOD BUS, UART, I2C.					
Module 4	Case Studies	Assignme nt	Programming Assignment		12 session
Topics: Various case studies of wearable system design: - Wearable Smart Watch, Hearing Aid for person with disability, Body parameter measurement in medical field, agricultural monitoring devices etc.					
List of Laboratory Tasks: Nil					
Targeted Application & Tools that can be used:					

Targeted Applications: Biomedical Embedded Systems Design, Wearable gadget design and development

Professionally Used Software: ARM Keil uVision-5, Code Composer Studio (CCS)

Project Work/Assignment:

1. Case Study: At the end of the course students will be given a ‘real-world’ application-based on wearable embedded system as a case study. Students will be submitting a report which will include Application Design, sensors used, middleware protocols used and working mechanism etc. in appropriate format.
2. Book/Article review: At the end of the course a literature review of any 01 recent articles from the reputed national and international journal/ conferences will be given by students. They need to refer to tools like Scopus/ Google-Scholar and submit a report on their understanding of the assigned article in appropriate format.
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to present their review work.

Text Book(s):

1. Andrew N. Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide, Designing and Optimizing System Software” , Morgan Kaufmann Publishers, 1st edition
2. Frank Vahid, Tony Givargis, “Embedded System Design: Unified Hardware/Software Design”, John Wiley & Sons, 2nd Edition,

Reference(s):

Reference Book(s):

1. Enzo Pasquale Scilingo, Gaetano Valenza, “Wearable Electronics and Embedded Computing Systems for Biomedical Applications” , MDPI AG, Switzerland, 1st Edition
2. Alexander G. Dean, “Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach” , ARM Education Media, 2nd Edition
3. ARM Cortex Datasheet available on (<https://www.arm.com/>)

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Online NPTEL course: - https://onlinecourses.nptel.ac.in/noc22_ee12/preview
2. Notes:
https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/third-party/ddi0100e_arm_arm.pdf
3. NPTEL online video content: -
<http://www.digimat.in/nptel/courses/video/106105160/L22.html>
4. <https://presiuniv.knimbus.com/user#/home>

E-content:

1. Jin-Ho Yoo, Hyun-Tae Jeong, Yeon Cho, “A Study On The Wearable Embedded System Platform” , The Journal of Korean Institute of Communications and Information Sciences, 2005
https://www.researchgate.net/publication/264114985_A_Study_On_The_Wearable_Embedded_System_Platform
2. Lech Józwiak, “Advanced mobile and wearable systems” ,Microprocessors and Microsystems, Volume 50, May 2017, Pages 202-221
<https://www.sciencedirect.com/science/article/abs/pii/S0141933117300741#!>
3. AMOL S. PATIL, UMESH J. TUPE, “Recent Trends in Platforms of Embedded Systems”, International Journal of Creative Research Thoughts, VOL. 8, issue.11
<https://www.ijcrt.org/papers/IJCRT2011003.pdf>
4. D.T sai, W.Morley, G.J.Suanninga, N.H.Lovell, A wearable real-time image processor for a vision prosthesis Computer Methods and Programs in Biomedicine, Volume 95, Issue 3, September 2009, Pages 258-269
<https://www.sciencedirect.com/science/article/abs/pii/S0169260709000923>

Topics relevant to "EMPLOYABILITY": Interfacing with ARM, programming ARM with assembly and C for developing EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Kiran Dhanaji Kale
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3435	Course Title: Wireless Technologies for Wearables Type of Course: Discipline Elective & Theory only	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of Engineering Mathematics, Basic concepts of Wearable Technology, Knowledge of basic EM theory and sensors					
Anti-requisites	NIL					
Course Description	1. Identify the need for development of wearable devices and its implications on various sectors. 2. Comprehend the design and development of various wearable inertial sensors and wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications. 3. Acquaint various wearable locomotive sensors as assistive devices for tracking and navigation					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Wireless Technologies for Wearables and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Identify and understand the need for development of wearable devices and its influence on various sectors. 2. Discuss the applications of various wearable inertial sensors for biomedical applications. 3. Comprehend the design and development of various wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications. 4. Design and develop various wearable devices for detection of physiological body signals, environmental monitoring, safety and navigational assistive devices 5. Identify the use of various wearable locomotive tools for safety and security, navigation. 6. Acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.					
Course Content:						
Module 1	Introduction to Wearable Devices	Assignment	Memory Recall based Quizzes		10 Sessions	
Topics: Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety. Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications Cardiac Activity, Pedometers.						
Module 2	Wireless technologies for wearable devices	Assignment / Quiz	Memory Recall based Quizzes		10 Sessions	
Topics: Topics: wireless technologies for wearable: NFC, BLE, wi-fi Cellular etc. Wearable system for BAN (Body area network), system architecture, Human movement identification system, Human activity recognition system, E-health application, Assistive technology for Disabilities, sports and fitness, Augmented reality.						

Module 3	Wearable Devices for Healthcare	Assignment / Quiz	Memory Recall based Quizzes		8 Sessions
Topics: Smart textile for neurological rehabilitation system (NRS), Study of flexible and wearable EMG sensors. Epidermal electronics system (EES), Study of Multi-parametric (ECG, EEG, EMG) Epidermal Electronics Systems. Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Study of flexible and wearable Piezoresistive sensors for cuffless blood pressure measurement. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles - thermistor, infrared radiation, thermopile.					
Module 4	Wearable Cameras and Microphones for Navigation	Assignment	Memory Recall based Quizzes		12 Sessions
Topics: Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist, forearm and feet, vests and belts, head-mounted devices. Targeted Application & Tools that can be used: Application Area: Wearable technology is a ubiquitous technology to monitor human beings or animals. It includes all the wearable devices, sensors in devices, communication protocols including Bluetooth, Zigbee and 3G/4G/5G, cloud computing, data fusion algorithms, and big data. The integration of all these technologies evolved an amazing technology with a huge attraction of people and within a few years, those companies who are doing their business are at the top. We are getting surrounded by wearable technology day by day. They have multiple applications in our daily life including health monitoring, education, activity monitoring, fashion, and security. Professionally Used Software: students can use open SOURCE Softwares like Arduino IDE, Python IDLE, Jupiter etc.					
Project work/Assignment:					
1. Mini Projects: At the end of the course students will be assigned a project work on solving many societal relevant problems in the field of wearables. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in an appropriate format. Presidency University Library Link . 3. Presentation: There will be a group presentation, where the students will be given a project on wearable device applications. They will have to explain/demonstrate the working and discuss the applications for the same Assignment-1: Study of Wearable EEG electrodes: Design and measurement of electrical activity of brain. Assignment-2: Study of Wearable EMG electrodes: Design and measurement of electrical activity of muscle cells. Assignment-3: Study of Wearable motion sensors using textile-based MEMS accelerometer					
Text Books:					
1. "Seamless Healthcare Monitoring", Toshiyo Tamura and Wenxi Chen, Springer 2018 2. "Wearable Sensors -Fundamentals, Implementation and Applications", by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014. 3. "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010.					

Reference Books:

1. "Wearable Electronics Sensors - For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015.
2. "Environmental, Chemical and Medical Sensors", by Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018
3. "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, by M. Mardonova and Y. Choi, vol. 11, p. 547, 2018.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Ambient assisted living and enhanced living environments: principles, technologies and control Ciprian Dobre, First Edition <<https://www.elsevier.com/books/ambient-assisted-living-and-enhanced-living-environments/dobre/978-0-12-805195-5> >
2. Introduction to wearable technologies
<<https://www.mdpi.com/books/pdfdownload/book/1088>>
3. Case studies on Wearable technology <<https://www.htciitm.org/wearables>>

E-content:

1. Patel, S., Park, H., Bonato, "A review of wearable sensors and systems with application in rehabilitation" J NeuroEngineering Rehabil 9, 21 (2012). <https://doi.org/10.1186/1743-0003-9-21>.
2. Muhammad Mahtab Alam, "Wearable Wireless Sensor Networks: Applications, Standards and Research Trends" Jan 2015 <http://dx.doi.org/10.1201/b20085-6>.
3. Bujari, A. & Gaggi, Ombretta & Quadrio, Giacomo. (2018). Smart Wearable Sensors: Analysis of a Real Case Study. 10.1109/PIMRC.2018.8580729. "Ieee Micro", vol. 16, no. 6 (1996), pp10-20.
4. Presidency University Library Link :- <https://presiuniv.knimbus.com/user#/home>

Topics relevant to "EMPLOYABILITY" : Wearable Devices for Healthcare, Wearable Cameras and Microphones for Navigation for developing EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr.M.S Divya Rani Dr. Sumantra Chaudhuri
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3437	Course Title: Wearable and Ubiquitous Computing Type of Course: Discipline Elective, Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of NFC, Wireless LAN					
Anti-requisites	NIL					

Course Description	The goal of this course is to acquaint students with some of the fundamental concepts and state-of-the-art research in the areas of ubiquitous computing. Since this field is rapidly progressing, the course is aimed at students who want to explore it as researchers or track its evolution. The major focus of this is to course is to explore the high level facilities, system architecture and protocols of the ubiquitous system and apply data analytics to facilitate next generation computing. A significant portion of the course will cover the Internet of Things (IoT). Less emphasis will be given to the hardware and device level details.			
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques using AI & IOT.			
Course Outcomes	On successful completion of this course the students shall be able to: (1) Describe the various types of location-based architectures and its application. (2) Discuss the basics of context aware architecture and its applications. (3) Explain the augmented reality of digital pen and paper. (4) Employ techniques IoT in data processing and analysis.			
Course Content:				
Module 1	Introduction to Networking Basics and Location in ubiquitous computing:	Quiz	Memory Recall based Quizzes	10Sessions
Topics: Overview, Challenges, NFC, Wireless LAN, Personal assistants, Location aware computing, Location tracking, Architecture, Location based service and applications, Location based social networks (LBSN), LBSN Recommendation.				
Module 2	Context-aware computing	Assignment/Quiz	Theoretical Understanding	11 Sessions
Topics: Context and Context-aware Computing, Issues and Challenges, Developing Context-aware Applications, System Architecture, Privacy and security in ubiquitous computing, Energy constraints in ubiquitous computing.				
Module 3	Wearable and Mobile affective computing	Assignment/Quiz	Theoretical Understanding	7 Sessions
Topics: Glass and Augmented Reality, Eye-Tracking, Digital Pen and Paper, Mobile social networking & crowd sensing, Event based social network, Human Activity and Emotion Sensing, Health Apps, Mobile p2p computing, Smart Homes and Intelligent Buildings, Mobile HCI.				
Module 4	Introduction to IoT and data analytics	Assignment	Theoretical Understanding	9 Sessions
Topics: Definition, trend, IOT components, IOT Applications, Cloud centric IOT, Open challenges, Architecture, Energy Efficiency, Participatory sensing, New Protocols, QoS, QoE, IOT and Data Management, Data cleaning and processing, Data storage, models, Search techniques.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Application Area is in the field of assistive robotics, Automatic machine translation, object detection etc.				

Professionally Used Software: python/C,C++,Jupyter Notebook on cloud/ MATLAB.	
Project work/Assignment:	
1.Case Studies: At the conclusion of each module, we will have a ‘case-based’ discussion session for approximately half the class period. Cases will be from lecture / journal article content by considering a ‘real-world’ scenario where the course concepts can be applied. We will post the case one week in advance. For each case, each student from each group formed will write a 1-2-page executive summary outlining their understanding, including relevant analyses, schematics, and graphs. Guidelines on report format will be provided with the first case.Presidency University Library Link. 2.Book/Article review: At the end of each module, a book or an article will be given to each student. They need to visit the library and write a report on their understanding about the assigned article for 1 page. 3.Presentation: There will a group presentation on latest trends and advancements in Wearable robots.	
Text Book(s):	
1. Ubiquitous Computing Fundamentals, John Krumm, CRC Press, 2010 First Edition 2. Papers from the ACM and IEEE digital libraries.	
Reference(s):	
1. Jacob Rosan, “Wearable Robots” , 2019, First Edition, Elsevier. 2. https://nptel.ac.in/courses/106/103/106103220/	
Online Resources (e-books, notes, ppts, video lectures etc.):	
1. Lecture Series on Embedded Systems by Dr. Santanu Chaudhury, Department of Electrical Engineering, IIT Delhi (315) Lecture - 37 Pervasive & Ubiquitous Computing - YouTube 2. Thad Starner reviews the greatest hits of wearable computing and describes an unusual and surprising application currently being explored at Georgia Tech, where Starner is an Associate Professor in the School of Interactive Computing (315) Wearable Computing: the Next Generation of 'Borg - YouTube	
E-content:	
1. Context-awareness in wearable and ubiquitous computing by D Abowd, AK Dey, R Orr, J Brotherton - Virtual Reality, 1998 – Springer. 2. An architecture concept for ubiquitous computing aware wearable computers by M Bauer, B Brugge, G Klinker, computing Systems ..., 2002 - ieeexplore.ieee.org 3. Overview of the Internet of Things and Ubiquitous Computing S Mehrotra, S Sinha, SK Sharma - Blockchain Technology for ..., 2021 - taylorfrancis.com	
Topics relevant to “EMPLOYABILITY SKILLS”: Semantic Web Data Management, Searching in IOT, Real-time and Big Data Analytics for The Internet of Things, Heterogeneous Data Processing, High-dimensional Data Processing, Parallel and Distributed Data Processingfordeveloping Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Ms. Swetha.G
Recommended by the Board of Studies on	15th BOS held on28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3438	Course Title: Wearable Prosthetics and Robots Type of Course: Discipline Elective, IoT Basket Theory Only		L-T-P-C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Basic concepts of mechatronics and biomechanics						
Anti-requisites	NIL						
Course Description	The purpose of this course is to enable the students to understand the fundamentals of wearable robot which is a mechatronic system that is designed around the shape and function of the human body, with segments and joints corresponding to those of the person it is externally coupled with. This course gives an overview of wearable robotics, providing the students with a complete understanding of the key applications and technologies suitable for its development. The course develops a technical thinking skills of the students and make them aware of the technology which is now employed in telemanipulation, man-amplification, neuromotor control research and rehabilitation, and to assist with impaired human motor control.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Wearable Prosthetics and Robots and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING						
Course Outcomes	On successful completion of this course the students shall be able to: (1) Describe the various types of exoskeletons and its application. (2) Discuss the basis of bioinspiration and biomimetic in wearable robots (3) Explain the kinematics dynamics involved in wearable robots. (4) Employ techniques for human-robot cognitive interaction.						
Course Content:							
Module 1	Introduction to Wearable Robots	Quiz	Memory Recall based Quizzes	10Sessions			
Topics: Wearable robots and exoskeletons, role of bio inspiration and bio mechatronics in wearable robots, Technologies involved in robotic exoskeletons, A classification of wearable exoskeletons: application domains.							
Module 2	Basis for bioinspiration and biomimetic in wearablerobots	Assignment/Quiz	Theoretical Understanding	9 Sessions			
Topics: Introduction; General principles in biological design: Optimization of objective functions- energy consumption, Multifunctionality and adaptability, Evolution; Development of biologically inspired design: Biological models, Neuromotor control structures and mechanisms as models, Muscular physiology as a model, Sensorimotor mechanisms as a model, Biomechanics of human limbs as a model.							
Module 3	Kinematics and dynamics of wearable robots	Assignment/Quiz	Theoretical Understanding	7 Sessions			
Topics:							

Introduction; Robot mechanics-motion equations: Kinematics analysis, Dynamic analysis; Human biomechanics: Medical description of human movements: Arm Kinematics, Leg kinematics, Kinematic models of the limbs, Dynamic modelling of the human limbs; Kinematics redundancy in exoskeleton systems: Introduction to kinematic redundancies, Redundancies in human-exoskeleton systems.

Module 4	Human-robot cognitive interaction	Assignment	Theoretical Understanding	9 Sessions
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Topics:
Introduction to human-robot interaction; cHRI using bioelectrical monitoring of brain activity; Physiology of brain activity; Electroencephalography (EEG) models and parameters; Brain-controlled interfaces: approaches and algorithms; cHRI through bioelectrical monitoring of muscle activity (EMG); Physiology of muscle activity; Electromyography models and parameters; Surface EMG signal feature extraction; Classification of EMG activity; Force and torque estimation; cHRI through biomechanical monitoring ; Biomechanical models and parameters; Biomechanically controlled interfaces: approaches and algorithms.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Assistive Robotics	Design a control system for exoskeleton knee joint	Python, C++	Healthcare, Rehabilitation
Telemanipulation	EEG-based control for remote prosthetic hand	MATLAB, OpenBCI	Telemedicine, Defense
Rehabilitation	EMG-based limb assistance using wearable device	Arduino, EMG sensors	Neurotherapy
Human Augmentation	Force estimation using sEMG data	TensorFlow, SciKit-Learn	Sports Tech, Military

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Design EMG-controlled robotic arm	Control prosthetic limb using biosignals	Arduino, MyoWare EMG sensor	Bio-signal mapping, actuation design
Simulate gait cycle in robotic exoskeleton	Model joint control strategies	MATLAB Simscape, ROS	Biomechanics, robotic kinematics

Text Book(s):

1. Pons, José L. Wearable robots: bio mechatronic exoskeletons, John Wiley & Sons, 2008

Reference(s):

1. Winter, David A. Biomechanics and motor control of human movement . John Wiley & Sons, 2009
2. Jacob Rosan, “Wearable Robots” , 2019, First Edition Wearable Robots” ,, Elsevier

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://nptel.ac.in/courses/112/107/112107289/>
2. <https://nptel.ac.in/courses/112/105/112105249/>
3. [\(315\) 06: Wearable Robotic Technologies - Chapter 3 - Exoskeletons \(Part 2\) - YouTube](#)

E-content:

1. Simulation of Stand-to-Sit Biomechanics for *Robotic* Exoskeletons and *Prostheses* with Energy Regeneration. IEEE Transactions on Medical *Robotics*
2. Benchmarking Wearable Robots: Challenges and ... - Frontiers-
<https://www.frontiersin.org > frobt.2020.561774 > full> by D Torricelli · 2020
3. Human-Centered Design of Wearable Neuroprostheses-<https://ojs.aaai.org > aimagazine > article > by JL Contreras-Vidal> · 2015.

Topics relevant to “EMPLOYABILITY SKILLS” : Electromyography models and parameters; Surface EMG signal feature extraction; Classification of EMG activity; Force and torque estimation for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Ms.Swetha.G
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

IoT & Sensor Technologies Basket

Course Code: ECE3439	Course Title: IoT Architecture and Protocols Type of Course:		L- T- P- C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	NIL						
Anti-requisites	NIL						
Course Description	The purpose of this course is to introduce the students to the Internet of Things (IoT) technologies and Industry 4.0 which is transforming the industry by integrating modern technology with the help of sensors, computational processes and communication technologies. The course inculcates critical thinking skill within students to develop and design a complete solution using program and interfacing hardware to provide wireless or wired smart solutions. The nature of course being comprehensive as well as application based, covers number of quizzes, simulations and interfacing practical's which helps to enhance students' abilities to become an IoT Application Designer						
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of student by using <u>PARTICIPATIVE LEARNING</u> techniques						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the types of Internets of Things (IoT) architectures namely, standard, 2-layer, 3-layer and simplified IoT architectures. (L2) CO2: Describe the functions of sensors and actuators. (L2) CO3: Choose the appropriate IoT platform from Cloud based, Edge based, or Fog based architecture for a given application scenario. (L3) CO4: Compare the cloud computing service models and cloud service providers for IoT applications. (L4) CO5: Analyze the IPV4 and IPV6 communication protocols used in IoT applications. (L4) CO6: Design an IoT based application using Arduino boards. (L3)						
Course Content:							
Module 1	IoT Architecture & components	Assignment/ Quiz	Memory Recall based Quizzes	12 Sessions			
Topics: Basics of IoT, Design and Components, future of the technology, scope and Challenges, IoT enabled Areas, characteristics, Market research for the technology, Sensors and actuators, M2M IoT standard Architecture, IoT world forum (IoTWF) standardized architecture. Architecture (2 ,3 Layer) , Physical device and control layer, Connectivity layer, edge computing layer, Upper layers, IoT reference Model. simplified IoT architecture-A core of IoT functional Stack							
Module 2	Data management	Assignment/ Quiz	Real time Application Project	12 Sessions			
Topics: Selection of IoT Platform, Embedded System, data management and computing stack- Edge computing, Fog computing cloud computing, Cloud architecture, SaaS, PaaS, IaaS. Cloud service provider Google Cloud, AWS							

Module 3	Communication in IoT	Assignment/ Quiz	Memory Recall based Quiz	11 Sessions
Iot Accessing technology- IEEE 802.15.1, networking layers, physical layer and topology. IPV4 and IPV6 Addressing IoT nodes, IoT Edge, 6LOWPAN, MQTT, AMQP, COAP and MDNS, Web socket Application aware communication, Network and channel aware communication – Topologies and Hierarchy, IoT LAN and WAN connectivity RFID, BLE, LPWAN, LORA .Real time application of IoT.				
List of Laboratory Tasks: NIL				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Healthcare	Remote patient monitoring	Raspberry Pi, AWS IoT Core	Healthcare, MedTech	
Agriculture	Smart irrigation system	Arduino, LoRa	AgriTech	
Transport	Vehicle tracking	GPS modules, MQTT	Logistics	
Retail	Smart inventory management	BLE, Cloud Dashboard	E-commerce	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
Build MQTT-based smart sensor network	Demonstrate lightweight IoT protocol usage	ESP32, Mosquitto	IoT stack implementation, publish-subscribe model	
Implement CoAP protocol on constrained devices	Test RESTful protocol in edge environments	Contiki OS, Cooja Simulator	Low-power networking, protocol simulation	
Project Work/Assignment:				
1.Case Studies: At the end of the course students will be given a 'real-world' application-based circuits like Power Amplifier, Signal/Function Generator etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format.				
2. Book/Article review: At the end of each module a book reference or an article topic will be given to each student. They need to visit the library and write a report on their understanding about the assigned article in appropriate format. <u>Presidency University Library Link</u> .				
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				
4.Assignment: Project Assignment: Design a IOT based application for healthcare and agriculture and physically challenged peoples.				
Assignment: 1] Write a brief report on Current IOT based systems available and identify their components, the Network they are using to communicate.				

Assignment: 2] Design a IOT based application for - Health care - Agriculture - Transport Management - Stock Management - COVID-19	
Text Book(s): Sudip Misra, Anandarup Mukherjee, Arijit Roy "Introduction to IOT ", Cambridge University Press, January 2021	
Reference(s): Reference Book(s): - Arshdeep Bagha & Vijay Madiseti, "Internet of Things a Hands-on Approach" - Adrian McEwen & Hakim Cassimally "Designing the Internet of Things" - IoT Fundamentals Networking Technologies, Protocols, and Use Cases for the Internet of Things By David Hanes, CCIE No. 3491 Gonzalo Salgueiro, CCIE No. 4541 Online Resources (e-books, notes, ppts, video lectures etc.): https://nptel.ac.in/courses/117/103/117103063/ https://nptel.ac.in/courses/108108179 E-Content: - - Cheena Sharma and Naveen Kumar Gondhi 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU) 23-24 Feb. 2018 Communication Protocol Stack for Constrained IoT Systems. https://ieeexplore.ieee.org/document/8519904/authors#authors - Bertha Mazon-Olivo and Alberto Pan IEEE Latin America Transactions 1 Jan.-2022 Internet of Things: State-of-the-art, Computing Paradigms and Reference Architectures. https://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=9662165 Isaac Odun-Ayo, M. Ananya, Frank Agono and Rowland Goddy-Worlu ,2018 18th International conference on Computational Science and Applications (ICCSA), 2-5 July 2018,Cloud Computing Architecture: A Critical Analysis. https://ieeexplore.ieee.org/document/8439638 Isaac Odun-Ayo, M. Ananya, Frank Agono and Rowland Goddy-Worlu ,2018 18th International Conference on Computational Science and Applications (ICCSA), 2-5 July 2018,Cloud Computing Architecture: A Critical Analysis. https://ieeexplore.ieee.org/document/8439638	
Topics relevant to the: "FOUNDATION SKILLS", Introduction and background on IoT Technology, Introduction to IOT Technology, Cloud Computing Topics relevant to the: " EMPLOYABILITY", Industry 4.0 and IoT.	
Catalogue prepared by	Mrs. Renuka Bhagwat
Recommended by the Board of Studies on	BOS NO: 15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 3/8/2022

Course Code: ECE3440	Course Title: Hardware and Software Architecture for secured IoT Systems Type of Course: Discipline Elective- IOT and Sensor Technologies Basket			L- T-P- C	3	0	0	3
Version No.	2.0							
Course Pre-requisites	Basic understanding of communication protocol stacks. Interfacing of Raspberry pi. Assembly language programming and computer system architecture knowledge.							
Anti-requisites	NIL							
Course Description	The course aims at studying holistically the software and hardware architectures of IoT Systems for better understanding of deployment in the real world. As both the architectures work in conjunction with each other so the course aims at systematically exploring key anchor points between the two and how they can create a functional IoT system.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Hardware and Software Architecture for secured IoT Systems and attain SKILL DEVELOPMENT through <u>PARTICIPATIVE LEARNING</u> techniques.							
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Recognize the Infrastructure and Networking Protocols technologies of Internet of Things (IoT). (L2) CO2: Demonstrate the Interfacing of sensors with Arduino / Raspberry Pi. (L3) CO3: Interpret the significance of Big Data and Cloud computing in IoT. (L3) CO4: Describe the features and concepts of Clustering and Web of Things (WoT). (L3) CO5: Analyze hardware and software requirements along with various implementation platforms for IoT systems. (L4)							
Course Content:								
Module 1	IoT Fundamentals and Reference Architecture, Software Design	Quiz	Memory Recall based Quizzes	10 Classes				
Topics: Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security. Control Units – Communication modules – Bluetooth – Zigbee – WIFI – GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc.), MQTT, Wired Communication, Power Sources								
Module 2	Programming the microcontroller for IoT	Assignment / Quiz	Programming and Simulation task	10 Classes				
Topics: IOT structure - RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems. Working principles of sensors – IOT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication.								

Module 3	Resource management and Web of Things	Assignment	Simulation Tasks	12 Classes
Topics: Clustering, Clustering for Scalability, Clustering for routing, Clustering Protocols for IOT The Future Web of Things – Set up cloud environment –Cloud access from sensors– Data Analytics for IOT- Rest Architectures- The web of Things				
Module 4	Hardware and Software of IoT	Assignment	System Design Task and Analysis	07 Classes
Topics: IoT Physical Devices and Endpoints – Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins. IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API				
Project work/Assignment: Project Assignment: Implementing Cloud services on Decentralized platforms. Presentation: There will a group presentation on the programming assignment or any course related self-study topic/research related topic they had done. Students will be made into group and given the programming assignment at the end of each module. Students need to use IoT Development Kits like Azure for these assignments. Tools: 1. Arduino IDE, Arduino Cloud 2. IoT Cloud Remote, Web Editor				
Textbook(s): 1. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019. 2. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach, 1st edition, University press, 2014. Reference Books: 1. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1 st edition, NCC Group, 2014 2. DaCosta, Francis, and Byron Henderson. 2. Rethinking the Internet of Things: a scalable approach to connecting everything, 1 st edition, Springer Nature, 2013. E-Content: 1. A Taxonomy of IoT Client Architectures https://ieeexplore.ieee.org/document/8354417 2. Software-Defined Edge Computing (SDEC): Principle, Open IoT System Architecture, Applications, and Challenges https://ieeexplore.ieee.org/document/8907456 3. Software Test Architectures and Advanced Support Environments for IoT https://ieeexplore.ieee.org/document/8411760 4. A Remotely Configurable Hardware/Software Architecture for a Distance IoT Lab https://ieeexplore.ieee.org/document/9556236 Online Resources (e-books, notes, ppts, video lectures etc.): 1. https://www.udemy.com/course/embedded-electronics-bootcamp-from-bit-to-deep-learning/ 2. https://nptel.ac.in/courses/106105159 3. https://rfwireless-world.com/IoT/IoT-architecture.html				

4. https://www.udemy.com/course/iot-solution-with-esp32-and-aws/	
Topics relevant to development of "EMPLOYABILITY SKILLS": Topics relevant to "EMPLOYABILITY SKILLS": System Design and Process Control in IoT, Leading skills for IoT computing are system design, architecture privacy and security for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Nipun Sharma
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3441	Course Title: IOT Edge Nodes and its Applications Type of Course: Theory	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Concepts of Data Communication and Computer Networks, Embedded Systems.					
Anti-requisites	NIL					
Course Description	This course provides insights into the fundamentals of IOT and IOT based Edge nodes and systems to provide students with a good depth of knowledge of desesigning Industrial IOT Systems for various applications. The course emphasizes on the IIOT architecture, Computing types, IOT Connecting technologies for IOT edge node.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of IOT Edge Nodes and its Applications and to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques using open-source Design Tools.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the frameworks for IIoT applications in industries. (L2) CO2: Interpret the challenges in implementing IIoT with different computing types in industry. (L3) CO3: Classify between centralized and federated learning approaches and their respective strengths and weaknesses. (L3) CO4: Illustrate Legacy Industrial and Modern Communication Protocols and Middleware Architecture, LoRaWAN- and Augmented reality. (L3) CO5: Appraise the appropriate protocol for communication between IoT devices. (L4) CO6: Examine real world applications of edge computing. (L4)					
Course Content:						
Module 1	Introduction to IoT	Assignment	Memory Recall based Quizzes	10 session		
Topics: Overview and Basic concepts of IoT, IoT architecture and components, - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, clouds, Data Analytics, Challenges. Various						

Architectures of IOT, Advantages & disadvantages. Physical Design of IoT, Logical Design of IoT, IoT enabling Technologies, IoT Applications.				
Module 2	Introduction to IIOT and the technical and business Innovators of Industrial Internet	Assignment	Memory Recall	10 session
Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT, Role of edge nodes in IoT. The Technical & Business Innovators of Industrial Internet: Miniaturization, Cyber Physical Systems, Wireless Technology, IP Mobility, NFV, Cloud and Fog, Big Data & Analytics, M2M & Artificial Intelligence, Augmented Reality, 3D Printing. IIOT Reference architecture.				
Module 3	Introduction to Edge Computing and Challenges in Federating Edge Resources:	Assignment	Analysis and Verification	10 session
Topics: Edge Computing Fundamentals: Definition and importance of edge computing, Differences between edge and cloud computing, Advantages and challenges of edge computing. IoT Edge Node Components: Sensors and actuators, Microcontrollers and processors, Communication modules and protocols, Power management in edge nodes. Relevant Technologies of Edge Computing, Cloud-Hierarchy of Edge Computing-Business Models-Opportunities and Challenges in Federating Edge Resources, and Orchestration of Network Slices in 5G, Edge, and Clouds				
Module 4	Protocols, Middleware Software Patterns and user case study for Industrial Internet Systems:	Quiz	Application	10 session
Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC. Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN Augmented reality- Real-World Smart Factories, Application of IIOT: Case study: Health monitoring, IoT smart city, Smart irrigation, Robot surveillance.				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Smart Manufacturing	Edge node-based fault monitoring	Raspberry Pi, Node-RED	Industry 4.0	
Precision Agriculture	Smart irrigation using edge nodes	Arduino, LoRaWAN	AgriTech	
Smart Healthcare	Wearable health monitoring device	ESP32, MQTT	Healthcare	
Smart Cities	Environment sensing edge node	NodeMCU, CoAP	Urban Development	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	

Design an IoT Edge Node for Temperature Monitoring	Understand sensor integration at the edge	Arduino IDE, DHT11 Sensor	Sensor interfacing, edge data acquisition, embedded system setup
Deploy MQTT-Based Messaging	Enable publish-subscribe communication	Mosquitto Broker, Node-RED	Message brokering, topic subscription, low-latency data flow
Simulate IIoT Gateway Connection	Visualize edge-cloud data flow	Packet Tracer, Node-RED	Protocol simulation, gateway interfacing, industrial communication architecture
Create Smart Irrigation Dashboard	Analyze real-time sensor data	ThingsBoard, Python	Data visualization, IoT dashboard design, real-time analytics

List of Laboratory Tasks: Nil

Course Code: ECE3442	Course Title: IoT and Cloud Computing Type of Course: Discipline Elective- IOT and Sensor Technologies Basket	L-T- P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students about the Computing basics and its services which include SaaS, PaaS, and IaaS. It also deals with different types of cloud such as Google, Amazon, IBM, Redhat, Microsoft and Salesforce.com					
Course Objective	The objective of the course is to familiarize the learners with the concepts of IoT and Cloud Computing and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain recent trends in computing such as Grid, Cluster, Distributed, Utility etc. (L2) CO2: Compare different computing paradigms (grid, cluster, distributed, utility, cloud) to select appropriate solutions for organizational needs. (L4) CO3: Analyze cloud computing architecture, service models (IaaS, PaaS, SaaS), and deployment models for different business requirements. (L4) CO4: Compare public cloud service providers (AWS, Azure, Google Cloud) and develop use cases for cloud migration strategies. (L4) CO5: Employ virtualization solutions using hypervisors and assess their impact on cloud infrastructure performance. (L3) CO6: Demonstrate the use of Platform as a Service (PaaS) and cloud storage services using simulation tools such as Google App Engine and EC2. (L3)					
Course Content:						
Module 1	Overview and Introduction of Computing	Assignment / Quiz	Implementation using Simulation tools		12 sessions	
Topics:						

Recent trends in Computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing - Business driver for adopting cloud computing. Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers. Properties, Characteristics & Disadvantages - Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing.				
Module 2	Cloud Computing Architecture	Assignment / Quiz	Implementation using Simulation Tools	13 sessions
Topics: Cloud computing stack - Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services. Service Models (XaaS) - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Deployment Models, Public cloud, Private cloud, Hybrid cloud, Community cloud.				
Module 3	Public Cloud Service Providers & Use Cases	Assignment / Quiz	Implementation using Simulation Tools	10 sessions
Topics: Service Providers: AWS, MS Azure, Google Cloud Platform, IBM Cloud. Use case related to organizations leveraging cloud computing platform / technology. Use case related to cloud migration depending upon environment.				
Module 4	Virtualization for Cloud	Assignment / Quiz	Implementation using Simulation Tools	10 sessions
Topics: Need for vitalization, Pros & Cons of vitalization, Types, System Deployment, Networking, Load Balancing Hypervisors, KVM, VMware, Virtual Box				
Targeted Application & Tools that can be used: Targeted Applications: Computing in all of the IoT applications connected to server.				
Professionally Used Software: Python , Eclipse , Thinger.io				
Project work/Assignment:				
Project Assignment: 1. Article review: At the end of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link . 3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 4. Project Assignment:- Implementation of various concepts in from deep learning using Python/ MATLAB/ SCILAB				
Textbook(s): 1 Velte T, Anthony, Velte J, Toby. "Cloud Computing-A Practical Approach", Tata McGraw Hill 2010. 2 Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper. "Cloud Computing for Dummies", Wiley Publication Inc.3.				
Reference(s): 1. Barry Sosinky. "Cloud Computing Bible", Wiley Publication Inc 2011. 2. John W. Rittinghouse, James F. Ransome. "Cloud Computing-Implementation, Management and Security", CRC Press, 2017. 3. K. Mehrotra, C. Mohan and S. Ranka, "Elements of Artificial Neural networks, MIT Press.				

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Free online course:- <https://www.udemy.com/course/building-cloud-infrastructure-with-terraform/> , Coursera - <https://www.coursera.org/learn/introduction-to-cloud>
2. NPTEL Video content: NPTEL - https://onlinecourses.nptel.ac.in/noc22_cs20/preview
3. online Notes - <https://www.coursera.org/learn/introduction-to-cloud>, https://gpmeham.edu.in/wp-content/uploads/2020/09/E-NOTES_OF_CLOUD_COMPUTING-3.pdf
4. Online PPTs - <https://www.slideshare.net/OECLIBOdishaElectron/cloud-computing-ppt-79142235>

E-content:

1. S. Z. Mohammadi and J. N. Navimipour, "Invalid cloud providers' identification using the support vector machine," International Journal Of Next-Generation Computing, vol. 8, no. 1, 2017. <https://ijngc.perpetualinnovation.net/index.php/ijngc/article/view/122>
2. Q. Zhang, L. Cheng, and R. Boutaba, "Cloud computing: state-of-the-art and research challenges," Journal of internet services and applications, vol. 1, no. 1, pp. 7-18, 2010. <https://jisajournal.springeropen.com/articles/10.1007/s13174-010-0007-6>
3. K. A. Rodrigues de Castro, "Feasible community cloud architecture for provisioning infrastructure as a service in the government sector," in Proceedings of the 20th Annual International Conference on Digital Government Research, pp. 35-40, Dubai, United Arab Emirates, June 2019. https://www.researchgate.net/publication/360118887_Descriptive_Literature_Review_and_Classification_of_Community_Cloud_Computing_Research?_sg%5B0%5D=started_experiment_milestone&_sg%5B1%5D=started_experiment_milestone

Topics related to development of "EMPLOYABILITY": Data storage in cloud computing (storage as a service) Platform and Storage, pricing, customers for developing Employability skill through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr. Nishant Sharan
Recommended by the Board of Studies on	21 st BOS held on 09/06/2025
Date of Approval by the Academic Council	Meeting No. 26 th , Dated 25/07/2025

Course Code: ECE3443	Course Title: Data Science for IOT Type of Course: Discipline Elective- IOT and Sensor Technologies Basket	L-T-P-C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	Basic concepts of Microprocessor programming and memory interfacing, knowledge of Python and Embedded C.			
Anti-requisites	NIL			
Course Description	The purpose of this course is to support the students to understand the fundamentals of Data Science and Internet of Things (IOT) along with real time applications. The course will give awareness to students, about how two independent technologies depend on each other. This course explains students about how IOT would collect data from physical objects through different sensors, and how big data will allow the faster and more efficient storage and processing of data. This course will make students to understand the meaning of big data, which is to process a large amount of data on real time basis by using different storage technologies. This course will help the students who want to choose their career as Data Scientists or IOT Analyst and also encourage students to become entrepreneurs to launch new products in IOT and Data Science.			
Course objective	The objective of the course is to familiarize the learners with the concepts of Data Science for IOT and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.			
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the core architecture, essential terminology, and foundational concepts of IoT ecosystems. (L2) CO2: Distinguish between various IoT and M2M protocols and their respective application frameworks. (L3) CO3: Examine the role of big data, cloud computing and storage. (L3) CO4: Illustrate usage of Hadoop and data analytics application. (L3) CO5: Develop firmware on an ESP platform to collect, process, and analyze real-time data from external hardware components. (L4) CO6: Assess the performance of data science workflows when applied to real-world IoT deployment scenarios. (L4)			
Course Content:				
Module 1	Fundamentals of IOT	Assignment/Quiz	IOT architectures, Frameworks and M2M	15Sessions
Introduction, Definitions & Characteristics of IOT, IOT Architectures, Physical & Logical Design of IOT, Enabling Technologies in IOT, History of IOT, About Things in IOT, The Identifiers in IOT, About the Internet in IOT, IOT frameworks, IOT and M2M				
Module 2	Data Handling & Analytics	Project	Data Analysis task	15Sessions
Introduction, Big data, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications				
Module 3	Applications of IOT	Assignment	IOT and Data Science. Real time applications	10Sessions
What is ESP8266 node-MCU □ Hardware Knowledge □ Hand Shake with ESP8266 □ Developing the Environment □ Overview about the board. Home Automation - Creating Webpage Button, Adding up required WEBPGE Elements Controlling Devices				
Targeted Application & Tools that can be used: Application Areas: Machine Learning, Deep Learning, Security Application, Home Automation, Wireless Communication in telecom industries.				
Professionally Used Software: Python, Embedded C, google cloud fire base				
Text Book(s): 1. HakimaChaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-1- 84821-140-7, Wiley Publications.Edition-1				

2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — “The Internet of Things: Key Applications and Protocols”, Wiley Publications. Edition-2	
References: 1. Daniel Minoli, — “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Wiley Publications Digital Signal Processing, 2/E Ganesh Rao, Pearson Education, Edition-1 Online Resources (e-books, notes, ppts, Video lectures): 1. Nptel video lectures on Introduction to internet of things by Prof. Sudeep Mishra, IIT Kharagpur- https://nptel.ac.in/courses/106/105/106105166/ 2. Nptel lectures on Data Science for Engineers, IIT madras by Prof. Shankar Narasimhan and Prof. Ragunathan Rangaswamy- https://nptel.ac.in/courses/106/106/106106179/ 3. Online material (PDF) on IOT Protocols and Standards http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html 4. https://presiuniv.knimbus.com/user#/home E-Content: 1. Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammed Aledhari and Moussa Ayyash Volume: 17, Issue: 4, Fourthquarter 2015 DOI: 10.1109/COMST.2015.2444095. 2. IEEE 1905.1-2013, “IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies,” 93 pp., April 12 2013, http://ieeexplore.ieee.org/document/6502164/ 3. A Survey of Data Partitioning and Sampling Methods to Support Big Data Analysis Mohammad Sultan Mahmud, Joshua Zhexue Huang, Salman Salloum, Tamer Z. Emara, and Kuanishbay Sadatdiynov, BIG DATA MINING AND ANALYTICS Volume 3, Number 2, June 2020. DOI: 10.26599/BDMA.2019.9020015. 4. Multi-Attention Fusion Modeling for Sentiment Analysis of Educational Big Data Guanlin Zhai, Yan Yang, Heng Wang, and Shengdong Du280, BIG DATA MINING AND ANALYTICS ISSN 2096-0654 06/06 pp311–319 Volume 3, Number 4, December 2020 DOI: 10.26599/BDMA.2020.9020024.	
Topics related to development of “EMPLOYABILITY”: Home Automation, Smart Cities for developing Employability skill through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Dr. K BhanuRekha Ms. R Anusha
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3444	Course Title: Industrial Internet of Things (IIoT) Type of Course Discipline Elective- IOT Basket	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of Internet of Things					
Anti-requisites	NIL					

Course Description	The Industrial Internet of Things (IIoT) involves in the use of smart sensors and actuators to enhance manufacturing and industrial processes. This course concentrates on the transformation of industrial processes through integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. This course links the automation system with enterprise, planning and product lifecycle.			
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the basic concepts of IIoT with business model, reference architecture and IIoT layers. (L2) CO2: Predict the requirements of IIoT big data analytics by utilizing machine learning, data science, and software-defined networks. (L3) CO3: Illustrate the predictive maintenance with IIoT technology and cyber physical systems. (L3) CO4: Apply IoT gateway, IoT edge system programming, cloud computing, real-time data monitoring, data analytics, and predictive maintenance techniques in IIoT applications. (L3) CO5: Apply Industrial IoT concepts in healthcare, power plants, inventory management, quality control, and facility management applications. (L3) CO6: Apply IIoT technologies, UAVs, and AR/VR-based safety systems to solve industrial safety, security, and process management problems through real-world case studies. (L3)			
Course Content:				
Module 1	Introduction	Assignment		10 Sessions
Topics: IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture-Part I, Part II. Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication.				
Module 2	IIoT Layers	Assignment		9 Sessions
Topics: Industrial IoT- Layers: IIoT Communication, IIoT Networking. Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science.				
Module 3	IIoT Data Monitoring and Control	Assignment		10 Sessions
Topics: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.				
Module 4	Application Domains	Assignment	Case Study	10 Sessions
Topics: Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies				
Targeted Application & Tools that can be used: Application: Industrial IoT is widely used in automated and remote equipment management and monitoring. A student will be able to find job in the following companies - Schneider Electric - Hewlett Packard - Ericsson - Oil and Gas Refineries Professionally Used Software:				

1. Exosite ExoSense IoT 2. AWS IoT SiteWise	
Text Book(s): 1. Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, First Edition, 2021 2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, First Edition 2021.	
References 1. Giacomo Veneri Antonio Capasso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0", Packt Publishers, First Edition, 2018 2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 1 st Edition, Wiley Publications 2010 3. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", 1 st Edition, River Publishers 2013. 4. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-1-84821-140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi.	
Online Resources (e-books, notes, ppts, video lectures etc.): 1. NPTEL Course on "INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS" by Dr. Sudip Misra, IIT KGP https://nptel.ac.in/courses/106105195 2. NPTEL Course on "Introduction to internet of things, By Prof. Sudip Misra, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc20_cs66/preview	
E-content: 1. Athanasios Bachoumis; Nikos Andriopoulos; Konstantinos Plakas; Aristeidis Magklaras, "Cloud-Edge Interoperability for Demand Response-Enabled Fast Frequency Response Service Provision", IEEE Transactions on Cloud Computing, Volume: 10, Issue: 1, 01 Jan.-March 2022, pp: 123 - 133 https://ieeexplore.ieee.org/document/9560071/authors#authors 2. S. Z. Mohammadi and J. N. Navimipour, "Invalid cloud providers' identification using the support vector machine," International Journal Of Next-Generation Computing, Volume. 8, No. 1, 2017. https://ijngc.perpetualinnovation.net/index.php/ijngc/article/view/122 3. He Li, Kaoru Ota, Mianxiong Dong, "Learning IoT in Edge: Deep Learning for the Internet of Things with Edge Computing", IEEE Network, Volume: 32, Issue: 1, Feb. 2018, pp:96 - 101, DOI: 10.1109/MNET.2018.1700202, https://ieeexplore.ieee.org/document/8270639 4. Yao-Chung Chang, Ying-Hsun Lai, "Campus Edge Computing Network Based on IoT Street Lighting Nodes", IEEE Systems Journal, Volume: 14, Issue: 1, March 2020, pp:164 - 171, https://ieeexplore.ieee.org/document/8490873	
Topics related to development of "SKILL DEVELOPMENT": IIoT Sensing, IIoT Processing, IIoT Communication. Topics related to development of "EMPLOYABILITY": Plant Safety and Security (Including AR and VR safety applications), Facility Management.	
Catalogue prepared by	Mr. Tony Aby Varkey M Ms. Srilakshmi K H
Recommended by the Board of Studies on	BOS NO: 15 th BOS held on 28/7/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3445	Course Title: Internet of Medical Things Type of Course: Program Core IoT Basket Theory	L- T-P- C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	Basics of Internet of Things and Biomedical Engineering			
Anti-requisites	NIL			
Course Description	The purpose of this course is to enable the students to appreciate the fundamental of Internet of Medical Things and its application in Healthcare Systems. This course is analytical in nature and needs a fair knowledge about basics of IoT related topics. The focus of the course will be to make health facilities accessible to everyone irrespective of their geographical location. Remote monitoring of the patients is one of the significant aspects of IoMT.			
Course Outcomes	On successful completion of this course the students shall be able to: 1. Summarize the architectures of IoMT Devices and their system applications. 2. Apply the IoMT Schema for Remote Patient Monitoring. 3. Examine the operation of Block chain Technology for Privacy-Protection of Medical health records. 4. Analyze the data compression methods for lossless Medical Data Transmission.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet of Medical Things (IoMT) and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques			
Course Content:				
Module 1	Introduction to IoMT	Quiz	Threats and Challenges of IoMT	12 Sessions
Topics: Introduction to IoMT, IoMT Devices: On-Body Devices, In-Home Devices, Community Devices, In-Clinic Devices, In-Hospital Devices, IoMT System Architecture: Data Collection Layer, Data Management Layer, Medical Server Layer, IoMT Attack Types, Challenges in IoMT Security Schemes.				
Module 2	Healthcare Schema using IoMT for Remote Patient Monitoring	Assignment	Solution for Storage and Transfer of Medical Data in IoMT	10 Sessions
Topics: Intelligent Transit Healthcare Schema Using IoMT Networking System: Vibration-Sensing Methodology for Accident Detection, System Safeguards, GPS Integration, Hospital Communication About Accident Location, MCU Connection with the ITH-IoMT Subsystem, GPS-Enabled Module for Location Information, ECG and Health Data Monitoring Schema.				
Module 3	Privacy Protection of IoMT-Based Health Records using Blockchain Technology	Assignment	GPS and GUI based medical data storage in EHR	8 Sessions
Topics: Introduction to Blockchain, Applications of Blockchain, Blockchain Advantages and Challenges, Personal Health Data Collection, Virtual Private Server (VPS)-Based Hyperledger Fabric Framework, Remote Monitoring Software Development				
Module 4	Medical Data Compression for Lossless Data Transmission	Assignment	Compression methods for telemedicine applications	8 Sessions
Topics: Introduction to Medical Data Compression: Lossless Compression, Lossy Compression, Significance of Medical Data Compression, Benefits of Medical Data Compression, Characteristics of Data Acquisition and Storage, Data Compression Techniques for Lossless Data Transmission: Coding Scheme, Bandwidth, Storage and Data Compression Techniques.				

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Remote Patient Monitoring	Monitoring cardiac activity using wearable sensors	Smart ECG devices, BLE, IoT Cloud	Healthcare, Telemedicine
Emergency Response Systems	Fall detection for elderly using accelerometers	IMUs, GPS modules	Assisted Living, Elderly Care
Health Data Management	Encrypted health data transmission	Blockchain, Hyperledger	Medical IT Services
Chronic Disease Management	Blood glucose monitoring and reporting	Smart glucose meters, IoMT platform	Diabetes Care, mHealth

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Simulate IoMT-Based Cardiac Monitoring	Understand wearable IoMT system design	Logisim, Arduino, BLE	Signal acquisition, wireless data transfer, health sensor integration
Implement GPS-Enabled Accident Detection	Enhance location-aware emergency systems	GPS Module, Embedded C, GUI Frameworks	Real-time tracking, embedded alerts, geolocation interfacing
Develop GUI for Telemedicine Portal	Enable interactive remote diagnosis	Python-Tkinter, WebSockets	GUI programming, asynchronous communication, real-time health data interface

QUIZ/Assignment:

1. Project/Programming Assignment: Students will be made into group and given the programming assignment at the end of each module. Students need to use GPS-GUI for these assignments.

Sample Assignment 1: Study of wearable smart devices for remote healthcare monitoring to detect cardiac diseases.

Sample Assignment 2: Smart assistance of elderly individuals in emergency situations at home.

2. Book Review/ Article review: A chapter of a book or an article will be given to each student. They need to visit the library and write a report on their understanding about the assigned article for 1 page. Presidency University Library Link: -

<https://presiuniv.knimbus.com/user#/home>

[Presidency University Library Link](#).

3. Presentation: There will a group presentation on the programming assignment or any course related self-study topic/research related topic they had done.

Text Book(s):

1. D. Jude Hemanth, J. Anitha George A, Tsihrintzis, *"Internet of Medical Things: Remote Healthcare Systems and Applications"*, 1st Edition, Springer Nature, Switzerland AG 2021, ISSN 2199-1073,ISSN 2199-1081 (electronic), Internet of Things ISBN 978-3-030-63936-5, ISBN 978-3-030-63937-2 (eBook)

[Internet of Medical Things: Remote Healthcare Systems and Applications - Google Books](#)

References

Reference Book(s)

1. Krishna Singh, Mohammed Elhoseny, Akansha Singh, Ahmed Elngar, "Machine Learning and the Internet of Medical Things in Healthcare", 1st Edition-2021, Elsevier Publication.
2. Qusay Hassan, "Internet of Things A to Z: Technologies and Applications", 1st Edition, The Institute of Electrical and Electronics Engineers, Inc. Published 2018 by John Wiley & Sons.

Online resources

1. Video lectures on "IoT Applications: Healthcare" by Prof. Dr. Sudip Misra, Department of Computer Science and Engineering, IIT Kharagpur.
<https://www.youtube.com/watch?v=WmlgDL44PG4>
2. E-Book, D. Jude Hemanth, J. Anitha George A, Tsihrintzis, "Internet of Medical Things: Remote Healthcare Systems and Applications", 1st Edition, Springer Nature
<https://doi.org/10.1007/978-3-030-63937-2>.
3. e-Book Series on "Internet of Things" by Giancarlo Fortino, Antonio Liotta, 1st Edition, Springer Nature. Electronic ISSN: 2199-1081, Print ISSN: 2199-1073,
<http://www.springer.com/series/11636>
4. Video lectures on "Introduction to IoT" by Prof. Dr. Sudip Misra, Department of Computer Science and Engineering, IIT Kharagpur,
https://www.youtube.com/watch?v=WUYAjsxwU4&list=PLE7VH8RC_N3bpVn-8QzOAHziEgmjQ2qE

E-content:

1. James, Christopher J., and Christian W. Hesse. "Independent component analysis for biomedical signals." Physiological measurement 26, no. 1 (2004): R15.
https://www.academia.edu/download/49895521/0967-3334_2F26_2F1_2Fr0220161026-21959-1bfp9y3.pdf
2. Addison, Paul S. "Wavelet transforms and the ECG: a review." Physiological measurement 26, no. 5 (2005): R155.
https://people.uwec.edu/walkerjs/primer/Papers/Addison_EEG_Review.pdf
3. Ce Zheng, Malcolm Egan, Laurent Clavier, Gareth W. Peters & Jean-Marie Gorce EURASIP Journal on Wireless Communications and Networking volume 2022, <https://jwcn-urasipjournals.springeropen.com/articles/10.1186/s13638-022-02110-w>.
4. Jose David Rodriguez Martinez, "A Wearable Platform for Patient Monitoring during Mass Casualty Incidents", 2018. Karlsruhe: KIT Scientific Publishing. DOI: <https://doi.org/10.5445/KSP/1000051989>
5. Nicola Carbonaro and Alessandro Tognetti, "Wearable Technologies", Printed Edition of the Special Issue Published in Technologies. MDPI BOOK publications.
<https://www.mdpi.com/books/pdfview/book/1088>
6. <https://presiuniv.knimbus.com/user#/home>

Topics relevant to "SKILL DEVELOPMENT" : IoMT devices used for Medical Application and identify the IoMT architectures for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by

Dr. Safinaz S

Recommended by the Board of Studies on

BOS Meeting NO: 15th, Dated BOS 28/07/2022

Date of Approval by the Academic Council

Academic Council Meeting No. 18th, Dated 03/08/2022

Artificial Intelligence Basket

Course Code: ECE3447	Course Title: Computational Intelligence and Machine Learning Type of Course: Discipline Elective- General Basket	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basic concepts of matrix operations, probability theory, vector and array representation.					
Anti-requisites	NIL					
Course Description	The course aims to make the students to understand the mathematical approaches for machine learning and computational intelligence algorithms. This course covers the basic concepts of Neural Networks which will enable the students to understand the concepts of machine learning. Concepts of Linear models for regression and classification will be discussed in such way that students can able to perform data analysis in practical applications. In this course, Computational intelligence algorithms are included to get better understanding of Artificial intelligence.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computational Intelligence and Machine Learning and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain the fundamentals of machine learning using supervised and unsupervised learning paradigms for model evaluation. (L2) CO2: Apply regression models using statistical estimation techniques for predictive modeling. (L3) CO3: Apply classification algorithms using decision boundaries and probabilistic learning methods for data classification. (L3) CO4: Employ feature engineering and validation techniques for improving machine learning model generalization. (L3) CO5: Utilize probabilistic and dimensionality reduction techniques for feature extraction and pattern analysis. (L3) CO6: Apply artificial neural network architectures for solving pattern recognition and classification problems. (L3)					
Course Content:						
Module 1	Fundamentals Machine Learning	Assignment	Quizzes	13 Sessions		
Topics: Introduction to computational intelligence and machine learning, supervised and unsupervised machine learning, Supervised Machine Learning:- Regression:- Linear Regression, Polynomial Regression, Classification:- Logistic Regression, Decision Trees, K-Nearest Neighbor, Naive Bayes, Random Forest, Support Vector Machine (SVM), Performance metrics for regression and classification models, Training and test splits, Feature selection and						

engineering, Overfitting/Under fitting of a model and their causes, Regularization, k-fold cross validation, confusion matrix

Module 2	Unsupervised Machine Learning	Assignment/mini project	Quizzes	10 Sessions
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Topics:
Introduction to unsupervised machine learning, Clustering, Association, Dimensionality Reduction, Comparison of supervised and unsupervised machine learning, Clustering: - Hierarchical clustering, K- Means Clustering, Dimensionality Reduction:- Principal Component Analysis (PCA), Independent Component Analysis

Module 3	Building Recommender Systems	Assignment/mini project	Programing	16 Sessions
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Topics:
Introduction To Artificial Neural Networks (ANNs), Types of Neural Networks: Feedforward Neural Network (FNN), Recurrent Neural Network (RNN), Convolutional Neural Network (CNN), Perceptron, Ex-Or Problem, Multilayer perceptron, Relation Between The Perceptron And Bayes Classifier For A Gaussian

Module 4	Applications and Case Studies in Machine Learning	Assignment/mini project	Programing / simulation	06 Sessions
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Case Studies of machine learning and neural networks such as healthcare, manufacturing, defence, banking, marketing and many more.

List of Laboratory Tasks: Nil

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Medical Diagnosis	Disease prediction using ML classification	Python, Scikit-learn	Healthcare, Biotech
Finance Forecasting	Stock trend analysis	Python, TensorFlow	Finance, FinTech
Smart City Planning	Traffic pattern clustering	Matlab, Python	Urban Planning, Government
IoT & Automation	Sensor data classification	Python, Embedded ML Tools	Manufacturing, Automotive

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Implement Perceptron Model	Understand basic neural computations	Python, NumPy	Neural activation modeling, binary classification logic
K-Means on Real Dataset	Cluster data and evaluate inertia	Python, Scikit-learn	Clustering, unsupervised learning, elbow method application
Support Vector Machine Application	Classify and visualize decision boundaries	Python, Scikit-learn	Margin maximization, kernel methods, decision boundary visualization
Genetic Algorithm for Optimization	Explore evolutionary strategies	MATLAB, DEAP	Fitness evaluation, mutation/crossover logic, convergence analysis

Text Books: 1. Pattern recognition and machine learning, Christopher M. Bishop, TMH, Springer, 2010 2. Algorithm Collections for Digital Signal Processing Applications Using Matlab, E.S. Gopi, Springer.	
Reference(s): Reference Books 1. Machine Learning and Artificial Intelligence, Ameet V Joshi, Springer, 2020. Online Resources (e-books, notes, ppts, video lectures etc.): 1. https://youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77 2. https://archive.ics.uci.edu/ml/index.php 3. https://presiuniv.knimbus.com/user#/home	
E-content: 1. Mengyuan Zhu, Jiawei Wang, Xiao Yang, Yu Zhang, Linyu Zhang, Hongqiang Ren, Bing Wu, Lin Ye, A review of the application of machine learning in water quality evaluation, Eco-Environment & Health, 2022, ISSN 2772-9850, https://doi.org/10.1016/j.eehl.2022.06.001. 2. Lin Li, Yici Cai, Qiang Zhou, A survey on machine learning-based routing for VLSI physical design, Integration, Volume 86, 2022, Pages 51-56, ISSN 0167-9260, https://doi.org/10.1016/j.vlsi.2022.05.003. 3. Vijaya B. Kolachalama, Machine learning and pre-medical education, Artificial Intelligence in Medicine, Volume 129, 2022, 102313, ISSN 0933-3657, https://doi.org/10.1016/j.artmed.2022.102313. 4. Sergio Ledesma, Mario-Alberto Ibarra-Manzano, Dora-Luz Almanza-Ojeda, Juan Gabriel Avina-Cervantes, Eduardo Cabal-Yepez, On removing conflicts for machine learning, Expert Systems with Applications, Volume 206, 2022, 117835, ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2022.117835	
Topics relevant to “EMPLOYABILITY SKILLS” : Artificial Neural Networks, Learning Algorithms, linear regression for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. G Tirumala Vasu
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th , Dated 23/10/2021

Course Code: ECE3448	Course Title : Neural Networks and Deep Learning Type of Course: Discipline Elective- General Basket	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NA					
Anti-requisites	NIL					

Course Description	The purpose of this course is to teach the major concepts, themes, and algorithm used in contemporary machine learning. The nature of this course is analytical with practical understanding. The first part of the course focuses the basics of Neural Network and the remaining practice the applications of deep learning by exploring foundational concepts, structuring popular networks and implementing models through modern technologies. The need for Deep learning helps to provide practical knowledge in handling and analyzing real-world applications. The course enhances programming abilities through assignments.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Neural Networks and Deep Learning and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING.		
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain the fundamental concepts of neural networks, including neuron models, learning paradigms, loss functions, and the limitations of traditional computing. (L2) CO2: Illustrate TensorFlow-based neural network workflows involving tensors, variables, computational graphs, and optimization concepts. (L3) CO3: Demonstrate the effect of activation functions, loss functions, and dimensionality on neural network learning behaviour. (L3) CO4: Illustrate the architecture and functional components of convolutional neural networks, including convolution, pooling, filters, and feature maps. (L3) CO5: Assess convolutional and sequence-based neural network models for feature extraction efficiency, architectural depth, and application suitability. (L3) CO6: Apply deep learning and reinforcement learning concepts to case studies in computer vision and healthcare applications. (L3)		
Course Content:			
Module 1	Introduction To Neural Networks	Quiz and assignments	20 SESSION
Topics: Neural Networks Overview- Types of Neural Networks- Applications of Neural Networks- Advantages of Neural Networks- Disadvantages of Neural Networks-- The Neural Network – Limits of Traditional Computing – Machine Learning – Neuron – FF Neural Networks – Types of Neurons – Softmax output layers- Tensor flow – Variables – Operations – Placeholders – Sessions – Sharing Variables – Graphs – Visualization- Stochastic gradient decent, Curse of Dimensionality. Loss function			
Module 2	Convolutional Neural Network	assignments	16 SESSION
Topics: Convolutional Networks- Architecture of CNN -Sequence Modeling: Recurrent and Recursive Nets – Feature Selection – Max Pooling – Filters and Feature Maps – Convolution Layer – Training and optimization of CNN parameters -Applications-			
Module 3	Deep Learning	Quiz and assignments	9 SESSION
Topics: Machine Learning Basics-Deep Feedforward Networks- Regularization for Deep Learning-Optimization for Training Deep Models- Recurrent Neural Network – Memory cells – sequence analysis – Reinforcement Learning –Q Learning – Applications: Deep learning for computer vision- Deep Learning Models for Healthcare Applications.			
Targeted Application & Tools that can be used: Application Area includes all modern electronic devices (Automation, Communication systems). The students will be able to join a profession which involves basics to high level of automation design and analysis. Professionally Used Software: PYTHON, MATLAB, JAVA. PyTorch, AWS cloud, Torch, Keras, TensorFlow-IBM Watson			
Text Book(s): 1. Simon S. Haykin, Neural Networks and Learning Machines, 3rd Ed, Pearson, 2009.			

2. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithms", O'ReillyMedia, 2017.	
Reference Book 1. José C. Principe, Neil R. Euliano, W. Curt Lefebvre, Neural and Adaptive Systems: Fundamentals through Simulations, John Wiley and Sons, 2000. 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016. 3. K. Mehrotra, C. Mohan, and S. Ranka, "Elements of Artificial Neural Networks", MIT Press	
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Introduction to Neural Networks Engineering Education (EngEd) Program Section 2. Introduction to the Artificial Neural Networks (semanticscholar.org) 3. Introduction to Neural Networks Basics (dataaspirant.com) 4. Microsoft PowerPoint - 1 - Intro.ppt (stir.ac.uk) 5. Index of /~tba3/stat665/lectures (yale.edu) 6. Introduction to Neural Network Convolutional Neural Network (analyticsvidhya.com) 7. Course Notes: Idempotent Productions (stanford.edu) 8. NPTEL - https://nptel.ac.in/courses/117/105/117105084/ 9. Artificial neural networks: a tutorial https://ieeexplore.ieee.org/abstract/document/485891 10. Artificial neural networks https://ieeexplore.ieee.org/abstract/document/8118 11. Python Machine Learning Tutorial (Data Science) - Bing video 12. Presidency University Library Link https://presiuniv.knimbus.com/user#/home	
E-content: 1. Sergiu Oprea, Pablo Martinez-Gonzalez, Alberto Garcia-Garcia, John Alejandro Castro-Vargas, Sergio Orts-Escolano, Jose Garcia-Rodriguez, and Antonis Argyros, (2022, June). A Review on Deep Learning Techniques for Video Prediction. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 44, NO. 6 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9294028 2. Qin Zou, Member, IEEE, Lihao Ni, Tong Zhang, and Qian Wang, "Deep Learning Based Feature Selection for Remote Sensing Scene Classification". In IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 12, NO. 11, NOVEMBER 2015. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7272047 3. Tsung-Han Chan, Kui Jia, Shenghua Gao, Jiwen Lu, Zinan Zeng, and Yi Ma, " PCANet: A Simple Deep Learning Baseline for Image Classification?", in IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 24, NO. 12, DECEMBER 2015 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7234886 4. Dionysis Goularas; Sani Kamis, "Evaluation of Deep Learning Techniques in Sentiment Analysis from Twitter Data" 2019, International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML). https://ieeexplore.ieee.org/xpl/conhome/8870906/proceeding	
Topics relevant to "EMPLOYABILITY SKILLS": Deep Learning, Neural network, Reinforcement Learning for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr G MUTHUPANDI Mrs ANUPAMA SINDGI
Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE3449	Course Title: Applications of Deep Learning Type of Course Discipline Elective-Signal Processing Basket		L-T-P-C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Basic concepts of statistics, algebra and matrix operations						
Anti-requisites	NIL						
Course Description	The purpose of this course is to enable the students to understand the theoretical concepts, algorithms and methodologies of Neural Networks, Deep Neural Networks, CNN, etc. The course also demonstrates the use of Python / MATLAB / SCILAB programming to develop classification applications using deep neural networks.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Applications of Deep Learning designed to improve the learner's <u>Employability Skills</u> by using <u>Participative Learning Methodologies</u> .						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Explain perceptron models, activation functions, backpropagation, optimization techniques, network width and depth, and the curse of dimensionality in deep learning. (L2) CO2: Apply activation functions, loss functions, backpropagation, and optimization techniques to train deep neural networks. (L3) CO3: Illustrate the architecture and operation of convolutional neural networks using layers, filters, parameter sharing, regularization, and performance metrics. (L3) CO4: Utilize transfer learning and classical CNN architectures to perform image learning tasks. (L3) CO5: Classify deep learning architectures based on their structural characteristics and application domains. (L3) CO6: Apply deep learning techniques for image classification, segmentation, and object detection in medical and agricultural applications. (L3)						
Course Content:							
Module 1	Fundamentals of Deep Learning	Quiz	Memory Recall based Quizzes	12 sessions			
Topics: The Perceptron - History, Discovery, and Theory, Multilayer Perceptron, Activation Functions: RELU, LRELU, ERELU Back-propagation algorithm and its variants, Width and Depth of Neural Networks, Curse of Dimensionality. Loss function, Optimization Techniques, Stochastic gradient decent							
Module 2	Deep Learning Architecture	Assignment / Quiz	Programming task	12 sessions			
Topics: Introduction to Deep Learning, Comparison - Machine Learning and Deep Learning, Architectural Overview of CNN, Layers, Filters, various performance metrics for CNN, Parameter sharing, Regularization, Concept of Transfer learning, Unsupervised Training of Neural Networks, Ethical considerations while developing Deep Learning Models							
Module 3	Variants of CNN	Assignment	Memory Recall based Quizzes	10 sessions			
Topics:							

Variants of CNN: LeNet, AlexNet, GoogleNet, ResNet, Highway Networks, PolyNet, YOLO, VGG, Inception, BLSTM, Deep Belief Networks.				
Module 4	Applications of Deep Learning	Assignment	Programming task	09 session
Topics: Deep Learning applications: Image Processing- Segmentation, Classification, object detection, Case studies from medical image processing, object detection, agricultural applications etc.				
List of Laboratory Tasks: Nil				
Targeted Application & Tools that can be used: Targeted Applications: Data analytics, Computer Vision - Image & Video Processing, Speech Recognition, Automatic machine translation, object detection etc. Professionally Used Software: Anaconda/ pytorch or google colab, Jupyter Notebook on cloud/ MATLAB Deep Learning Toolbox				
Text Book(s): 1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 1 st Edition				
Reference(s): Reference Book(s): 1. James Loy "Explore neural networks with Python", Packt Publisher, 1 st Edition 2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 1 st Edition 3. Seth Weidman "Deep Learning from Scratch ", O'Reilly Media, 1 st Edition 4. Francois Chollet "Deep Learning with Python", Manning Publications, 2 nd Edition.				
Online Resources (e-books, notes, ppts, video lectures etc.): 1. Free online self-paced course: - https://open.cs.uwaterloo.ca/python-from-scratch/ 2. Online notes: - https://open.cs.uwaterloo.ca/language-independent-lessons/ 3. NPTEL online video content: - http://www.digimat.in/nptel/courses/video/106106201/L01.html 4. Online ppts: - https://cs.uwaterloo.ca/~mli/Deep-Learning-2017-Lecture5CNN.ppt 5. Online ppts: - https://www.macs.hw.ac.uk/~dwcorne/Teaching/introdl.ppt 6. https://presiuniv.knimbus.com/user#/home				
E-content: 1. Sergiu Oprea, Pablo Martinez-Gonzalez, Alberto Garcia-Garcia, John Alejandro Castro-Vargas, Sergio Orts-Escolano, Jose Garcia-Rodriguez, and Antonis Argyros, (2022, June). A Review on Deep Learning Techniques for Video Prediction. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 44, NO. 6 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9294028 2. Qin Zou , Member, IEEE, Lihao Ni , Tong Zhang , and Qian Wang, "Deep Learning Based Feature Selection for Remote Sensing Scene Classification". In IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 12, NO. 11, NOVEMBER 2015. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7272047 3. Tsung-Han Chan, Kui Jia, Shenghua Gao, Jiwen Lu, Zinan Zeng, and Yi Ma, " PCANet: A Simple Deep Learning Baseline for Image Classification?", in IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 24, NO. 12, DECEMBER 2015 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7234886 4. Dionysis Goularas; Sani Kamis, "Evaluation of Deep Learning Techniques in Sentiment Analysis from Twitter Data" 2019, <i>International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)</i> . https://ieeexplore.ieee.org/xpl/conhome/8870906/proceeding				
Topics relevant to "EMPLOYABILITY SKILLS": CNN, RNN, Applications of Deep Learning, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Kiran Dhanaji Kale			

Recommended by the Board of Studies on	12th BOS held on 10/08/2021
Date of Approval by the Academic Council	Meeting No. 16th, Dated 23/10/2021

Course Code: ECE3451	Course Title: AI & Digital Health Type of Course: Discipline Elective- AI Basket	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Introduction to computer science, database management system.					
Anti-requisites	NIL.					
Course Description	Over the next decade artificial intelligence is likely to transform the biomedical world. Deep-learning algorithms could aid in developing new drugs, interpreting medical images, cleaning up electronic patient charts, and more. This subject explores the promise of this nascent revolution.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of AI& Digital Health and attain EMPLOYABILITY SKILLS through PARTICPATIVE LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Compare data analytics, machine learning and deep learning algorithms in digital health using Artificial Intelligence (AI). (L2) CO2: Classify the data applicable to treatment pathway, diagnostics and health administration. (L3) CO3: Examine the patient, medicine and supporting pharma data using Artificial Intelligence (AI). (L3) CO4: Infer the role of Artificial Intelligence (AI) in medical robots, empathy and Human Resources’ (HR) crisis. (L4) CO5: Interpret the values of evidence-based medicine and personalized medicine in improving the health outcomes. (L3) CO6: Apply connected medicine technologies for disease and condition management in healthcare systems. (L3)					
Course Content:						
Module 1	THE BASICS OF ARTIFICIAL INTELLIGENCE	Quiz	Memory Recall based Quizzes	10 Hours		
Artificial intelligence: a reference point for innovation, What is Artificial Intelligence?Narrow, general, or super?What do you need for developing A.I.?Data Analytics, Machine Learning & Deep Learning - Methods of Teaching Algorithms, Data in healthcare, A brief history and the current state of electronic medical records, Why do we need help from A.I. when it comes to data?Health data management, Treatment pathway design, Transforming diagnostics, Health assistance and administration, Patient management, Precision medicine, Supporting pharma: drug creation and clinical trials, FDA-approved Algorithms in Healthcare						

Module 2	APPLYING ARTIFICIAL INTELLIGENCE IN HEALTHCARE	Assignment/ Quiz	Conceptual Descriptive	10 Hours
Health data management, Treatment pathway design, Transforming diagnostics, Health assistance and administration, Patient management, Precision medicine, Supporting pharma: drug creation and clinical trials, FDA-approved Algorithms in Healthcare.				
Module 3	CHALLENGES OF ARTIFICIAL INTELLIGENCE	Assignment/ Quiz	Programming & Simulation	14 Hours
Misconceptions and overhyping, Technological limitations of A.I., Limitations of available medical data, The indispensable work of data annotators, Judgemental datasets and A.I. bias in healthcare, The need to regulate A.I., The ethics of A.I., Could you sue diagnostic algorithms or medical robots in the future? Should algorithms mimic empathy? Could A.I. Solve the Human Resources Crisis in Healthcare?				
Module 4	FUTURE OF HEALTHCARE	Assignment/ Quiz	Conceptual Descriptive	6 Hours
Shifting from Volume to Value, Evidence-based medicine, Personalized medicine, Connected Medicine: Disease and condition management, virtual assistant, Remote monitoring. Accessible diagnostic Tests. Digital health and Therapeutics.				

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Early Diagnosis	Develop CNN for X-ray image classification	Python, TensorFlow, Keras	Medical Imaging, Radiology
Precision Medicine	Design AI recommender system for treatment	Scikit-learn, Pandas	Genomics, Oncology
Remote Monitoring	IoT & AI-based wearable for vitals	Arduino, EdgeML	Telemedicine, Elderly Care
Health Records	Create NLP model for EHR summarization	spaCy, BERT	Health IT, Hospital Management

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Implement medical chatbot	Health assistance through NLP	Python, Dialogflow	Conversational modeling, NLP intent mapping
X-ray classification model	Diagnose pneumonia using CNN	Keras, TensorFlow	Medical image classification, CNN fine-tuning
Create GUI for patient database	Patient data management system	MySQL, Python Tkinter	Database GUI design, health data handling
Drug discovery with ML	Predict drug-likeness	AutoML, Scikit-learn	Drug screening, classification, model automation

Text Book(s):

T1: A guide to artificial Intelligence In healthcare, by Dr. Bertalan Meskó & Nóra Radó. The Medical Futurist Publishing, 1st edition, 2019.

T2: Artificial Intelligence in Healthcare, by Michael Matheny National Academy of Medicine, 1st edition, 2019. T3: Digital Health: Truly Transformational, by Rajendra Pratap Gupta, Publisher: Wolters Kluwer India Pvt Ltd, 1st edition, 2021. T4: Machine Learning and AI for Healthcare, by Arjun Panesar, Publisher: Apress. ISBN-13 (electronic): 978-1-4842-3799-1	
Online e-learning materials Coursera: 1. https://www.coursera.org/learn/introduction-to-digital-health 2. https://ocw.mit.edu/courses/health-sciences-and-technology/hst-947-medical-artificial-intelligence-spring-2005/ 3. https://www.mtu.edu/gradschool/programs/certificates/ai-healthcare/	
References: R1: Artificial Intelligence in Health Care System, by Amar Shukla & Lalit Kane, Nitya Publications R2: The Digital Health Revolution, by Kevin Pereau; Publisher: Transcendit Health	
E-Content 1. Yu, Kun-Hsing, Andrew L. Beam, and Isaac S. Kohane. "Artificial intelligence in healthcare." <i>Nature biomedical engineering</i> 2, no. 10 (2018): 719-731. 2. Noorbakhsh-Sabet, Nariman, Ramin Zand, Yanfei Zhang, and Vida Abedi. "Artificial intelligence transforms the future of health care." <i>The American journal of medicine, Elsevier</i>, 132, no. 7 (2019): 795-801. 3. Ghazal, Taher M. "Internet of things with artificial intelligence for health care security." <i>Arabian Journal for Science and Engineering, Springer nature</i> (2021): 1-12. 4. Mansour, Romany Fouad, Adnen El Amraoui, Issam Nouaouri, Vicente García Díaz, Deepak Gupta, and Sachin Kumar. "Artificial intelligence and internet of things enabled disease diagnosis model for smart healthcare systems." <i>IEEE Access</i> 9 (2021): 45137-45146. Topics relevant to "EMPLOYABILITY SKILLS": Health assistance and administration Patient management, Precision medicine, supporting pharma: drug creation and clinical trials, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout. Patient management Precision medicine, Supporting pharma: drug creation and clinical trials	
Catalogue prepared by	Dr. Pritam Keshari Sahoo and Dr. Ashutosh Anand
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3452	Course Title: Natural Language Processing Type of Course: Open Elective Theory only	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Prior exposure to discrete math, probability, linear algebra, optimization, linguistics, artificial intelligence, machine learning and familiarity with python will be useful but not required					
Anti-requisites	NIL					
Course Description	This course is intended as a theoretical and methodological introduction to the most widely used and effective current techniques, strategies and toolkits for natural language processing, with a primary focus on those available in the Python programming language through programming and simulation.					

Course Objective	This course is designed to develop <u>Entrepreneurial skills</u> by using <u>Experiential Learning Techniques</u>			
Course Outcomes	On successful completion of this course the students shall be able to: (1) Understand basics in natural language processing methods and strategies. (2) Evaluate the strengths and weaknesses of various NLP technologies and frameworks (3) Employ literary-historical NLP-based analytic techniques like stylometry, topic modeling, synsets and named entity recognition.			
Course Content:				
Module 1	Syntactic Processing	Assignment	Programming and Simulation task	09 Sessions
Topics: Introduction, Linguistic Background, Grammars and Parsing, Features and Augmented Grammars, Grammars for Natural Language, Toward Efficient Parsing, Ambiguity Resolution: Statistical Methods				
Module 2	Semantic Interpretation	Assignment	Programming and Simulation task	11 Sessions
Topics: Semantics and Logical Form, Linking Syntax and Semantics, Ambiguity Resolution, Other Strategies for Semantic Interpretation, Scoping and the Interpretation of Noun Phrases.				
Module 3	Context and World Knowledge	Assignment	Programming and Simulation task	10 Sessions
Topics: Knowledge Representation and Reasoning, Local Discourse Context and Reference, Using World Knowledge, Discourse Structure, Defining a Conversational Agent				
Module 4	INFORMATION RETRIEVAL AND LEXICAL RESOURCES:	Assignment	Programming and Simulation task	12 Sessions
Topics: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval - valuation Lexical Resources: World Net-Frame NetStemmers-POS Tagger- Research Corpora.				
Targeted Application & Tools that can be used: Application Area: Information Extraction, Machine Translation Professionally Used Software/Platforms/APIs/Library: 1. MonkeyLearn 2. AYLIEN 3. Spark NLP 4. IBM Watson 5. KILT				
Project work/Assignment:				
Assignment 1: Classification for Person Name Detection. Assignment 2: CRF tagging for NER Assignment 3: Neural Networks for Sentiment Analysis Assignment 4: Encoder-Decoder Models for Question Answering				
Text Book				

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming.

References

1. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
3. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit (O' Reilly 2009, website 2018)
4. Dipanjan Sarkar, Text Analytics with Python (Apress/Springer, 2016)

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [Natural Language Tool Kit](#)
2. [Stanford University CS224n: Natural Language Processing with Deep Learning](#)
3. [Paul Vierthaler's Stylometric PCA and Network Data Explorer](#)
4. [NLP 100 Exercise 2020 \(Rev 2\) - NLP100 2020](#)
5. [Natural Language Processing and Machine Learning \(princeton.edu\)](#)

E-content:

1. M. Chandhana Surabhi Velalar College of Engineering and Technology (July 2013) , “ Natural language processing future” , International Conference on Optical Imaging Sensor and Security (ICOSS),2013 Coimbatore, India
<https://ieeexplore.ieee.org/document/66784072>.
 2. Cher Don Liew, Murdoch University, “Survey of Machine Learning Algorithms Used in Natural Language Processing and Understanding Task” , October 2021
<https://www.researchgate.net/publication/358696237>
 3. Yulia Yu. Dyulicheva1, Elizaveta A. Bilashova Vernadsky Crimean Federal University, Vernadsky Ave., Simferopol, 295007, Crimea,” Learning analytics of MOOCs based on natural language processing” , Conference: 4th Workshop for Young Scientists in Computer Science & Software EngineeringAt: Kryvyi Rih, Ukraine, December 18, 2021.
<https://www.researchgate.net/publication/357173866>
 4. Kai Jiang, College of Foreign Languages, Huazhong Agricultural University, Wuhan, China Natural “Language Processing and Its Applications in Machine Translation: A Diachronic Review” 2020 IEEE 3rd International Conference of Safe Production and Informatization (IICSIP), November 2020, <https://ieeexplore.ieee.org/document/9332458>
- Other Resources:** Presidency University Library Link
<https://presiuniv.knimbus.com/user#/home>

Topics relevant to development of “FOUNDATION SKILLS” :

Catalogue prepared by	Dr. Rajiv Ranjan Singh Mr. Ramzan Basheer Ashwini B
Recommended by the Board of Studies on	BOS Meeting NO: 15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th, Dated 03/08/2022

Open Electives

Course Code: ECE3801	Course Title: Microprocessor based Systems Type of Course: Open Elective &Theory Only		L-T-P-C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	NIL						
Anti-requisites	Microprocessor Programming and Interfacing (ECE3003)						
Course Description	This course provides fundamental concepts of microprocessor-based systems. It also imparts knowledge of both hardware and software, culminating in a system design that can be used in real-world applications. The course highlights assembly language programs as well as hardware interconnections for commonly used applications.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Microprocessor based Systems and attain ENTREPRENEURIAL SKILLS through PARTICIPATIVE LEARNING.						
Course Outcomes	On successful completion of this course the students shall be able to: (1) Discuss the architecture and working principles of 8086 microprocessor. (2) Develop solutions using assembly language programming using coding and debugging skills. (3) Apply methods to interface memories and input/output devices to the microprocessor. (4) Deploy techniques to design a microprocessor-based system by interfacing programmable peripheral devices like 8255, 8254 etc.						
Course Content:							
Module 1	Fundamentals of Digital Systems and Microprocessors	Quiz	Memory Recall based Quizzes	10Sessions			
Topics: A quick review of Digital Systems - Number Systems, Logic Gates, Some important digital circuits like Multiplexers, Decoders, Flip-Flops / Latches and Registers, Intel’ s 8086 Microprocessor: Architecture, Programming Model, Pin Diagram, Min/Max Mode, Timing Diagram, Instruction cycle, Machine Cycle and T-states.							
Module 2	8086 Instruction Sets and Assembly Language Programming	Assignment / Quiz	Programming and Simulation task	12 Sessions			
Topics: Addressing Modes: Register Addressing, Immediate Addressing, Direct Addressing, Register Indirect Addressing, Base-Plus-Index Addressing, Register Relative Addressing, Base Relative-Plus-Index Addressing, Memory Addressing Mode., Instruction Sets: Data movement instructions, Program control instructions, Arithmetic and Logical Instructions, Stack Instructions, String Instructions. Assembly Language Programs.							

Module 3	Introduction to Interfacing Techniques	Assignment	Memory Interfacing Task and Analysis	10 Sessions																				
Topics: Review of some assembly programming concepts, I/O Interfacing: LEDs and toggle-switches as example, Memory Interfacing, Interrupts, Input/Output techniques: CPU initiated unconditional and conditional I/O transfer, device-initiated interrupt I/O transfer.																								
Module 4	Interfacing of Peripheral Devices with 8086	Assignment	System Design Task and Analysis	09 Sessions																				
Topics: Peripheral Devices, Programmable Peripheral Interface (Intel 8255A, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature), Programmable Interval timer (Intel 8254): pin configuration, internal block diagram of counter and modes of operation and counter read methods, READ-BACK command of Intel 8254, Microprocessor based system design.																								
Targeted Applications and Tools																								
<table><tr><th>Application Area</th><th>Hands-on Application Problem</th><th>Tools Utilised</th><th>Relevant Industries</th></tr><tr><td>Embedded Systems</td><td>LED Interfacing & Memory Access</td><td>Emu8086, Proteus</td><td>Consumer Electronics</td></tr><tr><td>Automation</td><td>Peripheral Device Control using 8255</td><td>Keil µVision, Multisim</td><td>Industrial Automation</td></tr><tr><td>Data Acquisition</td><td>Interrupt-driven I/O system</td><td>Multisim, Arduino IDE</td><td>Instrumentation</td></tr><tr><td>Smart Devices</td><td>Timer based scheduling with 8254</td><td>Proteus VSM</td><td>IoT and Embedded Startups</td></tr></table>					Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	Embedded Systems	LED Interfacing & Memory Access	Emu8086, Proteus	Consumer Electronics	Automation	Peripheral Device Control using 8255	Keil µVision, Multisim	Industrial Automation	Data Acquisition	Interrupt-driven I/O system	Multisim, Arduino IDE	Instrumentation	Smart Devices	Timer based scheduling with 8254	Proteus VSM	IoT and Embedded Startups
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Smart Devices	Timer based scheduling with 8254	Proteus VSM	IoT and Embedded Startups																					
Skill Building Through Experiential Learning																								
<table><tr><th>Activity / Task</th><th>Objective</th><th>Tools / Technologies Used</th><th>Skills Developed</th></tr><tr><td>Assembly program to add numbers</td><td>Understand assembly-language structure</td><td>Emu8086</td><td>Instruction-level coding; debugging</td></tr><tr><td>Memory interface design</td><td>Develop RAM/ROM access</td><td>Proteus</td><td>Memory mapping; hardware interfacing</td></tr><tr><td>LED toggle with 8255</td><td>Explore peripheral control</td><td>Multisim</td><td>Parallel I/O programming; hardware control</td></tr><tr><td>Timer-based interrupt</td><td>Perform time-critical task scheduling</td><td>Emu8086 + Proteus</td><td>Interrupt handling; real-time scheduling</td></tr></table>					Activity / Task	Objective	Tools / Technologies Used	Skills Developed	Assembly program to add numbers	Understand assembly-language structure	Emu8086	Instruction-level coding; debugging	Memory interface design	Develop RAM/ROM access	Proteus	Memory mapping; hardware interfacing	LED toggle with 8255	Explore peripheral control	Multisim	Parallel I/O programming; hardware control	Timer-based interrupt	Perform time-critical task scheduling	Emu8086 + Proteus	Interrupt handling; real-time scheduling
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Textbook(s): 1. Brey B. B., “The Intel Microprocessors” , Pearson, Eighth Edition.																								
References Reference Book(s) 1. Hall Douglas V. and Rao S. S. S. P., “Microprocessor and Interfacing” , McGraw Hill Education. 2. Das Lyla B., “The x86 Microprocessors” , Pearson. 3.Raj Kamal., “Microcontrollers: Architecture, Programming, Interfacing and System Design” , Pearson.																								

4. Microprocessor Programming and Interfacing Laboratory Manual
Online Resources (e-books, notes, ppts, video lectures etc.):
1. The Intel Microprocessors: Architecture Programming and Interfacing book by Barry B. Brey, Eighth Edition <https://userpages.umbc.edu/~squire/intel_book.pdf>
 2. Microprocessors Lectures adapted from slides and the textbook materials of Dr. Kip Irvine <<https://www.philadelphia.edu.jo/academics/qhamarsheh/page.php?id=13>>
 3. Documentation for Emu8086
 <<https://www.philadelphia.edu.jo/academics/qhamarsheh/uploads/emu8086.pdf>>
 4. Microprocessors and Interfacing NPTEL Video Lectures
 <<https://nptel.ac.in/courses/108/103/108103157/>>
 5. x86 Assembly Language Programming
 <<https://cs.lmu.edu/~ray/notes/x86assembly/>>

E-content:

4. Faggin, Federico, Marcian E. Hoff, Stanley Mazor, and Masatoshi Shima. "The History of the 4004." *Ieee Micro*, vol. 16, no. 6 (1996), pp. 10-20.
https://www3.nd.edu/~kogge/courses/cse40462-VLSI-fa18/www/Public/other/history_of_4004.pdf
 5. Brooks, David M., Pradip Bose, Stanley E. Schuster, Hans Jacobson, Prabhakar N. Kudva, AlperBuyuktosunoglu, John Wellman, Victor Zyuban, Manish Gupta, and Peter W. Cook. "Power-aware microarchitecture: Design and modeling challenges for next-generation microprocessors." *IEEE Micro*, vol. 20, no. 6 (2000), pp. 26-44.
<https://dominoweb.draco.res.ibm.com/reports/rc21876.pdf>
 6. Sima, Dezsö. "Decisive aspects in the evolution of microprocessors." *Proceedings of the IEEE*, vol. 92, no. 12 (2004), pp. 1896-1926.
<https://ieeexplore.ieee.org/document/1360164>
 7. Borkar, Shekhar, and Andrew A. Chien. "The future of microprocessors." *Communications of the ACM*, vol. 54, no. 5 (2011), pp. 67-77.
https://www.eng.auburn.edu/~agrawvd/COURSE/READING/ARCH/Future_of_microP_Borkar.pdf
 8. Radhakrishnan, Kaladhar, Madhavan Swaminathan, and Bidyut K. Bhattacharyya. "Power delivery for high-performance microprocessors—challenges, solutions, and future trends." *IEEE Transactions on Components, Packaging and Manufacturing Technology*, vol. 11, no. 4 (2021), pp. 655-671.
<https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9377004>.
6. <https://presiuniv.knimbus.com/user#/home>

Topics relevant to “ENTREPRENEURIAL SKILLS” : Assembly Language Programming concepts, Memory & I/O Interfacing, Interrupts and Programmable Peripheral ICs for developing Entrepreneurial Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Priyanka Ray
Recommended by the Board of Studies on	BOS Meeting NO: 15th, Dated BOS 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3802	Course Title: Artificial Neural Networks Type of Course: Open Elective Theory	L- T-P- C	3	0	0	3
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Version No.	1.0			
Course Pre-requisites	NA			
Anti-requisites	Computational Intelligence and Machine Learning (ECE3015)			
Course Description	The purpose of this course is to introduce the students to Machine learning and decision systems. The course is both conceptual and analytical and develops critical design skills by introducing the concept of “Thinking by machines” . We talk of gathering and processing of knowledge, and classifiers and controllers based on approximate reasoning. It is intended at introducing basic concepts to Non ECE and CSE students.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Artificial Neural Networks and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques			
Course Outcomes	On successful completion of this course the students shall be able to: .Distinguish Learning paradigms and Learning Algorithms for a simple neural network. .Explain the implementation of linearly separable/ non-linearly separable problems with SLP/ MLP. .Illustrate the implementation of non-linearly separable problems with MLP. .Discuss various real time problems and their solutions using ANN.			
Course Content:				
Module 1	Introduction To Artificial Neural Networks	Assignments	Assignments	09 SESSIONS
Topics: Module: 1: Natural and artificial neuron, Models Of A Neuron, simple real world learning problem like a two year baby learning sweet milk versus fire. Neural Networks- Associated Graphs And Feedback, Network Architectures And Knowledge Representation, 4 Rules of Knowledge. Learning Processes, Learning Algorithms and learning Paradigms. ANNs				
Module 2	Single layer perceptron for linearly separable problems	Quizzes and assignments	Quizzes and assignments	10 SESSIONS
Topics: Single Layer Feed forward N/W, Multilayer Feed Forward N/W, Rosenblatt’ s Perceptron, Error correction algorithm, Hebbian learning algorithm and Perceptron convergence algorithm. Introduction to Digital Logic gates. Implementation of learning with different algorithms for linearly separable digital logic gates. Derivation of perceptron convergence theorem and Introduction to LMS algorithm. Concept and Domain of MLP for non-linearly separable problems where SLP is unsuitable (no derivations).				
Module 3	Multilayer perceptron	Quizzes and assignments	Quizzes and assignments	10 SESSIONS
Topics: The back propagation algorithm, Forward path for function computation, back ward path for error computation and synaptic adjustments, X-OR Problem and why it cannot be implemented with SLP, Heuristics for making back propagation perform better.				
Module 4	Applications of ANN	Quiz	Quizzes and assignments	11 SESSIONS
Topics: Applications: Implementing Artificial Neural Network training process in MATLAB and Python, Introduction to CNN, Implementation of classification task on MATLAB,				

Implementation of image recognition using CNN on python, Demonstration of real time projects based on image classification on Teachable

List of Laboratory Tasks:

NA

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Healthcare	Disease prediction from patient data	Python (ANN, Keras)	Healthcare, Biomedical
Finance	Stock market trend prediction	MATLAB, Python	FinTech, Banking
Retail	Customer segmentation and recommendation	Python, TensorFlow	E-Commerce, Retail
Agriculture	Crop disease detection	Python, OpenCV, CNN	AgriTech, Startups
Security	Face recognition and surveillance	Python, Deep Learning	Surveillance, Cybersecurity

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Iris flower classification	Classify flower species using ANN	Python (scikit-learn), Jupyter Notebook	Pattern recognition; supervised learning
MNIST digit recognition	Recognize handwritten digits	TensorFlow/Keras	Image classification; deep learning
Stock price prediction	Predict stock trends	Python, pandas, Keras	Time-series forecasting; regression models
Music genre classification	Identify music genres from audio	Python, Librosa, ANN models	Audio feature extraction; multi-class classification
XOR gate simulation	Simulate XOR logic with MLP	MATLAB/Python	Logic gate modelling; neural computation

Project work/Assignment:

1. Sample Project works - Iris Flowers Classification Project, MNIST Digit Classification Machine Learning Project, Stock Price Prediction using Machine Learning, Wine Quality Test Project, Music Genre Classification Machine Learning Project, Handwritten Character Recognition

2. Sample Assignments -

- You went to an agriculture farm which cultivates vegetables. Identify any three problems which can be solved by machine learning and mention the steps of database preparation and training the models.
- Implement the perceptron model of a two-input XOR gate in MATLAB/ Python and verify the structure using the truth table.
- Please visit the college library or e-resource and find the below Journal and submit the report for the following paper (Attach the title of the journal and the paper)
- A single layer n/n is given with two input values $[x_1 \ x_2] = [0.05 \ 0.10]$; and initial weights as $w_1=0.15 \ w_2=0.20 \ w_3=0.25 \ w_4=0.30 \ w_5=0.40 \ w_6=0.45 \ w_7=0.50 \ w_8=0.55$; bias value as $b_1=0.35 \ b_2=0.60$; target value $T_1=0.01, T_2=0.99$. Show the steps for both forward and backward pass at the output layer.

3. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format.

[Presidency University Library Link](#).

Text Book(s):

- 1 Simon Haykin, "*Neural Networks and Learning Machines*", Pearson.

Reference Book(s)

1. C. Bishop, "Neural Networks for Pattern Recognition", Oxford University Press.
2. K. Mehrotra, C. Mohan, and S. Ranka, "*Elements of Artificial Neural Networks*", MIT Press
3. Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition) by Eric Matthes

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Introduction to ANN (NPTEL) - <https://nptel.ac.in/courses/117/105/117105084/>
2. Artificial Intelligence Courses (Udemy) - <https://www.udemy.com/topic/artificial-intelligence/>
3. Supervised Machine Learning: Regression and Classification by Dr. Andrew Ng (Coursera) - <https://www.coursera.org/learn/machine-learning>

E-content:

1. Ciregan, D., Meier, U., & Schmidhuber, J. (2012, June). Multi-column deep neural networks for image classification. In 2012 IEEE conference on computer vision and pattern recognition (pp. 3642-3649). IEEE. - <https://ieeexplore.ieee.org/abstract/document/6248110>
2. W. Lin and G. Chen, "Large Memory Capacity in Chaotic Artificial Neural Networks: A View of the Anti-Integrable Limit," in *IEEE Transactions on Neural Networks*, vol. 20, no. 8, pp. 1340-1351, Aug. 2009, doi: 10.1109/TNN.2009.2024148. - <https://ieeexplore.ieee.org/document/5166455>
3. K. B. Lee and H. S. Shin, "An Application of a Deep Learning Algorithm for Automatic Detection of Unexpected Accidents Under Bad CCTV Monitoring Conditions in Tunnels," *2019 International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)*, 2019, pp. 7-11, doi: 10.1109/Deep-ML.2019.00010. <https://ieeexplore.ieee.org/document/8876906>
4. D. Goularas and S. Kamis, "Evaluation of Deep Learning Techniques in Sentiment Analysis from Twitter Data," *2019 International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)*, 2019, pp. 12-17, doi: 10.1109/Deep-ML.2019.00011. <https://ieeexplore.ieee.org/document/8876896>

Topics relevant to "ENTREPRENEURIAL SKILLS" : Applications of ANN for developing Entrepreneurial Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue
prepared by

Ms Anupama S, Mr. Arvind Kumar

Recommended
by the Board
of Studies on

15th BOS held on 28/07/2022

Date of
Approval by
the Academic
Council

Meeting No. 18th, Dated 03/08/2022

Course Code: ECE3803	Course Title: Smart Electronics in Agriculture Type of Course:	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre- requisites	NA					
Anti-requisites	NIL					
Course Description	This course introduces the integration of electronics, embedded systems, and digital technologies in the field of agriculture to enhance productivity, sustainability, and efficiency. It provides students with a comprehensive understanding of how sensors, IoT, microcontrollers, cloud platforms, and data analytics can transform traditional agricultural practices into smart, data-driven, and automated systems. Students will explore fundamental concepts of precision agriculture, hydroponics, automation, and renewable energy-based systems while gaining insights into real-world applications such as smart irrigation, crop monitoring, livestock management, and agri-robots. The course emphasizes the role of embedded electronics, IoT communication protocols, cloud computing, and AI in building scalable smart agriculture ecosystems. Through theoretical foundations, case studies, and conceptual system design, learners will develop the ability to design and evaluate end-to-end smart agriculture solutions that leverage modern electronic and computing technologies for sustainable and digital agricultural development.					
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: C01: Explain the evolution of agriculture from traditional to modern systems and describe the role of electronics and digital technologies in transforming agricultural practices. C02: Identify and describe various agricultural sensors, actuators, microcontrollers, and communication protocols used in smart farming applications. C03: Design and demonstrate basic IoT-based architectures and embedded systems for monitoring and automation in agricultural environments. C04: Apply concepts of cloud computing, IoT, and data analytics to develop integrated smart agriculture solutions for improved decision-making. C05: Analyze case studies to evaluate the socioeconomic, environmental, and technological impacts of smart electronics and digital transformation in agriculture.					
Course Content:						
Module 1	Foundations of Smart Agriculture and Electronics	QUIZ	Comprehension level Quiz		14 classes	
Topics:						

Overview of Indian and Global Agriculture, The Green Revolution: Evolution and Technological Impacts, Methods of Agriculture: Traditional vs. Modern Approaches ,Role of Technology in Modern Agriculture, Introduction to Electronics in Agriculture ,Overview of Fertilizer, Pesticide, and Irrigation Technologies, Introduction to Sensors and Their Importance in Agriculture, Fundamentals of Data in Agriculture (Big Data Concepts),Introduction to Precision Agriculture, Basics of Hydroponics and Alternative Farming Methods, The Importance of Digital Transformation in Agriculture, Role of Data Analytics in Agricultural Decision-Making, Introduction to Smart Agriculture Ecosystem				
Module 2	Core Smart Electronics and Embedded Technologies	Case Study	Sensor and Embedded system	15 classes
Topics: Types of Sensors and Actuators Used in Agriculture, Principles of Agricultural Sensors (Soil, Moisture, Temperature, etc.), Selection, Placement, and Calibration of Sensors, Introduction to Embedded Systems in Agriculture, Microcontrollers (e.g., Arduino): Architecture, Programming, and Interfacing, Communication Protocols for Sensor Networks (Wired/Wireless Basics),Introduction to IoT in Agriculture: Concepts and Architecture Platform Overview; Device-to-Device and Device-to-Cloud Communication, Fundamentals of Edge and Fog Computing (Essentials Only; Complexities Reduced), Introduction to IoT Communication Protocols (MQTT, CoAP - Basic Application), Security and Privacy Concerns in Smart Agriculture, Introduction to Cloud Computing in Agriculture (Focus: SaaS Applications), Cloud Service Providers: Basic Overview (Google Cloud, etc.) ,RFID and Simple Actuator Controls in Agri-context (Focus on Integration Principles)				
Module 3	Applications, Integration, and Case Studies	Mini Project	System Design Task and Analysis	14 Classes
Topics: System Design Concepts for Smart Agriculture (Theory/Case-based),End-to-End IoT System Example for Agriculture, Smart Monitoring Systems: Crop, Environment, and Equipment, Automation in Irrigation and Greenhouses (Scenario-Based), Role of Renewable Energy in Smart Agriculture (Overview; Solar-Powered Devices), AI and Data Analytics Applications in Agri IoT (Introductory Concepts), Challenges of Scaling Smart Agriculture: Infrastructure and Societal Barriers, Urban Farming and Smart City Applications: E-Agriculture Overview, Introduction to Agribots (Emphasis on Sensors and Simple Robotics Theory),Aquaculture and Livestock Monitoring using Electronics (Essentials), Digital Transformation & Future Trends in Smart Agriculture, Socioeconomic and Environmental Impacts of Smart Electronics in Agriculture, Course Summary, Review, and Case Discussion (Recent Success Stories)				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Agriculture	Climate monitoring system	Arduino, DHT11, MQTT	AgriTech	
Aquaculture	Fish tank condition monitor	NodeMCU, pH sensor	Fisheries	
Urban Farming	Hydroponic nutrient controller	ESP32, Relay Modules	Smart Cities	
Smart Irrigation	Soil moisture sensing system	Raspberry Pi, Soil Sensors	Rural Automation	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
Design IoT-based smart irrigation	Automated irrigation	Arduino, soil sensor, relay	Sensor interfacing; IoT control	
Build weather data logger	Monitor temperature/humidity	DHT11, ESP32, cloud APIs	Data logging; cloud integration	

Create fish farm monitor	pH/temperature control	NodeMCU, pH sensor	Aquaculture monitoring; real-time feedback
Remote farm camera setup	Visual crop inspection	ESP32-CAM, web app	Remote imaging; web-based control

Project work/Assignment:

1. Case Studies: At the end of the course students will be given a 'real-world' application-based circuits like Power Amplifier, Signal/Function Generator etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format.
2. Book/Article review: At the end of each module a book reference or an article topic will be given to each student. They need to visit the library and write a report on their understanding about the assigned article in appropriate format. [Presidency University Library Link](#).
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.
4. Assignment: Project Assignment: Design a IOT based application for healthcare and agriculture and physically challenged peoples.
Assignment: 1] Write a brief report on Current IOT based systems available and identify their components, the Network they are using to communicate.
Assignment: 2] Design a IOT based application for
 - A. Climate condition monitoring and automated systems
 - B. Internet of Things on sustainable aquaculture system
 - C. IoT-based monitoring system for freshwater fish farming: Analysis and design
 - D. Design a IoT based agricultural system for optimal management

Textbook(s):

1. Ajith Abraham, Sujata Dash, Joel J.P.C. Rodrigues, Biswaranjan Acharya, Subhendu Kumar Pani "AI, Edge and IoT-based Smart Agriculture "1st Edition November 10, 2021
2. Rajesh Singh, Anita Gehlot, Bhupendra Singh, Sushabhan Choudhury Routledge "Internet of Things (IoT) Enabled Automation in Agriculture" CRC Press (Taylor & Francis), 2023
3. Sheetanshu Gupta, Wajid Hasan, Shivom Singh, Dharendra Kumar, Mohammad Javed Ansari, Shabistana Nisar "Agriculture 4.0: Smart Farming with IoT and Artificial Intelligence" CRC Press/Taylor & Francis, 2024 (1st ed)
4. Prasant Kumar Pattnaik, Raghvendra Kumar, S. N. Panda, Souvik Pal "IoT and Analytics for Agriculture" 2020

References

- 1.. Arshdeep Bagha & Vijay Madiseti, "Internet of Things a Hands-on Approach"
2. Adrian McEwen & Hakim Cassimally "Designing the Internet of Things" .
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, CCIE No. 3491 Gonzalo Salgueiro, CCIE No. 4541

E-Content: -

- 1 Vijaya Saraswathi R, Sridharani R, Saranya chowdary P ,Nikhil K Smart Farming: The IoT based Future Agriculture 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT) 25 February 2022 [Smart Farming: The IoT based Future Agriculture | IEEE Conference Publication | IEEE Xplore](#)
- 2 Cheena Sharma and Naveen Kumar Gondhi 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU) 23-24 Feb. 2018 Communication Protocol Stack for Constrained IoT Systems. <https://ieeexplore.ieee.org/document/8519904/authors#authors>

3	Bertha Mazon-Olivo and Alberto Pan IEEE Latin America Transactions 1 Jan.-2022 Internet of Things: State-of-the-art, Computing Paradigms and Reference Architectures. https://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=9662165
4	Isaac Odun-Ayo, M. Ananya, Frank Agono and Rowland Goddy-Worlu ,2018 18th International Conference on Computational Science and Applications (ICCSA), 2-5 July 2018,Cloud Computing Architecture: A Critical Analysis. https://ieeexplore.ieee.org/document/8439638
5	Introduction To Internet Of Things - Course (nptel.ac.in)
Topics relevant to development of “Emplobility” : The Internet of Things in agriculture for sustainable rural development. Internet of Things (IoT) in agriculture toward urban greening. Topics relevant to development of “Entrepreneurship” : Smart e-agriculture monitoring systems, AI-powered IoT. Surveying smart farming for smart cities, Farm Automation.	
Catalogue prepared by	Ms. Renuka Bhagwat
Recommended by the Board of Studies on	BOS NO: 15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 3/8/2022

Course Code: ECE3804	Course Title: Environment Monitoring system Type of Course: Open Elective	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	Internet of Things					
Course Description	This course provides fundamental concepts of various environment monitoring eco systems. It provides students with deep knowledge of sensors and data acquisition systems to monitor atmospheric Process, water resources, terrestrial ecosystems and wildlife monitoring systems. The course also provides students with deep knowledge of importance of single board computers and data loggers.					
Course Objective	The objective of the course is <u>SKILL DEVELOPMENT</u> of student by using <u>PARTICIPATIVE LEARNING</u> techniques					
Course Outcomes	On successful completion of this course the students shall be able to: (1) Describe the concepts of continuous real time monitoring systems with Internet of Things. (2) Understand constraints and opportunities of single board computers. (3) Describe the various setup to monitor and measure the data collected from environment. (4) Able to design and perform experiments on sensors and develop the projects based on the customer needs.					
Course Content:						

Module 1	Introduction	Quiz	Memory Recall based Quizzes	10 Sessions
Topics: Environmental systems, Echo systems and planet earth. Human Interaction with the environment, from measuring to knowing, continuous real time monitoring, data management and World Wide Web. Sampling, Ground based, airborne and spaceborne systems.				
Module 2	From Sensors to systems.	Assignment / Quiz	Memory Interfacing Task and Analysis	12 Sessions
Topics: Sensors and transducers: Principles of electrical quantities, circuits, sensor specifications, from sensors to transducers, case studies: from light sensors to a light transducer, from thermistor to temperature transducers, temperature transduces for air, soil and water. Thermocouples,using thermocouples.				
Module 3	Data Acquisition systems	Assignment	Memory Interfacing Task and Analysis	10 Sessions
Topics: Introduction to data loggers, applications in environment monitoring, analog channels, Real time clock, communications with datalogger, RS-232 standard, single board computers, ARM Architectures				
Module 4	Applications	Assignment	Programming and Simulation task.	09 Sessions
Topics: Atmospheric Process, water resources, terrestrial ecosystems and wildlife monitoring systems				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Air Quality Monitoring	Developing a PM2.5 and gas-level sensing system	Arduino, MQ Sensors	Smart Cities, Pollution Boards	
Water Quality Testing	Automated pH and turbidity monitoring	pH Sensor, Raspberry Pi	Agriculture, Water Supply Depts.	
Wildlife Tracking	GPS-enabled animal movement tracker	LoRa, GPS Module	Conservation Agencies	
Soil Monitoring	Soil moisture and temperature sensing for farms	ESP32, DHT11	AgriTech, Climate Research	
Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
Build an air-pollution sensor node	Understand sensor interfacing and air-quality measurement	Arduino + MQ135 + OLED	Gas-sensor integration; AQI measurement	
Log soil temperature with RTC	Acquire time-tagged data from analog sensors	ESP32 + RTC + DHT11	Time-synchronized sensing; data acquisition	
Create a web-based dashboard	Visualize live sensor data remotely	Python Flask, ThingSpeak	Web application development; data visualization	

Deploy a water-monitoring system	Collect real-time pH/turbidity levels	Raspberry Pi, pH & turbidity sensors	Water-quality sensing; sensor fusion
Project work/Assignment: 1. Mini Projects: At the end of the course students will be assigned a project work on solving many environmental monitoring issues in real time. 2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link. 3. Presentation: There will be a group presentation, where the students will be given a project on wearable device applications. They will have to explain/demonstrate the working and discuss the applications for the same.			
Textbook(s): Miguel. F Acevedo editors. "Real time Environment monitoring systems" Institution of Engineering and Technology, Taylor and Francis publication, First edition.			
References Reference Book(s) 1. Janick F Artiola editors. "Environmental Monitoring and characterization" . Elsevier academic press, second edition,2004. 2. Subash Chandra." Smart sensing for agriculture and environmental monitoring". Springer publisher, second edition,2010. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Ambient assisted living and enhanced living environments: principles, technologies and control Ciprian Dobre, First Edition < https://www.elsevier.com/books/ambient-assisted-living-and-enhanced-living-environments/dobre/978-0-12-805195-5 > 2. Introduction to wearable technologies <https://www.mdpi.com/books/pdfdownload/book/1088 > 3. Case studies on Wearable technology< https://www.htciitm.org/wearables> E-content: 1. Air Sampling Instruments for Evaluation of Atmospheric Contaminants (ISBN-13: 978-1882417087. 2. Standard Methods for the Examination of Water and Wastewater, 21st Ed. 2005 APHA, AWWA. https://www.worldcat.org/title/standard-methods-for-the-examination-of-water-and-wastewater/oclc/156744115. 3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. https://ieeexplore.ieee.org/document/8494144. 4. F. Sánchez-Rosario <i>et al.</i>, "A low consumption real time environmental monitoring system for smart cities based on ZigBee wireless sensor network," 2015, pp. 702-707, doi: 10.1109/IWCMC.2015.7289169. https://ieeexplore.ieee.org/document/7289169.			
Topics relevant to development of "SKILL" : System design for environmental monitoring systems.			
Catalogue prepared by	Dr. Divya Rani		

Recommended by the Board of Studies on	BOS NO: 15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: ECE3805	Course Title: Consumer Electronics Type of Course: Open Elective	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basics of Electronics					
Anti-requisites	NIL					
Course Description	This course is designed to enhance the knowledge, skills and attitude in performing testing assembling/disassembling of electronic components, maintaining and repairing audio/video products and systems, terminating/connecting electrical & electronics circuit and maintaining and repairing electrically-controlled domestic appliance .It also covers Computer operation with internet browsing, industry control system, Color TV, LCD, LED,CD VCD, DVD, IPS, UPS, cellular phone, House hold appliance and using specialized equipment repair and commissioning of consumer electronic products and systems.					
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Identify the devices and system functions 2. Classify the components in electronics 3. Demonstrate and explain the house hold appliances					
Course Content:						
Module 1	Audio Fundamentals, Devices & Systems	Assignment/ Quiz	Memory Recall based Quizzes	15 Sessions		
Topics: Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement, Microphone & Types, speaker types & working principle, Sound recording principle & types. Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement, Microphone & Types, speaker types & working principle, Sound recording principle & types.						
Module 2	Television Fundamentals	Assignment/ Quiz	Real time Application Project	15 Sessions		
Topics: Monochrome TV standards, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance, Different types of TV camera, Transmission standards.						

PAL-D colour TV receiver, Digital TVs:- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface, Digital Video, SDI, HDMI Multimedia Interface , Digital Video Interface, CD and DVD player.

Module 3	Home / Office Appliances	Assignment/ Quiz	Memory Recall based Quizzes	10 Sessions
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Home Appliances: Inverter, Microwave oven, Domestic Refrigerator, Controls in Refrigerator, Room Air Conditioning.

Office Appliances: Calculator, Facsimile (FAX) and Pager.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Audio Systems	Diagnose stereo speaker issues	Multisim, Oscilloscope	Entertainment, Automotive
Television Systems	Test video signal quality	HDMI Analyzer	Broadcasting, Retail
Home Appliances	Repair inverter system	Multimeter, Simulation	Home Electronics
Office Devices	Fix fax machine signal routing	Signal Tracer	Business Automation

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Disassemble audio system	Understand component functions	Hands-on tools, Multisim	Component identification; circuit tracing
Colour-TV signal test	Assess video signal integrity	Oscilloscope, DSO	Signal analysis; video troubleshooting
Fix microwave oven	Repair common faults	Practical exposure, test bench	Fault diagnosis; safety procedures
Smartphone-controlled device	Bluetooth interface control	Arduino, Android app	Wireless control; IoT integration

Project Work/Assignment:

1. Case Studies: At the end of the course students will be given a 'real-world' application based on consumer electronics. Students will be submitting a report on the same which will include in appropriate format.

2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format.

[Presidency University Library Link](#).

3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

4. Project Assignments:

Consumer electronic products are invariably covered by a 'Manufacturer's Warranty' which offers the purchaser some protection against defective workmanship and component failure during a limited term.

Assignment 1: Device control using Smart Phone's Bluetooth

Assignment 2: Stereophonic Acoustic Echo Suppression for Speech Interfaces for Intelligent TV Applications.

Text Book(s):

1. Bali.S.P, "*Consumer Electronics*", Pearson Education India, 2010 , latest edition

Reference(s):

Reference Book(s):

- R1 Bali R and Bali S.P, "*Audio video systems : principle practices & troubleshooting*" , Khanna Book Publishing Co. (P) Ltd., 2010 Delhi , India, latest edition
- R2 Gulati R.R., "*Modern Television practices*" , New Age International Publication (P) Ltd. New Delhi Year 2011, latest edition.
- R3 Gupta R.G. "*Audio video systems*" , Tata Mc graw Hill, New Delhi, India 2010, latest editio

Online Resources (e-books, notes, ppts, video lectures etc.):

1. <https://nptel.ac.in/courses/117108140>
2. https://en.wikipedia.org/wiki/Consumer_electronics

E-content:

1. H. Hoang, S. Lee, Y. Kim, Y. Choi and F. Bien, "An adaptive technique to improve wireless power transfer for consumer electronics," in IEEE Transactions on Consumer Electronics, vol. 58, no. 2, pp. 327-332, May 2012, doi: 10.1109/TCE.2012.6227430.
2. L. Morra, S. P. Mohanty and F. Lamberti, "Artificial Intelligence in Consumer Electronics," in IEEE Consumer Electronics Magazine, vol. 9, no. 3, pp. 46-47, 1 May 2020, doi: 10.1109/MCE.2019.2962163.
<https://ieeexplore.ieee.org/abstract/document/9055488>
3. F. Pieri, C. Zambelli, A. Nannini, P. Olivo and S. Saponara, "Is Consumer Electronics Redesigning Our Cars?: Challenges of Integrated Technologies for Sensing, Computing, and Storage," in IEEE Consumer Electronics Magazine, vol. 7, no. 5, pp. 8-17, Sept. 2018, doi: 10.1109/MCE.2017.2771515.

Topics relevant to the: "FOUNDATION SKILLS", Television fundamentals with their applications.

Topics relevant to the: "EMPLOYABILITY", Home / Office Appliances .

Catalogue prepared by

Recommended by the Board of Studies on

Date of Approval by the Academic Council

15th BOS held on 28/07/2022

Meeting No. 18th , Dated 03/08/2022

Course Code: ECE3806	Course Title: Product Design of Electronic Equipment Type of Course: Open Elective Theory only	L- T-P- C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	NIL			
Anti-requisites	NIL			
Course Description	The purpose of this course is to give the students the opportunity to improve their design abilities for some well-known consumer electrical goods. Basic circuit configurations for many different electronic goods are covered throughout the course. By taking into account their electrical, mechanical, ergonomic, and aesthetic design aspects, the students will be able to design and develop various electronic components. The course's thoroughness includes a variety of tests, computer-aided design-based tools, and mockup-based projects that help students develop their talents to work independently as product design engineers.			
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> technique for designing various electronic products			
Course Outcomes	On successful completion of this course the students shall be able to: (1) Outline various electronic products and their design considerations. (2) Discuss PCB design and fabrication flow.. (3) Report ergonomic, aesthetic and packaging requirements of electronic products. (4) Discover safety and reliability issues and compliance requirement in electronic products design.			
Course Content:				
Module 1	Overview of Electronic Products and Product Design Considerations	Quiz	Memory Recall based Quizzes	10 Classes
Topics: Audio Systems; Video Systems and; Domestic & Consumer; Air-conditioners and Refrigerators; Computers office Systems; Telephone & Mobile Radio Systems.				
Module 2	PCB Design and Manufacturing	Assignment / Quiz	Programming and Simulation task	12 Classes
Topics: Power Supply Design - Basic circuit configurations, Regulators, Switching Regulators, Switch Mode Power Supply, PWM Control methods; CAD Tools for PCB Design - Design Rules, Schematic, Simulation, Netlist Import, Place and Route, Advance PCBs; PCB Fabrication Process; Electromagnetic Interference (EMI) - EMC and EMI, EMI Reduction and Shielding.				
Module 3	Ergonomics and Packaging for Electronic Products	Assignment	Mock up Design and Analysis Tasks	10 Classes
Topics: Ergonomics and Aesthetics in Electronic Product Design - Overview of Ergonomics and Aesthetics in for Electronic Products, issues in placement and integration various electronic components; Packaging, Enclosures and Cooling of Electronic Systems; 3D Printing and Computer Aided Design.				
Module 4	Product Safety and Reliability	Assignment	System Design Analysis	07 Classes
Topics: Product safety and reliability issues; System Reliability - MTTF, MTBF, MTTR etc. Maintainability, Faults and their analysis; Standards related to electrical safety and fire				

hazards, Design techniques for ESD, RF interference and immunity, Line current harmonics and mains voltage surge.

Targeted Applications and Tools

Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries
Consumer Electronics	Design an ergonomic audio speaker system	Fusion 360, TinkerCAD	Appliance, Audio
Smart Devices	PCB Design for IoT-based temperature monitor	OrCAD, Eagle	IoT, Home Automation
Wearables	Compact, aesthetic fitness tracker mock-up	SolidWorks, 3D Printing	Healthcare, Fitness
Power Devices	Design EMI-protected SMPS module	LTSpice, MATLAB	Energy, Industrial Electronics

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Simulate & design audio-amplifier PCB	Understand PCB design flow	OrCAD, Proteus, KiCAD	PCB schematic capture; layout design
Prepare ergonomic product mock-up (e.g. mouse)	Apply ergonomic/aesthetic principles	Fusion 360, 3D printing	Industrial design; rapid prototyping
Reliability analysis of power-supply circuit	Estimate MTBF and analyse faults	MATLAB, LTSpice	Reliability engineering; failure analysis

Project work/Assignment:

1. Case Studies: At the end of the course students will be given a 'real-world' product design case studies. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. and/or a mock-up model in appropriate format.
2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format.
<<https://presiuniv.knimbus.com/user#/home>>.
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

Project Assignment: Carry out various design and analysis task for various consumer electronics products.

Assignment: 1] Simulate and design the layout of an audio amplifier PCB..

Assignment 2: Prepare a mockup model of an electronic product by considering ergonomic and aesthetic issues in mind (e.g. a new mouse, a new table lamp, an audio device etc.)

Textbook(s):

1. Bali, S. P. *Consumer Electronics*. Pearson Education India, 2007.
2. Mitzner, Kraig. *Complete PCB design using OrCad capture and layout*. Elsevier, 2011.

Reference(s):

Reference Book(s):

1. Mitzner, Kraig. *Complete PCB design using OrCad capture and layout*. Elsevier, 2011.
2. Reis, Ronald A. "Electronic project design and fabrication." (1989).

3. Bagad, V. S. *Electronics Product Design*. Technical Publications, 2009.
4. Ohring, Milton, and Lucian Kasprzak. *Reliability and failure of electronic materials and devices*. Academic Press, 2014.
5. O'Connor, Patrick, and Andre Kleyner. *Practical reliability engineering*. John Wiley & Sons, 2012.

Online Resources (e-books, notes, ppts, video lectures etc.):

7. Dr. Shabari Nath's NPTEL Lecture Notes and Videos on "Design of Power Electronic Converters" delivered by Paban Bujor Barua:
<https://www.youtube.com/watch?v=f1soGt0uNqc>
8. Dr. Shantanu Bhattacharya's NPTEL Lecture Notes and Videos on "Advanced manufacturing process for micro system fabrication" (IIT Kanpur):
https://www.youtube.com/watch?v=_QIVe7iFd4M
9. Prof. G. V. Mahesh's NPTEL Lecture Notes and Videos on "An Introduction to Electronics Systems Packaging", (IISc Bangalore): <https://nptel.ac.in/courses/108108031>
10. Prof. P. C. Pande's Lecture Notes on PCB Design (IIT Bmbay):
https://www.ee.iitb.ac.in/~pcpandey/courses/ee616/pcblayout_c_aug07.pdf

E-content:

4. Wallace, David R., and Mark J. Jakiela. "Automated product concept design: unifying aesthetics and engineering." *IEEE Computer graphics and applications* 13, no. 4 (1993): 66-75.
<https://ieeexplore.ieee.org/abstract/document/219453>
5. Dahl, D. W., Chattopadhyay, A., & Gorn*, G. J. (1999). The use of visual mental imagery in new product design. *Journal of Marketing Research*, 36(1), 18-28.
<https://www.jstor.org/stable/pdf/3151912.pdf>
6. Han, Sung H., Myung Hwan Yun, Jiyoung Kwahk, and Sang W. Hong. "Usability of consumer electronic products." *International journal of industrial ergonomics* 28, no. 3-4 (2001): 143-151.
<https://www.sciencedirect.com/science/article/abs/pii/S0169814101000257>
7. Kwahk, Jiyoung, and Sung H. Han. "A methodology for evaluating the usability of audiovisual consumer electronic products." *Applied ergonomics* 33, no. 5 (2002): 419-431.
<https://www.sciencedirect.com/science/article/abs/pii/S0003687002000340>
8. Creusen, Marielle EH, and Jan PL Schoormans. "The different roles of product appearance in consumer choice." *Journal of product innovation management* 22, no. 1 (2005): 63-81.
<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.0737-6782.2005.00103.x>
9. Archambeault, Bruce, Colin Brench, and Sam Connor. "Review of printed-circuit-board level EMI/EMC issues and tools." *IEEE Transactions on Electromagnetic compatibility* 52, no. 2 (2010): 455-461.
<https://ieeexplore.ieee.org/document/5466556>
10. Eshkeiti, Ali, Avuthu SG Reddy, Sepehr Emamian, Binu B. Narakathu, Michael Joyce, Margaret Joyce, Paul D. Fleming, Bradley J. Bazuin, and Massood Z. Atashbar. "Screen printing of multilayered hybrid printed circuit boards on different substrates." *IEEE transactions on components, packaging and manufacturing technology* 5, no. 3 (2015): 415-421.
<https://ieeexplore.ieee.org/document/7027841>

Topics relevant to development of "EMPLOYABILITY" : Working Principles of various electronic consumer products, PCB Design.

Topics relevant to development of "ENVIRONMENT AND SUSTAINABILITY SKILLS" : Types of materials and wastes produced during fabrication processes as well as discarded electronic waste.

**Catalogue
prepared by**

Dr. Rajiv Ranjan Singh

Recommended by the Board of Studies on	BOS NO: 15 th BOS held on 28/07/2021
Date of Approval by the Academic Council	Academic Council Meeting No. 18 th , Dated 03/08/2022

Course Code: ECE3807	Course Title: Introduction to Data Analytics Type of Course: Open Elective Theory	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Probability and Statistics					
Anti-requisites	NIL					
Course Description	This course presents an introduction to the concepts of data analysis, the role of a Data Analyst, and the tools that are used to perform data analytics. It will provide an understanding of the data ecosystem and the fundamentals of data analysis, such as data gathering or data mining. It also provides the knowledge required to effectively communicate data to stakeholders, and making a data driven decision. Throughout this course, students will learn the fundamentals of gathering data, and learning how to identify data sources. They will also learn how to clean, analyze, and share data with the use of visualizations and dashboard tools.					
Course Objective	This course is designed to develop <u>ENTREPRENEURIAL SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes	CO1] Describe the various processes of data analytics. CO2] Manipulate data in Python. CO3] Demonstrate an ability to solve and analyze the different types of data. CO4] Identify the need of data analytics.					
Course Content:						
Module 1	Introduction to Data Analytics	Quiz/Assignment	Memory Recall based Quizzes/Assignments		6 classes	
Topics: Data Analysis, Knowledge Domains of the Data Analyst, Understanding the Nature of the Data, Data Cleaning and Preparation, Handling Missing Data, Data Transformation, String Manipulation, The Data Analysis Process, Quantitative and Qualitative Data Analysis, Data Loading, Storage, and File Formats, I/O API Tools, CSV and Textual Files, Reading Data in CSV or Text Files, Time Series data analysis						
Module 2	Introduction to the Python' s World- Plotting and Visualization	Quiz/Assignment	Programming, Analysis and Visualization		8 classes	

Topics: Python–The Programming Language, Python 2 and Python 3, IPython, and Jupyter Notebooks, Essential Python Libraries, NumPy, pandas, matplotlib, SciPy, scikit-learn, Built-in Data Structures, Functions, and Files, The matplotlib Library, Plotting with pandas and seaborn, Other Python Visualization Tools.				
Module 3	Statistics, data, and Statistical Thinking	Assignment	Programming, Analysis and Visualization	8 classes
Topics: Describing Qualitative Data, Numerical Measures of Central Tendency, using the Mean and Standard Deviation to Describe Data, Methods for Detecting Outliers: Box Plots and z-Scores, Types of Random Variables, Probability Distributions for Discrete Random Variables, Expected Values of Discrete Random Variables, The Binomial Random Variable, The Poisson Random Variable, Statistical inference, Bias, The method of moments, least squares/weighted least squares, Maximum likelihood				
Module 4	Machine Learning with scikit-learn	Assignment	Programming, Analysis and Visualization	9 classes
Topics: The scikit-learn Library, Supervised Learning with scikit-learn, The Iris Flower Dataset, K-Nearest Neighbors Classifier, Linear Regression, The Least Square Regression, Support Vector Machines (SVMs)				
Targeted Applications and Tools				
Application Area	Hands-on Application Problem	Tools Utilised	Relevant Industries	
Retail Analytics	Sales data cleaning and forecasting	pandas, matplotlib	E-commerce	
Financial Markets	Stock price trend analysis	NumPy, seaborn	Banking/Finance	
Healthcare	Patient data visualization	Python dashboards	HealthTech	
Social Media	Sentiment analysis on tweets	NLTK, scikit-learn	Media & Marketing	
Skill Building Through Experiential Learning				
Activity / Task	Objective	Tools / Technologies Used	Skills Developed	
Data-cleaning assignment	Apply preprocessing techniques to real data	Python, pandas	Data wrangling; data quality improvement	
Visualization project	Build interactive dashboards	matplotlib, seaborn, plotly	Data visualization; dashboard design	
Model-building exercise	Create and test ML models	scikit-learn, Jupyter	Machine-learning modelling; evaluation	
Group presentation	Evaluate analytics applications in domains	Case study, PPT	Communication; critical analysis	
Project work/Assignment:				
1. Project: At the end of the course, students will be given a ‘real-world’ data analytics application based topic as a project. Students will be submitting a report, which will include different steps of data cleaning and preparation, plotting and visualization and Results of the analysis etc. in appropriate format.				

2. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.

3. Assignments:

Assignment 1: Using Python programming, the students are required to analyze loan application data.

Assignment 2: Using Python programming, the students are required to analyze stock price data and perform different steps of data cleaning and preparation, plotting and visualization

Textbook

T1. Wes McKinney, “Python for Data Analysis: Data Wrangling With Pandas, Numpy, And Ipython” , O’ Reilly Publications, 2017

T2. Fabio Nelli, “Python Data Analytics Data Analysis and Science Using Pandas, matplotlib, and the Python Programming Language” , Apress.

References

R1. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.

R2. Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. “John Wiley & Sons, Inc” .

Topics for Technology Enabled Learning:

1. Data Analysis with Python | Coursera, Offered by IBM

<https://www.coursera.org/professional-certificates/ibm-data-analyst>

2. Data Analytics with Python - NPTEL Online Courses, by Prof. A Ramesh | IIT Roorkee

https://onlinecourses.nptel.ac.in/noc21_cs45/preview

Other Resources:

Presidency University Library Link

<https://presiuniv.knimbus.com/user#/home>

1. [Big social data analytics of changes in consumer behaviour and opinion of a TV broadcaster | IEEE Conference Publication | IEEE Xplore](#)

2. [Forecasting Nike's sales using Facebook data | IEEE Conference Publication | IEEE Xplore](#)

Topics relevant to development of “FOUNDATION SKILLS” : Interpret the type of data analysis tools and techniques.

Topics relevant to “HUMAN VALUES & PROFESSIONAL ETHICS” : Concepts of Data collection and analysis for an assignment.

Catalogue prepared by	Mrs. Pallabi Kakati
Recommended by the Board of Studies on	BOS Meeting NO: 15th, Dated BOS 28/07/2022
Date of Approval by	Academic Council Meeting No. 18th, Dated 03/08/2022

the Academic Council	
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Course Code: ECE3808	Course Title: Machine Vision for Robotics Type of Course: Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NA					
Anti-requisites	NIL					
Course Description	The purpose of this course is to teach the principles and applications of vision system in modern manufacturing Environment. The nature of this course is analytical with practical understanding. It is also intended at introducing basic concepts to Non ECE and CSE students. The course is analytical in nature and needs fair knowledge of digital image processing. The first part of the course focuses the basics vision systems and object recognition. Further, it explores the knowledge in robot vision applications.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Explore various vision systems for Machines 2) Understand the image capturing and processing techniques 3) Apply the robotic operating system to Machines					
Course Content:						
Module 1	Overview of Machine Vision in IP	Quizzes and assignments	12 SESSION			
Topics: Basic Components - Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics - Cameras - Camera-Computer interface- Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours - Image Enhancement : Gray value transformations, image smoothing, Fourier Transform - Geometric Transformation - Image segmentation - Segmentation of contours, lines, circles and ellipses - Camera calibration - Stereo Reconstruction- Object recognition, Approaches to Object Recognition, Recognition by combination of views - objects with sharp edges, using two views only, using a single view, use of depth values.						
Module 2	Vision algorithms and applications	Quizzes and assignments	12 SESSION			
Topics: Transforming sensor reading, Mapping Sonar Data, aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.						
Module 3	ROBOT Vision	Quizzes and assignments	12 SESSION			
Topics: Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV - The cv_bridge Package						
Targeted Applications and Tools						
Application Area	Hands-on Application Problem	Tools Utilized	Relevant Industries			
Unmanned Vehicles	Stereo vision mapping	ROS, OpenCV, Python	Autonomous Systems			

Smart Surveillance	Real-time object tracking	TensorFlow, OpenCV	Security, Défense
Healthcare Robotics	Tracking surgical instruments	MATLAB, Keras	Medical Devices
Manufacturing Automation	Object detection on assembly lines	PCL, PyTorch	Industrial Robotics

Skill Building Through Experiential Learning

Activity / Task	Objective	Tools / Technologies Used	Skills Developed
Shape-from-shading reconstruction	Understand 3D surface estimation	MATLAB, Python	3D vision; surface reconstruction
ROS camera driver integration	Real-time image processing with robots	ROS, OpenCV	ROS integration; real-time vision processing
Book/article review	Build analytical reading skills	Library research	Technical literature review; critical thinking
Group presentation on vision task	Collaborative learning & technical discussion	PowerPoint, demonstration	Teamwork; communication of vision algorithms

Project work/Assignment:

1. Case Studies: At the end of the course students will be given a real-world scenario for any application like, Drive the solution of a shape-from-shading problem at a singular point, by fitting a smooth local shape near the singular point. Students will be submitting a report which will include Design and implementation methodology.
2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format.
[Presidency University Library Link](#).
3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.
4. Assignment 1:) Consider a flying robotic system that uses binocular stereo to obtain three dimensional information from pairs of images. Suppose that the scale of the recovered three dimensional coordinates is not known accurately because the baseline between exposure stations is not known with precision. Now suppose that two such three-dimensional models — obtained along different flight paths — are to be related. In this case, determining the absolute orientation requires that, in addition to translation and rotation, a scale factor relating the two three dimensional models be found as well.

Text Book(s):

- 6 Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications” , WILEY-VCH, Weinheim, 2008.
- 7 Damian m Lyons, “Cluster Computing for Robotics and Computer Vision” , World Scientific, Singapore, 2011.

References:

Reference Book

4. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addison - Wesley Publishing Company, New Delhi, 2007.
5. Shimon Ullman, "High-Level Vision: Object recognition and Visual Cognition", A Bradford Book, USA, 2000.
6. 3. R. Patrick Goebel, "ROS by Example: A Do-It-Yourself Guide to Robot Operating System - Volume I", A Pi Robot Production, 2012.
7. K. Mehrotra, C. Mohan, and S. Ranka, "Elements of Artificial Neural Networks", MIT Press

Online Resources (e-books, notes, ppts, video lectures etc.):

1. [6.801 / 6.868 Machine Vision, Lecture 2 \(mit.edu\)](#)
2. [6.801/6.866: Machine Vision, Lecture 8 \(mit.edu\)](#)
3. [6.801/6.866: Machine Vision, Lecture 11 \(mit.edu\)](#)
4. [6.801/6.866: Machine Vision, Lecture 13 \(mit.edu\)](#)
5. [6.801/6.866: Machine Vision, Lecture 23 \(mit.edu\)](#)
6. NPTEL - [Robotics - Course \(nptel.ac.in\)](#)
7. [Python Machine Learning Tutorial \(Data Science\) - Bing video](#)
8. [E-Book 1. Machine Vision \(November 1996 edition\) | Open Library](#)
9. <https://presiuniv.knimbus.com/user#/home>

E-Content

1. Carsten Steger, Markus Ulrich "A Multi-view Camera Model for Line-Scan Cameras with Telecentric Lenses (springer.com)" Journal of Mathematical Imaging and Vision (2022) 64:105-130 <https://doi.org/10.1007/s10851-021-01055-x>
2. Carsten Steger "A Comprehensive and Versatile Camera Model for Cameras with Tilt Lenses (springer.com)" Int J Comput Vis (2017) 123:121-159 DOI 10.1007/s11263-016-0964-8
3. Markus Ulrich, Christian Wiedemann, Carsten Steger: "CAD-Based Recognition of 3D Objects in Monocular Images" International Conference on Robotics and Automation (2009).
4. Aggarwal, M., Ahuja, N. A Pupil-Centric Model of Image Formation. International Journal of Computer Vision 48, 195-214 (2002). <https://doi.org/10.1023/A:1016324132583>

The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING in Robotic operating System (ROS)- installing and testing ROS camera Drivers, ROS to OpenCV

Catalogue prepared by	Dr G MUTHUPANDI
Recommended by the Board of Studies on	15 th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18 th , Dated 03/08/2022

MAC Basket

Course Code: PPS1025	Course Title: Industry Readiness Program – I (Audited Course) Type of Course: Practical Only Course	L- T - P- C	0	0	2	0
Version No.	1.0					
Course Pre-requisites	- Students are expected to understand Basic English. - Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					

Course Description	This course is designed to enable graduates to develop foundational communication and self-management skills essential for academic success, professional networking, and personal effectiveness. They will be able to initiate and maintain positive interactions, set and achieve goals efficiently, and communicate professionally in written form.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Employability for Young Professionals" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.		
Course Out Comes	On successful completion of this course the students shall be able to: CO 1 Distinguish between phatic and informative communication CO 2 Illustrate the components of a SMART goal using personal or academic examples CO3 Apply standard email etiquette practices to compose professional and context-appropriate emails		
Course Content			
Module 1	Phatic Communion & Networking	Classroom activities	10 Hours
Phatic Communion & Networking Subtopics: 1. Small talks - Mastering Conversations 2. Networking for Changing Times 3. Elevator Pitch 4. Evaluation (Elevator Pitch)			
Module 2	The Power Trio: S.W.O.T, S.M.A.R.T Goals and Habits	Role plays	10 Hours
The Power Trio: S.W.O.T, S.M.A.R.T Goals and Habits Subtopics: 1. Personal SWOT analysis 2. The Power of Habits & Habit Loop 3. Crafting Your Academic & Personal SMART Goals 4. Evaluation (Video on S W O T & SMART Goal worksheet)			
Module 3	Email Etiquettes	Individual and group presentation	10 Hours
Inbox Impact: Email Etiquette Subtopics: 1. Email Etiquette Basics 2. Email Mishaps - Identify & correct mistakes 3. Introduction to AI Writing Prompts 4. AI Email Writing Challenge (Real time drafting of AIAssisted Email)			
Faculty: L&D			
Targeted Application & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Activities			
REFERENCE MATERIALS: A. Reference Books (For Module 1): 1. Soft Skills - Enhancing Employability: Connecting Campus with Corporate" by M S Rao 2. Everyone Communicates; Few Connect: What the Most Effective People Do Different			

Hardcover

B. Reference Books (For Module 2):

3. Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones by James Clear
4. Goals! by Brian Tracy, 2018
5. S.M.A.R.T Goals -made simple by SJ Scott

C. Movies recommended.

My Fair Lady - 1964, The Intern - 2015

D. Videos to watch on Module 1.

1. Phatic Communication pt1
2. How to communicate confidently ? #learnenglish #janhavipanwar #speaking #communication

Assignment proposed for this course

Assignment 1: SMART Goal

Assignment 2: AI tools for prompt search

Continuous Individual Assessment

Module 1: Presentation

Module 2: Activity based assessment

Module 3: Class assessment

Course Code: PPS1026	Course Title: Industry Readiness Program - II (Audited Course) Type of Course: Practical Only Course	L- T - P- C	0	0	2	0
Version No.	1.0					
Course Pre-requisites	- Students are expected to understand Basic English. - Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					
Course Description	This course is designed to enable students learn styles of communication; team building and use empathy in leadership. The course will benefit learners in preparing themselves effectively through various activities and learning methodologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of “Industry Readiness for Young Professionals” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.					

Course Out Comes	On successful completion of this course the students shall be able to: CO 1 Apply different communication skills for success in workplace CO 2 Practice team building skills for career success CO3 Demonstrate ethical leadership skills in workplace
Course Content	

Course Code: APT4002	Course Title: Introduction to Aptitude (Audited)	L- P- C	0	2	0
Version No.	1.0				
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English				
Anti-requisites	Nil				
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.				
Course Outcomes	On successful completion of the course the students shall be able to: CO1] Recall all the basic mathematical concepts they learnt in high school. CO2] Identify the principal concept needed in a question. CO3] Solve the quantitative and logical ability questions with the appropriate concept. CO4] Analyze the data given in complex problems. CO5] Rearrange the information to simplify the question				
Course Content:					
Module 1	Quantitative Ability	Assignment	Bloom’ s Level: Application		12 Hours
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes					
Module 2	Logical Reasoning	Assignment	Bloom’ s Level: Application		18 Hours
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning					

Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS	
Text Book 1. Quantitative Aptitude by R S Aggarwal 2. Verbal & Non - Verbal Reasoning by R S Aggarwal	
References 1. www.indiabix.com 2. www.youtube.com/c/TheAptitudeGuy/videos	
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	L&D Department faculty members
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: APT4004	Course Title: Aptitude Training- Intermediate Type of Course: Practical Only Course	L- T - P- C	0	0	2	0
Version No.	1.0					
Course Pre-requisites	Students should have the basic concepts of Quantitative aptitude along with its applications in real life problems.					
Anti-requisites	NIL					
Course Description	This is a skill-based training program for the students. This course is designed to enable the students to enhance their skills in Quantitative Aptitude.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: CO1: Recall all the basic mathematical concepts. CO2: Identify the principle concept needed in a question. CO3: Solve the quantitative and logical ability questions with the appropriate concept. CO4: Analyze the data given in complex problems.					
Course Content:						
Module 1	Quantitative Ability 1	Assignment			16 Hours	
Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss						

Module 2	Quantitative Ability 2	Assignment	14 Hours
Topics: Time Speed and Distance, Boats and Streams, Simple Interest, Compound Interest, Probability, Permutation and Combination Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS Continuous Evaluation: CA1 - Online Test CA2 - Online Test CA3 - Online Test Assignment Text Book: 1. Fast Track Objective by Rajesh Verma 2. R S Aggarwal 3. Rakesh Yadav References: 1. www.indiabix.com 2. www.testbook.com 3. www.youtube.com/c/TheAptitudeGuy/videos Topics relevant to Skill Development: Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through components mentioned in course handout.			
Catalogue prepared by	Faculty of L&D		
Recommended by the Board of Studies on	BOS held on		
Date of Approval by the Academic Council	Academic Council Meeting held on		

Course Code: APT4006	Course Title: Logical and Critical Thinking Type of Course: Audited	L- T-P- C	0	0	2	0
Version No.	1.0					
Course Pre-requisites	Students should have the basic concepts of Logical reasoning and Critical thinking, along with its applications in real life problems.					
Anti-requisites	Nil					
Course Description	This is a skill-based training program for the engineering students (Undergraduate). This course is designed to enable the students to enhance their skills in Logical reasoning and Critical thinking.					
Course Objective	The objective of the course is to familiarize the learners with concepts in Logical reasoning and Critical thinking through problem solving techniques suitable for their career development.					

Course Outcomes	On successful completion of the course the students shall be able to:			
	CO1] Understand all the concepts.			
	CO2] Apply the concepts in problem solving (Bloom’s taxonomy Level 3)			
	CO3] Analyze and structure the reasoning techniques and spatial visualization skills			
Course Content:				
Module 1	Logical Thinking	Assignment		16 Hours
	Topics: Syllogisms, Cubes and Dices, Mirror and Water images, Paper cutting and Folding, Embedded figures & Completion of figures, Data Interpretation, Data sufficiency			
Module 2	Critical Thinking	Assignment		14 Hours
	Topics: Analogy, Symbol and Notations, Statement and assumption, Cause of action, Statement and conclusion, Puzzles			
	Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS			
Evaluation	Continuous Evaluation			
	· Topic wise evaluation			
	· Internal Assessments			
	Text Book 1. A new approach to reasoning verbal, non-verbal & analytical by BS Sijwali 2. R S Aggarwal 3. Kiran publications			
	References 1. www.indiabix.com 2. www.testbook.com 3. www.youtube.com/c/TheAptitudeGuy/videos			
	Topics relevant to Skill Development Logical reasoning and Critical thinking for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.			
Catalogue prepared by	L&D Department Faculty Member			
Recommended by the Board of Studies on				
Date of Approval by the Academic Council				