PRESIDENCY UNIVERSITY

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PROGRAMME REGULATIONS & CURRICULUM

2022-26

PRESIDENCY
SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

BACHELOR OF TECHNOLOGY
ELECTRICAL & ELECTRONICS ENGINEERING

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Approved by AICTE, New Delhi
PRESIDENCY GROUP OVER 40 YEARS OF ACADEMIC WISDOM

School of Engineering

Department of Electrical & Electronics Engineering

CURRICULUM STRUCTURE

Based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Program: BACHELOR OF TECHNOLOGY IN ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. [EEE]

2022-2026

(As amended up to the 24th Meeting of the Academic Council held on 3rd August 2024. This document supersedes all previous guidelines)

Regulations No: PU/AC24.9/SOE19/EEE/2022-26

Resolution No. 9 of the 24th Meeting of the Academic Council held on 3rd August 2024, and ratified by the Board of Management in its 24th Meeting held on 5th August, 2024)

August 2024

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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

- Commit 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 Electrical and Electronics Engineering

To be an industry driven Electrical &Electronics Engineering Department committed to develop globally competent Electrical & Electronics Engineering professionals dedicated to transform the society

1.6 Mission of Department of Electrical and Electronics Engineering

- Committed to inculcate application of Engineering knowledge, develop problem analysis and solving skills to be able to investigate complex engineering problems with modern tools.
- Create value-driven engineering professionals who are sensitive to societal concerns of environmental sustainability through ethical conduct.
- Develop excellent communication abilities with core skills of project management and team work.
- Imbibe passion for lifelong learning with individual growth path.
- Commitment towards excellence in Petroleum Engineering education through advancements in research and innovation.

- Design flexible course contents in disciplinary, interdisciplinary and research areas to enhance student's competitiveness.

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 2022-2026.
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 Programs of the 2022-2026 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 2024-2025.

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, 2024-2028;*

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 2022-2026 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 2022-2026 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 **Error! Reference source not found.** 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.**Error! Reference source not found.** 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 01: An Electrical & Electronics Engineering Professional serving the society.

PEO 02: A Teaching and Research Professional in the area of Electrical & Electronics engineering through lifelong learning.

PEO 03: A Freelancing consultant to the Electrical &Electronics Engineering Industry.

PEO 04: An entrepreneur in the Electrical &Electronics Engineering and other related areas of specialization.

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 the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning 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:

PSO 01: [Problem Analysis]: Identify, review research articles, formulate and analyse complex engineering problems related to modern Power System and Power Electronics & drives and to arrive substantiated inferences using first principles of mathematics, natural sciences and engineering sciences.

PSO 02: [Design/development of Solutions]: Design, develop and solve complex engineering problems related to modern Power System and Power Electronics & drives by designing system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental considerations.

PSO 03: [Modern Tool usage]: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities related

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, 2024-2028, 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. (Electrical and Electronics 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 Electrical and Electronics 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)

12.1 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.

12.2 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 0 of Academic regulations) shall be clearly defined in the Course Plan for every Course and approved by the DAC.

12.3 Format of the End-Term examination shall be specified in the Course Plan.

12.4 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 **Error! Reference source not found.** of Academic regulations) 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.

12.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage for different category of Courses

Nature of Course and Structure	Evaluation Component		Weightage	Minimum Performance Criteria	
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	Assignments, Seminars, Poster Presentations, Quizzes, Mini Projects, Term Papers, Hack-a-thons, Make-a-thons, Code-a-thons, etc. as prescribed in the Course Plan	25%	-	40%
		Mid Term Examination (to be conducted by CoE centrally)	25%		
	End Term Examination		50%	30%	
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	Laboratory Work / Practical exercises, conducted in every Laboratory / Practice session / activity, including Laboratory records, practice / project reports, attendance / class participation as applicable, and as prescribed in the Course Plan	50%	-	40%

		Mid Term Examination (to be conducted at Department/ School Level during regular lab slots)	25%		
	End Term Examination		25%	30%	
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.			40%	

The exact weightages of Evaluation Components shall be clearly specified in the 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 Clause **Error! Reference source not found.** of 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.

12.6 Minimum Performance Criteria:

12.6.1 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.

12.6.2 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.

12.6.3 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 Sub-Clause 12.6.1 and 12.6.2 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:

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer **Error! Reference source not found.** of Academic regulations) and approved by the Dean - Academics.

13.2 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.

13.3 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:

13.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 17.3 (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.

13.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 17.3(as per academic regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

13.3.3 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.

13.3.4 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.

13.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.

13.3.6 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.

13.3.7 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.

13.3.1 13.3.8 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 **Error! Reference source not found.**. 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

13.3.9 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.

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

13.4 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.**Error! Reference source not found.**), 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. (Electrical and Electronics Engineering) Program Structure (2022-2026) totalling 16 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. (Electrical and Electronics Engineering) 2022-2026: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	SCHOOL CORE	54
2	PROGRAM CORE	61
3	DISCIPLINE ELECTIVE	30
4	OPEN ELECTIVE	15
	Total Credits	**160 (Minimum)**

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. (Electrical and Electronics 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:

a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;

b. 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**;**

c. No dues to the University, Departments, Hostels, Library, and any other such centres/ Departments of the University; and

d. No disciplinary action is pending against her/him.

17.Curriculum Structure – School Core Course List and Program Core List

I. School Core Courses List						
SI NO	**Course Code**	**Course name**	**L**	**T**	**P**	**C**
1	MAT1001	Calculus and Linear Algebra	3	0	2	4
2	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3
3	MAT1003	Applied Statistics	1	0	2	2
4	MAT2003	Numerical Methods for Engineers	1	0	2	2
5	PHY1002	Optoelectronics and Device Physics	2	0	2	**3**
6	CHE1001	Environmental Studies	2	0	0	**-**
7	ENG1001	Foundation English	1	0	2	2
8	PPS1001	Introduction to soft skills	0	0	2	1
9	EEE1001	Fundamentals of Electrical and Electronics Engineering	3	0	2	4
10	ENG1002/ ENG2001	Technical English/ Advanced English	1	0	2	2
11	KAN1001/ KAN2001	Kali Kannada / Thili Kannada	1	0	0	1
12	PPS2001	Reasoning and Employment Skills	0	0	2	1
13	PPS2002	Being Corporate Ready	0	0	2	1
14	PPS4002	Introduction to Aptitude	0	0	2	1
15	PPS4005	Aptitude for Employability (Placement readiness I)	0	0	2	1
16	PPS3018	Preparedness for Interview	0	0	2	1
17	CSE1001	Problem Solving Using Java	2	0	2	3
18	CSE2001	Data Structures and Algorithms	3	0	2	4
19	PPS1002	Soft Skills for Engineers	0	0	2	1
20	CSE1002	Innovative Projects-Arduino using Embedded 'C' *	0	0	4	2
21	CSE1003	Innovation Project - Raspberry Pi using Python	0	0	4	2
22	PIP2001	Capstone Project	-	0	-	4
23	PIP4004	Internship	-	0	-	9
II. Program Core Courses List						
SI NO	**Course Code**	**Course name**	**L**	**T**	**P**	**C**
1	EEE2002	Electric Circuit Analysis	2	0	2	**3**

2	EEE2008	Electrical Power Generation Transmission and Distribution	3	0	0	**3**
3	EEE2001_v02	Signals and Systems	3	0	0	**3**
4	EEE2003	Electromagnetic Fields	3	0	0	**3**
5	EEE2009	Analog Electronics Circuits	3	0	0	**3**
6	EEE2015	Digital Electronics	3	0	0	**3**
7	EEE2016	Electrical Machines-I	3	0	0	**3**
8	EEE2061	Analog and Digital Electronics laboratory	0	0	2	**1**
9	EEE2060	Signals and Systems Laboratory	0	0	2	**1**
10	EEE2004_v02	Op Amps and Linear Integrated Circuits	3	0	2	**4**
11	EEE2005	Microprocessor and Microcontrollers	3	0	2	**4**
12	EEE2017	Electrical Machines-II	3	0	0	**3**
13	EEE2007	Control Systems Engineering	3	0	0	**3**
14	EEE2062	Electrical Machines Laboratory	0	0	2	**1**
15	EEE2012	Electrical and Electronics Measurements and Instrumentation	3	0	2	**4**
16	EEE2019	Power Electronics	3	0	0	**3**
17	EEE2020	Electrical Distribution Systems	3	0	0	**3**
18	EEE2063	Control Systems Engineering Laboratory	0	0	2	1
19	EEE2065	Power Electronics Laboratory	0	0	2	**1**
20	EEE3001	Electrical Drives	3	0	0	**3**
21	EEE3003	Switchgear and Protection	3	0	0	**3**
22	EEE3002	Power System Analysis	3	0	0	**3**
23	EEE2064	Electrical CAD Laboratory	0	0	2	**1**
24	EEE3061	Power System simulation laboratory	0	0	2	**1**

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 full fill 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, 2021). The same shall be prescribed in the Course Handout.

18.1 Internship

A student may undergo an Internship for a period of 4-6 weeks in an industry / company or academic / research institution during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters, subject to the following conditions:

18.1.1 The Internship shall be in 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 18.1.2 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 4-6 weeks in an Industry / Company or academic / research institution or the University Department (during the 5th / 6th / 7th Semester as applicable, subject to the following conditions:

18.2.1.1 The Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

18.2.1.2 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 18.2.1). 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:

18.3.1.1 The Capstone Project shall be in conducted in accordance with the Capstone Project

Policy prescribed by the University from time to time.

18.3.1.2 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 Capstone Project to a student.

18.3.1.3 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 18.3.2 above.

18.3.1.4 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 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 Capstone Project Policy of the University.

18.3.1.5 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:

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

18.4.1.2 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 3.5: Professional Electives Courses/Specialization Tracks – Minimum of 18 credits is to be earned by the student in a particular track and overall, 30 credits.						
General Basket						
S. No	**Course code**	**Course Name**	**L**	**T**	**P**	**C**
1	EEE3004	Special Electrical Machines	3	0	0	3
2	EEE3005	Digital control and state variable methods	3	0	0	3
3	EEE3006	High Voltage Engineering	3	0	0	3
4	EEE3007	Modern power electronics and AC drives	3	0	0	3
5	EEE3008	Materials in Electrical Systems	3	0	0	3

6	EEE3009	AI applications for Electrical Engineering	3	0	2	4
7	EEE3010	Electrical Estimation and Costing	3	0	0	3
8	EEE3011	Testing and Commissioning of Electrical Equipment's	3	0	0	3
9	EEE3012	Reactive power compensation and Management	3	0	0	3
10	EEE3013	VLSI Systems	3	0	0	3
11	EEE3014	Digital Signal Processing Systems	3	0	0	3
12	EEE3015	Industrial Automation with PLC and SCADA	2	0	2	3
13	EEE3016	Sensors Actuators and Controls	2	0	2	3
Power and Energy system Basket						
S.No	**Course code**	**Course Name**	**L**	**T**	**P**	**C**
1	EEE3021	Flexible A. C Transmission Systems (FACTS)	3	0	0	3
2	EEE3022	Electrical Power Quality	3	0	0	3
3	EEE3023	Computer Applications in power systems	3	0	2	4
4	EEE3024	Solar photovoltaic & Wind Energy Systems	3	0	0	3
5	EEE3025	Power System Operation & Control	3	0	0	3
6	EEE3026	Energy Auditing & Demand Side Management	3	0	0	3
7	EEE3035	Microgrid Operation & Control	3	0	0	3
8	EEE3028	Power System Planning	3	0	0	3
9	EEE3029	HVDC transmission	3	0	0	3
10	EEE3030	Energy Storage Systems	3	0	0	3
11	EEE3031	Electrical Power Utilization	3	0	0	3
12	EEE3032	Big Data Analytics in Power Systems.	3	0	0	3
13	EEE3033	Design of Reliability	3	0	0	3
14	EEE3034	Smart Grid Technologies	3	0	0	3
Automotive Electronics Basket						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	EEE3027	Electric Vehicle Technology	3	0	0	3
2	EEE3042	Automotive Embedded systems	2	0	2	3
3	EEE3043	AI Techniques for EVs and HEVs	3	0	0	3
4	EEE3044	Automation of Electrical systems	3	0	0	3
5	.EEE3045	Micro Electro Mechanical Systems	3	0	0	3
6	EEE3046	Sensors and Transducers	3	0	0	3
7	EEE3047	Automotive Electrical and Electronic systems for Two and Three Wheelers	3	0	0	3
8	EEE3048	Power Electronics Applications for Electrical Vehicles	3	0	0	3
9	EEE3049	Automotive safety system	3	0	0	3
10	EEE3036	Battery Management Systems	3	0	0	3
11	EEE3051	Microcontroller Applications	2	0	2	3
12	EEE3052	Control Systems for Robotic Applications	2	0	2	3
13	EEE3053	Electrical Drive Systems for Robotic Applications	2	0	2	3
14	EEE3054	Semiconductor devices and its applications	3	0	0	3
15	EEE3055	Photonic integrated circuit	3	0	0	3
16	EEE3056	Embedded Sensing, Actuation and Interfacing Systems	3	0	0	3

20. List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters. Credits to be earned:15

Sl. No.	Course Code	Course Name	L	T	P	Credit
		Chemistry Basket				
1	CHE1003	Fundamentals of Sensors	3	0	0	3
2	CHE1004	Smart materials for IOT	3	0	0	3
3	CHE1005	Computational Chemistry	2	0	0	2
4	CHE1006	Introduction to Nano technology	3	0	0	3
5	CHE1007	Biodegradable electronics	2	0	0	2
6	CHE1008	Energy and Sustainability	2	0	0	2
7	CHE1009	3D printing with Polymers	2	0	0	2
8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3
10	CHE1012	Introduction to Composite materials	2	0	0	2
11	CHE1013	Chemistry for Engineers	3	0	0	3
12	CHE1014	Surface and Coatings technology	3	0	0	3
13	CHE1015	Waste to Fuels	2	0	0	2
14	CHE1016	Forensic Science	3	0	0	3
		Civil Engineering Basket				
1	CIV1001	Disaster mitigation and management	3	0	0	3
2	CIV1002	Environment Science and Disaster Management	3	0	0	3
3	CIV2001	Sustainablility Concepts in Engineering	3	0	0	3
4	CIV2002	Occupational Health and Safety	3	0	0	3
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3
6	CIV2004	Integrated Project Management	3	0	0	3
7	CIV2005	Enviornmental Impact Assessment	3	0	0	3
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3
10	CIV2045	Environmental Meteorology	3	0	0	3
11	CIV3046	Project Problem Based Learning	3	0	0	3
12	CIV3059	Sustainability for Professional Practice	3	0	0	3
		Commerce Basket				
1	COM2001	Introduction to Human Resource Management	2	0	0	2
2	COM2002	Finance for Non Finance	2	0	0	2
3	COM2003	Contemporary Management	2	0	0	2
4	COM2004	Introduction to Banking	2	0	0	2
5	COM2005	Introduction to Insurance	2	0	0	2
6	COM2006	Fundamentals of Management	2	0	0	2
7	COM2007	Basics of Accounting	3	0	0	3
		Computer Science Basket				
1	CSE2002	Programming in Java	2	0	2	3
2	CSE2003	Social Network Analytics	3	0	0	3

3	CSE2004	Python Application Programming	2	0	2	3
4	CSE2005	Web design fundamentals	2	0	2	3
5	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	0	3
6	CSE3112	Privacy And Security In Online Social Media	3	0	0	3
7	CSE3113	Computational Complexity	3	0	0	3
8	CSE3114	Deep Learning for Computer Vision	3	0	0	3
9	CSE3115	Learning Analytics Tools	3	0	0	3
		Design Basket				
1	DES1001	Sketching and Painting	0	0	2	1
2	DES1002	Innovation and Creativity	2	0	0	2
3	DES1121	Introduction to UX design	1	0	2	2
4	DES1122	Introduction to Jewellery Making	1	0	2	2
5	DES1124	Spatial Stories	1	0	2	2
6	DES1125	Polymer Clay	1	0	2	2
7	DES2001	Design Thinking	3	0	0	3
8	DES1003	Servicability of Fashion Products	1	0	2	2
9	DES1004	Choices in Virtual Fashion	1	0	2	2
10	DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2
11	DES1006	Colour in Everyday Life	1	0	2	2
12	DES2080	Art of Design Language	3	0	0	3
13	DES2081	Brand Building in Design	3	0	0	3
14	DES2085	Web Design Techniques	3	0	0	3
15	DES2089	3D Modeling for Professionals	1	0	4	3
16	DES2090	Creative Thinking for Professionals	3	0	0	3
17	DES2091	Idea Formulation	3	0	0	3
		Electrical and Electronics Engineering Basket				
1	EEE1002	IoT based Smart Building Technology	3	0	0	3
2	EEE1003	Basic Circuit Analysis	3	0	0	3
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3
4	EEE1005	Electric Vehicles & Battery Technology	3	0	0	3
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3
		Electronics and Communication Engineering Basket				
1	ECE1003	Fundamentals of Electronics	3	0	0	3
2	ECE1004	Microprocessor based systems	3	0	0	3
3	ECE1005	Journey of Communication Systems	3	0	0	3
4	ECE3089	Artificial Neural Networks	3	0	0	3
5	ECE3090	Digital System Design using VERILOG	3	0	0	3
6	ECE3091	Mathematical Physics	3	0	0	3
7	ECE3092	Photonic Integrated Circuits	3	0	0	3
8	ECE3093	Machine learning for Music Information Retrieval	3	0	0	3
9	ECE3094	Video Processing and Computer Vision	3	0	0	3
10	ECE3095	Blockchain and Cryptocurrency Technologies	3	0	0	3

11	ECE3096	Natural Language Processing	3	0	0	3
12	ECE3097	Smart Electronics in Agriculture	3	0	0	3
13	ECE3098	Environment Monitoring Systems	3	0	0	3
14	ECE3099	Modern Wireless Communication with 5G	3	0	0	3
15	ECE3100	Underwater Communication	3	0	0	3
16	ECE3101	Printed Circuit Board Design	3	0	0	3
17	ECE3102	Consumer Electronics	3	0	0	3
18	ECE3103	Product Design of Electronic Equipment	3	0	0	3
19	ECE3104	Vehicle to Vehicle Communication	3	0	0	3
20	ECE3105	Wavelets and Filter Banks	3	0	0	3
21	ECE3106	Introduction to Data Analytics	3	0	0	3
22	ECE3107	Machine Vision for Robotics	3	0	0	3
		English Basket				
1	ENG1008	Indian Literature	2	0	0	2
2	ENG1009	Reading Advertisement	3	0	0	3
3	ENG1010	Verbal Aptitude for Placement	2	0	2	3
4	ENG1011	English for Career Development	3	0	0	3
5	ENG1012	Gender and Society in India	2	0	0	2
6	ENG1013	Indian English Drama	3	0	0	3
7	ENG1014	Logic and Art of Negotiation	2	0	2	3
8	ENG1015	Professional Commuication Skills for Engineers	1	0	0	1
		Fitness and Wellness Basket				
1	DSA2001	Spirituality for Health	2	0	0	2
2	DSA2002	Yoga for Health	2	0	0	2
3	DSA2003	Stress Management and Well Being	2	0	0	2
		Kannada Basket				
1	KAN1003	Kannada Kaipidi	3	0	0	3
2	KAN2003	Pradharshana Kale	1	0	2	2
3	KAN2004	Sahithya Vimarshe	2	0	0	2
4	KAN2005	Anuvadha Kala Sahithya	3	0	0	3
5	KAN2006	Vichara Manthana	3	0	0	3
6	KAN2007	Katha Sahithya Sampada	3	0	0	3
7	KAN2008	Ranga Pradarshana Kala	3	0	0	3
		Foreign Language Basket				
1	FRL1004	Introduction of French Language	2	0	0	2
2	FRL1005	Fundamentals of French	2	0	0	2
3	FRL1009	Mandarin Chinese for Beginners	3	0	0	3
		Law Basket				
1	LAW1001	Introduction to Sociology	2	0	0	2
2	LAW2001	Indian Heritage and Culture	2	0	0	2
3	LAW2002	Introdcution to Law of Succession	2	0	0	2
4	LAW2003	Introduction to Company Law	2	0	0	2
5	LAW2004	Introduction to Contracts	2	0	0	2
6	LAW2005	Introduction to Copy Rights Law	2	0	0	2
7	LAW2006	Introduction to Criminal Law	2	0	0	2
8	LAW2007	Introduction to Insurance Law	2	0	0	2

9	LAW2008	Introduction to Labour Law	2	0	0	2
10	LAW2009	Introduction to Law of Marriages	2	0	0	2
11	LAW2010	Introduction to Patent Law	2	0	0	2
12	LAW2011	Introduction to Personal Income Tax	2	0	0	2
13	LAW2012	Introduction to Real Estate Law	2	0	0	2
14	LAW2013	Introduction to Trademark Law	2	0	0	2
15	LAW2014	Introduction to Competition Law	3	0	0	3
16	LAW2015	Cyber Law	3	0	0	3
17	LAW2016	Law on Sexual Harrassment	2	0	0	2
18	LAW2017	Media Laws and Ethics	2	0	0	2
		Mathematics Basket				
1	MAT2008	Mathematical Reasoning	3	0	0	3
2	MAT2014	Advanced Business Mathematics	3	0	0	3
3	MAT2041	Functions of Complex Variables	3	0	0	3
4	MAT2042	Probability and Random Processes	3	0	0	3
5	MAT2043	Elements of Number Theory	3	0	0	3
6	MAT2044	Mathematical Modelling and Applications	3	0	0	3
7	MAT2029	Optimization technique	3	0	0	3
		Mechanical Engineering Basket				
1	MEC1001	Fundamentals of Automobile Engineering	3	0	0	3
2	MEC1002	Introduction to Matlab and Simulink	3	0	0	3
3	MEC1003	Engineering Drawing	1	0	4	3
4	MEC2001	Renewable Energy Systems	3	0	0	3
5	MEC2002	Operations Research & Management	3	0	0	3
6	MEC2003	Supply Chain Management	3	0	0	3
7	MEC2004	Six Sigma for Professionals	3	0	0	3
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3
9	MEC2006	Safety Engineering	3	0	0	3
10	MEC2007	Additive Manufacturing	3	0	0	3
11	MEC3069	Engineering Optimisation	3	0	0	3
12	MEC3070	Electronics Waste Management	3	0	0	3
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3
16	MEC3201	Industry 4.0	3	0	0	3
		Petroleum Engineering Basket				
1	PET1005	Geology for Engineers	2	0	0	2
2	PET1006	Overview of Energy Industry	2	0	0	2
3	PET1007	Introduction to Energy Trading and Future Options	2	0	0	2
4	PET1008	Sustainable Energy Management	2	0	0	2
5	PET2026	Introduction to Computational Fluids Dynamics	3	0	0	3
6	PET2028	Polymer Science and Technology	3	0	0	3
7	PET2031	Overview of Material Science	3	0	0	3
8	PET2032	Petroleum Economics	3	0	0	3

		Physics Basket				
9	PHY1003	Mechanics and Physics of Materials	3	0	0	3
10	PHY1004	Astronomy	3	0	0	3
11	PHY1005	Game Physics	2	0	2	3
12	PHY1006	Statistical Mechanics	2	0	0	2
13	PHY1007	Physics of Nanomaterials	3	0	0	3
14	PHY1008	Adventures in nanoworld	2	0	0	2
15	PHY2001	Medical Physics	2	0	0	2
16	PHY2002	Sensor Physics	1	0	2	2
17	PHY2003	Computational Physics	1	0	2	2
18	PHY2004	Laser Physics	3	0	0	3
19	PHY2005	Science and Technology of Energy	3	0	0	3
20	PHY2009	Essentials of Physics	2	0	0	2
		Management Basket				
1	MGT1001	Introduction to Psychology	3	0	0	3
2	MGT1002	Business Intelligence	3	0	0	3
3	MGT1003	NGO Management	3	0	0	3
4	MGT1004	Essentials of Leadership	3	0	0	3
5	MGT1005	Cross Cultural Communication	3	0	0	3
6	MGT2001	Business Analytics	3	0	0	3
7	MGT2002	Organizational Behaviour	3	0	0	3
8	MGT2003	Competitive Intelligence	3	0	0	3
9	MGT2004	Development of Enterprises	3	0	0	3
10	MGT2005	Economics and Cost Estimation	3	0	0	3
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3
12	MGT2007	Digital Entrepreneurship	3	0	0	3
13	MGT2008	Econometrics for Managers	3	0	0	3
14	MGT2009	Management Consulting	3	0	0	3
15	MGT2010	Managing People and Performance	3	0	0	3
16	MGT2011	Personal Finance	3	0	0	3
17	MGT2012	E Business for Management	3	0	0	3
18	MGT2013	Project Management	3	0	0	3
19	MGT2014	Project Finance	3	0	0	3
20	MGT2015	Engineering Economics	3	0	0	3
21	MGT2016	Business of Entertainment	3	0	0	3
22	MGT2017	Principles of Management	3	0	0	3
23	MGT2018	Professional and Business Ethics	3	0	0	3
24	MGT2019	Sales Techniques	3	0	0	3
25	MGT2020	Marketing for Engineers	3	0	0	3
26	MGT2021	Finance for Engineers	3	0	0	3
27	MGT2022	Customer Relationship Management	3	0	0	3
28	MGT2023	People Management	3	0	0	3
		Media Studies Basket				
1	BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2
2	BAJ3051	Digital Photography	2	0	2	3

3	BAJ3055	Introduction to New Anchoring and News Management	0	0	2	1
		Research URE Basket				
1	URE2001	University Research Experience	-		-	3
2	URE2002	University Research Experience	-		-	0

21. List of MOOC (NPTEL) Courses

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

Sl. No.	Course ID	Course Name	Duration
1	noc25-ee14	Computer-Aided Design of Electrical Machines	12 Weeks
2	noc25-ee31	Embedded Sensing, Actuation and Interfacing Systems	12 Weeks
3	noc25-ee40	Fuzzy Sets, Logic and Systems & Applications	12 Weeks
4	noc25-ee51	Modern Computer Vision	12 Weeks
5	noc25-ee57	Operation and Planning Of Power Distribution Systems	12 Weeks
6	noc25-ee58	Optical Fiber Sensors	12 Weeks
7	noc25-ee63	Power Management Integrated Circuits	12 Weeks
8	noc25-ee69	Principles of Digital Communication	12 Weeks

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

Sl. No.	Course ID	Course Name	Duration
1	noc25-ag06	Machine Learning for Soil and Crop Management	12 Weeks
2	noc25-ag09	Soil and Water Conservation Engineering	12 Weeks
3	noc25-ag10	Water Quality Management Practices	12 Weeks
4	noc25-cs08	Blockchain and its Applications	12 Weeks
5	noc25-cs49	Machine Learning for Engineering and science applications	12 Weeks
6	noc25-de04	Strategies for Sustainable Design	12 Weeks
7	noc25-ge31	Rural Water Resources Management	12 Weeks
8	noc25-ge25	One Health	12 Weeks
9	noc25-ge17	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	12 Weeks

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

I Semester

Sl. No.	Course Code	Course Name	CREDIT STRUCTURE			Type of Course	CONTACT HOURS	TYPE OF SKILL	COURSE ADDRESSES TO
			L	P	C				
1	MAT1001	Calculus and Linear Algebra	3	2	4	School Core	5	F	
2	CSE1001	Problem Solving Using Java	2	2	3	School Core	4	S/EM	
3	PHY1002	Optoelectronics and Device Physics	2	2	3	School Core	4	F	
4	ENG1001 / ENG1002	Foundation English/ Technical English	1	2	2	School Core	3	F/S	
5	PPS1001	Introduction to soft skills	0	2	1	School Core	2	S	HP
6	KAN1001 / KAN2001	Kali Kannada / Thili Kannada	1	0	1	School Core	1	S	
		TOTAL	9	10	14		26		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

II Semester +Summer Term									
Sl. No.	Course Code	Course Name	CREDIT STRUCTURE			Type of Course	CONTACT HOURS	TYPE OF SKILL	COURSE ADDRESSES TO
			L	P	C				
1	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	3	School Core	3	F	
2	MAT1003	Applied Statistics	1	2	2	School Core	3	EM	
3	EEE1001	Fundamentals of Electrical and Electronics Engineering	3	2	4	School Core	5	S	
4	CSE2001	Data Structures and Algorithms	3	2	4	School Core	5	S	
5	EEE2002	Electric Circuit Analysis	2	2	3	Program Core	4	S	
6	EEE2008	Electrical Power Generation Transmission and Distribution	3	0	3	Program Core	3	S	
7	EEE XXXX	Discipline Elective - I	3	0	3	Discipline Elective	3	EM	
8	XXX XXX	Open Elective - I	3	0	3	Open Elective	3	S	ES
9	ENG1002/ ENG2001	Technical English/ Advanced English	1	2	2	School Core	3	F/S	
10	CHE1001	Environmental Studies	2	0	-	School Core	2	S	ES

11	PPS1002	Soft Skills for Engineers	0	2	1	School Core	2	S/EM	
12	CSE1002	Innovative Projects-Arduino using Embedded 'C' *	0	4	2	School Core	4	S	
		TOTAL	24	16	30		36		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

- * CSE1002 can be completed in 1st or 2nd semester.

III Semester +Summer Term									
Sl. No.	**Course Code**	**Course Name**	**CREDIT STRUCTURE**			**Type of Course**	**CONTACT HOURS**	**TYPE OF SKILL**	**COURSE ADDRESSES TO**
			L	**P**	**C**				
1	EEE2001_v02	Signals and Systems	3	0	3	Program Core	3	S	
2	EEE2003	Electromagnetic Fields	3	0	3	Program Core	3	S	
3	EEE2009	Analog Electronics Circuits	3	0	3	Program Core	5	S	
4	EEE2015	Digital Electronics	3	0	3	Program Core	5	S	
5	EEE2016	Electrical Machines-I	3	0	3	Program Core	4	S	
6	EEE2061	Analog and Digital Electronics laboratory	0	2	1	Program Core	3	S	
7	EEE2060	Signals and Systems Laboratory	0	2	1	Program Core	3	S	
8	PPS2001	Reasoning and Employment Skills	0	2	1	School Core	3	S/EM	HP
9	CSE1003	Innovation Project - Rasberry Pi using Python	0	4	2	School Core	3	S	
		TOTAL	15	10	20		32		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

IV SEMESTER									
Sl. No.	**Course Code**	**Course Name**	**CREDIT STRUCTURE**			**Type of Course**	**CONTACT HOURS**	**TYPE OF SKILL**	**COURSE ADDRESSES TO**
			L	**P**	**C**				
1	MAT2003	Numerical Methods for Engineers	1	2	2	School Core	3	S	
2	EEE2004_v02	Opamps and Linear Integrated Circuits	3	2	4	Program Core	5	S	
3	EEE2005	Microprocessor and Microcontrollers	3	2	4	Program Core	5	S	ES
4	EEE2017	Electrical Machines-II	3	0	3	Program Core	3	EM	ES

5	EEE2007	Control Systems Engineering	3	0	3	Program Core	3	S	
6	EEE2062	Electrical Machines Laboratory	0	2	1	Program Core	2	S	
7	EEE XXXX	Discipline Elective - II	3	0	3	Discipline Elective	3	EM	
8	PPS2002	Being Corporate Ready	0	2	1	School Core	2	S/EM	HP/GS
		TOTAL	16	10	21		26		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

V SEMESTER									
Sl. No.	**Course Code**	**Course Name**	**CREDIT STRUCTURE**			**Type of Course**	**CONTACT HOURS**	**TYPE OF SKILL**	**COURSE ADDRESSES TO**
			L	**P**	**C**				
1	EEE2012	Electrical and Electronics Measurements and Instrumentation	3	2	4	Program Core	5	S	
2	EEE2019	Power Electronics	3	0	3	Program Core	3	S	ES
3	EEE2020	Electrical Distribution Systems	3	0	3	Program Core	3	S	
4	EEE XXXX	Discipline Elective - III	3	0	3	Discipline Elective	3	EM	
5	EEE XXXX	Discipline Elective - IV	3	0	3	Discipline Elective	3	EM	
6	EEE XXXX	Discipline Elective - V	3	0	3	Discipline Elective	3	RM	
7	XXX XXXX	Open Elective – II (Course from Management Basket)	3	0	3	Open Elective	3	S	ES
8	EEE2063	Control Systems Engineering Laboratory	0	2	1	Program Core	2	S	
9	EEE2064	Electrical CAD Laboratory	0	2	1	Program Core	2	S	
10	PPS4002	Introduction to Aptitude	0	2	1	School Core	2	S	
		TOTAL	21	8	25		29		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

VI SEMESTER									
Sl. No.	**Course Code**	**Course Name**	**CREDIT STRUCTURE**			**Type of Course**	**CONTACT HOURS**	**TYPE OF SKILL**	**COURSE ADDRESSES TO**
			L	**P**	**C**				
1	EEE3001	Electrical Drives	3	0	3	Program Core	3	S	ES
2	EEE3003	Switchgear and Protection	3	0	3	Program Core	3	EM	

3	EEE3002	Power System Analysis	3	0	3	Program Core	3	EM	HP
4	EEE3061	Power System simulation laboratory	0	2	1	Program Core	2	S	
5	EEE2065	Power Electronics Laboratory	0	2	1	Program Core	2	S	
6	EEE XXXX	Discipline Elective - VI	3	0	3	Discipline Elective	3	EM	
7	EEE XXXX	Discipline Elective - VII	3	0	3	Discipline Elective	3	EM	
8	EEE XXXX	Discipline Elective - VIII	3	0	3	Discipline Elective	3	EM	
9	CSE3217	Data Structure and Web Development with Python	0	2	1	School core	2	S	
10	MGT2007	Digital Entrepreneurship (Open Elective – III)	3	0	3	Open Elective	3	S	ES
11	PPS4005	Aptitude for Employability	0	2	1	School Core	2	S/EM	
		TOTAL	20	10	25		28		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

VII SEMESTER									
Sl. No.	**Course Code**	**Course Name**	**CREDIT STRUCTURE**			**Type of Course**	**CONTACT HOURS**	**TYPE OF SKILL**	**COURSE ADDRESSES TO**
			L	**P**	**C**				
1	EEE XXXX	Discipline Elective - IX	3	0	3	Discipline Elective	3	EM	
2	EEE XXXX	Discipline Elective - X	3	0	3	Discipline Elective	3	EM	
3	XXX XXXX	Open Elective - IV	3	0	3	Open Elective	3	S	ES
4	DES2001	Design Thinking (Open Elective - V)	3	0	3	Open Elective	3	S/EM/ EN	
5	PPS3018	Preparedness for Interview	0	2	1	School Core	2		
6	PIP2001	Capstone Project	-	-	4	School Core			
		TOTAL	12	2	17		14		
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

VIII SEMESTER

Sl. No.	Course Code	Course Name	CREDIT STRUCTURE			Type of Course	CONTACT HOURS	TYPE OF SKILL	COURSE ADDRESSES TO
			L	P	C				
1	PIP4004	Internship	-	-	9	School Core	-	EM	
		TOTAL	0	0	9				
F - Foundation; S - Skill Development; EM-Employability; EN-Entrepreneurship skills; GS-Gender Sensitization; ES - Environment and sustainability; HP - Human values and Professional Ethics.									

23. Course Catalogues

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.

Course Code: MAT1001	**Course Title: Calculus and Linear Algebra** **Type of Course:1] School Core Lab Integrated**		**L-T- P-C**	**3**	**1**	**0**	**4**
Version No.		2.0					
Course Pre-requisites		Basic Concepts of Limits, Differentiation, Integration					
Anti-requisites		**NIL**					
Course Description		The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature.					
Course Objective		The objective of the course is to **familiarize the learners with the concepts of "**CALCULUS AND LINEAR ALGEBRA"**and attain Skill Development throughproblem solving techniques**.					
Course Out Comes		On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations.					
Course Content:							
Module 1	**Linear Algebra**						**16 Classes**
	Review: Types of matrices, elementary transformations, **Linear Algebra:** Echelon form, rank of a matrix, consistency and solution of system of linear equations - Gauss elimination method, Gauss-Jordan method.						

	Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.				
Module 2	**Partial Derivatives**				**14 CLASSES**
	Review: Differential calculus with single variable. **Differential Calculus:** Partial differentiation, Homogeneous functions and Euler's theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers. Engineering Applications of partial derivatives.				
Module 3	**Integral calculus**				**12 Classes**
	Review: Integral calculus for single integrals. **Integral calculus:** Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates. Beta and Gamma functions–inter-relation-evaluation of integrals using gamma and beta functions. Evaluate double & triple integrals.				
Module 4	**Differential Equations**	**Assignment**		**Programming**	**16 Classes**
	Definition, types of differential equations, order and degree, Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non - Exact Differential Equations. Higher order Differential Equation with constant coefficients and with right hand side of the form eax, sinax, cosax, eaxf(x), xnf(x) etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, Method of Variation of Parameters. Engineering applications of differential equations.				
	Targeted Application & Tools that can be used: The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design. Tools Used: Python.				
	Assignment:				
	1. List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using C Programming/Python. 2. 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. Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011 2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.				

	References: 1. Victor Henner, Tatyana Belozerova, MickhailKhenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013. 2. Walter Ledermann, Multiple integrals, Springer, 1st edition 3. Lay, Linear Algebra ansd its applications, 3rd Ed., 2002, Pearson Education India. 4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 5. MatLab usage manual **E-resources/ Web links:** 1. https://nptel.ac.in/courses/109104124 2. https://nptel.ac.in/courses/111106051 3. https://nptel.ac.in/courses/111102137 4. https://www.cuemath.com/learn/mathematics/algebra-vs-calculus/ 5. https://stanford.edu/~shervine/teaching/cs-229/refresher-algebra-calculus 6. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/linear-algebra/ 7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
	Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software.for **Skill Developmentthrough** Experiential Learning **methodologies.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by		Dr Veeresh A Sajjanara and Dr V Nagendramma
Recommended by the Board of Studies on		13th BOS held on 04/01/2025
Date of Approval by the Academic Council		24th ACM held in 3rd August 2024

Course Code: MAT1002	**Course Title: Transform Techniques, Partial Differential Equations and Their Applications** **Type of Course:School Core**	**L-T-P- C**	**3**	**0**	**0**	**3**
Version No.	2.0					
Course Pre-requisites	**MAT1001 - Linear Algebra and Calculus**					
Anti-requisites	**NIL**					
Course Description	This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solution of difference equations using z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations.					
Course Objective	The objective of the course is **Skill Development**of student by using **Problem Solving Techniques.**					

Course Outcomes	On successful completion of this course the students shall be able to: CO-1: Express functions in terms of uniformly convergent Fourier series. CO-2: Apply Laplace transform technique to solve differential equations. CO-3: Employ z-transform technique to solve difference equations. CO-4: Solve a variety of partial differential equations analytically.			
Course Content:				
Module 1	**Fourier Series**			**10 CLASSES**
Fourier series: Fourier series - Euler's formulae - Dirichlet's conditions - Change of Interval - half range series – RMS value – Parseval's identity – Computation of harmonics. Engineering Applications of Fourier series.				
Module 2	**Integral Transforms**			**15 Classes**
Laplace Transform: Definition and Laplace transforms of elementary functions. Properties of Laplace transform. Laplace transform of periodic function, unit-step function and impulse function and the related problems. Inverse Laplace transform of standard functions and problems, initial and final value theorems. Convolution theorem, solution of linear ordinary differential equations, LCR circuit problems. **Fourier Transform:** Integral transforms, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms. Engineering Applications of Fourier transform.				
Module 3	**Z Transform and Difference Equations**			**8 Classes**
Definition of Z-transform, Z transforms of standard functions and the related problems, standard inverse Z transforms and problems, computation of inverse Z-transform by partial fraction and convolution methods, solution of difference equations using Z-transforms. Business and Engineering Applications of Z transform.				
Module 4	**Partial Differential Equations**			**12 Classes**
Partial Differential Equations: Formation of PDEs, solution of non-homogeneous PDEs by direct integration, solution of homogeneous PDEs involving derivatives with respect to only one independent variable, method of separation of variables, solution of the Lagrange's PDE of the type Pp + Qq = R. **Applications of PDEs**: Various possible solutions of the one dimensional wave and heat equations by the method of separation of variables, D'Alembert's solution of the wave equation, solution of related boundary value problems.				
Targeted Applications& Tools that can be used: Applications to electrical engineering, vibrational analysis, acoustics, optics, signal processing, image processing, quantum mechanics, econometrics and shell theory by means of Fourier Series and integral transforms. Opens up new approaches in terms of Z-transform to solving one of the central problems of modern science involvingdifference equations. Finding the solutions of boundary value problems involving PDEs with reference to wave, heat, and Laplace equations.				
Assignment: Mention the Type of Project /Assignment proposed for this course				
Two Assignments based on the applications of the concepts leading to a minimum of 5 engineering problems from a common pool of problems.				
Text Book 1. Erwin Kreyszig, 2017: " Advanced Engineering Mathematics", 10th Edition, John Wiley.				
References:				

6. B. S. Grewal, 2017: "Higher Engineering Mathematics" 45th Edition, Khanna Publishers.
7. Peter V O'Neil, 2015: "Advanced Engineering Mathematics", 7th Edition, Cengage Learning.
8. Glyn James, 2016:"Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education.
9. Michael D. Greenberg, 2018:"Advanced Engineering Mathematics", 2nd Edition, Pearson Education.

Topics relevant to the development of Foundation Skills: **All the solution methods.**
Topics relevant to development of Employability skills: **Use of relevant scientific application packages.**

Catalogue prepared by	Dr.Veeresha A Sajjanara and Dr.Ananya Tripathi
Recommended by the Board of Studies on	12th BOS held on 05/07/2024
Date of Approval by the Academic Council	24th ACM held in 3rd August 2024

Course Code: MAT1003	**Course Title:Applied Statistics (Only Theory 3 hours)** **Type of Course:** School Core	**L T P C**	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mindthe future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "**Applied Statistics"and attain**Skill Development Through Problem Solving techniques**.					
Expected Outcome:	At the end of this course, students will be in a position to 1. applythe techniques of descriptive statistics effectively 2. interpret the ideas of probability and conditional probability 3. demonstrate the knowledge of probability distributions 4. Computestatistical parameters, correlation and regression, probability and sampling distributions using R software.					

Module 1	**Descriptive Statistics**	Assignment	Coding needed	**10 classes**
Introduction toStatistics, Dataandstatisticalthinking,reviewofbasicstatisticalparameters,Covariance,Correlation, Types of Measures of Correlation -Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression**.**				
Module 2	**Probability**			**6 classes**

Introduction to Probability, Probability of an event, AdditionPrinciple,Multiplicationlaw,ConditionalProbability, Total Probability and Baye's theorem with examples				
Module 3	**Random Variables and Probability Distributions**		Coding needed	**14 classes**
Introduction to Randomvariables,Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial,**Negative Binominal(Self Study)**, Poisson, Normal and Exponential distributions				
Module 4	**Sampling Theory**		Coding needed	**15 classes**
Introduction to Sampling Theory,Population, Statistic, Parameter, Sampling Distribution, Standard Error.Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests,Large Sample Tests: Z-Test for Single Mean and **Difference of Means (Self Study)**, Small Sample Tests: Student's t-Test for Single Mean and **Difference of Means,** F-Test, Chi-Square Test.				

Targeted Application & Tools that can be used:

The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems.
Tools used: R Software / MS-Excel

Text Book

1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.

References

1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018.
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019.
4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.
5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.
6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.

Topics relevant to SKILL DEVELOPMENT:The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mindthe future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions for**Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Sathish S and Dr. Juliet Raja

Recommended by the Board of Studies on	13th BOS held on 04/01/2025
Date of Approval by the Academic Council	24th ACM held in 3rd August 2024

Course Code: **MAT2003**	**Course Title:** **NUMERICAL METHODS FOR ENGINEERS** **Type of Course: School Core**	**L-T- P-C**	1	0	2	2
Version No.	1.0					
Course Pre-requisites	MAT1002 – Transform Techniques, Partial Differential Equations and Their Applications					
Anti-requisites	**Nil**					
Course Description	The coursefocuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically.This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations,system of equations, interpolation, differentiation and integration. This course also deals with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "NUMERICAL METHODS FOR ENGINEERS" and attain Skill Development Through Problem Solving.**					
Course Outcomes	On successful completion of the course the students shall be able to: 1]Solve algebraic and transcendental equations numerically. 2] Adopt numerical techniques to differentiate and integrate functions. 3] Apply numerical methods to solve ordinary differential equations.					
Course Content:						
Module 1	**Numerical solution of Algebraic and Transcendental Equations**			**15 Classes**		
Algebraic and Transcendental Equations, Regula -Falsi method, Bisection method (Self study), Secant method,Newton-Raphson method, and NR method for non-linear Equations, Fixed-point iteration method. System of Linear Equations: Introduction, LU decomposition method, Gauss-Jacobi method, Gauss-Seidel iteration method, Largest Eigen value and corresponding Eigen vector by Power method& Jacobi Method.						
Module 2	**Numerical Interpolation,**			**15 Classes**		

	differentiationand Integration			
Numerical Interpolation: Newton's forward and backward interpolation method, Newton's divided difference method, Lagrange's method, numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's Rule. Area between the two curves.				
Module 3	**Numerical solution of ODEs and PDEs**			**15 Classes**
Solution of ordinary differential equations: Initial Value problems:Taylor's series method, Picard's method, Euler's Method, Modified Euler's method, Runge-Kutta method, Milne's predictor-corrector formula. Adams -Bashforth method**,** Boundary value problems - Finite difference methods for ODE. Numerical solution for LCR & damped forced oscillatory equations. Solution of partial differential equations: Schmidt Explicit Formula for Heat Equation, Crank-Nicolson method. Numerical solution to Wave, Laplace & Heat Equation.				
Targeted Application & Tools that can be used: The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics so as to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.				
Assignment: 1. Gauss-Jacobi iteration method. 2. Numerical differentiation. 3. Gaussian quadrature rule for numerical integration. 4. Taylor series method for ODEs. 5. Implicit and explicit schemes for PDEs.				
Text Books T1: M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and EngineeringComputations, 6th Edition, New age Publishing House, 2015. T2: Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley& Sons (India), 2014.				
References: R1: B.S. Grewal, Numerical methods in engineering and science, 10th Edition, Khanna publishers, 2016. R2: B.S. Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publishers. R3: Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers," 7th Ed., McGraw-Hill Edition, 2015. R4: C. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill, 2012.				
Topics relevant to SKILL DEVELOPMENT: Thiscoursefocuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically.This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations,system of equations, interpolation, differentiation and integration with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods for**Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr. Shilpa			
Recommended by the Board of Studies on	13th BOS held on 04/01/2025			

Date of Approval by the Academic Council	24th ACM held in 3rd August 2024

Course Code: PHY1002	**Course Title: Optoelectronics and Device Physics** **Type of Course: 1] School Core & Laboratory integrated**	L-P-C	2	2	3
Version No.	1.0				
Course Pre-requisites	**NIL**				
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, experimental and analytical skills. The associated 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: Describe the concepts of semiconductors, magnetic materials and superconductors. CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices. CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers. CO4: Explain the applications of lasers and optical fibers in various technological fields. CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. **[Lab oriented].**				
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Optoelectronics and device physics "and attain **Skill Development**through **Experiential Learning** techniques				
Course Content:					
Module 1	**Fundamentals of Materials.**	Assignment	Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software.		**No. of Classes: 07**
Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Superconductors: Josephson effect.					

Module 2	**Advanced Devices and applications**	Assignment	Data collection on efficiency of solar cells.	**No. of Classes: 8**
Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs				
Module 3	**Quantum concepts and Applications**	Term paper	Seminar on quantum computers.	**No. of classes : 8**
Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron.Heisenberg's uncertainty principle				
Module 4	**Lasers and Optical fibers**	Term paper	Case study on medical applications of Lasers.	**No. of classes :07**
Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling. 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.				
List of Laboratory Tasks: Experiment No. 1: Experimental errors and uncertainty using excel Level 1: Calculation of accuracy and precision of a given data Level 2: propagation of errors in addition, subtraction, multiplication and division. Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction. Level 1: Determination of Wavelength of Laser Level 2: Finding the particle size of lycopodium powder. Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier. Level 1: To determine the proportionality of Hall Voltage and magnetic flux density Level 2: To determine the polarity of Charge carrier. Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions. Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage. Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance. Experiment No. 5: To study input and output characteristics of a given Transistor. Level 1: To determine the input resistance of a given transistor. Level 2: To determine current transfer characteristics and transistor parameters of a given transistor. Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire.				

Level 1: Determination of Fermi energy and Fermi temperature of given metal wire.
Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.

Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage.
Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.
Level 2: To measure the photo-current as a function of the irradiance at constant voltage.

Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.
Level 1: To study the I-V characteristics
Level 2: I-R characteristics of a solar cell as a function of the irradiance.

Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .
Level 1: Calculate the numerical aperture.
Level 2: study the losses that occur in optical fiber cable.

Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.
Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.
Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.

Experiment No. 11: To study the hysteresis loop of an iron core and to find its coercivity and retentivity. To show the effect of varying voltage and frequency on hysteresis loop.
Level 1: To study the hysteresis loop of an iron core and to find its coercivity and retentivity. .
Level 2: To show the effect of varying voltage and frequency on hysteresis loop.

Experiment No. 12: Determining the wavelength of the electrons for different accelerator voltages by applying the Bragg condition and Confirming the de Broglie equation for the wavelength.
Level 1: Determining the wavelength of the electrons for different accelerator voltages by applying the Bragg condition.
Level 2: Confirming the de Broglie equation for the wavelength.

Experiment No. 13: To measure the transition temperature and resistivity of a high temperature superconductor.
Level 1: To measure the transition temperature.
Level 2: To determine the resistivity of a high temperature superconductor.

Experiment No. 14: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage.
Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs
Level 2: Determination of knee voltage.

Experiment No. 15: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.
Level 1: Determination of Stefan's constant
Level 2: Verification of Stefan-Boltzmann Law.

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 Book

1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2018.

References:

1.Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002.

2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011.

3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017.

4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012.

5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019

E-Resourses:

1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live
3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live
4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live
5. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Fundamentals of materials, Lasers and optical fibers.

forSkill 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.Anindita, Dr.Sivasankar Reddy, Dr. Naveen C S, Dr. Mohan kumar Naidu, Dr.Deepthi P R, Dr.Mahaboob Pasha, Dr.Ranjeth Kumar Reddy, Dr.

	Pradeep Bhaskar, Dr. G. Srinivas Reddy, Dr.Saurav Kumar Kajli, Dr.CharanPrasanth
Recommended by the Board of Studies on	12th BOS conducted on 11th January 2025
Date of Approval by the Academic Council	

Course Code: **CHE1001**	**Course Title:** **Environmental Studies** **Type of Course:** **Pass-fail course**	**L- P- C**	1	2	0
Version No.	1.0				
Course Pre-requisites	NIL				
Anti-requisites	**NIL**				
Course Description	This course provides basic scientific knowledge and understanding of how our world works from an environmental perspective. Topics covered include: basic principles of ecosystem function; biodiversity and its conservation; human population growth; water resources, solid waste management; water, air and soil pollution; climate change; energy resources, and sustainability.				

	This course caters to Environment and Sustainability.			
Course Objective	The objective of the course is 'SKILL DEVELOPEMNT' of the student by using EXPERIENTIAL LEARNING techniques			
Course Outcomes	On successful completion of this course the students shall be able to: 1) outline the need for eco-balance 2) Acquire basic knowledge about global climate change with particular reference to the Indian context. 3) Identify ways to protect the environment			
Course Content:				
Module 1	**Environment and Ecosystem**	Assignment	Data Collection	**05 Classes**
Topics: Significance and need for environmental studies, Applications of environmental science in various engineering disciplines; Environmental ethics; Ecosystem, earth - life support system and ecosystem components; Energy flow in ecosystem; Biogeochemical cycles; Effect of human activities on these cycles.				
Module 2	**Biodiversity**	Assignment	Data Collection	**06 Classes**
Topics: Importance, types, factors affecting biodiversity; Species interaction - Extinct, endemic, endangered and rare species; mega-biodiversity; Hot-spots; Ecological succession; Genetically Modified crops; Threats and Conservation of biodiversity.				
Module 3	**Sustaining Natural Resources**	Case study	Data analysis	**07 Classes**
Topics: Food, soil conservation and pest management – Water resources: Water footprint and virtual water – Desalination – Energy resources-Renewable and non-renewable, efficiency and conservation.				
Module 4	**Environmental pollution and challenges**	Case study	Data analysis	**07 Classes**
Topics: Environmental hazards: Biological, Chemical, Nuclear, Biomedical, noise, e-waste; Risk and evaluation of hazards; Types of pollution: Air and water – Pollution sources, effects and mitigation. Water quality management; Solid waste management (land); Climate disruption, global warming and ozone depletion.				
Module 5	**Human Population Change and Environment**	Assignment	Data Collection	**05 Classes**
Topics: Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women empowerment. Sustaining human societies: Economics, environment, policies and education.				
Targeted Application & Tools that can be used: Application areas are Energy, Environment and sustainability **Tools:** Statistical analysis of environmental pollutants using excel origin etc.				
Project work/Assignment:				

Project Assignment:
Assessment Type:

- Midterm exam
- Term Paper- (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource)
- Project Review-I and II
- Project work
- Project report
- End Term Exam
- Self-Learning

1. **Write a State of Environment (SoE) report of your town/city/state/country**
2. **A video recorded statement/presentation of their own ideas on environmental mitigation**
3. Individual students will carry out analysis of polluted solid, liquid and gaseous samples and propose suitable mitigation measure(s). A detailed and in-depth report needs to be submitted for each case. This may include preparation of reagents, sample preparation (extraction), chemical analysis carried out, instruments and tools used, data collected and processed, inferences made and conclusions arrived at. Necessary theory support be given in the form of reference links to ebooks (or details like page numbers), journals and websites. A plagiarism check report be submitted which may carry weightage in report evaluation.

Text Book

1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA

Reference Books

7. David M. Hassenzahl, Mary Catherine Hager, Linda R. Berg (2017), Visualizing Environmental Science, 5th Edition, John Wiley & Sons, USA.
8. William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.

Skill Sets

All topics in theory component are relevant to Environment and Sustainability.

Lab/Project Skill sets

1. An attitude of enquiry.
2. Ability to interpret events and results.
3. Ability to work as a leader and as a member of a team.
4. Observe and measure physical phenomena.
5. Write reports.
6. Select suitable equipment, instrument and materials.
7. The ability to follow standard test procedures.
8. An awareness of the Professional Ethics.
9. Need to observe safety precautions.

Catalogue prepared by	Department Faculties
Recommended by the Board of Studies on	5th BOS: 6th August 2021
Date of Approval by the Academic Council	16th Academic council

ENG2001	**Advanced English**	**L- T- P- C**	1	0	2	2

Version No.	2.0
Course Pre-requisites	ENG1002 Technical English
Anti-requisites	**NIL**
Course Description	This course is designed to equip students to enhance their communication abilities in Listening, Speaking, Reading, and Writing. The curriculum covers interpersonal communication principles, the art of speech writing and delivery (including impromptu speaking), strategic approaches to critical reading, the identification of logical fallacies, and persuasive writing. Furthermore, the course will introduce students to the potential of AI tools and the techniques of prompt engineering to elevate their communication skills in the digital age. Upon course completion, students will be well-prepared to communicate effectively and critically in both academic and professional environments.
Course Outcomes	On successful completion of the course the students shall be able to: 1. Recognize the elements of interpersonal and cross-cultural communication to address communication challenges effectively. 2. Demonstrate the ability to deliver structured and impromptu speeches using effective speaking techniques. 3. Interpret textual and visual materials using critical reading strategies to evaluate arguments, logic, and persuasion. 4. Produce persuasive and analytical essays using effective argumentation techniques and structured writing strategies.

Course Content: Theory

Module 1	**Foundations of Effective Communication**	**Case Studies/ Role play**	**Cross-Cultural Competency**	**4 Classes**

Topics:
- Fundamentals of Interpersonal Communication
- Verbal, Non-verbal, and Paraverbal communication.
- Cultural dimensions theory (Hofstede's Cultural Dimensions).
- Active Listening Techniques
- Common Errors in Communication

Module 2	**Mastering Speech Delivery**	**JAM**	**Public Speaking Confidence**	**4Classes**

Topics:
- Introduction to Prompt Engineering
- Speech Preparation and Organization
- Techniques for Effective Impromptu Speaking
- Practice Speech Delivery

Module 3	**Critical Reading and Logical Analysis**	**Worksheet**	**Critical Thinking and Analysis**	**4 Classes**

Topics:
- Critical Reading Strategies: Contextualizing, Figurative Language, Evaluating Logic of an Argument, Recognizing Emotional Manipulation, Analysing Visuals
- Recognizing Logical Fallacies: Slippery Slope, False Dilemma, Post Hoc, Hasty Generalization, Ad Hominem, Straw Man,Bandwagon, No True Scotsman, Red Herring, Appeal to Authority, Sunk Cost, Appeal to ignorance

Module 4	**Writing Effective Arguments**	**Assignment**	**Clear and Coherent Writing**	**3 Classes**

Topics**:**
- Understanding Critical Writing
- Building Arguments (Pathos, Ethos, Logos)
- Techniques for Persuasion

Course Content: Practical Sessions

Module 1	**Foundations of Effective Communication**	**8 Classes**

1. **Interpersonal Communication**
   Charades with a Twist/Tone and Emotion Experiment/Mixed Messages Challenge/Role Reversal Conversations/ObservationExercise
2. **Cross-cultural Communication**
   Cultural Iceberg Analysis/Role-Play: Cross- Cultural Scenarios/Stereotypes vs Realities/Cross-/Cultural Negotiation Exercise/Cultural Sensitivity Case Studies
3. **Active Listening**
   Bingo TEDx/Story Building/Listening for Key Details/Interactive Podcast Listening/Fact or Opinion
4. **Instagram/YouTube Vocabulary Activity**

Module 2	**Mastering Speech Delivery**	**8Classes**

5. **Speech Writing**
6. **Impromptu Speech**
   JAM /"Would You Rather" Explainer/Picture Prompt Speech/Reverse Speech Crafting

Module 3	**Critical Reading and Logical Analysis**	**8 Classes**

7. **Critical Reading Strategies**
   Critical Reading Worksheet/Identifying Bias in News Articles
8. **Recognizing Logical Fallacies**
   Debate Challenge with Fallacy Detection/Fallacy Investigation with Podcasts or Social Media

Module 4	**Writing Effective Arguments**	**6 Classes**

9. **Building Arguments**
   Causes or Effects/Appeal Mash-Up/Debates on Controversial Topics
10. **Persuasive Writing**
    Creative Persuasive Writing/Opinion Writing

Targeted Application & Tools that can be used: Quizziz, Chatgpt, Gemini, Youtube, Instagram, Quillbot, Grammarly, Padlet

References

1. Adler, R. B., Rodman, G., &DuPré, A. (2019). *Understanding human communication (14th ed.)*. Oxford University Press.
2. Moore, B. N., & Parker, R. (2020). *Critical thinking* (13th ed.). McGraw-Hill Education.
3. DeVito, J. A. (2019). The interpersonal communication book (15th ed.). Pearson.
4. Ting-Toomey, S., & Dorjee, T. (2018). Intercultural competence: A model for teaching and assessing cross-cultural communication. *Journal of Intercultural Communication, 47*(2), 213–229. https://doi.org/10.1016/j.jicc.2018.03.004
5. https://www.ted.com/

Topics Relevant to "employability": Teamwork and Collaboration,Critical Thinking and Problem-Solving

Topics Relevant to "Human Values and Professional Ethics": Critical reasoning, Inclusivity and Fairness

Catalogue prepared by	**Dr. Tychicus David, Dr. Jayalakshmi E**

Recommended by the Board of Studies on	**8th January 2025**
Date of Approval by the Academic Council	

Course Code: CSE1006	**Course Title:** Problem Solving using JAVA **Type of Course: Integrated**	**L-T- P-C**	2	0	2	3
Version No.	2.0					
Course Pre-requisites	CSE1004 – Problem Solving Using C					
Anti-requisites	Nil					
Course Description	This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real time secure applications by applying these concepts and also for effective problem solving. The students interpret and understand the need for objectoriented programming to build applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVAand attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Describe the basic programming concepts. [Understand] **CO2:**Apply the concept of classes, objects and methods to solve problems. [Application] **CO3:** Apply the concept of arrays and strings. [Appy] **CO4:** Implement inheritance and polymorphism building secure applications. [Apply] **CO5:** Apply the concepts of interface and error handling mechanism. [Apply]					
Course Content:						
Module 1	**Basic Concepts of Programming and Java**	Assignment	Problem Solving			**15 Sessions (L3 + P12)**
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.						
Module 2	**Classes, objects, methods and Constructors**	Assignment	Problem Solving			**17 Sessions (L3 + P14)**
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods. Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.						
Module 3	**Arrays, String and String buffer**	Assignment	Problem Solving			**13 Sessions (L3 + P10)**
Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.						
Module 4	**Inheritance and Polymorphism**	Assignment	Problem Solving			**17 Sessions (L3 + P14)**

Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.

Module 5	**Input & Output Operation in Java**	Assignment	Problem Solving	**13 Sessions (L3 + P10)**

Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.

P1: Programming Exercises on Basic Concepts.

LEVEL 1: Discuss about datatypes and variables.

LEVEL 2: Demonstrate a simple java program

P2: Programming Exercises on Basic Concepts.

LEVEL 1: Discuss about datatypes and variables.

LEVEL 2: Demonstrate a simple java program

P3: Programming Exercises on operators, expressions based on a given scenario.

LEVEL 1: Explain operators, expressions.

LEVEL 2: Demonstrate operators

P4: Programming Exercises Command Line Arguments based on a given scenario.

LEVEL 1: Explain command line arguments

LEVEL 2: Demonstrate command line arguments

P5: Programming Exercises on basic Input/ Output functions and Control Statements: Branching

LEVEL 1: Explain Input/ Output functions

LEVEL 2:Demonstrate Control Statements: Branching

P6: Programming Exercises on Control Statements: Looping

LEVEL 1: Explain variour loops.

LEVEL 2:Demonstrate Control Statements: Looping

P7: Programming Exercises on Creating Objects, classes on a given scenario.

LEVEL 1: Illustrate class, object and methods.

LEVEL 2: Execute java program using class and objects

P8: Programming Exercises on Adding methods and Constructors to the class based on a given scenario.

LEVEL 1: Illustrate methods and constructors

LEVEL 2: Execute java program using methods and constructors

P9: Programming Exercises on methods based on a given scenario.

LEVEL 1: Illustrate method overloading

LEVEL 2: Apply method overloading for the given scenario.

P10: Programming Exercises on methods based on a given scenario.

LEVEL 1: Illustrate constructors overloading

LEVEL 2: Apply constructor overloading for the given scenario

P11: Programming Exercises on methods for static members bassed on a given scenario.

LEVEL 1: Benefits of usage static members

LEVEL 2: Usage of Static Members for the given scenario

P12: Programming Exercises on static methods based on a given scenario.

LEVEL 1: Benefits of usage static methods

LEVEL 2: Usage of Static Methods for the given scenario.

P13: Programming Exercises on nested Classes based on a given scenario.

LEVEL 1: Benefits of usage nested classes

LEVEL 2: Apply the concept of usage of nested classes for the given scenario

P14: Programming Exercises on Arrays and its built-in functions based on a given scenario.

LEVEL 1: Illustrate one dimensional arrays and its functions.

LEVEL 2: Demonstrate programs with single-dimensional arrays and operations.

P15: Programming Exercises on Arrays and its built-in functions based on a given scenario.

LEVEL 1: Illustrate multi dimensional arrays and its functions.

LEVEL 2: Demonstrate programs with multi-dimensional arrays and operations.

P16: Programming Exercises on String Class and its built-in functions based on a given scenario.

LEVEL 1: Explain about String class and String methods.

LEVEL 2: Execute simple java applications for String and StringBuffer operations

P17: Programming Exercises on String Buffer Class and its built-in functions based on a given scenario.

LEVEL 1: Explain about StringBuffer class and String methods.

LEVEL 2: Execute simple java applications for String and StringBuffer operations

P18: Programming Exercises on String Builders and its built-in functions based on a given scenario.

LEVEL 1: Explain about String Builders.

LEVEL 2: Execute java applications for String Builders

P19: Programming Exercises on single, multi level Inheritance and super keyword based on given scenario.

LEVEL 1: Explain single and multi level inheritance.

LEVEL 2: Demonstrate simple applications for the different types of inheritance

P20: Programming Exercises hierarchical Inheritance and super keyword based on given scenario.

LEVEL 1: Explain hierarchical inheritance.

LEVEL 2: Demonstrate simple applications for hierarchical inheritance

P21: Programming Exercises on Overriding.

LEVEL 1: Differentiate method overloading and method overriding.

LEVEL 2: Demonstrate simple program with dynamic method dispatch.

P22: Programming Exercises on Final based on given scenario.

LEVEL 1: Implement programs using concept of final.

LEVEL 2: Use final keyword for the given problem

P23: Programming Exercises on Abstract keyword based on given scenario.

LEVEL 1: Implement programs using concept of Abstract.

LEVEL 2: Use abstract keyword for the given problem

P24: Programming Exercises on Interface based on a given scenario.

LEVEL 1: Differentiate abstract class about interface

LEVEL 2: Implement interfaces in the given problem

P25: Programming Exercises on Exception Handling based on a given scenario.

LEVEL 1: Explain exception handling

LEVEL 2: Solve the given problem using exception handling mechanism.

P26: Programming Exercises on Character Stream Classes based on a given scenario.

LEVEL 1: Explain Character Stream Classes

LEVEL 2: Solve the given problem using Character Stream Class.

P27: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P28: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P29: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P30: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.

Text Book

T1 Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education, 11th Edition,2019.

References

R1. Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Tenth Edition, Pearson 2015.

R2: James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.4th Edition, 2000.

R3. E. Balagurusamy, "Programming with Java", Tata McGraw Hill Education, 6th Edition, 2019.

E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf

E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub)

Web **resources**
ps://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q
ps://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to development of "Skill Development":

1. Static Polymorphism
2. Method overloading, constructors
3. constructor overloading
4. this keyword
5. static keyword and Inner classes
6. Inheritance and Polymorphism.

for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

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

Course Code: CSE3216	**Course Title:** Mastering Object- Oriented Concepts in Python **Type of Course:** Lab	**L- T- P- C**	0	0		2
Version No.	1					
Course Pre-requisites	CSE1005 – Programming in Python					
Anti-requisites	NIL					
Course Description	This course covers mastering object-oriented concepts in Python, including classes, inheritance, polymorphism, and encapsulation. Students will learn to design and implement robust, reusable code using real-world examples. Ideal for those with basic Python knowledge, it enhances problem-solving skills and software development proficiency.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Mastering Object Oriented Concepts in Python and attain Skill Development through Experiential Learning.**					
Course Out Comes	**CO1:**Explain features of Oops along with creation of Python classes and objects to represent real world Objects.[Understand] CO2:Demonstrate inheritance, polymorphism, and abstraction in Python to build maintainable and extendable software systems.[Apply] CO3:Demonstrate exception handling in Python to build robust error-handling mechanisms and debugging tool and Assess various file handling techniques in Python.[Apply]					

Course Content:				
Module 1	**Introduction to OOPS, Classes and Objects**	MCQ	Assignment	**10 Sessions**
Topics: **Introduction to OOPs:** Problems in Procedure Oriented Approach, Specialty of Python Language, Features of OOPS - Classes and Objects, Encapsulation, Abstraction, Inheritance and Polymorphism. **Classes and Objects:** Creating a Class, The Self Variable, Constructor, Destructors, Types of Variables, Namespaces, Types of Methods - Instance Methods, Class Methods, Static Methods, Passing Members of One Class to Another Class, Inner Classes.				
Module 2	**Inheritance and Polymorphism**	MCQ	Assignment	**10 Sessions**
Constructors in Inheritance, Overriding Super Class Constructors and Methods, The Super() Method, Types of Inheritance – Single Inheritance, Multiple Inheritance, Method Resolution Order(MRO), Polymorphism, Duck Typing Philosophy of Python, Operator Overloading, Method Overloading, Method Overriding. **Abstract Classes and Interfaces:** Abstract Method and Abstract Class, Interfaces in Python, Abstract Classes vs. Interfaces.				
Module 3	**Exceptions and Files in Python**	MCQ	Assignment	**10 Sessions**
Exceptions: Errors in a Python Program – Compile-Time Errors, Runtime Errors, Logical Errors. Exceptions, Exception Handling, Types of Exceptions, The Except Block, The assert Statement, User-Defined Exceptions, Logging the Exceptions. **Files in Python:** Files, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods.				
Targeted Application & Tools that can be used: Python, PyCharm				
Project work/Assignment:				
Assignment: Module 1 Assignment: Design and implement a Python application that simulates a banking system using classes and methods for customers and accounts. Module 2 Assignment: Develop a Python application that simulates Library management system that demonstrates inheritance, polymorphism and abstraction concepts. Module 3 Assignment: Develop a Python program that handles different types of exceptions while processing user input for a movie ticket booking system showcasing exception handling and File handling concepts.				
Text Book **1.** Dr. R Nageshwara Rao, "Core Python Programming", Dreamtech Press, 3rd Edition, 2021.				
References 1. Alex Martelli, Anna Ravenscroft & Steve Holden, "Python in a Nutshell The Definitive Reference", O'Reilly Media, 3rd edition, 2017. 2. Luciano Ramalho, "Fluent Python Clear, Concise, and Effective Programming", O'Reilly Media, 2nd edition, 2022. 3. Mark Lutz, "Learning Python: Powerful Object-Oriented Programming", O'Reilly Media, 5th edition, 2013. 4. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media, 3rd edition, 2013.				
Weblinks:				

1. www.learnpython.org 2. https://realpython.com/python3-object-oriented 3. https://www.tutorialspoint.com/python/python_oops_concepts.htm
Topics relevant to "SKILL DEVELOPMENT": Building Real-World Applications Using OOPS Concepts, Error Handling and Debugging Techniques, Concurrency in Python, Advanced File Handling Techniques, Creating and Managing Python Packages and Modules, Designing and Implementing Python Interfaces **This is attained through assessment component mentioned in course handout.**

Catalogue prepared by	Ms. Yogeetha B R
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CSE1002	**Course Title: Innovative Project-Arduino Using Embedded C**	**L- T-P- C**	0	0	0	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	In this course the students will learn fundamental concepts of 'C' and Embedded C, problem solving using C in a systematic way to read and write the C code and to implement them on Arduino prototype board. The course will also demonstrate how to assemble various sensory devices and program them using Arduino platform as a basis. Students will have the opportunity of gaining real-world experience in handling IoT devices involving hardware and software combinations. The course also offers in-depth knowledge of designing, developing, coding and implementing Arduino projects.					
Course Objective	The objective of the course is **Employability Skills** of student by using **PARTICIPATIVE LEARNING** techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to** 1) Write a program using Arduino programming language using Embedded 'C'. 2) Explain the main features of the Arduino prototype board 3) Demonstrate the hardware interfacing of the peripherals to Arduino system. 4) Demonstrate the functioning of live projects carried out using Arduino system.					
Course Content:						

Module 1: Basics of C, Branching and looping: Structure of C programs,Variables, Keywords, Datatypes, declaration and Initialization,**Decision Making and Branching:** if, if-else, else-if ladder, switch statement**Decision making and looping**: for, while, and do-while statements
(9 Hrs) [Blooms level selected: Comprehension Level]

Module 2: Arrays, functions, strings: Arrays: Introduction, one dimensional array, two dimensional array,Functions: User defined functions, Categories, searching and sorting,Strings: Introduction, string handling functions.

(8 Hrs) [Blooms level selected: Comprehension Level]

Module 3: Structures and Pointers: Structure definition ,syntax and application of structures, definition of pointers ,syntax, pass –by-reference.

(5 Hrs) [Blooms level selected: Application Level]

Module 4: Introduction to Arduino and Sensory Devices:
Introduction to Arduino, Pin configuration, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables,i/o Functions, Arduino IDE, Various Cloud PlatformsArduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor , Connecting Switches and actuators , sensor interface with Arduino.

Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications.Introduction to online Simulators: Working with Tinkercad Simulator
(8 Hrs) Application Level) [Blooms level selected: Application Level]

Topics: Types of Arduino boards, sensors, 3D Printer

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 and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: students can use open SOURCE Softwares Arduino IDE and Tincker CAD

Project work/Assignment:

1. Projects: At the end of the course students will be completing the project work on solving many real time issues.

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 presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same

Textbook(s):
E Balagurusamy "Programming in ANSI C" , Mc Graw Hill Publications,7th Edition

Monk Simon "Programming Arduino: Getting Started with Sketches", Mc Graw Hill Publications Second Edition

References

Reference Book(s)

1. Neerparaj Rai "Arduino Projects for Engineers" BPB publishers,first edition, 2016.

2. Ryan Turner "Arduino Programming " Nelly B.L. International Consulting Ltd. first edition,2019.

1) https://www.tutorialspoint.com/arduino/index.html.
2) https://create.arduino.cc/projecthub/projects/tags/sensor.
3) https://3dprinting.com/what-is-3d-printing.

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

1. Arduino trending Projects <https://www.https://projecthub.arduino.cc/>
2. Introduction to Arduino <https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>
3. Case studies on Wearable technology<https://www.hticiitm.org/wearables>

E-content:

1. Cattle Health Monitoring System Using Arduino and IOT (April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002)

2. M H Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, Pragya Singh"IOT BASED SMART SECURITY SYSTEM USING ARDUINO" 2021 JETIR August 2021, Volume 8, Issue 8.

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. Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.

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

Catalogue prepared by	Dr. Divya Rani/Dr Ashutosh Anand
Recommended by the Board of Studies on	BOS NO:
Date of Approval by the Academic Council	Academic Council Meeting

Course Code: CSE1003	**Course Title: Innovative Projects using Raspberry Pi**	**L- T-P- C**	-	-	-	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide an in-depth understanding of Raspberry-pi Single Board Computers and their application in various real time projects involving sensors. Throughout the course, students will learn Raspberry-pi programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Raspberry-pi, read sensor data, and use it to control various output devices This course is suitable for advance learners who are interested in exploring the world of electronics and developing practical applications using Raspberry-pi and sensors.					
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies by using sensors and their interfacing to solve real-time problems **.**					
Course Outcomes	**On successful completion of the course the students shall be able to** 5) Understand the concept of micro python 6) Explain the main features of the Raspberry-pi prototype board 7) Analyse the hardware interfacing of the peripherals to a Single board computer system. 8) Demonstrate the functioning of live projects carried out using Raspberry-pi system					
Course Content:						

Module 1	**Introduction to Micro python**	Hands-on	Interfacing Task and Analysis	**4 Sessions**
Topics: Introduction to MicroPython, Comparison with other programming languages, Setting up the MicroPython development environment, Basics of MicroPython syntax and structure.				
Module 2	**Working with Raspberry-pi**	Hands-on	Interfacing Task and Analysis	**4 Sessions**
Introduction to raspberry pi boards, pin-diagram, different types of raspberry pi boards and its application, LED and switch control. Mastering Modules, Setup Raspberry - PuTTY SSH,VNC Viewer to interface with more complicated sensors and actuators. Various Libraries and its functions.				
Topics: Micro Python, types of Raspberry-pi boards, sensors, 3D Printer				
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 and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: students can use open SOURCE Softwares Thonny Python, Python IDLE etc.

Project work/Assignment:

1. **Projects: At the end of the course students will be completing the project work on solving many real time problems.**
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 presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same**

Textbook(s):

Monk Simon "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", Publisher(s): O'Reilly Media, Inc. ISBN: 9781098130923 fourth Edition.

References

Reference Book(s)

1. Charles Bell Micro Python for the Internet of Things: A Beginner's Guide to Programming with Python on Microcontrollers" by" Edition 1, 2017, ISBN 978-1-4842-3123-4

2. Stewart Watkiss "Learn Electronics with Raspberry Pi " Apress Berkeley, CA . second edition,2020. ISBN978-1-4842-6348-8

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

4. Raspberry-pi Projects <https://magpi.raspberrypi.com/articles/category/tutorials/>
5. Introduction to internet of things<https://nptel.ac.in/courses/106105166>
6. Case studies on Wearable technology<https://www.hticiitm.org/wearables>

E-content:

5. Basil, ElizaSawant, S.D."IoT based traffic light control system using Raspberry Pi "DOI 10.1109/ICECDS.2017.8389604

6. Supriya S, 2Dr. Aravinda "Green leaf disease detection and identification using Raspberry Pi https://www.irjet.net/archives/V9/i8/IRJET-V9I847.
7. Dr. E.N. Ganesh., "Health Monitoring System using Raspberry Pi and IOT" DOI : http://dx.doi.org/10.13005/ojcst12.01.03

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

Catalogue prepared by	Dr. Divya Rani /Dr Ashutosh Anand
Recommended by the Board of Studies on	BOS NO: 17Th BoS meeting held on 5th July 2023
Date of Approval by	Academic Council Meeting No. 21 dated on _____

the Academic Council	

Course Code: EEE1001	**Course Title: Fundamentals of Electrical and Electronics Engineering** **Type of Course: School Core Theory and Integrated lab.**	**L-T-P-C**	3	**0**	2	4
Version No.	2.0					
Course Pre-requisites	MAT1001- Calculus and Linear Algebra MAT1002- Transform Techniques, Partial Differential Equations and Their Applications					
Anti-requisites	**Nil**					
Course Description	This is a fundamental Course which is designed to know the use of basic of electrical engineering principles occurs in different occupation. The content will betaught and implemented with the aim of developing different types of skills in using different types of electrical testing and measuring instruments. This course also develops a competence of trouble shooting by applying the knowledge gained in the laboratory.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Electrical and Electronics Engineering and attain **Skill Development** through **Experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Discuss the basic concepts of DC and AC circuits. 2. Explain the basic theory and operation of DC and AC Machines. 3. Associate the use electrical measurements and Instruments. 4. Discuss the basic electronic components and its applications. 5. Verify the basic laws of Electrical Engineering. 6. Compute the various parameters in electrical and electronic circuits.					
Course Content:						
Module 1	Introduction to DC and AC Circuits	Simulation		10 Session		
	Basic Terminology and classification of elements, Series and Parallel Circuits, KVL and KCL. AC Circuits: Different Terminologies and AC Generation, AC through pure Resistive, Inductive and Capacitive circuits. Series R-L Circuit with AC excitation.					
Module 2	Fundamentals of Electrical Machines	Experimental based learning		10 Sessions		

	Topics: **Electrical Machines:** Working principle, operation and application of DC Generator, DC motor, Transformer, Induction motor and Alternator.			
Module 3	Electrical Measurements and Instrumentation	Experimental based learning		10 Sessions
	Topics: **Electrical Measurements and Instrumentation:** Concept of true value, measured value, types of errors and computation of errors, Energy meter, Types			
	of sensors and transducers, Introduction to virtual Instrumentation. Electrical Installation: Electrical Wiring Accessories, Electrical wiring in residence, Lamp Circuits, Different protective devices. Earthing system. Energy Consumption calculations.			
Module 4	**Electronics**	Case study		10 Sessions
	Electronics: PN junction diode, forward and reverse bias, diode approximation – Rectifiers, BJT, Introduction to Operational amplifiers			
	List of Laboratory Tasks: **Experiment No 1**: Measurement of voltage, current in a circuit. **Level 1**: Consider a simple circuit of your choice and perform the wiring & testing of voltage and current in the series combination & parallel combination of resistors on bread board set-up. **Level 2**: For the same circuit considered in level 1, perform the simulation using ORCAD/Multisim/MATLAB. **Experiment No 2**: Measurement of -Voltage Calculate the Power & Power Factor of the Circuit **Level 1**: Measure and calculate the electrical parameters by a bread board set up of a simple AC series R-L circuit at your choice. **Level 2:** For the same circuit considered in level 1, perform the simulation using ORCAD/Multisim/MATLAB. **Experiment No 3:** Testing a DC Generator under different loading conditions. **Level 1**: Observe the voltage build up process of self-excited DC shunt generator **Level 2:** Observe the fact that the shunt generator is having a fairly constant output voltage with variation in load. **Experiment No 4**: Measurement of resistance in DC Circuits. Level 1: Perform the measurement of resistance in a simple DC Circuit using a Multimeter. Level 2: Perform the measurement of resistance in a simple DC Circuit using NI Lab View. **Experiment No 5**: Practice of simple Lamp Circuits **Level 1**:Make a circuit with One lamp controlled by one switch with PVC surface conduit system and a provision of 2/3 Pin socket. **Level 2**: Make a circuit for ceiling fan with regulator. **Experiment No 6**: Load test on DC shunt motor **Level 1**: Conduct load test on DC shunt motor and calculate the efficiency. **Level 2**: Obtain the various characteristics of DC shunt motor **Experiment No 7**: VI characteristics of PN junction and Zener diode Level 1: Obtain the VI characteristics of PN junction and Zener diode Level 2: To find cut-in voltage, static and dynamic resistances in both forward and reverse biased conditions for zener diode **Experiment No 8**: Characteristics of JFET in Common source Configuration Level 1:Obtain the Drain Characteristics and Transfer Characteristics of a Junction Field Effect Transistor (JFET). Level 2: Measure drain resistance, trans-conductance and amplification factor. **Experiment No 9**: Half Wave and Full Wave Rectifier. Level 1: To study the operation of Half wave and Full wave rectifier without filter and obtain Ripple Factor, Efficiency and Percentage Regulation Level 2: To study the operation of Half wave and Full wave rectifier with filter.			

Experiment No 10: Demonstration on physical installation on Earthing.
Level 1: Demonstration on physical installation on Pipe Earthing.
Level 2: Demonstration on physical installation on Plate Earthing.

Targeted Application & Tools that can be used:
Troubleshooting various electrical appliances & ORCAD, Multisim, MATLAB.

Text Book

1. **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.
2. A. P. Malvino, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007

References

1. A.K. Sawhney, "A course in Electrical & Electronics Measurements & Instrumentation.
2. K Uma Rao, A Jaya Lakshmi, "Basic Electrical engineering" I K International publishing house Pvt.Ltd.
3. John Hiley, Keith Brown and Ian McKenzie Smith, "HUGHES Electrical and Electronic Technology", 10th Edition (Indian Edition published by Dorling Kindersley), Pearson, 2011
4. Samarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, Prentice Hall India, 2007.

Online resources:

1. https://www.digimat.in/nptel/courses/video/108105112/L01 "Fundamentals of Electrical Engineering-Basic Concepts, Examples"
2. Case study: https://nptel.ac.in/courses/108/102/108102146/ "Introduction to Electrical Machines"
3. Seminar Topic: https://nptel.ac.in/courses/108/105/108105153/ "Electrical Measurements"

Ebook: https://puniversity.informaticsglobal.com

Topics relevant to "SKILL DEVELOPMENT": All the experiments which are listed for **Skill Development** through **Experiential Learning Techniques**. This is attained through the assessment component mentioned in course handout.

Catalogue prepared by	Dr. Jisha L K Mr. Bishakh Paul
Recommended by the Boardof Studies on	BoS No: 12 th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

1. PROGRAM CORE COURSES

<table>
<tr><td>Course Code: EEE2002</td><td colspan="5">Course Title: Electric Circuit Analysis
Type of Course:1] Program Core
2] Theory & Laboratory integrated</td><td>L- T-P-C</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="10">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="10">Students should have basic knowledge of Engineering Mathematics
Solving simultaneous linear algebraic equations, Differential Equations, Laplace Transforms</td></tr>
<tr><td>Anti-requisites</td><td colspan="10">NIL</td></tr>
<tr><td>Course Description</td><td colspan="10">This course dwells upon problem solving in area of electrical networks by using various network reduction techniques and theorems. It also delves into analysis of electrical circuits using basic mathematics concepts. The course deploys use of Multisim/MATLAB Simulink software to analyse and simulate various types of electrical networks.</td></tr>
<tr><td>Course Objective</td><td colspan="10">The objective of the course is Skill Development through Experiential learning techniques. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Course Out Comes</td><td colspan="10">On successful completion of the course the students shall be able to:
1] Understand various network reduction techniques to reduce the complexity of circuits
2] Describe various network theorems
3] Explain the behaviour of RL and RC circuits for DC and AC excitation.
4] Interpret the parameters of two port networks
5] Analyse basic concepts of poly phase circuits.
5] Apply the various blocks used for simulation of AC and DC Circuits in Multisim
6] Create various types of AC and DC circuits with the help of MATLAB SIMULINK environment.</td></tr>
<tr><td>Course Content:</td><td colspan="10"></td></tr>
<tr><td>Module 1</td><td colspan="2">Module:1 Network Reduction Techniques:</td><td>Assignment</td><td colspan="3">Programming/Simulation</td><td colspan="3">6 Sessions</td></tr>
<tr><td colspan="11">Topics: Types of electric circuit elements and sources, Source transformation, mesh analysis, Nodal analysis.</td></tr>
<tr><td>Module 2</td><td colspan="2">Module: 2 Network Theorems:</td><td>Assignment</td><td colspan="3">Programming/Simulation</td><td colspan="3">8 Sessions</td></tr>
<tr><td colspan="11">Topics: Statement of all Network Theorems, Explanation of Superposition theorem, Thevenin’s theorem, Maximum power transfer theorem and numerical examples on these theorems (DC & AC)</td></tr>
<tr><td>Module 3</td><td colspan="2">Module:3 Transient analysis and Resonance</td><td>Assignment</td><td colspan="3">Simulation</td><td colspan="3">8 Sessions</td></tr>
<tr><td colspan="11">Topics: Initial conditions, transient analysis of RL, RC circuits, Laplace transforms of RL, RC circuits with step input, concept of Resonance.</td></tr>
</table>

Module 4	Module :4 Two port networks	Assignment	Simulation	**5 Sessions**

Topics: 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.

List of Laboratory Tasks:

Experiment N0 1: SIMULATION OF NODAL ANALYSIS FOR DC CIRCUITS using MULTISIM

Level 1: To Simulate a simple DC Circuit with only independent voltage sources and resistors for determining the all node voltages using Multisim

Level 2: To Simulate a DC Circuit with resistors, dependent and independent voltage as well as current sources for determining the all node voltages and currents using Multisim.

Experiment No. 2: SIMULATION OF ELECTRIC CIRCUITS FOR DETERMINING THEVENIN'S EQUIVALENT using MULTISIM

Level 1: To Simulate a simple DC Circuit with only independent voltage sources and resistors for determining the thevenin's equivalent across only one resistance using Multisim.

Level 2: To Simulate a DC Circuit with resistors, dependent and independent voltage as well as current sources for determining the thevenin's equivalent across one dependent current source using Multisim.

Experiment No. 3: SIMULATION OF SUPERPOSITION THEOREM FOR DC CIRCUITS using **MULTISIM**

Level 1: To Simulate a simple DC Circuit with only independent voltage sources and resistors for determining the current across only one resistance using by applying Superposition theorem using Multisim.

Level 2: To Simulate a DC Circuit with resistors, dependent and independent voltage as well as current sources for determining the voltage and current across one resistor by applying Superposition theorem using Multisim.

Experiment No. 4: SIMULATION OF MAXIMUM POWER TRANSFER THEOREM FOR DC CIRCUITS using MULTISIM

Level 1: To Simulate a simple DC Circuit with only independent voltage sources and resistors for determining the maximum power absorbed across only one resistance using by applying maximum power transfer theorem using Multisim.

Level 2: To Simulate a DC Circuit with resistors, dependent and independent voltage as well as current sources for determining the maximum power absorbed across only one resistance by applying maximum power transfer theorem using Multisim.

Experiment No. 5: SIMULATION OF TRANSIENT AND PARAMETRIC ANALYSIS OF SERIES RL and RC CIRCUITS USING VARIOUS TYPES OF INPUT SIGNALS using MATLAB

Level 1: To find out the transient response and parametric analysis by simulation of RL and RC circuit Using impulse and Step Inputs

Level 2: To find out the transient response and parametric analysis by simulation of RL and RC circuit Using Sinusoidal Input

Experiment No. 6: THREE PHASE CIRCUIT REPRESENTING GENERATOR TRANSMISSION LINE AND LOAD using MATLAB

Level 1: To analyse three phase currents and voltages by the analysis of three phase circuit representing the Generator, Transmission line and loads using Multisim when both the generator and the load is star connected.

Level 2: To analyse three phase currents and voltages by the analysis of three phase circuit representing the Generator, Transmission line and loads using Multisim when the generator is star connected and the load is Delta connected.

Experiment No. 7: MULTISIM SIMULATION OF AC CIRCUITS using MATLAB

Level 1: To Simulate a simple AC Circuit with only resistors for determining voltages and currents across all resistors using Multisim

Level 2: To Simulate an AC Circuit resistors, inductors and capacitors for determining voltages, currents and phase angle across all components using Multisim.

Targeted Application & Tools that can be used:

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

Text Book

1] Ravish.R.Singh, "Electrical Networks", Mcgraw Hill company,2009

2. Charles K Alexander and Matthew N O Sadiku "Fundamentals of Electric Circuits Sixth (6th) 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 learning resources

1. Seminar: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=electric%20circuit%20analysis
2. https://www.tutorialspoint.com/network_theory/index.htm
3. https://nptel.ac.in/courses/108/105/108105159/
4. Electric Circuits: A Primer, Olivier, J. C , 2018 https://puniversity.informaticsglobal.com:2284/ehost/ebookviewer/ebook/bmxlYmtfXzE4MjU5MjZfX0FO0?sid=ee128722-77d3-4bae-a3e8-39a07f91cb69%40redis&vid=22&format=EB&rid=1
5. Case Study **https://www.scribd.com/document/420348012/Case-Study**
6. **https://presiuniv.knimbus.com/user#/home**

Topics relevant to "SKILL DEVELOPMENT": Network Reduction Techniques and Source transformation for **Skill Development through Experiential learning techniques.** This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Bishakh Paul Mr K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No: 12 th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE2008	**Course Title: Electrical Power Generation Transmission and Distribution** **Type of Course: Program Core & Theory only**		**L- T-P-C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	EEE1001 (Fundamentals of Electrical & Electronics Engineering), EEE2002 (Electrical Circuit Analysis) Fundamentals of Electrical Engineering, Analysis of Series and parallel circuits. Loop & Node Analysis, Network Theorems and also the basic concepts of two port network.						
Anti-requisites	**Nil**						
Course Description	This course covers electricity generation, transmission, and distribution. The course teaches students to identify energy sources, electrical power generation, power system economic terminology, and transmission and distribution system performance modelling and analysis. The course improves analysis. Assignments employing Mi Power/ETAP/MATLAB/PSCADA/Power World Simulator/PSSE improve programming skills.						
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Electrical Power Generation Transmission and Distribution and attain **Skill Development** through **Problem Solving** methodologies.						
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Describe the working of Hydroelectric, Thermal, Nuclear, Wind, Solar power plants, etc., 2. Summarize the economic aspects of power system operation and its effects. 3. Solve the numerical examples of performance of a transmission line. 4. Explain various aspects of Construction of a Transmission line. 5. Discuss the effects of a few Important Phenomenon associated with Transmission of power. 6. Summarize different distributions systems.						
Course Content:							
Module 1	Introduction & Sources of Electric Power generation	Assignment	Data Collection	**8 Sessions**			
Topics: Introduction to electrical energy generation and sources like Hydel, Thermal, Nuclear, Solar, Wind, Fuel Cell, Tidal, Gas and etc. Selection of Site, Working and constructional details of Hydro, Thermal, Nuclear, Wind and Solar Power plants.							
Module 2	Economic Aspects	Assignment	Computation of domestic electric bill by developing program.	**8 Sessions**			
Topics: Introduction, Terms commonly used in System Operation, Diversity factor, Load factor, Plant Capacity factor, Plant use factor, Plant Utilization factor, Loss factor & Load duration curve, Definition & Problems. Electric Power Tariff: Cost of Generating Station, factors influencing the rate of tariff designing. Types of Tariff – Definition & Problems. Power Factor Improvement.							
Module 3	Transmission Line Parameters	Assignment	Programming/Simulation	**8 Sessions**			
Topics: Introduction to line parameters- resistance, inductance and capacitance. Basic Concepts of Computation of Line Inductances and capacitance for various types of line configurations. Classification of transmission lines and its modelling. ABCD constants of transmission lines and Numerical Examples on Performance of Transmission Lines.							
Module 4	Construction of overhead Transmission Lines	Assignment/Case Study	Programming/Simulation/Data Collection/	**8 Sessions**			
Topics: Introduction, Types of supporting structures and line conductors used. Concept of Sag, Stringing chart. Over Head Insulator: Introduction, Insulator Materials, Types of Insulators, Potential							

Distribution over a string of suspension insulator, String Efficiency and numerical examples. Concept of Corona, Power Loss due to Corona and Numerical examples.				
Module 5	Distribution Systems	Term paper/Assignment/Case Study	Simulation/Data Collection	**8 Sessions**
Topics: Introduction, Classifications of distribution system- A.C and D. C Systems, Requirements and Design Considerations in Distribution System. Underground Cable: Introduction, Types of Cables, Thermal Characteristics, Cable Laying, Selection of Cables, Comparison between Overhead lines and underground cables.				
Targeted Application & Tools that can be used: Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards. Professionally Used Software: Mi Power/ ETAP/ MATLAB/PSCADA/Power World Simulator/PSSE.				
Text Book 1. A. Chakrabarti, M.L. Soni and P.V. Gupta, "Power System Engineering", Dhanpat Rai and Co. New Delhi.				
References 1. S. N. Singh, "Electrical Power Generation, Transmission and Distribution", PHI 2. D.P. Kothari, I.J. Nagrath, "Modern Power System Analysis", TMH 3. V.K.Mehta, Rohit Mehta "Principles of Power System", S. Chand Publishers. 4. IEEE 1863-2019 - IEEE Guide for Overhead AC Transmission Line Design				
Online Resources: 1. EBook: https://puniversity.informaticsglobal.com/ 2. Seminar: https://nptel.ac.in/courses/108/102/108102047/ 3. Case Study: http://www.digimat.in/nptel/courses/video/108102047/L01.html 4. https://www.youtube.com/watch?v=Od0k9nqtoCM (Underground Cable Laying-by Power Sector Skill Council) 5. https://www.youtube.com/watch?v=Z2cELqtxysA (Overhead Line erection- by Power Sector Skill Council) 6. https://www.youtube.com/watch?v=LPN1NZBz810 (Conductor Sag Demonstration- by Power Sector Skill Council))				
Topics relevant to "SKILL DEVELOPMENT": Various types Transmission line Modelling and applications of various transmission lines For **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr. Snehaprabha T V. Mr. Ravi V Angadi.			
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/02/2022			
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022			

Course Code: EEE2001 v02	**Course Title: Signals and Systems** **Type of Course: Program Core Theory only**	**L- T-P-C**	3	0	0	3
Version No.	**2.0**					
Course Pre-requisites	Knowledge of differential and integral calculus, ordinary differential equations, and introductory complex variables required. Use of MATLAB software for basic signal operations.					
Anti-requisites	**NIL**					

Course Description	The purpose of this course is to familiarize with the importance of signals and signal processing systems and to develop the basic abilities of understanding and analysing the types of signals, systems and filters. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical and computing. The course develops analytical and logical thinking skills. The course also enhances the programming abilities through assignments.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Signals and Systems and attain **Skill Development** through **Problem Solving** methodologies
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Identify different types of signals and systems based on their properties 2. Summarize the behaviour of LTI systems to periodic and aperiodic signals using Fourier Transforms. 3. Discuss the transform- domain signal and frequency response using DFT 4. Classify techniques of dealing with discrete systems using the z-transform.
Course Content:	

Module 1	Introduction to Signals and Systems	Assignment	Programming	**10 Sessions**

Topics:
Representation of Continuous and Discrete-time Signals, Classification of signals, Transformation of Independent Variables –Time Shifting, Time Scaling and Time Reversal, Representation of Continuous and Discrete Time Systems. Classification of systems.

Module 2	Analysis of LTI System	Assignment / Quiz	Programming	**10 Sessions**

Topics:
Impulse Response of Continuous and Discrete Time LTI Systems, Convolution, Fourier Series Representation of Continuous Time and Discrete-time periodic signals, Properties of Fourier Series,

Module 3	Analysis of Continuous and Discrete LTI Systems	Assignment	Programming	**12 Sessions**

Topics:
Sampling Theorem, Effects of Sampling and Aliasing. Sampling of Continuous Time Signals, Review of Laplace Transform, Region of Convergence, Mapping of s-plane to z-plane.

Targeted Application & Tools that can be used:
Signals and signal processing is a branch of electrical engineering and finds its applications in different professional fields such as audio signal processing, digital image processing, video compression, speech recognition, control systems, research and development, digital communications, digital synthesizers, radar, sonar, financial signal processing, seismology and biomedicine.
Professionally used tools: MATLAB / Python

Textbooks
1. Signals and Systems by Alan V. Oppenhein, Alan S. Willsky and S. Hamid, 2nd edition, Pearson 2016.
2. John G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, Pearson Education, 2012.

References
1. B.P. Lathi, "Signals, Systems & Communications" BSPublications, 5th Reprint, 2008.
2. Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, "Signals & Systems", TMH, 2001.
3. Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 3rd edition, Pearson new international edition, 2014.
4. Digital Signal Processing, P Ramesh Babu, Pearson Education.

Online Resources:
1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://nptel.ac.in/courses/117/101/117101055/
3. https://www.youtube.com/results?search_query=signals+and+systems
4. https://puniversity.informaticsglobal.com

Topics relevant to "SKILL DEVELOPMENT": Mapping of s-plane to z-plane are the topics for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	BoS No: 13th, held on 27/12/2021
Date of Approval by the Academic Council	18th Academic Council meeting held on 03/08/2022

Course Code: EEE2003	**Course Title: Electromagnetic Fields** **Type of Course: Program Core & Theory only**	**L- T-P-C**	3	0	0	3
Version No.	**2.0**					
Course Pre-requisites	[1] Vector Calculus and Differential Equations Basic concepts of vector addition, multiplication, partial differentiation and integration.					
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 Theory and attain **Skill Development** through **Problem Solving** methodologies					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Select the suitable coordinating system for Electromagnetic field systems. 2. Explain the concept of electrostatics fields. 3. Describe the principles of magneto statics fields. 4. Summarize the static and time varying field equations.					
Course Content:						
Module 1	Introduction to vector analysis and coordinate systems	Assignment	Task on choosing the proper coordinate system for Analysis in various applications	07 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	08 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	08 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	05 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 handout.				
Catalogue prepared by	Mr. K Sreekanth Reddy Mr. Bishakh Paul			
Recommended by the Board of Studies on	BoS NO: 12th , held on 27/7/2021			
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21			

Course Code: **EEE2009**	**Course Title: Analog Electronics Circuits** **Type of Course: Program Core and Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This course discusses the importance of analog electronics and to develop the basic abilities of understanding and analysing the analog circuits. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical computation. The course develops the critical thinking and analytical skills and enhances the simulation and programming abilities through assignments.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Analog Electronics and attain **Skill Development** through **Problem Solving** methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the characteristics of diodes and transistors. 2. Summarize the working of feedback amplifiers. 3. Describe various types, characteristics and modes of FETs 4. Review the operation of power amplifiers and the working of various Oscillators			
Course Content:				
Module 1	Introduction to Diodes and Transistors	Assignment	Case study	**09 Sessions**
Topics: Clippers, clampers, rectifiers, zener diode, Transistor, transistor at low frequencies, H-parameters equivalent circuit.				
Module 2	Amplifier circuits	Assignment	Simulation task	**09Sessions**
Topics: RC coupled amplifier, two cascaded CE and multistage CE amplifiers, Feedback amplifiers, Voltage-Series and Current-Series Feedback, Current-Shunt and Voltage-Shunt Feedback.				
Module 3	Field Effect Transistors.	Test	Quiz	**08 Sessions**
Topics: JFET, MOSFET, Equivalent circuits and biasing of JFET's & MOSFET's				
Module 4	Oscillators	Assignment	Simulation task	**09 Sessions**
Topics: Sinusoidal Oscillators, Barkhausen's Criterion, RC Phase-shift oscillator, analysis and derivation of frequency of oscillation of phase shift oscillator, Colpitts and Hartley Oscillators, Crystal Oscillator, Power Amplifiers, Frequency stability.				
Targeted Application & Tools that can be used: Application Area is amplifying speech or music, TV broadcasting and displaying, cell phone, satellite communications, computers, remote control, home automation, traffic light control etc., Professionally Used Software: PSpice/ Multisim/ Logisim/ MATLAB/HDL				
TextBooks 1. Integrated Electronics: Analog and Digital Circuits and Systems, L/e, Jaccob Millman, Christos Halkias and Chethan D. Parikh, Tata McGraw-Hill Education, India, 2nd edition, 2017. 2. Electronic Devices and Circuit Theory, Robert L Boylestad and Louis Nashelsky, 11th Edition, Pearson Education				
References 1. Electronic Devices and Circuits, Jimmy J Cathey, Schaum's outline series. 2. Anil K. Maini, Varsha Agrawal, "Electronic Devices & Circuits", Wiley, 2nd Edition **Online resources:** 1. Ebook:http://presiuniv.knimbus.com:2232/cgi-bin/koha/opac-detail.pl?biblionumber=3800&query_desc=kw%2Cwrdl%3A%20Integrated%20Electronics 2. Case study: http://presiuniv.knimbus.com:2232/cgi-bin/koha/opac-detail.pl?biblionumber=8072&query_desc=kw%2Cwrdl%3A%20Electronic%20Devices%20and%20Circuits 3. https://edge.edx.org/courses/MITx/6.002x-temp/Circuits_And_Electronics/about 4. Seminar topic: https://www.electronics-tutorials.ws/				
Topics relevant to "SKILL DEVELOPMENT": Numerical associated with Diodes and Transistors, Power amplifier, Colpitts oscillator for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.				

Catalogue prepared by Updated by	Dr. Sumit Kumar Jha
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/07/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: **EEE2015**	**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	NIL					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to understand the importance of digital electronics and to develop the basic abilities of understanding and analysing the digital circuits. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematical computation. The course develops the critical thinking and analytical skills. The course also enhances the simulation and programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Electronics and attain **Skill Development** through **Problem Solving methodologies.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1] Discuss the concepts of number systems, Boolean algebra, and logic gates 2] Apply minimization techniques to simplify Boolean expressions. 3] Demonstrate the Combinational circuits for a given logic. 4] Illustrate the Sequential logic circuits					
Course Content:						
Module 1	Fundamentals of Number systems-Boolean algebra and digital logic	Assignment	Simulation task	**09 Sessions**		
Topics: Review of Number systems, Number base conversions, complements of numbers, Binary Codes, Boolean theorems and Boolean algebra, Boolean functions- canonical and standard forms, Digital logic gates.						
Module 2	Boolean function simplification	Assignment	Simulation task	**11 Sessions**		
Topics: Introduction, two, three, four variable K-Maps, utilizing Don't care conditions, Quine McClusky Method for simplification. Universal Gates (NAND & NOR) Implementations.						
Module 3	Combinational Logic circuits.	Test	Quiz	**12 Sessions**		
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders						

Module 4	Sequential Logic Circuits	Test	Quiz	**13 Sessions**

Topics:
Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters

Targeted Application & Tools that can be used:
Application Area is in computers, remote control, home automation, traffic light control etc.,
Professionally Used Software: PSpice/ Multisim/ Logisim/ MATLAB/HDL

Text Book
1 Digital Design, 5/e, Morris Mano and Michael D. Cilette, Pearson.
2. Jain, R. P., "Modern Digital Electronics", McGraw Hill Education (India).

References
1. Roth, Charles H., Jr and Kinney Larry L., "Fundamentals of logic Design", Cengage Learning.
2. Digital Principles, 3/e, Roger L. Tokheim, Schaum's outline series.

Online Resources:
1. https://edge.edx.org/courses/MITx/6.002x-temp/Circuits_And_Electronics/about
2. https://www.electronics-tutorials.ws/
3. https://presiuniv.knimbus.com/user#/home
4. https://www.academia.edu/22542562/Foundations_of_Analog_and_Digital_Electronic_Circuits
5. Ebook: Basic Digital Electronics by M. V. Subramanyam, Bhupesh Bhatia, Second edition. New Delhi : Laxmi Publications Pvt Ltd. 2017. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=0&sid=78146d72-6f9f-4dd9-97df-eef3b22b8fc5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=3103309&db=nlebk
5. case study topic: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=digital%20electronics

Topics relevant to "SKILL DEVELOPMENT": K-Map, Storage elements: latches and flip flops, registers, counters for **Skill Development** through **Problem Solving Methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue updated by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council meeting held on 3/8/2022

Course Code: EEE 2016	**Course Title: Electrical Machines-I** **Type of Course: Program Core**	**L- T-P-C**	**3**	**0**	**0**	**3**
Version No.	**2.0**					
Course Pre-requisites	**EEE1001-Fundamental Electrical and Electronics Engineering** The course learning demands the familiarization of Fundamental of Electrical and Electronics Engineering in prior taking up this course.					
Anti-requisites	**Nil**					

Course Description	This course provides a basic understanding of DC machines and transformers and helps to gain the skills for operating DC machines. The course also equips students with ability to understand and analyse the equivalent circuits of DC Machines and Transformers.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Machines-I and attain **Skill Development** through **Problem Solving** methodologies.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. **Discuss** the construction and working principle of DC Machines. 2. **Express** the performance of DC Machines. **3. Summarize** features and characteristics of Transformers. 4. **Infer** the standard operating procedures established for Three phase Transformers.			
Course Content:				
Module 1	Energy Conversion and DC Generator	Assignment	Simulation task	**12 Sessions**
Topics: Principles of Energy conversion – basic magnetic circuit analysis Faradays law of electromagnetic induction – singly and doubly excited magnetic field systems. DC Generator – construction, principle of operation – emf equation – types of Characteristics commutation - armature reaction.				
Module 2	DC Motor	Assignment	Simulation task	**9 Sessions**
Topics: DC motor – principle of operation – torque equation – types –starting – speed control – various testing – braking, Hopkinson's test, Swinburne's test.				
Module 3	Single-Phase transformer	Assignment	Quiz	**11 Sessions**
Topics: principle of operation – types – basic construction – equivalent circuit - regulation and efficiency – auto transformer.				
Module 4	Three-Phase transformer	Assignment	Quiz	**6 Sessions**
Topics: Three phase transformer connection-Scott connection – all day efficiency - Sumpner's test - parallel operation of transformers				
Targeted Application & Tools that can be used: • The course subject finds it application in many major areas of technologies like **Locomotives, Elevators, Excavators, Steel Mills, Rolling Mills and many more.**				
Text Book 1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007. 2. Nagrath, I.J.and Kothari, D.P., 'Electrical Machines',Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.				
References 1. Arthur Eugene Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw Hill Education Publications, 6 th Edition, 2002. 2. Vincent Del Toro, 'Electrical Engineering Fundamentals', 2nd Edition, Prentice hall Publications, 2003. 3. Parkar Smith, N.N., 'Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributers, 1984. **online learning resources:** 1. Case study: chrome 2. extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ijarcce.com/upload/2016/may-16/IJARCCE%20246.pdf 3. Ebook: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp 4. newsearch=true&queryText=Digital%20signal%20processing%20applications. 5. https://puniversity.informaticsglobal.com:2282/ehost/viewarticle/render?data=dGJyMPPp44rp2%2				

	fdV0%2bnjisfk5Ie45PFKs6yzSrOk63nn5Kx95uXxjL6srU6tqK5KsJayUq6quEmxls5lpOrweezp33vy3%2b. 6. Ebook: https://presiuniv.knimbus.com/user#/home.
Topics relevant to "SKILL DEVELOPMENT" : DC Motor control and Operating transformer at various load conditions for **Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr Kamalapathi
Recommended by the Board of Studies on	15th BoS held on 27/07/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE2061	**Course Title: Analog and Digital Electronics laboratory** **Type of Course: Laboratory**	**L- T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	EEE2009-Analog Electronic circuits: Knowledge of Diode, Transistor Digital Electronics: Knowledge of Boolean Function and rules, Types of Gates					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to enable the students to develop the basic abilities of analysing the analog and digital circuits. The course is practical laboratory based wherein students get an opportunity to validate the concepts taught in theory and enhances the ability to visualize the real system performance. The course develops the critical thinking and analytical skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analog and Digital Electronics Laboratory experiments 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, instrument and materials. 9. Locate faults in systems. 10. Manipulative 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 this course the students shall be able to:** 1. Sketch the characteristics and waveforms relevant to standard electronic circuits. 2. Demonstrate the working of electronic circuits to obtain the V-I Characteristics. 3. Implement various combinational logic circuits using gates. 4. Construct combinational logic circuits and sequential circuits
Course Content:	

List of Laboratory Tasks:

Experiment No 1: Conduct an experiment on rectifiers to determine the ripple factor and efficiency with and without filters.
Level 1: To observe the output waveform of half wave and full wave rectifier with and without filter and to compute ripple factor and efficiency.

Level 2: Verify the experimental results of half wave and full wave rectifiers using Multisim Software.

Experiment No. 2: Conduct experiment to test diode clipping and clamping circuits.
Level 1 : To construct clipping and clamping circuits for different reference voltages and to verify the theoretical response with experimental response.

Level 2 : Verify the experimental results with Simulink.

Experiment No. 3: Conduct an experiment on series voltage regulator using Zener Diode to find the regulation characteristics.
Level 1 : To Sketch characteristic curve and to compute various parameters of Zener diode
Level 2 : Select the values and comment on shunt and series resistance to maintain a constant voltage.

Experiment No. 4: Conduct on experiment to analyse the characteristics of Transistor
Level 1 : To obtain input and output characteristics of a transistor and to calculate input resistance and current gain using h parameters.

Experiment No. 5: Conduct an experiment RC Coupled Amplifier to find the frequency response
Level 1 : To analyze RC coupled amplifier and to sketch frequency response curve.

Experiment No. 6: Verify the Logic Gates truth table
Level 1: Verify basic logic gates on Digital Logic Trainer kit.
Level 2: Construct basic logic gates using universal gates and verify using Digital Logic Trainer kit

Experiment No. 7: Verify the Boolean Function and Rules
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 8: Design and Implementations of HA/FA
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 9: Construct and verify the HS/FS logic circuits
Level 1 :By using basic logic and XOR gates and Trainer Kit connected to input of second FF.
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 10: Study of Flip flops
Level 1: Verify the operation of SR and D Flip-Flops on Digital Logic Trainer kit
Level 2: Study of JK Flip-flop from the specifications given in the form of Truth table

Targeted Application & Tools that can be used:
Application Area is amplifying speech or music, TV broadcasting and displaying, cell phone, satellite communications, computers, remote control, home automation, traffic light control etc.,

Professionally Used Software: PSpice/ Multisim/ Logisim/ MATLAB/HDL

TextBooks

1. Integrated Electronics: Analog and Digital Circuits and Systems, L/e, Jaccob Millman, Christos Halkias and Chethan D. Parikh, Tata McGraw-Hill Education, India, 2nd edition, 2017.
2. Analog and Digital Electronics Laboratory Manual by Presidency University

References

1. Electronic Devices and Circuits, Jimmy J Cathey, Schaum's outline series.
2. Electronic Devices and Circuit Theory, Robert L Boylestad and Louis Nashelsky, 11th Edition, Pearson Education
3. Digital Principles, 3/e, Roger L. Tokheim, Schaum's outline series.

Online resources:

1. https://presiuniv.knimbus.com:2232/cgi-bin/koha/opac-detail.pl?biblionumber=3800&query_desc=kw%2Cwrdl%3A%20Integrated%20Electronics
2. https://presiuniv.knimbus.com:2232/cgi-bin/koha/opac-detail.pl?biblionumber=8072&query_desc=kw%2Cwrdl%3A%20Electronic%20Devices%20and%20Circuits
3. https://edge.edx.org/courses/MITx/6.002x-temp/Circuits_And_Electronics/about
4. https://www.electronics-tutorials.ws/
5. https://www.academia.edu/22542562/Foundations_of_Analog_and_Digital_Electronic_Circuits

Topics relevant to "SKILL DEVELOPMENT": 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.

Catalogue prepared by Updated by	Dr. Sumit Kumar Jha
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE2060	**Course Title: Signal and systems Laboratory** **Type of Course: Laboratory**	**L-T- P- C**	0	0	2	1
Version No.	2.0					
Course Pre-requisites	EEE2001_v03-Signals and Systems					
Anti-requisites	**NIL**					

Course Description	The course aims at developing practical understanding of the generation and simulation of basic signals, using standardized environments such as MATLAB. Experiments cover fundamental concepts of basic operation on matrices, generation of various signals and sequences, operation on signals and sequences, convolution, autocorrelation and cross correlation between signals and sequences. The objective of this laboratory is to develop analytical skills and learn basic signals, and system responses.
Course Objective	The objective of the course is to familiarize the learners with the concepts of experiments in signals and systems laboratory 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. The ability to follow standard test procedures. 9. An awareness of the need to observe safety precautions. 10. To judge magnitudes without actual measurement.
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Analyze various types of signals and systems. 2. Validate the concept of various signals and system operations. 3. Understand the plotting of pole-zero in s plane and z plane. 4. Analyze the spectrum of signals using Fourier transform.
Course Content:	

List of Laboratory Tasks:

Experiment No 1: Generations of Various Signals and sequences (periodic and Aperiodic), such as Unit impulses, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.

Level 1: Write the MATLAB code, debug and run it to get the desired output
Level 2: To Analyse the output and to modify the parameters in the code to Understand various concepts (like varying the amplitude or frequency) on signal generation.

Experiment No 2: Operation on Signals and sequences such as addition, Multiplication, Scaling, Shifting, Folding, Computation of energy and average power

Level 1: Write the MATLAB code, debug and run it to get the desired output
Level 2: To Analyse the output and to understand various concepts on Operations on signals and write code for mixed operations.

Experiment No 3: Convolution between Signals and Sequences.

Level 1: Write the MATLAB code, debug and run it to get the desired output (using in built commands) and sketch the output waveform.
Level 2: To Analyse the output and to understand various concepts of convolution and to write the code without using the in-built convolution function.

Experiment No 4: Verification of linearity and time invariance properties of a given continuous/discrete system.

Level 1: Write the MATLAB code, Debug and run it to get the desired output for given systems operations.
Level 2: To analyze the output and to understand various concepts of linearity and time invariance property by modifying the code and checking for different systems.

Experiment No 5: Computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.

Level 1: Write the MATLAB code, Debug and run it to get the desired standard signal shapes.
Level 2: To Analyse the output and to understand the system response and write code for other elementary signal response.

Experiment No 6: Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.

Level 1: Write the MATLAB code, Debug and run it to get the desired output.
Level 2: To Analyse the output and to find Fourier Transform for elementary signals and to verify the same theoretically.

Experiment No 7: Wave form synthesis using Laplace Transforms.

Level 1: Write the MATLAB code, Debug and run it to get the desired output for the given time- domain function.
Level 2: To Analyse the output and to understand various concepts by verifying problems similar to those taught in theory.

Experiment No 8: Locating the zeros and poles and plotting the pole-zero maps in S- plane and Z- plane for the given transfer function.

Level 1: Write the MATLAB code, Debug and run in to get the desired output.
Level 2: To Analyse the output and to understand various concepts on stability.

Experiment No 9: To compute auto correlation and cross correlation between signals and sequences.

Level 1: Write the MATLAB code, Debug and run in to get the desired output.
Level 2: To Analyze the correlation of various signals and measure the degree to which the two signals are similar.

Experiment No 10: To calculate distribution and density functions of standard random variables.

Level 1: Write the MATLAB code, Debug and run in to get the desired output.
Level 2: To Analyze the distribution and density function of standard random variables.

Targeted Application & Tools that can be used:
Signals and systems are a branch of electrical engineering and finds its applications in different professional fields such as audio signal processing, digital image processing, video compression, speech recognition, control systems, research and development, digital communications, digital synthesizers, radar, sonar, financial signal processing, seismology and biomedicine.
Professionally used tools: MATLAB / Python

Course Material

1. Signals and systems Lab Manual, Presidency University, Bengaluru.

TextBooks:

1. Signals and Systems by Alan V. Oppenhein, Alan S. Willsky and S. Hamid, 2nd edition, Pearson 2016.
2. John G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, Pearson Education, 2012.

Reference Books:

1. B.P. Lathi, "Signals, Systems & Communications" BS Publications, 5th Reprint, 2008.

2. Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, "Signals & Systems", TMH, 2001.
3. Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 3rd edition, Pearson new international edition, 2014.
4. Digital Signal Processing, P Ramesh Babu, Pearson Education.

Online resources:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://nptel.ac.in/courses/117/101/117101055/
3. https://www.edx.org/course/signals-and-systems-part-1
4. https://www.tutorialspoint.com/signals_and_systems/index.htm
5. https://presiuniv.knimbus.com/user#/home_

Topics relevant to "SKILL DEVELOPMENT": All the experiments which are listed for **Skill Development** through **Experiential Learning Techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Sumit Kumar Jha
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/22

Course Code: EEE2004 v02	**Course Title: Op-amps and Linear Integrated Circuits** **Type of Course: Program Core, Theory & Integrated Laboratory**	**L-T- P- C**	3	0	2	4
Version No.	2.0					
Course Pre-requisites	Electric Circuit Analysis &Analog and Digital Electronics: Knowledge of passive and active elements, Network theorems, fundamental topics of semi- conductor devices					
Anti-requisites	NIL					
Course Description	This course provides the basics knowledge of Linear ICs such as Op-amp, Regulators and Timers. It highlights the use of mathematical tools for analysis of such circuits and devices. The project assignment helps to validate the concepts taught in theory as well as to enhances the ability to visualize the real-world problems to provide a solution using various simulation tools like Ps spice, Multisim etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Op-amps and Linear Integrated Circuit**s** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the block diagram and characteristics of OP-AMPs. 2. Classify linear and nonlinear applications of OP-AMPs. 3. Calculate the values of circuit components used for building various signal generators and multivariates. 4. Demonstrate the working of A/D & D/A converters and the function of application specific ICs such as Voltage regulators. 5. Interpret the practical experiment results with theoretical concepts of OP-AMPs					
Course content:						
Module 1	Introduction to Op-amps	Assignment	Data collection and analysis task(data sheet parameters)	**12 Sessions**		

Operational amplifiers: Introduction, Block diagram representation of a typical Op-amp, Schematic symbol, Characteristics of an Op-amp, Ideal op-amp, Equivalent circuit, Ideal voltage transfer curve, Open loop configuration, Differential amplifier, Inverting & non – inverting amplifier.				
Module 2	Applications of op-amps	Assignment	Simulation based tasks	**12 Sessions**
General Linear Applications: concept of virtual ground, Inverting and Non-inverting Amplifiers, Summing amplifiers, Difference amplifiers, Differentiator, Integrator Active filters: First & Second order high pass & low pass Butterworth filters Non Linear Applications: Precision Half Wave and Full wave rectifiers				
Module 3	Waveform generators & 555 timer circuits	Mini Project	Hands on project using op-amps/555 timer	**9 Sessions**
Comparators & Converters: Basic comparator, Zero crossing detector, Inverting & noninverting Schmitt trigger circuit Signal generators: Triangular / rectangular wave generator, RC Phase shift oscillator. IC 555 Timer: 555 Timer Functional block diagram and description, Monostable operation, Applications				
Module 4	Voltage regulators & converters	Assignment	Data collection based assignments	**12 Sessions**
Voltage regulator IC's: Basics of Voltage Regulators, Line regulation, Load Regulation, Ripple rejection, Adjustable voltage regulators using LM317 D & D/A Converters: Basics, Analysis of binary weighted DAC 3bit, Analysis of 3 bit R-2R DAC, successive approximation ADC, Flash ADC.				
Targeted Application & Tools that can be used: Application Area includes: Consumer and industrial devices, Industrial instrumentation, Communication and Signal processing circuits, Space and defense applications Professionally Used Software: Ps- spice/Multisim/Matlab				
List of Laboratory Tasks: **Experiment No.1:** To realize an inverting and non-inverting amplifier circuit for a given gain, analyze its frequency response and compare the waveforms with simulation Level 1: Rig up the circuit of an Inverting and non-inverting amplifier for a given gain and validate the waveforms using simulation. Level 2: Analyze the frequency response of an op – amp amplifier under inverting and non - inverting configuration for a given gain. **Experiment No. 2:** To verify the operation of an op – amp as an inverting summing amplifier Level 1: Rig up the circuit of an inverting summing amplifier for a gain of 2 with a dc voltage of 1.5V and compare the results with simulation. Level 2: Rig up the circuit an inverting summing amplifier to mix a sinusoidal signal and a dc signal without saturation for an amplification factor of 10 and compare the results with simulation. **Experiment No.3:** : To verify the operation of an op – amp as a difference amplifier and compare the waveforms with simulation. Level 1: Rig up the circuit of a difference amplifier for a gain of 2 with an input signal of DC value 1.5v and a sinusoidal voltage of 1vp-p. Compare the waveforms with simulation Level 2: Rig up the circuit of a difference amplifier to mix a sinusoidal signal and a dc signal without saturation for an amplification factor of 2. Compare the waveforms with simulation. **Experiment No.4:** To verify the operation of an op – amp as differentiator and integrator and observe the waveforms Level 1: Rig up an integrator circuit using op-amp. Determine the minimum and maximum frequency for which it works as an integrator and verify it practically for a square wave input. Plot the output. Level 2: Rig up a differentiator circuit using op-amp. Determine the minimum and maximum frequency for which it works as differentiator and verify it practically for a square wave input. Plot the output. **Experiment No.5:** To Design and verify a precision half-wave and a full-wave rectifier and determine the transfer characteristics.				

Level 1: Rig up a precision half wave rectifier which rectifies negative half cycle with a transfer characteristic of slope 10
Level 2: Rig up a precision full wave rectifier with a transfer characteristic of slope 1
Experiment No.6: To obtain the frequency response of active low pass and high pass filter and determine 3dB frequencies of both filters.
Level 1: plot the frequency response for the first order high pass filter with a cut-off frequency of 10kHz with a pass band gain of 1.5.
Level 2: plot the frequency response for the first order low pass filter with a cut-off frequency of 15.9kHz with a pass band gain of 1.5.what changes need to be done the design to achieve frequency scaling.
Experiment No.7: To realize an op – amp based function generator to generate sine, square and triangular waves of desired frequency.
Level 1: Design and rig up a RC phase shift oscillator using Op-Amp 741 and (i) Plot the output waveform (ii) Measure the frequency of oscillation
Level 2: To rig up a square and triangular wave generator using Op-Amp 741 and (i) Plot the output waveform (ii) Measure the frequency of oscillation
Experiment No.8: To design and verify an IC 555 timer based Astable and monostable Multivibrator
Level 1: To design symmetrical and asymmetrical Astable Multivibrator using IC 555 and to plot the output waveforms
Level 2: To design monostable Multivibrator using IC 555 for t=1ms

Textbooks

1. Gayakwad Ramakant A. "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson.
2. David A Bell, "Operational Amplifiers and Linear ICs", 3rd edition, PHI.

References

1. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", New Age International, New Delhi, 2010
2. B. Somanthan Nair, "Linear Integrated Circuits; Analysis, Design and Applications", Wiley India 2013
3. Maheshwari L. K. and Anand M. M. S., "Analog Electronics", PHI

Online resources:

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-20/
3. case study: https://assignmentpoint.com/case-study-operational-amplifier/
4. https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": All the experiments which are listed are for **Skill Development** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/07/2022
Date of Approval by the Academic Council	18th Academic Council meeting dated 03/08/2022

Course Code: EEE2005	**Course Title: Microprocessor and Microcontrollers** **Type of Course: Theory & Laboratory Integrated**	**L-T- P-C**	**3**	**0**	**2**	**4**
Version No.	**2.0**					
Course Pre-requisites	**NIL**					
Anti-requisites	**Nil**					
Course Description	The course introduces the microcontrollers' architecture, programming, interfacing and as well as their applications. The course requires the fundamental understanding of digital circuits and C programming. The course extends the experimental understanding of the same which enables the students to develop programming and interfacing skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Microprocessor and Microcontrollers and attain **Skill Development** through **Experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1] Describe the architectural features of microprocessors and microcontrollers. 2] Explain the addressing modes, instruction set and I/O port programming of microcontroller. 3] Discuss the programming and Interfacing of peripheral devices with microcontroller. 4] Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051 5] Demonstrate the interfacing of the microcontroller experimentally to control some of the electric devices.					
Course Content:						
Module 1	**8051 Microcontroller**	Assignment		Data Analysis		**6 Sessions**
Topics: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.						
Module 2	**8051 Instruction Set**	Assignment		Programming		**6 Sessions**
Topics: 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.						
Module 3	**8051 Stack, I/O Port Interfacing and Programming**	Assignment		Programming		**6 Sessions**
Topics: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops.						
Module 4	**8051 Timers and Serial Port**	Assignment		Programming		**6 Sessions**
Topics: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication-						
Module 5	**8051 Interrupts and Interfacing Applications**	Assignment		Programming		**5 Sessions**
Topics: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804.						

List of Laboratory Tasks:

Experiment No 1: Arithmetic and logic operations using microcontrollers
Write a program to sort a given array of numbers logically in descending and ascending order.

Experiment No 2: Choose a microcontroller, write Delay and counter program using its instruction set.
write a Program to generate a delay of 20ms using timers.

Experiment No 3: Interfacing of ADC and DAC to microcontrollers

Write a program to generate square and triangular waveforms DAC interface.

Experiment No 4: Alphanumerical digits on a LCD panel interfacing with microcontroller.
write a Program to execute a running display of alphanumeric digits in clockwise direction.

Experiment No. 5: Control the dc motor by Interfacing it with a microcontroller
Execute unidirectional and bidirectional dc motor control.

Targeted Application & Tools that can be used:

- The course subject finds it application in many major areas of technologies like **Consumer Electronics Products**, **Instrumentation** and **Process Control**, **equipment**, **Medical Instruments**, **Communication**, **Multimedia Application**, **Automobiles and many more**.
- The tools that are used in this course are **8051 programming** and interfacing Kit, interfacing devices, PIC microcontroller kit.

Text Book

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.
2.R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

References

1.D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
3. Raj Kamal ,"Microcontrollers: Architecture, Programming, Interfacing and System Design " Pearson 1st Edition, 2012
4.Datasheets of microcontrollers

online learning resources:

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_eee/Notes/NE2/BEC%20013
2. %20Automotie%20electronics.pdf
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee99/
4. **Seminar:**https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true& queryText=op%20amps
5. Case study
   https://puniversity.informaticsglobal.com:2282/ehost/viewarticle/render?data=dGJyMPPp44rp2%2
   fdV0%2bnjisfk5Ie45PFKs6yzSrOk63nn5Kx95uXxjL6srU6tqK5KsJayUq6quEmxls5lpOrweezp33vy3%2b
6. 2G59q7SbOts062q7JKtJzxgeKzs3nhqeNOtqqrUd%2bprkWyq99%2bq9eze7Kj30zhqrFP4qyzebbZvorj2
7. ueLpOLfhuWz44ak2uBV59%2fmPvLX5VW%2fxKR57LOvUbWntk6xraR%2b7ejrefKz7nzkvPOE6srjkPIA &vid=29&sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis
8. Ebook: https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": All the experiments which are listed are for **Skill Development** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Topics relevant to "ENVIRONMENTAL AND SUSTAINABILITY": Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	
Catalogue prepared by	Mr. SARIN Assistant professor Dept.of EEE, SoE,PU
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting No18., Dated 03/08/2022

Course Code: EEE2017	**Course Title: Electrical Machines-II** **Type of Course: Program Core** **Theory only**	**L- T-P-C**	**3**	0	**0**	**3**
Version No.	**2.0**					
Course Pre-requisites	**Electrical Machines-I** Basics of Electrical Engineering and Electromagnetic Fields					
Anti-requisites	**NIL**					
Course Description	This course provides a basics of AC machinery fundamentals, machine parts and helps to gain the skills for controlling of AC machines. It highlights the use of mathematical tools for analyzing the performance of machines. The course also inculcates the ability to analyses the performance of Induction and Synchronous Machines in industrial and domestic applications. Mini project and Assignments enhances the ability to visualize the real-world applications using tools like MATLAB, caspoc softwares etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Machines-II and attain **Skill Development** through **Problem Solving** methodologies					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe the operation of alternators. 2. Explain the principle of operation of synchronous motors. 3. Analyze the performance of the three phase Induction using the phasor diagrams and equivalent circuits. 4. Analyze the performance of the single phase Induction motors.					
Course Content:						
Module 1	**A**lternators	Assignment	Data Analysis	10 Sessions		
Topics: construction, principle and types - armature reaction - load characteristics – voltage regulation – two-reaction theory – parallel operation						
Module 2	**S**ynchronous motors	Assignment	Industrial Applications of Synchronous motor	9 Sessions		
Topics: Principle of Operation, Synchronous machines on infinite bus bars - phasor diagram - V and inverted-V curves - Hunting and its suppression - starting methods.						
Module 3	Poly-phase induction motors	Industrial Visit	Study of motors used in various sections of the Industry	10 Sessions		
Topics: construction, principle and types – no-load and load characteristics – no-load and blocked rotor test - equivalent circuit – circle diagram- Starting and speed control method						

Module 4	Single-phase induction motors	Assignment	Simulink Model development	9 Sessions

Topics: - construction, principle and types - double revolving field theory – equivalent circuit.

Targeted Application & Tools that can be used:

- The course subject finds it application in many major areas of technologies like Power generation, Transmission and distribution sectors and motion Control equipment, Medical Instruments, Automobiles and many more.

Text Book

1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.
2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.

References

1. Arthur Eugene Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw Hill Education Publications, 6th Edition, 2002.
2. Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon PressOxford, 1989.
3. Parkar Smith, N.N., 'Problems in Electrical Engineering', CBS Publishers and Distributers, 9th Edition, 1984
4. M. G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers & Distributors Pvt. Ltd., New Delhi, 3rd Edition, 2002.

Online learning resources:

1. https://nptel.ac.in/courses/105108128
2. https://www.youtube.com/watch?v=yfUVaZ_TOuc&ab_channel=ReliaSoftSoftware
3. Ebook:chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://ndesoneandik.files.wordpress.com/2012/04/dimitri- kececioglu-reliability-engineering-handbook-vol-1.pdf
4. Case study: https://www.reliableplant.com/Read/30719/reliability-case-studies.
5. https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": Induction Motor control at various torque conditions and Voltage regulations of alternator or **Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.
Topics relevant to "ENVIRONMENT & SUSTAINABILITY": Induction Motor Operation, Synchronous motor.

Catalogue prepared by	Mr. K KAMALAPATHI
Recommended by the Board of Studies on	BoS No:15, held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/8/2022

<table>
<tr><td>Course Code: EEE2007</td><td colspan="3">Course Title: Control Systems Engineering
Type of Course: Program core and Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">2.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Signals and signal processing Systems
Types of systems, transfer function, test input signals</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">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</td></tr>
<tr><td>Course Objective</td><td colspan="8">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</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
1] Express the transfer function for a variety of Electrical, Mechanical, Electromechanical systems using Signal Flow graphs.
2] Summarize the time domain specifications for various test input signals and stability conditions based on zeros and poles of transfer function.
3] Explain different types of analysis in time domain and frequency domain to know the nature of stability of the system.
4] Describe the importance of compensation techniques and State variable model.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">System Components and their representation</td><td>Assignment</td><td colspan="2">Programming</td><td colspan="2">09 Sessions</td></tr>
<tr><td colspan="9">Topics:
Introduction to control systems, mathematical models of physical systems-differential equations of physical systems, Mechanical systems, Electrical systems, and signal flow graphs.</td></tr>
<tr><td>Module 2</td><td colspan="2">Time Response Analysis</td><td>Assignment</td><td colspan="2">Programming / Simulation</td><td colspan="2">09 Sessions</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>Module 3</td><td colspan="2">Stability Analysis</td><td>Assignment</td><td colspan="2">Programming</td><td colspan="2">09 Sessions</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>Module 4</td><td colspan="2">Control Techniques & State Space model</td><td>Assignment</td><td colspan="2">Programming/Simulation</td><td colspan="2">07 Sessions</td></tr>
<tr><td colspan="9">Topics:
Necessity of Compensation techniques, Concept of State, State variables & State model, Concepts of controllability and observability.</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:</td></tr>
</table>

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://puniversity.informaticsglobal.com
2. Case study: https://people.disim.univaq.it/~costanzo.manes/Didattica_Teoria_dei_Sistemi/System_Theory_Web_Resources.html
3. 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	Mr. K Sreekanth Reddy Mr. Ravi V Angadi
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting , Dated 23/10/2021

Course Code EEE2062	**Course Title: Electrical Machines Laboratory** **Type of Course: Laboratory**	**L-T- P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	EEE2017 – Electrical Machines II courses basic concepts like working principle, constructional details, characteristics, application of various AC and DC machines.					
Anti-requisites	**Nil**					
Course Description	This laboratory course enhances the ability in validating the methods of controlling various DC and AC machines. The laboratory sessions will likely achieve the goals of visualizing and analyzing the working of widely used rotating machines at various loading conditions, improving teamwork abilities and practical skills. The course intends to develop critical and analytical thinking abilities to control and analyze the fundamentals of DC and AC machines.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Machines Laboratory experiments 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, instrument and materials.** 9. Locate faults in systems. 10. Manipulative 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 Out Comes	**On successful completion of the course the students shall be able to:** 1. Analyze the basic theory and operation of electrical machines. 2. Demonstrate how electrical machines fit into the larger context of power systems. 3. Demonstrate the procedures and analysis techniques to perform and describe electromagnetic and electromechanical tests on electrical machines. 4. Demonstrate the speed control of machines using converters.
Course Content:	
	List of Laboratory Tasks: **Experiment No 1:** Load test on DC shunt motor to draw speed–torques characteristics. **Experiment No. 2:** Field Test on DC series machines. **Experiment No. 3:** Speed control of DC shunt motor by armature and field control. **Experiment No. 4:** Load test on three phase induction motor. **Experiment No. 5:** No-load and Blocked rotor test on three phase induction motor to draw (i)equivalent circuit and (ii)circle diagram. Determination of performance parameters at different load conditions **Experiment No. 6:** Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics. **Experiment No. 7:** Conduct suitable tests to draw the equivalent circuit of single-phase induction motor and determine performance parameters. **Experiment No. 8:** Conduct an experiment to draw V and Inverted V curves of synchronous motor at no load and load conditions.
Targeted Application & Tools that can be used: The application of electrical machines has been extensively employed in industrial applications such as electric vehicles and battery-powered devices such as wheelchairs, power tools, guided vehicles, welding equipment, X-ray and tomographic systems, and computer numerical control (CNC) machines. Professionally Used Software: MATLAB/PSIM	

Course Material

1. Electrical Machines Laboratory Manual, Presidency University, Bengaluru.

Text Book:

1. "Electric Machinery", Fitzgerald, Kingslay, Umans, Tata McGraw-Hill.

Reference Books:

1. Electric Machinery Fundamentals, Chapman, McGraw-Hill Higher Education.
2. Electric Machinery, P.S.Bimbhra, Khanna Publishers.
3. Electric Machines, Nagrath and Kothari, Tata McGraw-Hill.
4. Power Electronics Lab Manual by Presidency University

Online Learning Resources:

1. https://presiuniv.knimbus.com/user#/home
2. https://www.youtube.com/watch?v=PmBqB-4hgW4&list=PLs5_Rtf2P2r5YY5b23uDGrtpo42ezMmGp&ab_channel=KreatryxGATE-EE%2CECE%2CIN
3. https://ieeexplore.ieee.org/abstract/document/8820546.
4. Control of Induction motor, Andrzej M. Trzynadlowski, https://doi.org/10.1016/B978-0-12- 701510-1.X5000-4

Topics relevant to "SKILL DEVELOPMENT": 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.

Catalogue prepared by	Dr. Joshi Manohar V Mr. Sumit Kumar Jha
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/22

Course Code: **EEE2012**	**Course Title: Electrical and Electronics Measurements and Instrumentation** **Type of Course: Program Core Theory & Integrated Laboratory**	L-T- P- C	3	0	2	4
Version No.	**2.0**					
Course Pre-requisites	Fundamentals of various electrical elements, components and its characteristics, Basics of Digital and Analogue devices.					
Anti-requisites	**NIL**					
Course Description	The course intends to provide a basic understanding of measurement systems thereby facilitating simple measurement systems for a given application based on the requirement with the knowledge in suitable software's. The integrated laboratory enhances the ability to identify various measuring equipment's and meters thereby predicting correctly their expected performance through different calibration methods and simulation tools which also enhances team work, hands on practical skills and programming skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical and Electronics Measurements and Instrumentation laboratory and attain **Skill Development** through **Experiential Learning** techniques					

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1. Describe the importance of measurement systems in industries
2. Explain different types of measuring instruments, their construction, operation and characteristics.
3. Identify the instruments suitable for typical measurements.
4. Apply the knowledge about transducers and Instrument transformers to use them effectively.
5. Evaluate uncertainties involved in any measurement from experimental results.
6. Demonstrate and train the students in the calibration and use of different measuring instruments</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Concepts of Measurements and its statistical Analysis</td><td>Quiz</td><td>Data Analysis task</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration - Principle and types of analog and digital voltmeters, ammeters.</td></tr>
<tr><td>Module 2</td><td>Functional concepts of various Electromechanical Instruments & Characteristics</td><td>Group Discussion</td><td>Data Collection</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Galvanometers, DC Ammeter and DC voltmeter -Permanent Magnet moving Coil Instrument- Moving iron instrument, EMMC instrument-Multi range ammeter and voltmeter-Calibration - Bridges for computation of R,L and C, Q factor.</td></tr>
<tr><td>Module 3</td><td>Electrical and Electronic Instruments</td><td>Assignment</td><td>Programming Task</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Cathode Ray oscilloscope (CRO)-Digital Storage oscilloscope(DSO)-Digital Voltmeter (DVM)-Digital Multimeter (DMM)-Construction and characteristics of Current Transformers and Potential Transformers. Construction and working of energy meters, Trivector meters, Bi-directional Energy meters.</td></tr>
<tr><td>Module 4</td><td>Transducers and Data Acquisition systems</td><td>Assignment</td><td>Data Collection and Analysis</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Function Generators, Spectral and Harmonic Distortion analyzers, Smart sensors and Telemetry.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:
Experiment No 1: Familiarization with virtual instrumentation using Lab-VIEW Software
Level 1: To conduct an experiment to analyse the principles of Virtual Instrumentation (VI) and implement using lab-VIEW software</td></tr>
</table>

Level 2: To conduct an experiment to convert from degree Celsius to Fahrenheit using VI tools

Experiment No 2: **Calibration and Measurement of unknown resistance using Wheatstone Bridge**

Level 1: To conduct an experiment to measure the given unknown medium resistance using Wheatstone bridge.

Level 2: To conduct an experiment to calibrate the given bridge by plotting the graph between o/p voltage vs load and to determine the static sensitivity and Imprecision of the instrument.

Experiment No 3: **Measurement of unknown inductance using Maxwell's inductance bridge.**

Level 1: To conduct an experiment to measure the given unknown inductance using Maxwell's inductance bridge.

Level 2: To conduct an experiment to comparing the variable standard self-inductance with the practically obtained value and report the uncertainties observed in the given Maxwell's Inductance bridge

Experiment No 4: Measurement of component values and voltage drop across the series combination of given resistors using NI ELVIS II+ workstation.

Level 1: To conduct an experiment to measure the component values of the given resistors using NI ELVIS II+ workstation

Level 2: To conduct an experiment to calculate voltage drop across the given resistors in a voltage divider circuit using NI ELVIS II+ workstation.

Experiment No 5: Measurement of phase difference and power factor of a series R-L and R-C circuit using NI ELVIS II+ workstation

Level 1: To conduct an experiment to measure the phase difference and power factor of a series R-L, R-C circuit using NI ELVIS II+ workstation

Level 2: To conduct an experiment to calculate the error in the power factor and measure the time difference (dT) observed at the peak values

Experiment No 6: Measurement of 3 phase active power and reactive power using 2 wattmeter method.

Level 1: To measure 3 phase active and reactive power supplied to a given load using 2 wattmeter method.

Level 2: To calculate the power factor and examine the range of power factor for better power utility.

Experiment No 7: Measurement of active, reactive and apparent energy consumed by a 3 phase synchronous motor using a trivector meter.

Level 1: To record active, reactive and apparent energy supplied to a 3 phase synchronous motor using a trivector meter**.**

Level 2: To Plot the graph of Power factor vs output Energy consumed for the first 15 minutes.

Experiment No 8: **Measurement of amplitude, frequency, THD of an external signal using NI myDAQ and Lab-VIEW.**

Level 1: To analyse the principles of Data acquisition, measurement of amplitude, frequency, THD of an external signal through Virtual Instrumentation using NI myDAQ and Lab-VIEW.

Level 2 : To generate various signals through Virtual Instrumentation using NI myDAQ and Lab-VIEW

Text Book:

1. A. K. Sawhney, "Electronics and Electrical Measurements", Dhanpat Rai& Sons.

References

1. H. S. Kalsi, "Electronic Instrumentation", McGraw Hill.
2. David A. Bell, "Electronic Instrumentation & Measurements", Oxford University Press / PHI.

Online Resources

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://www.youtube.com/watch?v=xLjk5DrScEU&list=PLt5syl71JKf0IacRzLI-02Q_udP4nJiJg
3. https://www.researchgate.net/figure/Results-of-1-kHz-electrical-measurements-on-case-study-core-plugs-using-reservoir-brine_tbl2_264898895

4. https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d2706929%26site%3dehost-live	
Topics relevant to "SKILL DEVELOPMENT": All the experiments which are listed for **Skill Development** through **Experiential Learning** Techniques. This is attained through the assessment component mentioned in course handout	
Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BoS No: 12th, held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE2019	**Course Title: Power Electronics** **Type of Course: Program Core Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Electric Circuit Analysis, MATLAB/PSIM/SCILAB software for simple operations. Basic concepts of semiconductor physics, basics of loop analysis and transients of circuit analysis.					
Anti-requisites	NIL					
Course Description	This course is a very important and fundamental course for the conversion, control and monitoring of electric energy using power converters. The course uses the fundamentals of mathematics, modelling and software tools and enhance the process of learning. The course is both conceptual and analytical in nature and imparts the basic skills of developing the Simulink models, Programming and hardware interfacing through assignments and mini projects.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Power Electronics and attain **Skill Development** through **Problem Solving** methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Select the suitable semiconductor switching device in the design of power converters 2) Apply the phase-controlled technique in control of AC-DC converters with different loads 3) Demonstrate the operation of Choppers and AC Voltage controllers 4) Explain the operation and control of Inverters					
Course Content:						
Module 1	Power Semiconductor Switching Devices	Assignment	Data sheet collection and Analysis task			**10Sessions**
Topics: Silicon Controlled Rectifiers (SCR's) - BJT - Power MOSFET - Power IGBTs - Basic theory of operation of SCR – Static and Dynamic characteristics of SCR -Salient points. Two transistor analogy of SCR –Firing circuits of SCR –Numerical problems						

Module 2	Phase Controlled Rectifiers (AC-DC controllers)	Hands on Task	Simulation and Arduino based controller for 12V dc motor	**10 Sessions**
Topics: Phase control technique - Single phase and three phase Line commutated converters - Half wave and fully controlled converters with different loads. Average load voltage and current- Numerical Problems.				
Module 3	Choppers and AC Voltage Regulators	Assignment	Development of Simulink model and Analysis	**15 Sessions**
Choppers: Time ratio control and Current limit control strategies – Step up and step down choppers- Load voltage and currents different loads-Numerical problems Switch Mode Power Converters: Basics of switch mode converters- Buck converter, Boost converter - Buck-Boost converters AC Voltage Controllers: AC voltage controllers – Single phase two SCR's in anti-parallel with R and RL loads - RMS load voltage, current and power factor- wave forms , Numerical problems, Cycloconverters: Introduction to Cycloconverters- Types of cycloconverters-working-Applications of Cycloconverters				
Module 4	Inverters(DC-AC converters)	Assignment	Simulation using Scilab and Analysis	**10 Sessions**
Inverters – Single phase inverter – bridge inverter, 3 phase inverter – Waveforms, Voltage control techniques for inverters- Pulse width modulation techniques – Numerical problems.				

Targeted Application & Tools that can be used:

The application of power electronic converters in the fields of sustainable energy technologies such as wind energy, solar power, wave energy, and fuel cells are described. Furthermore, industrial applications like electric drives, Electric Vehicles and induction heating as well as application of power electronics for power transmission, harmonics control and voltage stability issues.

Professionally Used Software: MATLAB/PSIM/Scilab

Text Books

1. M.H.Rashid, "Power Electronics Power Electronics Devices, Circuits and Applications ,Fourth Edition , Pearson,2017
2. Dr P S Bimbhra , "Power Electronics" ,Khanna Publishers, Fifth Edition,1990

References

1. M.D. Singh and Khanchandani K.B, "Power Electronics", T.M.H. Second edition, 2017

Online resources

1. Lecture Series on Power Electronics by Prof. B.G. Fernandes, Department of Electrical Engineering,IIT Bombay. For more details on NPTEL visit http://nptel.ac.in
2. https://www.pdfdrive.com/fundamentals-of-power-electronics-e5904858.html
3. https://ieeexplore.ieee.org/document/9545403 (case study)
4. https://springerplus.springeropen.com/articles/10.1186/2193-1801-2-370
5. https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": Fundamentals of switching devices, Control parameters to vary average and RMS value of output voltage of power converters for **Skill Development** through **Problem Solving methodologies.** This is attained through **assessment** component mentioned in course handout.

Topics relevant to "ENVIRONMENT and SUSTAINABILITY": Power converters and semiconductor devices.

Catalogue prepared by	Dr Joshi Manohar V & Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/02/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE2020	**Course Title: Electrical Distribution System** **Type of Course: Program Core and Theory only**	**L- T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	EEE1001-Fundamentals of Electrical and Electronics Engineering. Knowledge of basic concepts of electric circuits and Basics of MATLAB or any programming tool.					
Anti-requisites	**Nil**					
Course Description	The course teaches electrical power distribution. The course covers supply system and distribution practises, load characteristics and load modelling, distribution feeders, voltage drop and power loss calculations, substation equipment, location and grounding, protection, system planning, and automation. Critical thinking and analysis are also taught. Improve design and simulation skills in the course with AutoCAD, MATLAB, MiPower, and other current tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Distribution System and attain **Skill Development** through **Participative Learning** methodologies.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Compute the various factors associated with the distribution systems. 2. Develop Single line diagram of various types of Substations. 3. Determine the voltage drop for the given feeder system. 4. Identify the basic requirements of protection scheme and automation system.					
Course Content:						
Module 1	Introduction to Distribution Systems	Assignment	Programming	**10 Sessions**		
Topics: Introduction, supply systems, the distribution systems, load characteristics and load modelling: Loads and Load Characteristics, Various factors, Relation Between Load and Loss Factor: A Simplified Approach, Load Growth and Diversified Demands, Load Modeling, Load Growth and Forecasting.						
Module 2	Substations Equipment, Location and Grounding	Assignment	Design a SLD of SS using CAD Software.	**12 Sessions**		
Topics: Introduction, Substation Components, Symbols for Equipment in Sub-Stations, Classification of Sub-Stations, Comparison between Outdoor and Indoor Sub-Stations, Bus-Bar Arrangements in						

Sub-Stations, Key Diagram of 66/11 kV Sub-Station, Key Diagram of 11kV/400 V Indoor Sub-Station, Gas Insulated Substation (GIS), Grounding and Earth Connections and Earthing System.				
Module 3	Distribution Feeders	Assignment	Case Study	**12 Sessions**
Topics: Introduction, Primary and Secondary Distribution, Distribution Substation Location and Planning, Feeder Loading and Voltage-Drop Considerations, Voltage-Drop in Feeder Lines with Different Loadings, primary and secondary distribution networks and Design Considerations. Numerical examples on voltage droop in feeder.				
Module 4	Protection & Distribution system Automation	Assignment	Programming/Simulation	**11 Sessions**
Topics: Introduction, Basic Requirements, and Overcurrent Protection: Fuses, Circuit Breakers, Protective Relays and Relaying, Coordination Between Different Protective Devices. Distribution Automation: Basic Definitions, Project Planning, Communication, Sensors, Supervisory Control and Data Acquisition (SCADA), Consumer Information Service (CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR) & Automation Systems.				
Targeted Application & Tools that can be used: Various industries/ organization like KPTCL, HESCOM, BESCOM, CHESCOM, GESCOM, MESCOM and other states government and private sector working in the field of Power distribution analysis and protection system. Professionally Used Software: Mi Power/ ETAP/ MATLAB/PSCADA/Power World Simulator/PSSE.				
Text Books 1. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing Company, 6th edition, 1997 2. Electric Power Distribution systems- by V Kamaraju, Tata McGraw–hill Publishing company, 2009.				
References 1. Electric Power Distribution system, Engineering – by TuranGonen, McGraw–hill Book Company. 2. Principles of Power System- by S. Chand Publishers (Revised Edition) 3. William H. Kersting, Distribution System Modeling and Analysis, CRC Press 4. Anthony J. Pansini, 'Guide to Electrical Power Distribution Systems, The Fairmont Press **online learning resources** 1. EBook: https://puniversity.informaticsglobal.com/menu 2. Seminar: https://onlinecourses.nptel.ac.in/noc19_ee62/ 3. Case Study:https://www.emerald.com/insight/content/doi/10.1108/eb010130/pdfplus/html 4. https://www.emerald.com/insight/content/doi/10.1108/COMPEL-12-2016-0586/pdfplus/html				
Topics relevant to "SKILL DEVELOPMENT": Various types of Distribution Modelling and applications for **Skill Development** through **Participative Learning**. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	**Mr. Ravi V Angadi**			
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22			
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/8/22			

Course Code: EEE2063	**Course Title: Control Systems Engineering Laboratory** **Type of Course: Laboratory**	**L- T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	EEE2007 - Control systems Engineering Time response, Compensators, Stability, simulation using MATLAB					
Anti-requisites	**Nil**					
Course Description	The purpose of this course is to provide an opportunity to validate the concepts taught in the course control system engineering and enhances the ability to visualize the real system performance by conducting the experiments through hardware and software The course develops critical thinking and analytical skills of the student. The course also enhances the student's programming and simulation abilities					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Control Systems Engineering Laboratory experiments 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, instrument and materials. 9. Locate faults in systems. 10. Manipulative 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 Out Comes	**On successful completion of the course the students shall be able to:** 1. Summarize the time domain specifications for second order system. 2. Explain the behaviour of lag, lead and lag - lead compensating networks 3. Analyze the performance of P, PI, and PID controllers. 4. Analyze the stability of LTI system using Root locus and Bode plots					
Course Content:						

List of Laboratory Tasks:

Experiment N0 1: Time Response of Second Order System.

Level 1: To determine the time response characteristics of a second order system to a step input when the system is underdamped, over damped and critically damped and evaluation of time response specifications.

Level 2: To comment on the effect of additional poles and zeros on time response of second order system in MATLAB

Experiment No. 2: RC Lead Compensating Network.

Level 1: To implement a passive RC lead compensating network for the given specifications and to obtain its frequency response.

Level 2: To implement a passive RC lead compensating network for the given specifications and to obtain its frequency response using MATLAB software.

Experiment No. 3: RC Lag Compensation Network.
Level 1: To project a passive RC lag compensating network for the given specifications and to obtain its frequency response.

Experiment No. 4: RC Lag-Lead Compensation.
Level 1: To study the Frequency Response of a given Lead-Lag Compensating Network.
Level 2: To study the Frequency Response of a given Lead-Lag Compensating Network using NI Lab.

Experiment No. 5: Effect of P, PI and PID on a Second Order System
Level 1: To study the steady state performance of an analog P, PI & PID controller using PID controller kit.
Level 2: To simulate the effect of P, PI, PD and PID Controllers on a given second order system for a unit step input by developing a MATLAB Code.

Experiment No. 6: Characteristics of Servo Motor.
Level 1: To study the Speed-Torque and Speed-Back e.m.f. characteristics of AC Servomotor.

Experiment No. 7: Stability Analysis (Bode, Root Locus) of LTI System using MATLAB.
Level 1: To analyse frequency response of a system by plotting Root locus, bode plot using MATLAB software.

Experiment No. 8: DC Position control System using MATLAB
Level 1: To simulate a DC position control system using MATLAB and obtain its step response.

Targeted Application & Tools that can be used:
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.

Course Material

1. Control Systems Lab Manual, Presidency University, Bengaluru.

Text Book:

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

Reference Books:

1. K. Ogata, 'Modern Control Engineering', Pearson Education Asia / PHI, 4th Edition.
2. Benjamin Kuo, 'Automatic Control Systems', PHI, 7th Edition.
3. Hasan Saeed, automatic control Systems with MATLAB programs, S K Kataria and sons, Latest ed.

Online Resources:

1. https://puniversity.informaticsglobal.com
2. Ebook: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-2011/unit-2-signals-and-systems/designing-control-systems/
3. Case study: https://nptel.ac.in/courses/107/106/107106081/

Topics relevant to "SKILL DEVELOPMENT": Computing and performing the stability of the given system and assessing the stability by using theoretically and practically are for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Jisha L K
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021

Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: **EEE2065**	**Course Title:** **Power Electronics Laboratory** **Type of Course:** **Program core Laboratory**	**L-T-P- C**	0	0	2	1
Version No.	2.0					
Course Pre-requisites	Power Electronics, MATLAB/PSIM/SCILAB software for simple operations.					
Anti-requisites	NIL					
Course Description	This laboratory course gives an opportunity in validating the methods of controlling various power converters and analysing the characteristics of power semiconductor devices. The laboratory sessions will likely achieve the goals of visualizing and analysing the working of power converters at various conditions, improving teamwork abilities and practical skills. The course intents to develop critical and analytical thinking abilities to control the power converters.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of experiments on Power Electronics 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, instrument and materials.** 9) Locate faults in systems. **10) Manipulative 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 this course the students shall be able to:** 1 Demonstrate the characteristics of SCR, MOSFET, and IGBT by experimentation. 2 Illustrate operation of power converters for various loads. 3 Analyse the firing circuits for converters. 4 Demonstrate the speed control of machines using converters					
Course Content:						
List of Laboratory Tasks: Experiment No 1: To plot the static characteristics of the SCR.						

Level 1: To obtain the V-I characteristics of SCR and determine holding current and forward break over voltage.
Level 2: For a given SCR, comment on how the magnitude of forward break over voltage changes with increasing of gate current.

Experiment No. 2: To plot the static characteristics of Power MOSFET/ Power IGBT
Level 1: To plot the drain and trans conductance characteristics of power MOSFET
Level 2: To study V-I characteristics of IGBT and hence determine the output resistance and trans-conductance.

Experiment No. 3: To study SCR RC triggering circuit for a single-phase rectifier.
Level 1: To turn on the SCR using RC triggering circuit for single phase half wave rectifier and to observe the waveforms across R load by varying the width of firing pulses
Level 2: To study the performance and waveforms of full wave rectifier using RC triggering circuit.

Experiment No. 4: To study the operation of single phase semi converter (half controlled bridge rectifier) with different loads
Level 1: To study the performance and waveforms of single-phase half-controlled rectifier with R load
Level 2: To use single phase semi converter for controlling the speed of a separately excited DC motor

Experiment No. 5: To study the triggering of SCR using digital triggering

Level 1: To study SCR digital triggering circuit for a single-phase controlled rectifier

Level 2: To Simulate and validate the relationship between load voltage and firing angle for single phase-controlled rectifier using MATLAB/PSIM

Experiment No. 6: To control the speed of universal motor by AC voltage controller

Level 1: To control speed of universal motor using AC Voltage Controller and to plot the speed V/S firing angle graphically

Level 2: To Simulate and validate the above results using MATLAB/PSIM

Experiment No. 7: To study the AC voltage control by using TRIAC – DIAC combination
Level 1: To study AC voltage controller using TRIAC – DIAC combination connected to lamp load and to plot load voltage (rms) Vs firing angle.
Level 2: To study AC voltage controller using TRIAC – DIAC combination connected to R-L load and compare the results with that of resistive load.

Experiment No. 8: To obtain speed control of a separately excited d.c motor using Type A chopper.
Level 1: To obtain speed control of a separately excited d.c motor using an IGBT/ MOSFET Type A chopper and to plot output voltage & speed vs duty cycle
Level 2: verify the relationship between output voltage and firing angle for the above chopper theoretically

Experiment No. 9: To study single phase fully controlled rectifier with RL load
Level 1: To identify the difference between the conduction angles In case of single phase fully controlled rectifier with R and R-L loads.
Level 2: To understand the effect of freewheeling diode in case of fully controlled rectifier with R-L load.

Experiment No. 10: To obtain speed control of stepper motor using motor logic controller circuit
Level 1: To obtain speed control of stepper motor using motor logic controller circuit and at the same time verify the truth table for full step mode
Level 2: To obtain speed control of stepper motor and verify the truth table for half step mode

Targeted Application & Tools that can be used:
The application of power electronic converters in the fields of sustainable energy technologies such as wind energy, solar power, wave energy, and fuel cells are described. Furthermore, industrial applications like electric drives, Electric Vehicles and induction heating as well as application of power electronics for power transmission, harmonics control and voltage stability issues.
Professionally Used Software: MATLAB/PSIM/Scilab

Textbooks
1 M.H.Rashid, "Power Electronics Power Electronics Devices, Circuits and Applications ,Fourth Edition , Pearson,2017
2. Power Electronics Lab Manual by Presidency University

References
1. M.D. Singh and Khanchandani K.B, "Power Electronics",T.M.H. Second edition, 2017
2. Dr P S Bimbhra , "Power Electronics" ,Khanna Publishers, Fifth Edition,1990

Online resources
6. Lecture Series on Power Electronics by Prof. B.G. Fernandes, Department of Electrical Engineering,IIT Bombay. For more details on NPTEL visit http://nptel.ac.in
7. https://www.pdfdrive.com/fundamentals-of-power-electronics-e5904858.html
8. https://ieeexplore.ieee.org/document/9545403 (case study)
9. https://springerplus.springeropen.com/articles/10.1186/2193-1801-2-370
10. https://puniversity.informaticsglobal.com

Topics relevant to "SKILL DEVELOPMENT": Laboratory experiments for controlling various power converters and analysing the characteristics of power semiconductor devices for **Skill Development** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr Joshi Manohar V& Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/07/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: **EEE3001**	**Course Title: Electrical Drives** **Type of Course: Program Core Theory Only**	**L-T-P- C**	3	0	0	3
Version No.	**2.0**					
Course Pre-requisites	[1] Electrical Machines [2] Power Electronics, Basic concepts of DC and AC motors, Control of power electronic converters.					
Anti-requisites	**NIL**					

Course Description	The course intends to provide a basic understanding of various power converters fed electrical motor drives. It gives insight into electric drive systems to analyze the steady-state and dynamic characteristics of speed and torque characteristics of ac & dc drives used in the modern industry. The course also develops the critical thinking abilities to apply in the area of variable-speed drives and energy conservation which are used in various industrial, domestic, and traction applications. Mini projects and Assignments enhance the ability to visualize real-world applications using tools like MATLAB, caspoc software etc.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Electrical Drives and attain **Skill Development** through **Problem Solving** methodologies.			
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the dynamics of Electric Drives and multi-quadrant operation 2. Select the power converter in control of d.c drive systems. 3. Apply suitable control method in induction motor drives 4. Choose the proper Electric Drive system for energy conservation and industrial applications			
Course Content:				
Module 1	Introduction to Electrical Drives and its Dynamics	Assignment	Data collection and Data analysis task	8 Sessions
Topics: Fundamentals of Electrical Drives-Power converters used in modern electrical motor drives; analyze the steady-state and dynamic characteristics of commonly used drives in the modern industry –Muti- quadrant operation. Numerical problems.				
Module 2	Operation &Analysis of D.C Drives	Assignment	Hands on &Programming task.[Arduino based four quadrant operation of converter/chopper fed 24V dc motor drive for food processing industry]	8 Sessions
Topics: Single phase and three phase rectifier fed dc motor drives. Analysis of chopper fed dc motor drives- Numerical Problems.				
Module 3	Operation and Analysis of Induction Motor Drives	Assignment	Simulation task	9 Sessions
Topics: Control of Induction motor drives, .Stator voltage control: Variable voltage and variable frequency control, rotor resistance control, slip power recovery- Numerical Problems				
Module 4	Operation of Synchronous motor drives and Industrial Drives	Assignment	Simulation task [using Caspoc software and Analysis]	8 Sessions
Topics: Synchronous motor drives, Energy efficient drives, losses in electrical drive system, Energy conservation in electric drives. Traction Drives, industrial drives – paper mills, rolling mills, textile mills, and cement mills				

Targeted Application & Tools that can be used: The application areas of Electrical Drives are: Industrial operations such as in rolling mills, textile mills, cement mills, processing plants.
Professionally Used Software: MATLAB/ Caspoc

Text Books

1. G.K DUBEY, "Fundamentals of Electrical Drives", Second edition, Narosa publishing house,2001
2. W. Shepherd, L. N. Hulley and D. T. Liang, "Power Electronics and motor control", Second Edition, Cambridge University Press, 1995.

References

1. N.K De and P.K. Sen, "Electrical Drives", PHI.
2. S.K Pillai, "A First Course on Electric Drives", Wiley Eastern Ltd.
3. Bimal K Bose, "Modern Power Electronics and AC Drives" Pearson, 2015

Online learning resources:

1. noc19-ee65-lec01 - YouTube(NPTEL Video Lectures)
2. Dynamic Simulation of Electrical Machines and Drive Systems Using MATLAB GUI | IntechOpen
3. PDF⋙ Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines) - DonnamiraTTookMrs
4. www.sciencedirect.com/science/article/abs/pii/S1364032111004308
5. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT":

1. Rectifier fed DC Motor control at various torque conditions
2. Inverter fed AC Motors control at various torque conditions

For **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Topics relevant to "ENVIRONMENT AND SUSTAINABILITY":

1. Energy conservation and saving in Electrical Drives

Catalogue prepared by	Dr Joshi Manohar V
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE3003	**Course Title: Switchgear Protection Type of Course: Program Core and Theory only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Electrical Power Generation, Transmission and distribution systems Performance of Transmission lines: short line, medium line and long line, Trends in Transmission and Distribution.					
Anti-requisites	**NIL**					
Course Description	This course provides the basic knowledge with regards to the need for protection of electric power systems. The course aims to understand the requirement of switchgear used in power system networks and conceptually visualize the basic aspects of protection involved in power systems. It develops an insight into the protection schemes followed in power system.					

Course Objectives	The objective of the course is to familiarize the learners with the concepts of Switchgear Protection and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	After the completion of the course students shall be able to: 1. Discuss the importance of protection in power system. 2. Explain the operation of fuses and switches in power system protection. 3. Identify various types of circuit breakers and their mechanism of operation. 4. Choose protective relaying schemes in conventional and modern relays			
Course Content:				
Module 1	Introduction to protection, switches and fuses	Assignment	Data Analysis	**10 Sessions**
Topics: Introduction to Protection-Need for protective systems, Components of a protection system, Introduction to switches-switches, isolators, Fuse characteristics and types- open type, semi enclosed re-wirable type, D type cartridge fuse, HRC fuse and their applications.				
Module 2	Circuit breakers	Assignment	Problem Solving	**12 Sessions**
Topics: Circuit Breakers and operational characteristics -Circuit breakers, Arc interruption theories, RRRV Classification of circuit breakers-oil circuit breakers, Air circuit breakers, SF6 circuit breakers, Vacuum circuit breaker				
Module 3	Protective relays	Assignment	Problem Solving	**13 Sessions**
Topics: Introduction to relays, theory of protection and classification -zones of protection, primary and backup protection, Essential qualities of protection, Classification of relays based on technology and functionality Protective relaying characteristics and parameters-Over current relays- instantaneous, time current relays, Numerical Overcurrent Relays, IDMT characteristics and parameters and operation with required formulas, Time and current settings of overcurrent relays, PSM and TSM calculations Directional relay, Differential relay, Effect of Line Length and Source Impedance on Performance of Distance Relays, Electromechanical distance protection relays-Operating principle of Distance protection relays, Balanced (Opposed) Voltage Differential Protection, Wire Pilot Protection, Carrier Current Protection, Electromechanical Impedance relay, Pilot Relaying Scheme, Electromechanical Reactance relay, Electromechanical MHO relay, Static relays-microprocessor based relays				
Module 4	Unit protection schemes	Assignment	Problem Solving	**10 Sessions**
Topics: Protection scheme for alternator, induction motor and transformer, Buszone Protection, Frame Leakage Protection.				
Targeted Application & Tools that can be used: The protection finds its application in whole of the power system network as an integral part of it. Specifically finds its application in protection of electrical devices and equipment of the power systems such as generators, transformers, transmission lines, buses and motors. The Commercially available simulation software tools like MiPower /MATLAB are utilized as professional tool.				
TextBooks 1. Badri Ram and D.N. Vishwakharma, "Power System Protection and Switchgear", Second Edition, McGraw Hill Education , 2011 2. Sunil S.Rao, "Switchgear Protection and power systems", 13th edition, Khanna Publishers,2014.				

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References

1. BadriramandViswaKharma, "Power System Protection and Switchgear",TMH
2. Y. G. Paithankar and S.R. Bhide, "Fundamentals of Power Systems Protection", PHI, 2nd Edition, 2013.
3. Ravindarnath and Chandra,"Power System Protection and Switchgear", New Age Publications.

Online resources

1. Case study: https://puniversity.informaticsglobal.com/openFullText.html?DP=https://ieeexplore.ieee.org/document/7967241/
2. https://ieeexplore.ieee.org/document/712612
3. https://ieeexplore.ieee.org/document/5060940
4. Ebook: https://puniversity.informaticsglobal.com/user#/home

Topics relevant to the "SKILL DEVELOPMENT": Arc interruption in circuit breaker, Rate of rise of restriking voltage, Protection schemes in alternator for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in the course handout.

Catalogue prepared by	Ms. Ramya N
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
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Course Code: EEE3002	**Course Title: Power System Analysis** **Type of Course: Program Core and Theory only**	**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	EEE212: Transmission and Distribution. Knowledge on Integration, Differentiation, and Transmission line parameters, Performance analysis of Transmission line parameters, Basics of MATLAB and MI Power.					
Anti-requisites	**Nil**					
Course Description	This course introduces Representation of Power System Components, discusses Symmetrical Components, analysis of Symmetrical & Unsymmetrical Faults in the Power System. It deals with various methods to solve the power flow. It also discusses stability concept and contingency analysis. The course develops critical thinking and analytical skills. The course also enhances the programming and simulation skills through modern tools such as MATLAB, MiPower and etc.,					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Power System Analysis and attain **Skill Development** through **Problem Solving methodologies**.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Model the network of power system components. 2. Apply GS and NR methods to compute the load flow for given power system netbook. 3. Analyze the fault current in power system for different types of faults. 4. Illustrate the concept of stability of power system. 5. Analyse the concept of contingency of power system.					

Course Content:				
Module 1	Representation of Power System Components:	Assignment	Programming/Simulation	**10 Sessions**
Topics: Basic Concepts of Network Modelling of power system- Equivalent circuit of Transmission line, Transformer, Synchronous Generators, Concepts of per Unit Systems, Formation of Network Matrices.				
Module 2	Load Flow Studies	Assignment	Programming/Simulation	**11 Sessions**
Topics: Concepts of Load Flow Model, Development of Load Flow Model, and Solution of Load flow Equations, Numerical Examples, Practical Applications of Load Flow Solutions.				
Module 3	Fault Analysis	Case Study	Programming/Simulation	**11 Sessions**
Topics: Basic Concepts of Fault Analysis in power systems, Types of Faults, Symmetrical Fault Analysis Method, Asymmetrical Fault Analysis Method, and Numerical Examples.				
Module 4	Power system Stability	Case Study	Programming/Simulation	**10 Sessions**
Topics: Basic Concepts of Power System Stability, Angle In stability, Voltage Instability, Development of Mathematical models for static and transient stability analysis and solutions. Voltage stability analysis methods.				
Module 5	Introduction to Contingency Analysis	Case Study	Simulation	**10 Sessions**
Topics: Concept of contingency analysis, types of contingency analysis, importance of contingency analysis power system, Case Studies.				
Targeted Application & Tools that can be used: Power System Load flow studies, protection and stability for real time test systems. Professionally Used Software: Mi Power/ ETAP/ MATLAB/PSCADA/Power World Simulator/PSSE.				
Text Book 1. A Modern Power system Analysis – by I.J.Nagrath&D.P.Kothari: Tata McGraw–Hill Publishing Company, 2nd edition. 2. Power System Analysis by Hadi Saadat – TMH Edition.				
References 1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill. 2. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc. 3. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – CengageLearning publications. **online learning resources** 5. EBook: https://puniversity.informaticsglobal.com 6. Seminar: https://onlinecourses.nptel.ac.in/noc19_ee62/ 7. Case Study: http://www.eolss.net/sample-chapters/c05/e6-39a-06-02.pdf. 8. https://www.ebookmela.co.in/download/power-system-analysis-operation-and-control-by-abhijit-chakrabarti				
Topics relevant to development of " SKILL DEVELOPMENT": Performing the load flow analysis for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course hand-out. **Topics related to development of "HUMAN VALUES and PROFESSIONAL ETHICS":** Performing the load flow analysis as per the IEEE standards by giving case study.				
Catalogue prepared by	**Mr. Ravi V Angadi**			
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21			

Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE2064	**Course Title: Electrical Cad Laboratory** **Type of Course: Laboratory**	**L-T- P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Basic Knowledge of Working & Constructions details of Electrical Machines (DC & AC). Overview of the generation, transmission and distribution. Basic Auto Cad commands knowledge's.					
Anti-requisites	**Nil**					
Course Description	This course introduces computer applications in electrical engineering and practical expertise in The course develops an understanding of DC and AC machine windings; single line diagrams of generating stations and substations' covering; incoming circuits; electrical machine assembly drawings (Transformer, DC Machine, and Alternator) using design data, sketches, or both; and simple domestic and commercial wiring drawings/sketches as per standards using AUTO CAD Software. Critical thinking and analysis are also taught. Modern tool training improves drawing skills (AUTOCAD).					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Cad Laboratory experiments 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, instrument and materials.** 9. Locate faults in systems. 10. **Manipulative 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 Out Comes	**On successful completion of the course the students shall be able to:** 1. Develop the armature winding of both DC and AC Machine. 2. Develop the layout of Generating Stations and Substations Covering, Incoming Circuits. 3. Develop the sectional views of transformers, DC machine and alternator. 4. Develop the plan/layout of domestic/commercial wiring.					
Course Content:						
List of Laboratory Tasks:						

Experiment No 1: Develop a DC Armature winding diagram for the given data;
Level 1: Winding Diagrams of D.C. Machines Simplex/ Double Layer Lap Windings (By using Auto CAD Software).
Level 2: Winding Diagrams of D.C. Machines Simplex/ Double Layer Wave Windings (By using Auto CAD Software).
Experiment No 2: Develop a single line diagram of Substation.
Level 1: Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Single bus bar) Power Transformers, Circuit Breakers, Isolators, Earthing Switches, Instrument Transformers, Surge or Lightning Arresters, Communication Devices (Power Line Carrier) and Line Trap.
Level 2: Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Double bus bar), Power Transformers, Circuit Breakers, Isolators, Earthing Switches, Instrument Transformers, Surge or Lightning Arresters, Communication Devices (Power Line Carrier) and Line Trap
Experiment No 3: Develop a AC Armature winding diagram for the given data;
Level 1: Winding Diagrams of A. C. Machines Simplex/ Double Layer Lap Windings (By using Auto CAD Software).
Level 2: Winding Diagrams of A. C. Machines Simplex/ Double Layer Wave Windings (By using Auto CAD Software).
Experiment No 4: Develop a Transformers Assembly Drawings Using Design Data, Sketches or Both.
Level 1: Transformers - Sectional Views of Single and Three Phase Core Transformers.
Level 2: Transformers - Sectional Views of Single and Three Phase Shell Type Transformers.
Experiment No 5: Develop a DC Machines Assembly Drawings Using Design Data, Sketches or Both.
Level 1: DC Machine- Sectional Views of Yoke with Poles, Armature.
Level 2: DC Machine- Sectional Views of Yoke with Poles, Armature and Commutator.
Experiment No 6: Develop an Alternator Assembly Drawings Using Design Data, Sketches or Both.
Level 1: Alternator- Sectional Views of star connected Stator and Rotor.
Level 2: Alternator- Sectional Views of Delta connected Stator and Rotor.
Experiment No 7: Develop an Alternator Assembly Drawings Using Design Data, Sketches or Both.
Level 1: Alternator- Sectional Views of star connected Stator and Rotor.
Level 2: Alternator- Sectional Views of Delta connected Stator and Rotor.
Experiment No 8: Develop a domestic and commercial wiring.
Level 1: Domestic wiring- Sketch the domestic wiring layout plan.
Level 2: Commercial wiring- Sketch the commercial wiring layout plan.

Targeted Application & Tools that can be used:
Application Area is design and development of electrical machines for various applications. Professionally Used Software: AUTOCAD/ Suitable CAD software can be used for drawings.

Course Material

1. Electrical Cad Laboratory Manual, Presidency University, Bengaluru.

Text Book:

1. A. K. Sawhney, " A course in Electrical Machine design", DhanpatRai, 6th, Edition, 2013
2. V. N. Mittle, "Design of Electrical Machines", N.C. Jain Publishers.
3. D M. Yogesh, B.S Nagaraja, N. Nandan, "Computer Aided Electrical Drawing", PHI

Reference Books:

1. K. L. Narang , " Electrical Engineering Drawing", SatyaPrakashan, 2014.
2. K.M. Vishnu Murthy, "Computer-Aided Design of Electrical Machines", B S Publications.

Online resources:

1. https://puniversity.informaticsglobal.com/
2. https://www.autodesk.in/solutions/electrical-design
3. https://elecdes.com/electrical-cad-software/elecdes-electrical-cad-software
4. https://ieeexplore.ieee.org/document/9782226/

Topics relevant to "SKILL DEVELOPMENT": 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.	
Catalogue prepared by	Mr. Ravi V Angadi
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE3061	**Course Title: Power System Simulation Laboratory** **Type of Course: Program Core & Laboratory**	**L- T- P- C**	0	0	2	1
Version No.	2.0					
Course Pre-requisites	Basic Concepts of Network Modelling of power system, Concepts of per Unit Systems, Formation of Network Matrices, Concepts of Load Flow Model, Basic Concepts of Fault Analysis in power systems, Basic Concepts of Power System Stability and basic knowledge of MATLAB Coding.					
Anti-requisites	**Nil**					
Course Description	This course introduces computer applications in power system engineering and provides practical knowledge. MATLAB/Mipower fundamentals, power system analysis like load flow, short circuit, and D analysis, economic load dispatch, and contingency analysis will be simulated and studied in this lab. The course improves critical thinking and analysis. Through current tools, the course improves programming and Simulink modelling.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Power System Simulation laboratory experiments and attain **Skill Development** through **Experiential Learning** techniques.					
Basic skill sets required for the laboratory:						
	The students shall be able to develop: **14) An attitude of enquiry.** **15) Confidence and ability to tackle new problems.** **16) Ability to interpret events and results.** **17) Ability to work as a leader and as a member of team.** **18) Assess errors and eliminate them.** 19) Observe and measure physical phenomenon. **20) Write Reports.** **21) Select suitable equipment, instrument and materials.** **22) Locate faults in systems.** **23) Manipulative skills for setting and handling equipment.** **24) The ability to follow standard test procedures.** 25) An awareness of the need to observe safety precautions. 26) To judge magnitudes without actual measurement.					
Course Out Comes	**On successful completion of the course the students shall be able to:** CO. 1. Develop a program in MATLAB/ Mi-Power to assess the YBus, and ZBus of the given power system network.					

	CO. 2. Inference the power flow solution of the given power system network by using the Mi-Power software package. CO. 3. Inference the fault analysis of the given power system network by using Mi-Power software package. CO. 4. Demonstrate the stability analysis for the given power system network by using Mi-Power software package. CO. 5. Illustrate the economic load dispatch for the given power system. CO. 6. Examine the severity of the system by conducting contingency study for a given power system network.
Course Content:	

List of Laboratory Tasks:

Experiment No 1: Develop a MTALAB Code to compute Ybus.

Level 1: Formation of Y Bus without mutual coupling by using MATLAB

Level 2: Formation of Y Bus without mutual coupling by using Mi Power

Experiment No 2: Develop a MTALAB Code to compute Ybus.

Level 1: Formation of Y Bus with mutual coupling.

Level 2: Formation of Y Bus with mutual coupling by using Mi Power

Experiment No 3: Develop a MTALAB Code to compute Zbus. .

Formation of Z Bus .

Experiment No 4: Develop a MTALAB Code to compute system parameters

Determination of bus currents and bus for specified power system network.

Experiment No 5: Load flow analysis by Gauss-Siedel method.

Perform a load flow analysis without any acceleration factor by using Mipower software package.

Experiment No 6: Load flow analysis by newton raphson method.

Perform a load flow analysis by using Mipower software package.

Experiment No 7: Fault Analysis of given power system network.

Perform a symmetrical fault analysis for the given power system network.

Experiment No 8: Transient Stability Studies

Analyze the transient stability of a single line diagram of a 5 bus system with three generating units, four lines and two transformer and two loads, comment on the stability of the machine.

Experiment No 9: Optimal Generator scheduling.

Determine the cost equations and loss co-efficients of different units in the plant are given. Determine economic generation for total load demand of 240MW.

Experiment No 10: Contingency Analysis

Preform the contingency analysis for the given 5 bus system network and interpret the results.

Targeted Application & Tools that can be used:

Power System Load flow studies, protection and stability for real time test systems.

Professionally Used Software: Mi Power/ ETAP/ MATLAB/PSCADA/Power World Simulator/PSSE.

Course Material

1. Power System Simulation Lab Manual , Presidency University, Bengaluru.

Text Book:

1. A Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata McGraw–Hill Publishing Company, 2nd edition.
2. Power System Analysis by Hadi Saadat – TMH Edition.

Reference Books:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
3. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – CengageLearning publications.

Online resources:

1. https://puniversity.informaticsglobal.com/
2. https://onlinecourses.nptel.ac.in/noc19_ee62/
3. http://www.eolss.net/sample-chapters/c05/e6-39a-06-02.pdf.
4. https://www.ebookmela.co.in/download/power-system-analysis-operation-and-control-by-abhijit-chakrabarti

Topics relevant to "SKILL DEVELOPMENT": Performing suitable experiments to compute the load flow analysis using the modern tools like MATLAB, Mi Power for **Skill Development** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Mr. Ravi V Angadi
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE3004	**Course Title: Special Electrical Machines** **Type of Course: Discipline Elective & Theory only**	**L-T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**Electrical Machines** knowledge on various AC Machines, DC Machines & Transformers					
Anti-requisites	**NIL**					
Course Description	The basic objective of this course is to introduce the theory, construction, design, control electronics and in-depth analysis of several special electrical machines as an extension to the study of AC & DC electrical machines. This course also extend the fundamental principles into a way of critical thinking for problem solving in real time applications thereby learning analytical skills and programming skills through Lab VIEW/MATLAB.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Special Electrical Machines and their Applications and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the construction, principle of operation and power converter for switched reluctance motor and stepper motor 2. Explain construction, principle of operation, theory of torque production in brushless DC motor and Permanent magnet synchronous motor. 3. Implement the control aspect of special electrical machines using Lab VIEW/MATLAB. 4. Interpret the features of electric motors for Traction applications.					
Course Content:						
Module 1	**Switched Reluctance Motor and Stepper Motor**	**Assignment**	**Simulation task**			**10 Sessions**
Switched Reluctance Motor Construction, Principle of operation, design of stator and rotor pole arc, power converter for switched reluctance motor. **Stepper Motors** Construction, principle of operation-theory of torque production, Types of stepping motor.						
Module 2	**Permanent Magnet Brushless D.C. Motors and Permanent Magnet Synchronous Motors**	**Assignment**	**Simulation task/Data collection Task**			**10 Sessions**

Permanent Magnet Brushless D.C. Motors
Construction, principle of operation ,EMF and Torque equations , Torque speed characteristics , Sensor less motors , Motion control
Permanent Magnet Synchronous Motors
Construction, Principle of operation , EMF and torque equations, Starting, Rotor configurations, Dynamic model

Module 3	**Control of Special Machines and Applications**	**Quiz**	**Data Analysis**	**10 Sessions**

Open loop control and closed loop control of stepper motor using Microprocessor, Characteristics of stepper motor in open loop drive, DSP Control of switched reluctance motor for fraction type load, DSP/Microprocessor Control of brushless dc motor, Applications.

Module 4	**Electric Motors for traction drives**	**Group Discussion**	**Data Analysis**	**9 Sessions**

AC motors, DC motors, single sided linear induction motor for traction drives, comparison of AC and DC traction.

Targeted Application & Tools that can be used:
Application Areas are Motor Design, Automation companies like Schneider Electric, Mitsubishi electric etc, Automobiles and Electrical Vehicle Manufacture companies like Tesla etc.
Professionally Used Tools: LabVIEW/MATLAB

TextBooks:
1. Venkata Ratnam K, Special Electrical Machines, CRC Press, 2009.
2. Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.

References
1. Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.
3. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.

Online Resources
1. https://nptel.ac.in/courses/108/102/108102156/
2. https://www.youtube.com/watch?v=DMDTkXeFkb8
3. Ebook : https://puniversity.informaticsglobal.com/login
4. Seminar topic: https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=special%20electric%20machines%20review%20papers
5. Case study: https://www.researchgate.net/publication/342360681_Economic_Benefits_of_Energy-Efficient_Electrical_Machines_A_Case_Study

Topics relevant to "EMPLOYABILITY SKILLS": PMBL DC Motor, Control of switched reluctance motor for developing **Employability Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ramya K
Catalogue updated by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3005	**Course Title: Digital control and state variable methods** **Type of Course: Discipline Elective & Theory only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Control system Engineering: Basic concepts of control systems, Basic analysis of transfer function in frequency and time domain					
Anti-requisites	NIL					
Course Description	This course in electrical engineering introduces the fundamental concepts, principles and application of digital control system analysis and design. The course emphasizes the principles of various digital control systems in daily life and the basic concepts of pulse transfer function for various systems. The course is analytical in nature and needs mathematical computations. The course also develops programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital control and state variable methods and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** (1) Apply z-transforms and block-diagram reduction techniques to discrete time systems. (2) Demonstrate pulse transfer function and state space models of the given discrete time system. (3) Explain different controllers in time/frequency domain to improve the system performance. (4) Discuss full order and reduced order observers for state estimation.					
Course Content:						
Module 1	Fundamentals of Digital Control System	Assignment	Quiz	**11 Sessions**		
Block diagram of digital control system, Advantages of digital control system, Examples of digital control systems, Sampling operations, Zero order hold, Aliasing. Z–Transforms: Introduction, Properties and the theorems of Z-transforms, Inverse Z-transforms, Z- Transform method for solving difference equations						
Module 2	Pulse Transfer function and state space analysis	Assignment	Problem solving	**12 Sessions**		

Pulse transfer function, block diagram analysis of sampled-data systems, Pulse transfer function of ZOH.
State Space Analysis: State Space Representation of discrete time systems, Solution of linear time invariant discrete time state equation, Pulse Transfer Function Matrix, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Eigen values and eigen vectors, Discretization of continuous time state space equations.

Module 3	Discrete Time Control System	Assignment	Simulation	**10 Sessions**

Design of Discrete Time Control System by Conventional Methods: Design based on based on root locus, Design based on the frequency response method –Bilinear Transformation and Design procedure in the w-plane, Digital PID controller.

Module 4	State feedback Controllers and Observers	Assignment	Problem solving	**12 Sessions**

State feedback Controllers and Observers: Design of state feedback controller through pole placement- Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.

Targeted Application & Tools that can be used:
Application Area in Control system Engineering, Automation, and control industries
Software Tools: MATLAB/Simulink

Textbooks

1. Discrete-Time Control Systems by K. Ogata, PHI Learning, 2nd edition, 2008.
2. Digital Control and State Variable Methods by M. Gopal, Tata McGraw-Hill Companies, 2nd edition, 2010

References

1. Digital Control Systems, B.C. Kuo, Oxford University Press, 2nd edition, 2003.
2. Digital Control Engineering, M.Gopal, New Age International Publishers, 2nd edition, 2003

Online Resources

1. https://nptel.ac.in/courses/108/103/108103008/
2. https://www.jntuknotes.com/2020/08/digital-control-systems.html
3. E-book: https://puniversity.informaticsglobal.com/menu
4. Seminar topic: https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=Digital%20control%20and%20state%20variable%20methods
5. Case study: https://cse.sc.edu/~gatzke/cache/ray-6.pdf

Topics relevant to "EMPLOYABILITY SKILLS": various digital controllers for developing **Employability Skills** through **Problem Solving Methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms Ragasudha C P
Recommended bythe Board of Studies on	BoS No: 14th BoS held on 22/02/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on0 3/08/2022

Course Code: **EEE3006**	**Course Title: High voltage Engineering** **Type of Course: Discipline Elective** **Theory only**		**L- T-P-C**	3	**0**	0	3
Version No.	2.0					
Course Pre-requisites	Electromagnetic Fields					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental aspects of insulation breakdown in materials. The course provides adequate content about the design, measurement, and assessment of high voltage electrical equipment, test techniques, and over-voltage phenomena. The course gives an opportunity to understand the concepts by simulation through any open-source software packages available for the simulation and analysis of high voltage circuits.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of High voltage Engineering and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Describe the conduction and breakdown mechanism of solid, liquid, gas dielectric materials 2) Explain generation of high voltage and current in electrical systems 3) Discuss the different methods of measurement of high voltage and current 4) Identify the overvoltage phenomenon and the testing methodologies for different high voltage equipment.					
Course Content:						
Module 1	**Conduction and Breakdown**	Assignment	Data Collection		**6 Sessions**	
Topics: Dielectric breakdown in Gaseous, Liquid and Solid Insulators Mechanism of breakdown of gases –Townsend's criteria, Streamer theory; Paschen's Law, Penning effect, Corona discharges,						
Module 2	**Generation of High Voltage and current**	Assignment	Simulation		**12 Sessions**	
Topics: High DC voltage – Rectifier circuit, Voltage doubler circuit, Cockroft-Walton Voltage Multiplier Circuit. High AC voltage – Cascaded Transformer, Series Resonant circuit. High Impulse voltage and current – Impulse generator circuit, Marx circuit, Impulse current generator.						
Module 3	**Measurements of High Voltages and Currents**	Assignment	Simulation		**12 Sessions**	
Topics: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.						

Module 4	**Overvoltage Phenomenon and Testing of High Voltage**	Case Study	Data Collection	**15 Sessions**

Topics: Apparatus Overvoltage due to lightning, Overvoltage due to switching surge, faults or otherabnormalities, Methods of Protection against HV surge, Insulation coordination in HV apparatus. Standard test procedures, Laboratory test procedures, Testing of – Insulators, Bushings, Circuit breakers,
Isolators, Transformer, Cables, surge diverters.

Targeted Application & Tools that can be used:

The high voltage engineering specifically finds its application in every other critical manufacturing and processing industries as an integral part of it. Its generation circuit, its test benches and standard test procedures on are topics of higher priority.
The Commercially available simulation software tools like MATLAB are utilized as professional tool in the course and students are encouraged to use any open-source software available.

Text Book

1. M. S. Naidu & V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Education, 5 th Edition, 2013
2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 3 rd Edition, 2012

Online learning resources

1. https://nptel.ac.in/courses/108/104/108104048/
2. https://electrical-engineering-portal.com/download-center/books-and-guides/electricity-generation- t-d/lecture-notes-hv-engineering
3. Ebook: https://puniversity.informaticsglobal.com
4. Seminar topic: https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=high%20voltage%20en gineering
5. Case study: https://www.highvoltageservices.co.uk/category/high-voltage-electrical-case-studies/

Topics relevant to "EMPLOYIBILITY SKILLS": Statistical evaluation of measurement data, Principle and types of analog and digital voltmeters, ammeters. for Developing **"Employability Skills"** through **Participative Learning Techniques.** This is attained through assessment components mentioned in course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	12th. BoS held on 27/7/2021
Date of Approval by theAcademic Council	16th Academic Council Meeting, dated 23 /10/2021

Course Code: **EEE3007**	**Course Title: Modern power electronics and AC drives** **Type of Course: Discipline Elective & Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Power Electronics Basic concepts of Power Electronics, Basic Structure and Applications of various power Electronic Switches					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to understand the basic concepts and design of advanced power electronics and AC drives. This course includes the detailed analysis of several AC drives used and their analysis. The course is both conceptual and analytical in nature. The course develops the simulation abilities through assignments and project work. The course also enhances the ability to identify suitable drives for specific industrial applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Modern power electronics and AC drives and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the torque speed characteristics for different control parameters by their equivalent circuit analysis 2. Select different slip recovery drive schemes for speed control of I.M. at rotor side. 3. Explain Vector control of Induction Motor Drive 4. Illustrate the characteristics of synchronous motor using UPF and constant flux linkage control 5. Interpret the speed Control of variable Reluctance motor drive and brushless DC motor drive.					
Course Content:						
Module 1	AC Drives	Assignment	Data collection	**10 Session**		
Topics: Introduction to AC Drives: Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation Variable frequency operation constant v/f operation – Variable stator current operation.						
Module 2	Control of Induction motor drives	Assignment	Problem solving	**13 Session**		
Topics: Control of Induction motor drives at Stator side Scalar control – Voltage fed inverter control – Open loop volts/Hz control – Control of Induction Motor Drive at Rotor Side and Vector Control Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of a Kramer Drive – Static Scherbius Drive – modes of operation. Vector control of Induction Motor Drives: Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control – Adaptive control principles						
Module 3	Control of Synchronous motor drives	Assignment	Problem Solving	**12 Session**		
Topics: Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control. Controllers: Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque – speed control scheme						
Module 4	Variable	Assignment	Problem Solving	**10 Session**		

	Reluctance and Brushless DC Motor drives			

Topics: Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive. Brushless DC Motor drives: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.

Targeted Application & Tools that can be used:
Application Area is Power Electronics and Electric Drives, Automobile industries, Electric Vehicles
Software Tools: MATLAB/Simulink

Textbooks

1. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1 st edition – 2002
2. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1st edition

References

1. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull pergman Press (For Chapters II, III, V) 1st edition
2. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey (for chapters I, II, IV) - 1 st edition
3. Power Electronic circuits Devices and Applications – M H Rashid – PHI – 1995.
4. Fundamentals of Electrical Drives – G.K. Dubey – Narora publications – 1995 (for chapter II) Power Electronics and Variable frequency drives – BK Bose – IEEE Press – Standard publications - 1 st edition – 2002.

Online Resources

1. https://nptel.ac.in/courses/108/104/108104011/
2. https://lecturenotes.in/subject/1374/advanced-electric-drives
3. Ebook: https://puniversity.informaticsglobal.com
4. Seminar topic: https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=modern%20power%20 electronics%20and%20ac%20drives%20review%20paper
5. Case study: https://www.researchgate.net/publication/251830696_Power_Electronics_and_AC_Machine_Drives_-_Advances_and_Trends

Topics relevant to "EMPLOYABILITY SKILLS": Control of Induction Motor Drive at Rotor Side, Brushless DC Motor drives are for developing **Employability Skills** through **Problem Solving Methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Sarin MV
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/2/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/8/2022

Course Code: EEE3008	**Course Title: Materials in Electrical Systems** **Type of Course: Discipline Elective & Theory only**	**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Material Physics Properties of conductors, Semi-Conductors and Insulators.					
Anti-requisites	**NIL**					

Course Description	This course provides a fundamental knowledge of the materials used in electrical systems. The course needs basic concepts of semiconductor physics and chemistry to understand the concepts of properties of electrical materials, PV cells and in batteries. The course is conceptual in nature and develops the ability to identify exact material suitable for specific application.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Materials in Electrical System**s** and attain **Employability Skills** through **Participative Learning** techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the importance of Electrical properties 2. Discuss Power Generation and Light generation concepts. 3. Identify the materials used in Energy storage devices. 4. Illustrate the materials used in various engineering applications.			
Course Content:				
Module 1	Introduction	Quiz	Data Analysis task	**09 Session**
Topics: Economic relevance of the materials sector for electrical applications in the world, Physical basis of electrical conduction, Electrical conductivity in metals, Semiconductors, Intrinsic conduction properties, Extrinsic conduction by doping, Conjugated semiconductors (organic semiconductors), Superconductivity, Ionic conductivity. Introduction Properties and Application of Piezoelectric materials, Eletrostrictive materials, Ferromagnetic materials, Magnetostrictive materials, Shape memory alloys, Electro archeological fluids, Magneto archeological fluids, Smart hydrogels.				
Module 2	Power generation and light generation	Assignment		**09 Session**
Topics: Power generation by photovoltaic cells, Working principle of solar cells, Materials for solar cells, Potential for power generation, Material trends in photovoltaic cells. Light Generation by LEDs inorganic LEDs: IR, red, green, blue, UV; Organic LEDs (small molecules and polymer).				
Module 3	Electric energy storage	Assignment	Presentations	**09 Session**
Topics: Basics electrochemical reactions, Batteries, Battery structure and function, Traditional materials, Materials development for increased energy density, Fuel cells/electrolysis.				
Module 4	Materials for power electronics for power control	Quiz	Data Collection and Analysis	**09 Session**
Topics: Basic Requirements, Power diodes, Types of power devices- Bipolar power devices, Unipolar power devices, Material Trends in power electronics: Si, SiC, GaN, ZnO, C (diamond, etc.)				
Targeted Application & Tools that can be used: Application Area include all Electrical and Electronics material Manufacturing companies Intel Corporation, Samsung Semiconductor, Texas Instruments Inc. Micron Technology Inc.etc., Professionally Used Software: LabVIEW/MATLAB				
TextBooks 1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers 2. Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University Press New Delhi. 3. Power Semiconductor Devices by Vitezslav Benda, John Gowar and D.A. Grant				

References

1. Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.
2. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.
3. Electronic properties of engineering materials by J. D. Livingston

Online Resources

1. https://www.youtube.com/watch?v=3W-rOtTc3ek
2. https://www.youtube.com/watch?v=XaId7WR0mGo
3. Ebook:https://puniversity.informaticsglobal.com/search/searchresult.jsp?newsearch=true&queryText=Digital%20signal%20processing%20applications
4. Seminar topic: Case study: https://my.eng.utah.edu/~ma5090/topic.htm

Topics relevant to "EMPLOYABLITY SKILLS": Materials for solar cells , Power diodes, Types of power devices Bipolar power devices, Unipolar power devices are for developing **Employability Skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout.

Topics relevant to "ENVIRONMENT AND SUSTAINABLITY": Battery structure and function, Traditional materials, Materials development for increased energy density.

Catalogue prepared by	Ms. Sarin M V
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting, held on 23/10/2021

Course Code: EEE3009	**Course Title: AI applications for Electrical Engineering** **Type of Course: Discipline Elective Theory & Integrated Laboratory**	**L-T-P-C**	3	0	2	4
Version No.	2.0					
Course Pre-requisites	**Data Structures and Algorithms** Basic Data Structures: Arrays, Strings, Stacks, Queues, Basic math operations (addition, subtraction, multiplication, division, exponentiation), Basic Recursion, Basic Dynamic Programming.					
Anti-requisites	**NIL**					
Course Description	This course enables to locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms and to observe the concepts of feed forward neural networks and about feedback neural networks. This course is logical and conceptual in nature which enhances the critical thinking and reasoning skills. The course develops the programming skills through regular assignments and concepts.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of AI applications for Electrical Engineering and attain **Employability Skills** through **Experiential Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to** 1. State the importance of feed forward neural networks, feedback neural networks and learning techniques 2. Select the suitable learning techniques for Electrical Engineering applications. 3. Analyse fuzziness involved in various systems and fuzzy set theory.					

	4. Develop fuzzy logic control for applications in electrical engineering 5. Develop genetic algorithm for applications in electrical engineering			
Course Content:				
Module 1	**Artificial Neural Networks**	Assignment	Problem solving	**10 Session**
Topics: Introduction-Models of Neural Network – Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzman learning – Supervised learning – Unsupervised learning – Reinforcement learning – learning tasks				
Module 2	**ANN Paradigms**	Assignment	Problem solving	**10 Session**
Topics: Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network. Characteristics of NN, Learning Methods, LMS and Back Propagation Algorithm, training Examples of models, Advances in Neural networks				
Module 3	**Fuzzy Logic**	Assignment	Algorithm Development	**10 Session**
Topics: Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers – Fuzzy Inference –Principal component analysis, Autoencoder: Architecture, Sparsity. Long short term memory units in RNN.				
Module 4	**Genetic Algorithm**	Assignment	Algorithm development	**10 Session**
Topics: Introduction-Encoding – Fitness Function-Reproduction operators – Genetic Modeling – Genetic operators – Crossover – Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover – Crossover Rate – Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators – Generational cycle-convergence of Genetic Algorithm. ANN in space vector PWM wave synthesis for 2-level and multi-level converters				

List of Laboratory Tasks:

Experiment No. 1

Neural Network Activation Functions and Learning Rules

Level 1: Generation of activation functions using NN Toolbox Commands that are being used in neural networks

Level 2: Write a user defined MATLAB function to generate the following activation functions that are being used in neural networks using basic equations. Also plot them showing grid lines, title and xlabel. Use axis square

Experiment No. 2

Development of logic using MP and Hebb Neuron Model

Level 1: Generate ANDNOT function using McCulloch Pitts neural net by MATLAB Program

Level 2: Implementation of AND logic gate using Hebb learning Rule

Experiment No. 3

Supervised Learning Using NN Toolbox

Level 1:

Generate code for Neural Network with more than one input vectors

Level 2:

Design a Perceptron net as a gate traffic controller across the road to control the accidents occurring on the roads regularly.

Experiment No. 4

Development and Testing of Perceptron NN Algorithm (Single layer feed forward network)

Level 1: Write a MATLAB program for perceptron net for an AND function with bipolar inputs and targets Using NN Toolbox

Level 2: Verify results using NN GUI in MATLAB

Experiment No. 5

Development of Fuzzy Membership Functions and fuzzy set Properties

Level 1: Using MATLAB commands draw the triangular & Gaussian membership function for x = 0 to 10 with increment of 0.1. Triangular membership function is defined between [5 6 7] & Gaussian function is defined between 2 & 4
Level 2: Write a program to implement fuzzy set operation

Experiment No. 6

Development of logic for fuzzy relations
Level 1: Find the fuzzy relation using fuzzy max-min method and max-product method using MALAB

Experiment No. 7

Fuzzy Equivalence Relation
Level 1: Find whether the given matrix is reflexive or not
Level 2: Find whether the given matrix is transitivity or not

Experiment No. 8

Design of a Fuzzy controller for the following system using Fuzzy tool of MATLAB/Simulink
Level 1: Implementing Fan speed Controller using Fuzzy tool in Matlab
Level 2: Design of a Fuzzy controller for the following system using Fuzzy tool of Matlab Water heater Controller

Targeted Application & Tools that can be used:
Application Area is Computer Science Applications, Electric Drives, Electric Vehicles, Control Systems
Professionally Used Software: MATLAB/Simulink

Textbook

1. S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2003
2. Saifullah Khalid.,**"Applications of Artificial Intelligence in Electrical Engineering " March 2020**

References

1. P. D. Wasserman, Van Nostrand Reinhold," Neural Computing Theory & Practice" – New York, 1989.
2. Bart Kosko," Neural Network & Fuzzy System" Prentice Hall, 1992.
3. G. J. Klir and T. A. Folger," Fuzzy sets, Uncertainty and Information"-PHI, Pvt.Ltd,1994.
4. D. E. Goldberg," Genetic Algorithms"- Addison Wesley 1999

Online Resources

1. https://online.egr.msu.edu/articles/ai-machine-learning-electrical-computer- engineering-applications/
2. https://iopscience.iop.org/article/10.1088/1742-6596/1087/6/062
3. https://www.youtube.com/watch?v=y4cAHVLGTIE
4. S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2003
5. https://puniversity.informaticsglobal.com:2229/login.aspx?_direct=true&db=nlebk&AN=2706929&site=ehost-live

Topics relevant to "EMPLYOBILITY SKILLS": Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network for developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Sarin MV
Recommended by the Board of Studies on	14th BoS held on 22/2/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE3010	**Course Title: Electrical Estimation and Costing** **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 Power generation, transmission and distribution equipment's. Basics of indoor/outdoor substation equipment's. Basic understanding of numerical calculations.			
Anti-requisites	**NIL**			
Course Description	The purpose of this course is to provide an understanding of the basic concepts, design, and estimation of distribution systems and substations. This course develops and ability to design earthing systems for residential and commercial buildings and discuss practical aspects of condition monitoring and maintenance of various electrical equipment. It enhances learning the testing of various electrical equipment. This course also enhances the analytical abilities through assignments.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **E**lectrical Estimation and Costing and attain **Employability Skills** through **Problem Solving** methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Interpret electrical drawings and understand estimation fundamentals. 2. Estimate and costing of the wiring installation of residential and commercial buildings. 3. Estimate the material requirements and cost for overhead transmission and distribution lines. 4. Estimate the material requirements and cost for substation setup.			
Course Content:				
Module 1	Standards for estimation	Assignment	Data collection	**10 Session**
Topics: Role of National Electric code and IE rules- types of wires and cables – selection of ratings of copper and aluminium wires and underground cables as per IS code– protective devices such as fuses, relays, MCB's and ELCB's - Selection of fuses for motors. Types of fuses. General rules for wiring – determination of number of sub circuits. Determination of ratings of main switch/isolator – DB – Distribution Board –single line diagram using standard electrical signs and symbols of single phase/three phase circuits.				
Module 2	Wiring installation	Assignment	Data collection and estimation	**12 Session**
Topics: Wiring estimation for single phase/three phase residential consumers – schematic layout and diagram – single phase /three phase wiring estimation for small scale industries/offices/commercial building – Electrical Design and Estimation for High rise building. Design of lightning protection of residential buildings.				
Module 3	Estimation in Transmission and Distribution (T&D) Systems	Assignment	Data collection and estimation	**13 Session**
Topics: Overview of T&D Systems- Components: transformers, poles, conductors, insulators., Transmission line configurations and their cost implications., Estimation Techniques- Load calculation and voltage drop considerations, Designing overhead and underground distribution networks. Costing of T&D Projects- Labor and material cost estimation for poles, cables, and transformers, Environmental and regulatory compliance costs. Case Studies- Real-world T&D project estimation (e.g., rural electrification).				
Module 4	Substation Estimation	Assignment	Data collection and estimation	**10 Session**
Topics: Substation equipments – outdoor – indoor substations – layouts – components – selection of HV and EHV power and distribution transformers and switchgears – layout & schematic diagram				

for (a) 16MVA, 110/11KV outdoor substation (b) 11KV/415V, 63KVA outdoor / indoor substations. Earthing – Pipe earthing, Plate earthing, earthmat design - test procedure.
Targeted Application & Tools that can be used: Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards
Textbooks 1. Gupta J.B Kataria& Sons -Electrical installation, Estimation & Costing 2. Raina&Battacharys, Electrical System Design, Estimation & Costing, Wiley Eastern
References 1. Estimating and Costing by S.K Bhattacharya, Tata McGraw Hill, 3 rd edition, 2006 2. National Electric Code, Bureau of Indian Standard Publications 3. S.L Uppal&Garg - Khanna publishers. Electrical wiring estimating and costing 4. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., 2 ndedition, 2003. 5. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, 2 nd edition, 2006. 6. ISI, National Electric Code, Bureau of Indian Standard Publications **Online Resources** 1. https://nptel.ac.in/courses/108101167 2. https://www.scribd.com/document/360113853/ELECTRICAL-ESTIMATION-COSTING-pdf 3. https://www.youtube.com/watch?v=D04uxZpgp6M 4. https://presiuniv.knimbus.com/user#/home
Topics relevant to "EMPLOYABILITY SKILLS": Wiring estimation for single phase/three phase residential consumers – schematic layout and diagram – single phase /three phase wiring estimation for small scale industries/offices/commercial building for developing **Employability Skills** through **Problem Solving Methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BoS No: 14th, held on 22/02/2022
Date of Approval by the Academic Council	18th Academic Council meeting held on 03/08/22

Course Code: EEE3011	**Course Title: Testing and Commissioning of Electrical Equipment's.** **Type of Course: 1]. Discipline Elective & 2]. Theory only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Electric Power Generation, Transmission and Distribution Switchgear and Protection Electrical and Electronics Measurements and Instrumentation Basic concepts of Power generation, transmission and distribution equipment's. Basics of indoor/outdoor substation equipment's.					
Anti-requisites	**NIL**					

<table>
<tr><td>Course Description</td><td colspan="4">Power systems and industrial plants are made up of a variety of electrical drives, transformers, circuit breakers, and other equipment that must be installed, commissioned, and maintained on a regular basis to avoid permanent breakdown. It is required to carry out or supervise the installation, commissioning, and maintenance of various electrical equipment in power stations, substations, and industry. This course will enable to understand the concepts, and principles behind the installation, commissioning, and maintenance of electrical equipment in power stations, substations, and industry.</td></tr>
<tr><td>Course Objectives</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Electrical Equipment Testing and Commissioning and attain Entrepreneurial Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to
1. Prepare of maintenance schedule of different equipment and machines
2. Interpret various electrical equipment, machines and domestic appliances.
3. Select procedure of different types of earthing for different types of electrical installations.
4. Distinguish about electrical safety regulations and rules during maintenance</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Safety Management</td><td>Assignment</td><td>Case study</td><td>10 sessions</td></tr>
<tr><td colspan="5">Topics: Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure - Building installation, Domestic appliances, Industrial premises, earthing of substation, generating station and overhead line.</td></tr>
<tr><td>Module 2</td><td>Installation of Electrical Equipment</td><td>Assignment</td><td>Data collection</td><td>9 sessions</td></tr>
<tr><td colspan="5">Topics: Inspection of Electrical Equipment at site, Storage Electrical Equipment at site, Foundation of Electrical Equipment at site, Alignment of Electrical Machines, Tools/Instruments necessary for installation, technical report, Inspection, storage and handling of transformer, switchgear and motors</td></tr>
<tr><td>Module 3</td><td>Testing of Transformer, Plant and Equipment</td><td>Assignment</td><td>Presentation</td><td>9 sessions</td></tr>
<tr><td colspan="5">Topics: General Requirements for Type, Routine and Special Tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation 13 28 resistance; Dielectric tests; Temperature-rise, insulation and HV test, dielectric absorption, switching impulse test. Testing of Current Transformer and Voltage Transformer, power transformer, distribution transformer</td></tr>
<tr><td>Module 4</td><td>Installation and Commissioning of Rotating Electrical Machines</td><td>Assignment</td><td>Presentation</td><td>9 sessions</td></tr>
</table>

Topics: Degree of protection, cooling system, installation, commissioning and protection of induction motor and rotating electric machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator, protection and automation

Targeted Application & Tools that can be used:

Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Board**s.**

Textbooks

1. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi

References

1. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, 2008.
2. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
3. Philip Kiameh, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGrawHill, 2003.
4. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipments/machines.

Online resources:

5. https://www.iimu.ac.in/upload_data/Tender/SpecialConditionsWSequipment1.pdf
6. https://www.sciencedirect.com/topics/engineering/commissioning-process
7. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi
8. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live
5. https://puniversity.informaticsglobal.com

Topics relevant to "ENTREPRENEURIAL SKILLS": Inspection of Electrical Equipment, Earthing Procedure - Building installation inspection of Electrical Equipment, Earthing Procedure - Building installation for developing **Entrepreneurial Skills** through **Participative Learning techniques**. This is attained through the assessment component mentioned in course handout.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS": Safety Management during Operation and Maintenance, electric tests, insulation and HV test.

Catalogue prepared by	**Mr. K Sreekanth Reddy**
Recommended by the Board of Studies on	BoS No: 15th held on 27/7/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/08/2022

Course Code: EEE3012	**Course Title: Reactive Power Compensation and Management.** **Type of Course: Discipline Elective & Theory only**	**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	EEE2008 (Electrical Power Generation Transmission and Distribution) Knowledge on Transmission line parameters, Performance analysis of Transmission line parameters and MATLAB Simulation.					
Anti-requisites	**NIL**					
Course Description	This course provides the basic knowledge of compensation techniques, different types of compensation for transmission systems, reactive power coordination, reactive power management on the utility side and it leads to the development of analytical skills for effective power system management.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Reactive Power Compensation and Management and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Distinguish the importance of load compensation for different loads 2. Illustrate distinct compensation techniques used in transmission lines 3. Demonstrate models for reactive power coordination. 4. Distinguish demand side reactive power management. 5. Distinguish user side reactive power management.					
Course Content:						
Module 1	Compensation of loads	Assignment	Data Collection			**6 Sessions**
Topics: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.						
Module 2	Reactive Power Compensation for transmission lines under steady state	Assignment/Case Study	Data collection			**7 Sessions**
Topics: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples						
Module 3	Reactive Power Coordination	Assignment/Case Study	Data collection			**7 Sessions**
Topics: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.						
Module 4	Demand Side Management	Assignment/Case Study	Simulation/Data Collection			**7 Sessions**
Topics: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels Distribution side Reactive power Management: System losses –loss reduction methods – Reactive power planning – Economics Planning capacitor placement – retrofitting of capacitor banks						
Module 5	User Side Management	Assignment/Case Study	Simulation/Data Collection			**7 Sessions**
Topics: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors and types of available capacitor, characteristics and Limitations of Reactive						

power management in electric traction systems and arc furnaces. Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations-furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

Targeted Application & Tools that can be used:

Application Area is effective reactive power compensation in real time. Professionally Used Software: MATLAB and Simulink and MI Power.

TextBooks

1. Reactive power control in Electric power systems by T.J.E. Miller, John Wiley and sons, 1982.
2. Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004.

References

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiley publication.
2. Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004

Online resources

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119967286
2. https://www.cedengineering.com/courses/fundamentals-of-reactive-power-and-voltage-regulation-in-power-systems
3. http://www.cbip.org/ExternalFile/REACTIVE%20POWER%20MANAGEMENT.pdf
4. https://puniversity.informaticsglobal.com:2229/login.aspx? direct=true&db=nlebk&AN=2706929&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Load patterns, basic methods of load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers for developing **Employability skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Snehaprabha T V
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/2/22
Date of Approval by the Academic Council	18th Academic Council Meeting, Dated on 03/08/22

Course Code: EEE3013	**Course Title: VLSI Systems** **Type of Course: Discipline Elective , Theory Only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Digital electronics Basics of Digital Logic design circuits					
Anti-requisites	**Nil**					

Course Description	The course introduces the fabrication and layout techniques necessary to design large scale systems. It improves the knowledge on understanding electrical properties of MOS transistor and analysis of CMOS, CMOS inverters. It also develops the ability to identify the steps which are required for VLSI system design. The course is analytical in nature. The course develops programming skills through Assignments.
Course Objective	The objective of the course is to familiarize the learners with the concepts of VLSI Systems and attain **Employability Skills** through **Participative Learning** techniques.
Course Out Comes	On successful completion of the course the students shall be able to: 1. Summarize the methodologies for fabricating the ICs. 2. Illustrate logic circuits using CMOS and its equivalent layout for fabrication. 3. Analyze the delay and power dissipation in logic circuits by analyzing the characteristics of CMOS. 4. Apply arithmetic circuits for various applications.
Course Content:	

Module 1	Overview of VLSI and VHDL	Assignment	Quiz	**No. of Sessions:10**
The VLSI design process, Architectural design, logical design, Physical design, layout styles, Full custom, Semi-custom approaches, Introduction Verilog HDL, Gate level, data flow, behavioral modelling				
Module 2	Introduction to MOS Devices	Assignment	Case study	**No. of Sessions: 12**
Introduction to MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, MOSFET as a Switch, Threshold voltage, MOS Device Design Equations, Body effect, Second order effects. MOS Transistor Circuit Model. Stick Diagram, Layout Design Rules.				
Module 3	Combinational logic Circuits	Mini project	CMOS Design/Programming task	**No. of Sessions: 12**
Introduction, Static CMOS Design- Complex Logic Gates, Ratioed Logic, Pass-Transistor Logic, Transmission gate Logic, Dynamic CMOS Logic Design: Dynamic Logic Design Considerations. Speed and Power Dissipation of Dynamic logic, Signal integrity issues, Cascading Dynamic gates.				
Module 4	Designing arithmetic circuits	Mini project continued	seminar	**No. of Sessions: 11**
Adders-Ripple carry, Carry-Look ahead, Multiplier using Array based-Ripple carry adder, Carry-Save adder, Multiplier using Tree based-Wallace Tree, Dadda Tree, Booth Multiplier, Squarer. Modelling of arithmetic circuits using HDL				

Targeted Application & Tools that can be used:

Application: VLSI circuits are used everywhere, including microprocessors in a personal computer, chips in a graphic card, digital camera or camcorder, chips in a cell phone, embedded processors, and safety systems like anti-lock braking systems in an automobile, personal entertainment systems, medical electronic systems etc

List of Open Source Software/learning website: HDL

Text Book

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A design perspective". Second Edition, Prentice Hall of India, 2013.
2. Neil H.E.Weste, David Money Harris, "CMOS VLSI DESIGN: a circuits and systems perspective", Fourth edition, Pearson 2015.

References

1. Samir Palnitkar, "Verilog HDL", Prentice Hall, 2010.
2. Sung-Ma Kong, Yusuf Leblebici and Chulwoo Kim, "CMOS digital integrated circuits: analysis and design", 4th edition, McGraw-Hill Education, 2015.

Online resources:

1. https://nptel.ac.in/courses/117102060
2. https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
3. Ebook: Analog and Digital VLSI Circuit Design by Panda, Saradindu First edition. New Delhi : Laxmi Publications Pvt Ltd. 2015, https://presiuniv.knimbus.com/user#/home
4. Seminar topic: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=Digital%20signal%20processing%20applications
5. Case study: http://users.ece.utexas.edu/~adnan/ecd-summer-05.pdf
6. https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS": Verilog HDL, Signal integrity issues, Modelling of arithmetic circuits using HDL for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE3014	**Course Title: Digital Signal Processing System** **Type of Course: Discipline Elective, Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Signals and Systems, z-transforms					
Anti-requisites	**Nil**					
Course Description	The course emphasis is on theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. It also develops knowledge in selection of suitable sensor based on requirement and application. The course is analytical in nature and needs basic knowledge of mathematical and computing. The course develops programming skills through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Signal Processing and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. **Describe** the basic concepts of discrete-time signals 2. **Apply** DFT for digital signal analysis. 3. **Discover** IIR filter for a given specification 4. **Compute** FIR filter coefficients for a given specification					
Course Content:						

Module 1	**Basics of DSP, Fourier Transforms, and Convolution**	Assignment	Quiz	**No. of Sessions:10**
Linear convolution of sequences using DFT, Introduction to Circular convolution, Circular convolution-Concentric circle method and Matrix multiplication method, Calculation of linear convolution from circular convolution.				
Module 2	**FFT Algorithms**	Assignment	Case study	**No. of Sessions: 13**
Introduction to FFT, Comparison of FFT with Direct evaluation of the DFT, DIT-algorithm: Radix-2 DIT-FFT algorithm and its problems. DIF-algorithm: Radix-2 DIF-FFT algorithm and its problems, Comparison. IDFT using FFT algorithm.				
Module 3	**IIR Filter Design and Realizations**	Mini project	Design of a filter/Programming task	**No. of Sessions:** 13
IIR filters –Introduction- characteristics of analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.				
Module 4	**FIR Filter Design and Realizations**	Mini project continued	seminar	**No. of Sessions: 10**
Sampling method, direct form realizations - Bartlett and Blackmann window functions, Parallel and Lattice structures, General-purpose digital signal processors				

Targeted Application & Tools that can be used:

Application: DSP is used primarily in areas of the audio signal, speech processing, RADAR, seismology, audio, SONAR, voice recognition, secure communications, electro-optics, intelligence an array of military applications can benefit from the digital signal processing (DSP) capabilities of programmable logic.

List of Open Source Software/learning website: NPTEL, MATLAB

Text Book

1. John G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, Pearson Education.
2. Sanjit K. Mitra, Digital Signal Processing, 4th edition.
3. (L1) : Lecture notes /PPT

References

1. Sophocles J. Orfanidis, "Introduction to Signal Processing" 2nd edition, Prentice Hall, Inc, 2010
2. Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 3rd edition, Pearson new international edition, 2014.
3. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems: Technology and modeling, Willey Publications,2012.
4. Lawrence R Rabiner and Bernard Gold, "Theory andData Acquisition and Signal Processing Pearson India Education Services, 2016.

Online resources:

1. https://nptel.ac.in/courses/117102060
2. https://www.tutorialspoint.com/digital_signal_processing/index.htm
3. Ebook: Digital Signal Processing, Regis, Carlos Danilo Miranda, New York : Momentum Press. https://presiuniv.knimbus.com/user#/home
4. Seminar topic: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText= Digital%20signal%20processing%20applications
5. Case study: https://www.slideshare.net/VaibhavTayal8/dsp-case-study
6. https://presiuniv.knimbus.com/user#/home.

Topics relevant to "EMPLOYABILITY SKILLS": Design of IIR filters from analog filters, DIF-algorithm for developing **Employability Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	15th held on 27/7/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/8/2022

Course Code: EEE3015	**Course Title: Industrial Automation with PLC and SCADA** **Type of Course: Discipline Elective & Theory & Integrated Laboratory**	L-T-P- C	2	0	2	3

Version No.	1.0
Course Pre-requisite	**NIL**
Anti-requisites	**NIL**
Course Description	This course deals with PLC hardware/software and their importance in automation. SCADA deals with communication protocols and real time control of power systems using EMS. The course is both conceptual and analytical in nature. It develops programming and simulation skills. The associated laboratory provides an opportunity to validate the concepts Taught and enhances the ability to visualize the real system performance
Course Objective	The objective of the course is to familiarize the learners with the concepts of Industrial Automation with PLC and SCADA and attain **Employability Skills** through **Experiential Learning** techniques

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1) Evaluate network protocols that provide interoperability and communication technologies
2)Write PLC codes for automation applications requiring special functions.
3)Use PLC for an automatic control system confining to standards.
4)Apply SCADA for various utilities.
5) Verify the theoretical concepts and applications of PLCs by conducting experiments.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Programmable Logic Controllers:</td><td>Assignment</td><td>List all the PLC applications in industries like Siemens, ABB, Schneider Electric</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Topics: Advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.</td></tr>
<tr><td>Module 2</td><td>PLC Programming Methodologies:</td><td>Quiz</td><td>Programming</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Topics: Ladder diagram, STL, functional block diagram, SFC, Instruction List. Creating ladder diagram from process control descriptions, Introduction to IEC61131 international standard for PLC.</td></tr>
<tr><td>Module 3</td><td>Introduction to SCADA</td><td>Assignment</td><td>Simulation</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Topics: Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions.</td></tr>
<tr><td>Module 4</td><td>Distributed Control Systems:</td><td>Case study</td><td>Simulation</td><td>5 Sessions</td></tr>
<tr><td colspan="5">DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:

Experiment No.1: To construct PLC programs in LAD using Siemens Step 7-Micro/Win 32 and to run and debug the programs on S7-200 PLC.
Experiment No. 2: To study the operation of bit logic instructions and to construct PLC program using the bit logic instructions.
Experiment No.3: To construct sequencer using bit logic instructions only.</td></tr>
</table>

Experiment No.4: To study the operation of different types of timers.

Experiment No. 5: To use the PLC timers in a process control.

Experiment No.6: To study the operation of different types of counters and to use the PLC counters and timers in a process control.

Experiment No.7: To use jump and subroutine in a process control.

Targeted Application is **Siemens, ABB, Power-grid, Yokogawa Electric**

Tools that can be used: **NI Lab-VIEW , Siemens Step 7-Micro/Win 32, S7-200 PLC**

Text Books

1. W.Boldon, 'Programmable logic controllers', 5th Edition, Elsevier India Pvt. Ltd., New Delhi, 2011.

2. Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.

References

1. Robert Radvanovsky, Jacob Brodsky, "Handbook of SCADA/Control Systems Security", 2nd edition, CRC press, 2016.

2. G. K. McMillan, Douglas Considine, "Process/Industrial Instruments Hand book", 5th edition, McGraw Hill, New York, 2009.

Online learning resources

1. Case study https://presiuniv.knimbus.com/user#/home
2. Seminar https://presiuniv.knimbus.com/user#/home
3. https://electrical-engineering-portal.com/resources/plc-programming-training
4. https://www.plcacademy.com/
5. Ebook:https://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering/plc-book

Topics relevant to development of "EMPLOYABILITY SKILL": PLC programming, SCADA fordeveloping **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting No.18, Dated 03/08/22

Course Code: EEE3016	Course Title: Sensors Actuators and Controls Type of Course: Discipline Elective, Theory & Integrated Laboratory	L-T- P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Basic electronics & Measurements and Instruments: Basic electronics: Basic principle and operation of electronic devices, Basic measurement devices and working principles					
Anti-requisites	NIL					
Course Description	This course covers topics on fundamentals and applications of several diverse types of sensors, actuators, and their controls. Standard communication protocols between sensors, actuators, and control units will be covered. Moreover, the course will show how to develop sensor and actuator systems for practical applications. Assignments will involve the use of Arduino hardware and software.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Sensors Actuators and Controls and attain **Employability Skills** through **Experiential Learning** techniques					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Summarize the types of sensors and transducers 2. Explain applications of inductive and capacitive sensors 3. Explain characteristics and applications of actuators 4. Explain the principles and examples of micro sensors and actuators 5. Verify the theoretical concepts and applications of sensors and actuators through conducting experiments.					
Course content:						

Module 1	SENSORS	Assignment	Problem solving	**12 Sessions**
Difference between sensor, transmitter, and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signals: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor				
Module 2	INDUCTIVE & CAPACITIVE TRANSDUCERs	Assignment	Problem solving	**11 Sessions**
Inductive transducers: - Principle of operation, construction details, characteristics, and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – several types & signal conditioning- Applications: - capacitor microphone, capacitive pressure sensor, proximity sensor.				
Module 3	ACTUATORS	Assignment	Problem solving	**10 Sessions**
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Piezoelectric Actuator				
Module 4	MICRO SENSORS AND MICRO ACTUATORS	Assignment	Project development	**12 Sessions**
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.				

List of Laboratory Tasks:

Experiment No. 1

STUDY OF RC ACTIVE LOW PASS AND HIGH PASS FILTER CIRCUITS

Level 1: To study and setup a second order RC active high pass filter for the given specifications with a 3-dB cutoff frequency and study its frequency response.

Level 2: To study the characteristics of a second order RC active low pass and a high pass filter for a cut-off frequency, = 5 kHz and to find the practical cut-off frequency for the given gain of 2 and capacitor C1 = 0.01 µF.

Experiment No. 2

INTRODUCTION TO VIRTUAL INSTRUMENTAION

Level 1: To get familiarized with the basic programming techniques in Lab-VIEW.

Level 2: To Create a Body Mass Index calculator using clusters.

Experiment No. 3

INTERFACING DATA ACQUISITON SYSTEM HARDWARE WITH COMPUTER

Level 1: To create a virtual function generator in Lab-VIEW using NI9263 Analog Output Module.

Level 2: To generate a digital signal using NI9472 Digital Output Module and acquire the same using NI9421 Digital Input Module.

Experiment No. 4

STUDY OF CHARACTERISTICS OF IR SENSOR USING NI myRIO

Level 1: To study the features of NI myRIO device.

Level 2: To apply calibration techniques to obtain the characteristics of an IR sensor using NI my-RIO device.

Experiment No. 5

STUDY OF CHARACTERISTICS OF PRESSURE SENSOR

Level 1: To measure the applied air pressure using a pressure sensor and to study its characteristics.

Experiment No. 6

STUDY OF CHARACTERISTICS OF TEMPERATURE SENSORS I

Level 1: To measure the applied temperature using a thermocouple and to study its characteristics.

Level 2: To realize the working of MEMS IC temperature sensor.

Experiment No. 7

STUDY OF CHARACTERISTICS OF LOAD CELL

Level 1: To develop a weighing machine and to study the characteristics of a strain gauge-based cantilever type load cell.

Targeted Application & Tools that can be used:

Application Area is Various types of Industries, Robotics, Automation of machines

Professionally Used Software: MATLAB/Simulink, Lab-VIEW (NI)

Textbooks

1. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.
2. Sergej Fatikow and Ulrich Rembold, "Microsystem Technology and Macrobiotics", First edition, Springer - Verlag Newyork, Inc, 1997.

References

1. Robert H Bishop, "The Mechatronics Handbook", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.,
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, Chemical and smart structures," First edition, Kluwer academic publishers, Springer, 1997.
4. Manfred Kohl, "Shape Memory Actuators", first edition, Springer

Online Resources

1. Seminar topic: https://www.slideshare.net/saaz1425/dc-motor-23906628
2. https://www.electricaleasy.com/2014/01/basic-working-of-dc-motor.html
3. Case study: https://www.youtube.com/watch?v=hmP5CSIendo
4. ebook: https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABLITY SKILLS": Engineering Science for Microsystems design and Fabrication Technologies, Analysis of MEMS sensors and actuators using IntelliSuite, Micromachining for

developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Ramya K
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/07/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/22

Course Code: EEE3021	**Course Title: Flexible A. C Transmission Systems (FACTS)** **Type of Course: Discipline Elective & Theory only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	[1] Power System Analysis [2] Power Electronics Basics of Power Electronic components and switching techniques.					
Anti-requisites	**NIL**					
Course Description	This course deals with various FACTS devices which are used for proper operation of existing AC system and make it more flexible in normal and abnormal conditions. The course develops the analytical skills. It also develops Simulation abilities of different types of FACTS Controllers in MI power Software.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Flexible A. C Transmission Systems (FACTS) and attain **Employability Skills** through **Participative Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1) Classify various compensators suited for various power system purposes. 2) Describe the converter configuration for different power systems applications such as HVDC, FACTS etc. 3) Explain the behaviour of the power system with different shunt and series compensators. 4) Summarize the benefits of incorporating FACTS devices in Power System					
Course Content:						
Module 1	Power Transmission control	Assignment	data analysis task		**9 Sessions**	
Topics: FACTS concept and General system considerations - Transmission Interconnections, Flow of power in an AC system, basic types of FACTS controllers, IEEE definitions, FACTS devices in India and abroad. Shunt compensation and shunt FACTS devices - Concept of shunt compensation, objectives of shunt compensation, variable impedance type shunt compensators (TCR, TSC, FC-TCR, TSC-TCR) - circuit diagram, principle of operation, working, waveforms / characteristics. Simulation assignment in MI Power						

Module 2	Static power convertor:	Paper Presentation	Simulation and Programming Task	**12 Sessions**
Topics: Switched converter type shunt compensator (STATCOM) - circuit diagram, principle of operation, working, waveforms / characteristics, control schemes for shunt compensators. Series compensation and Series FACTS devices - Concept of series compensation, objectives of series compensation, variable impedance type series compensators (GCSC, TSSC, TCSC), Switching converter type series compensators - circuit diagram, principle of operation, working, waveforms/characteristics, control schemes for series compensators. Simulation assignment in MI Power				
Module 3	Unified Power Flow Controllers	Case Study	Simulation and data analysis task	**12 Sessions**
Topics: Static voltage and phase angle regulators - Objectives of voltage and phase angle regulators, power flow control, improvement of transient stability, power oscillation damping, thyristor-controlled voltage and phase angle regulators. Combined FACTS compensators and other special purpose FACTS devices - Unified Power flow Controller (UPFC) - objectives and need, principle of operation, Interline power flow controller (IPFC) - objectives and need, principle of operation. NGHSSR damper, thyristor-controlled braking resistor (TCBR). Simulation assignment in MI Power				
Targeted Application & Tools that can be used: Application Area is Power System Stability and reactive power compensation using FACTS Devices in organizations like Power-grid, BESCOM, NTPC and Tata Power Corporation. Professionally Used Software: MI Power, MATLAB				
Text Books 1. Padiyar K. R, "FACTS controllers in power transmission and distribution", New Age Publishers, India, 2007. 2. Narayan G Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley-IEEE Press; 1st edition (10 December 1999)				
References **1.** T. J. E. Miller, "Reactive power control in Electric systems", Wiley-Interscience Publication, John Wiley and sons, 1982. 2. Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS – Concepts and technology of Flexible AC transmission system", IEEE power Engineering Society, 1999. **Online resources** 1.Seminar:https://nptel.ac.in/courses/108/107/108107114/ 2.Case study: https://www.academia.edu/41556656/Flexible_AC_Transmission_Systems_FACTS_Controllers FACTS_D 3. Ebook: https://puniversity.informaticsglobal.com				
Topics relevant to "EMPLOYABILITY SKILLS": Static Power converters, SVC and STATCOM for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.				

Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	12th BoS held on 27/07/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3022	**Course Title: Electrical Power Quality** **Type of Course: Discipline Elective & Theory only**		**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 create an awareness of the various issues affecting the Electrical power quality and the techniques available to improve the quality of power. The course is both conceptual and analytical in nature and should have fair knowledge in mathematics and programming. The course develops the critical thinking and analytical skills.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electrical Power Quality and attain **Employability Skills t**hrough **Participative Learning** techniques.						
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the issues and concerns of power quality. 2. Analyze the effects of voltage sags, interruptions and transients in power quality and various mitigation techniques. 3. Identify various sources of harmonics and effects of harmonic distortion. 4. Estimate power quality in distribution planning						
Course Content:							
Module 1	**Overview of Electric Power Quality**	Assignment/ Case Study	Data Collection and Analysis	**08 Sessions**			
Topics: Overview of Electric Power Quality- Need of Power Quality monitoring, Basic terminologies used, Various causes for reduction in Power Quality, Power Quality Standards and recommended practices, Power Quality issues and concerns of the country.							
Module 2	Voltage sags and Interruptions	Assignment	Programming	**09 Sessions**			
Topics: Voltage sags- Causes for Voltage sags, magnitude and variation of voltage sags, estimating voltage sag performance effect on drives and peripherals– monitoring & mitigation of voltage sags. Interruptions -Origin of Long & Short interruptions – influence on various equipment – monitoring & mitigation of interruptions.							
Module 3	Transient Over voltage and Harmonics	Quiz	Data Collection and Analysis	**08 Sessions**			

Topics:
Transient Over voltage- Sources of transient over voltages, principles of over voltage protection, utility capacitor switching transients.

Harmonics- Fundamentals of harmonics, Harmonic distortion, harmonic indexes, harmonic sources from different loads, effects of harmonic distortion, principles for controlling harmonics, devices for controlling harmonic distortion, harmonic filters

Module 4	Power factor improvement, Power quality measurement equipment	Assign ment	Simulation/Data Analysis	14 **Sessions**

Power factor improvement- Effects of poor power factor, Passive power factor compensation, Active Power factor compensation.
Power quality measurement equipment: types, wiring and grounding testers, Multimeters, digital cameras, oscilloscopes, disturbance analyser's spectrum and harmonic analysers, flicker meters, smart power quality monitors, transducer requirements.

Module 5	Power Quality Benchmark	Assignmen t	Simulation/Da ta Analysis	**06 Sessions**

Power Quality Benchmark- Introduction, Benchmark Process, power quality in distribution planning

Targeted Application & Tools that can be used:

Application Area is Electricity Generation, Transmission and Distributed companies, Power Grid and State Electricity Boards, All industries
Professionally Used Software: MATLAB/Mi Power.

Textbooks

1. Power Quality: Problems and Mitigation Techniques, Bhim Singh, Ambrish Chandra, Kamal Al- Haddad, First Edition, © 2015 John Wiley & Sons, Ltd. Published.
2. Electrical Power Systems Quality, Roger C. Dugan, Surya Santoso, Mark.F.Mc Granaghan, H. Wayne Beaty, Paperback, McGraw Hill, Professional, Technology, 7th June 2012 .

References

1. Power Quality, C. Sankaran, by CRC Press, December 21, 2001.
2. Power Quality in Power Systems and Electrical Machines, Second Edition, Ewald Fuchs and Mohammad A. S. Masoum,Elsevier Inc,2015.
3. M. H. Bollen, Understanding Power Quality Problems, 1st ed., IEEE Press, 2001.

Online Resources

1. https://nptel.ac.in/courses/108/107/108107157/
2. https://www.youtube.com/watch?v=X6k9fOfxlyg&ab_channel=AVOTrainingInstitute
3. **https://irinfo.org/10-01-2012-sinicola/**
4. **A Research Article Power quality issues in a stand-alone microgrid based on renewable energy**
5. **https://puniversity.informaticsglobal.com:2098/science/article/pii/B9780128233467000098**

Topics relevant to "EMPLOYABILITY SKILLS": Statistical evaluation of measurement data, Principle and types of analog and digital voltmeters, ammeters for developing **Employability Skills** through **Participative Learning techniques.** This is attained through the assessment component mentioned in the course handout.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS": Standards and calibration of Potential Transformers and Electronic Instrument.

Catalogue prepared by	Mrs. Jisha L K
Recommended by the Board of Studies on	12th. BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3023	**Course Title: Computer Applications in power systems** **Type of Course: Discipline Elective & Theory**	**L-T-P-C**	3	0	0	3
Version No.	**2.0**					
Course Pre-requisites	Basic Knowledge on Electric Power Generation, Transmission and distribution, Data Structure and algorithms					
Anti-requisites	**NIL**					
Course Description	This course imparts comprehensive knowledge on modelling of Synchronous machine along with different stability aspects. In addition, the course also introduces power system stability related issues. The course consists of conceptual and analytical aspects which needs fair knowledge of Mathematical computation. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments and case studies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Applications to power systems and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Out Comes	**On successful completion of this course the students shall be able to:** 1. Discuss the power system stability problem. 2. Discuss various components used in modelling of power system for stability analysis. 3. Explain the fundamental aspects of Small Signal Stability Analysis. 4. Explain the concept of transient stability analysis.					
Course Content:						
Module 1	Introduction to power system stability	Assignment	Data Analysis	**10 Sessions**		
Topics: Definition of stability, classification of stability, Rotor angle stability, frequency stability, voltage stability, mid-term and long- term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB)						

Module 2	Power System Modelling for Stability Analysis	Assignment	Simulation	**10 Sessions**
Topics: Synchronous machine modeling: sub-transient model, two axis model, one axis (flux decay) model, classical model. Excitation systems modeling: DC excitation, AC excitation and static excitation. Prime mover and energy supply systems modeling. Transmission line modeling, load modeling.				
Module 3	Small signal stability Analysis	Presentation	Simulation	**9 Sessions**
Topics: Fundamental concepts, state space representation, Modal analysis: Eigen properties, participation factors, stability assessment. Effects of excitation system on stability, power system stabilizer and its design, Angle and voltage stability of multi-machine power systems and phenomenon of sub synchronous resonance.				
Module 4	Transient Stability Analysis	Presentation	Simulation/Data Analysis	**12 Sessions**
Topics: Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability,				

Targeted Application & Tools that can be used:

Application Area is being expertise in Power System Stability Analysis and get placed in Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards. Professionally Used Software: MI Power/ PS CAD, MATLAB.

TextBooks

1. "Power system stability and control", P. Kundur, Tata- McGraw Hill.
2. "Power System stability. Modelling, Analysis and Control" by Abdelhay A Sallam and Om P. Malik.

References

1. "Power system dynamics", K.R.Padiyar, BSP publications.
2. "Power system stability", M.A.Paiand Peter W.Sauer, Pearson Education

Online Resources

1. https://nptel.ac.in/courses/108107028
2. https://scholar.google.co.in/scholar?q=Case+study+on+Computer+aided+Power+System+Analysis&hl=en&as_sdt=0&as_vis=1&oi=scholart
3. https://puniversity.informaticsglobal.com
4. https://www.youtube.com/watch?v=_uoy5YV8C_8&list=PLbSEVsipX-JRnyo8DjIiPGVP3FbTBo6Ap

Topics relevant to "EMPLOYBILITY SKILLS":numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability fordeveloping **Employability Skills**through**Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BOS NO: 12th, held on 27/07/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: **EEE3024**	**Course Title: Solar Photovoltaic and wind energy systems** **Type of Course: Discipline elective & Theory only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This course provides an understanding of the conversion principles and technology behind Various Solar and Wind Energy Systems. It also examines the issues involved in the integration of various Solar Photovoltaic and wind energy sources with the help of Simulation and their economics for heat, power, and transportation needs. It also develops analytical thinking abilities.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Solar Photovoltaic and wind energy systems and attain **Employability Skills** through **Participative Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1) Summarize the various Global Energy scenarios and issues. 2) Explain the working principle of solar energy system components 3) Explain the working principle of Wind energy system components 4) Discuss about the modelling of Integrated energy systems.					
Course Content:						
Module 1	Global and National Energy Scenario	Assignment	data analysis task	**12 Sessions**		
Topics: Overview of conventional & renewable energy sources, need, potential &development of renewable energy sources, Future of Energy Use, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, CO2 reduction potential of renewable energy- concept of Hybrid systems.						
Module 2	Solar Energy:	Paper Presentation	Programming/Simulation	**12 Sessions**		
Topics: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Solar-Electrical Power Generation, general Solar Photo Voltaic (SVP) system, Different configurations, SPV system components and their characteristics, Stand-Alone and Grid Connected SPV systems						
Module 3	Wind Energy	Paper Presentation	Programming/Simulation	**11 Sessions**		

Topics: Wind Energy Conversion, Potential, Nature of the wind, Wind Data and Energy Estimation, Site selection, Types of wind turbines, Wind farms, Wind Generation and Control using DFIG, classification of wind, characteristics, offshore wind energy – Hybrid systems, wind energy potential and installation in India.				
Module 4	Integrated Energy Systems:	Paper Presentation	Simulation/Data Analysis	**10 Sessions**
Topics: Introduction, Integrated Smart infrastructure, Integrated Energy system Modeling, Various Integrated energy schemes, their cost benefit analysis.				

Targeted Application & Tools that can be used:
Application Area is TATA Solar, Luminous, GE, Siemens, State and Regional load dispatch centres
Professionally Used Software: MI Power, MATLAB Simulink

Text Book(s)

1: Renewable Energy- Edited by Godfrey Boyle-oxford university, press, 3rd edition, 2013.
2: Solar Photovoltaic Power Systems: Principles,Design and Applications, by **Dr. Sundaravadivelu S** (Author), **Mr. Suresh R. Norman** (Author), **Dr. Johnsi Stella I,** Notion Press, 2018.

Reference Book(s)

1. Integrated energy systems modeling--Karlsson, Kenneth Bernard; Skytte, Klaus Morthorst; Published in: DTU International Energy Report 2015
2. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.

Online Resources

1. https://www.coursera.org/courses?query=solar%20energy
2. https://alison.com/courses/engineering/renewable-energy
3. https://www.youtube.com/watchv=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk&ab_channel=NPTELIITGuwahati
4. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=3&sid=15d54a1f-070b-_4419-b1d2
5. https://www.tandfonline.com/doi/full/10.1080/23311916.2016.1189305

Topics relevant to "EMPLOYABILITY SKILLS": Solar-Electrical Power Generation, Wind Generation, Wind Data and Energy Estimation for developing **Employability skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout.

Topics relevant to "ENVIRONMENT AND SUSTAINIBILITY": Over view of conventional & renewable energy sources, need, potential &development of renewable energy sources, Future of Energy Use, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, CO2 reduction potential of renewable energy

Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3025	**Course Title: Power System Operation and Control** **Type of Course: Discipline Elective & Theory only**		**L-T-P-C**	3	0	0	3
Version No.	**2.0**						
Course Pre-requisites	Knowledge on Transmission line parameters, Performance analysis of Transmission line parameters, Z_{bus} and Y_{bus} formations for a single area in real time test system and MATLAB Simulation						
Anti-requisites	**NIL**						
Course Description	The purpose of this course is to introduce the operation and control of power systems. The course develops analytical ability to study the unit commitment for load dispatch, load frequency control, effective generation in interconnected power systems. The course aids the analytical skills in effective operation of power system. This course develops programming abilities with the help of MATLAB software tools.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Power System Operation and Control and attain **Employability Skills** through **Participative Learning** techniques.						
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Demonstrate the unit commitment problem for economic load dispatch. 2. Describe the knowledge of LFC of a single Area System. 3. Describe the knowledge of LFC of a Two Area System. 4. Inspect the usage of energy with limited resources. 5. Interpret the interchange in inter connected power systems.						
Course Content:							
Module 1	Unit commitment problem and solution for optimal power flow	Assignment	Data Collection	**10 Sessions**			
Topics: Constraints in UCP, UCP solution methods. Priority list method, introduction to Dynamic programming Approach. OPF without inequality constraints, inequality constraints on control variables and dependent variables.							
Module 2	LFC for Single Area System	Assignment/Case Study	Data collection	**12 Sessions**			
Topics: Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic Response-Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation, steady state response.							
Module 3	LFC for Two Area System	Assignment/Case Study	Data collection	**12 Sessions**			
Topics: Load frequency control of two-area system, uncontrolled case and controlled case, tie-line bias control, steady state representation. Optimal two-area LF control- performance Index and optimal parameter adjustment. Load frequency control and Economic dispatch control, regulation of two generators in parallel.							
Module 4	Generation based on	Assignment/Case Study	Simulation/Data Collection/	**10 Sessions**			

	limited Supply of Energy			

Topics: Take-or-pay fuel supply contract, composite generation production cost function. Solution by gradient search techniques, Hard limits and slack variables, Fuel scheduling by linear programming. PMU – system monitoring, data acquisition and controls – System hardware configurations – SCADA and EMS functions – state estimation problem – measurements and ero

Targeted Application & Tools that can be used:
Application Area is Power System operation in real time. Professionally Used Software: MATLAB and Simulink and MI Power.

Text Books

1. Power Generation, Operation and Control - by A.J.WoodandF.Wollenberg, Johnwiley& sons Inc. 1984.
2. Modern Power System Analysis - by I.J.Nagrath & D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.

Topics relevant to "EMPLOYIBILITY SKILLS": Load frequency control of two-area system, uncontrolled case and controlled case, tie-line bias control, steady state representation for Developing **"Employability Skills"** through **Participative Learning Techniques.** This is attained through assessment components mentioned in course handout.

Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	12th BoS held on 27/07/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: **EEE3026**	**Course Title: Energy Audit and Demand side Management** **Type of Course: Discipline Elective & Theory only**	**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	EEE 2008 - Electrical Power Generation Transmission and Distribution Basic concepts of Power Generation and transmission and tariff schemes.					
Anti-requisites	**NIL**					
Course Description	Energy Audit helps to map the flow of energy (in its various forms) across the value chain, highlighting areas for interventions. It also introduces to the methods of evaluating lifetime of machine based on time value money and demand,economic analysis with repect to demand side management. This course is designed to develop analytical ability on the mechanism of energy audit and the technologies/simulation tools typically employed to undertake an audit exercise, supported by case studies & site visits.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Energy Audit and Demand side Management and attain **Entrepreneurial Skills** through **Problem Solving** methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Discuss the need of energy audit and energy audit methodology. 2. Explain audit parameters and working principles of measuring instruments used to measure the parameters. 3. Illustrate energy audit of boilers, furnaces, power plant, steam distribution system and compressed air systems. 4. Illustrate energy audit HVAC systems, motors, pumps, blowers and cooling towers. **5.** Explain load management techniques, effects of harmonics, electricity tariff, improvement of power factor and losses in transmission.			
Course Content:				
Module 1	**Energy Audit: Methodology and Types**	Assignment	Data Collection	**11 Sessions**
Topics: Energy Scenarios: Energy Conservation, Energy Audit, Energy Scenarios, Energy Consumption, Energy Security, Energy Strategy, Codes, standards and Legislation. Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training.				
Module 2	**Energy Audit: Boilers & Buildings**	Case Study/ Assignment	Data Collection/ Design	**9 Sessions**
Topics: Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods. Energy Audit Applied to Buildings: Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.				
Module 3	**Energy Audit of HVAC Systems**	Case study	Data Collection	**11 Sessions**
Topics: Introduction to HVAC, Components of Air – Conditioning System, Types of Air – Conditioning Systems, Human Comfort Zone and Psychrometry, Vapour – Compression Refrigeration Cycle, Energy Use Indices, Energy – Saving Measures in HVAC, Star Rating and Labelling by BEE. Electrical-Load Management: Electrical Basics, Electrical Load Management, Variable- Frequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor.				
Module 4	**Energy Audit: Motors, Lighting system and DSM**	Assignment/ Presentation	Data Collection / Estimation	**14 Sessions**
Topics: Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities. Demand side Management: Scope of DSM, Evolution of DSM concept, DSM planning and Implementation, Load management as a DSM strategy, Applications of Load Control, End use energy conservation, Tariff options for DSM.				

Targeted Application & Tools that can be used:
Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards
Professionally Used Software: Mi Power/ PS CAD

Textbooks:

1. **"**Industrial Energy management systems" Array .C, White,Philip S, David R Brown, Hemisphere publishing corporation, New York.
2. "Handbook on Energy Audit "Sonal Desai McGraw Hill 1st Edition, 2015

References

1. "Energy management "by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.

Online resources:

1. https://www.youtube.com/watch?v=iY2YaIlfEGk
2. https://vemu.org/uploads/lecture_notes/03_01_2020_1480276911.pdf
3. https://idoc.pub/documents/anilkumar-km-notes-for-energy-auditing-demand-side-management-unit1-1pdf-klzzqgxxpglg
4. Case study: A Research article onDemand Side Management: Demand Response, Intelligent Energy Systems, and Smart Loads
5. Ebook: https://puniversity.informaticsglobal.com:2069/document/7503335

Topics relevant to "ENTREPRENEURIAL SKILLS": The load Management techniques, effects of harmonics, electricity tariff, improvement of power factor and losses in transmission for developing **Entrepreneurial Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Topics relevant to HUMAN VALUES and PROFESSIONAL ETHICS: Energy- Saving measures in New buildings, Audit, Saving Tips .

Catalogue prepared by	Ms. Ramya N
Catalogue Updated by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE3035	**Course Title: Microgrid Operation and Control** **Type of Course: Discipline Elective & Theory only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					

Course Pre-requisites	**Power Electronics** **Knowledge of different power electronics converter circuits and their working**
Anti-requisites	**NIL**
Course Description	The course describes the concept of Microgrid with emphasis on its configuration, characteristics, distributed renewable and non-renewable generation technologies. The course deals with the IEEE standard used for DER Integration I, integration of solar sources and PV control. The course is conceptual in nature and improves analytical skills.
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Microgrid Operation and Control and attain **Employability Skills** through **Participative Learning** techniques.
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Outline the significance of microgrid in big utility grid. 2. State IEEE standard 1547-2018 while designing the controllers. 3. Explain PWM based controllers to extract maximum power from SPV system 4. Summarize the hierarchical microgrid control
Course Content:	

Module 1	Concept of Microgrid	Assignment	Data Analysis	**8 Sessions**
Topics: Concept of Microgrid, Distributed generation and Microgrid concept: Introduction, Power System Structure, Traditional Grid, Microgrid definition and characteristics, typical micro grid configuration, distributed renewable energy technologies, non-renewable distributed generation technologies, interconnection of microgrids, technical and economical advantages of micro grid, key challenges,				
Module 2	DER integration I	Quiz	Data Analysis	**7 Sessions**
Topics: IEEE Standard for Interconnection (IEEE Std 1547™-2018) : concept of area electric power system, point of common coupling, point of coupling, General interconnection technical specifications and performance Requirements, Reactive power capability and voltage/power control requirement, Voltage and Frequency disturbance ride-through requirements				
Module 3	DER integration II	Assignment	Simulation	**7 Sessions**
Topics: Integration of solar sources: Modeling of the Entire PV Energy Conversion System, PV Controller, EES Controller, Grid Connection Control. Steps of control of entire PV energy system. Integration of wind power: Speed and power relations, Power extracted from the wind, Aerodynamic torque control, Control of a PMSG based wind energy generation system.				
Module 4	DER integration III	Case study	Programming	**11 Sessions**
Topics: Hierarchical Microgrid Control, Local or primary Control : Droop Control, Droop Control in Inverter-based Distributed Generators, performance of primary controller, Secondary Control and Tertiary Control. Centralized and decentralized Energy Management System (EMS) in microgrids				

Targeted Application is **Power-grid, KPTCL,BHEL.**
Tools that can be used: **MATLAB**

Text Books

1. " H. Lee Willis, Walter G. Scott, 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. Robert Lasseter, Paolo Piagi, 'Micro-grid: A Conceptual Solution', PESC 2004, June 2004.

References

1.M. Godoy Simoes, Felix A. Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
2.F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.

Online resources **Case Study** 1. https://www.electricalindia.in/power-distribution-systems-in-india/Assignment 2. https://onlinelibrary.wiley.com/doi/full/10.1002/2050-7038.12885 3. https://puniversity.informaticsglobal.com	
Topics relevant to "EMPLOYABILITY SKILLS": Reactive power capability and voltage/power control requirement for developing **Employability Skills** through **Participative Learning techniques**. This is attained through the assessment component mentioned in course handout.. **Topics relevant to "ENVIRONMENT & SUSTTAINABILITY":** Integration of solar sources, PV Energy Conversion System, wind energy generation system.	
Catalogue prepared by	Ms Jisha L k/Mr Sumit Kumar Jha
Recommended by the Board of Studies on	15th BoS held on 27/7/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on Dated 03/08/2022

Course Code: EEE3028	**Course Title: Power System Planning** **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 Electrical Power Generation, transmission and distribution					
Anti-requisites	**NIL**					
Course Description	This course covers power system planning,Economics,operation and management issues as well as reliability in deregulated environment. The course will give a compreshensive overview of power system relaibility. Evaluation of generation , transmission and distribution system relaibility and their impacts on system planning will be dealt with.The course is designed to develop conceptual and analytical ability.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Power System Planning and attain **Entrepreneurial Skills** through **Participative Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Discuss primary components of power system planning, planning methodology for optimum power system expansion and load forecasting. 2. Explain economic appraisal to allocate the resources efficiently and appreciate the investment decisions 3. Discuss expansion of power generation and planning for system energy in the country, evaluation of operating states of transmission system, their associated contingencies and the stability of the system. 4. Discuss principles of distribution planning, supply rules, network development and the system studies					
Course Content:						
Module 1	Power System & Electricity Forecasting	Assignment	Simulation/Modelling and analysis	**10 Sessions**		
Topics:						

Planning Principles, Planning Process, Project Planning, Power Development, National and Regional Planning, Enterprise Resources Planning, Planning Tools, Power Planning Organization, Scenario Planning. Load Requirement, System Load, Electricity Forecasting, Forecasting Techniques, Forecasting Modelling, Spatial – Load Forecasting, Peak Load - Forecast, Reactive – Load Forecast, Unloading of a System.

Module 2	Power-System Economics	Case Study	data Collection task	**8 Sessions**

Topics:
Financial Planning, Techno – Economic Viability, Private Participation, Financial Analysis, Economic Analysis, Transmission, Rural Electrification Investment, Total System Analysis, Credit - Risk Assessment.
Generation Expansion: Generation Capacity and Energy, Generation Mix, Clean Coal Technologies Renovation and Modernization of Power Plants.

Module 3	Transmission Planning	Case study	Data Collection and Analysis	**8 Sessions**

Topics:
Transmission Planning Criteria, Right – of – Way, Network Studies, High – Voltage Transmission, HVDC Transmission, Conductors, Sub – Stations, Power Grid, Reactive Power Planning, Energy Storage

Module 4	Distribution Planning	Assignment/ Presentation	Simulation/Data Analysis	**12 Sessions**

Topics: Distribution Deregulation, Planning Principles, Electricity – Supply Rules, Criteria and Standards, Sub – Transmission, Basic Network, Low Voltage Direct Current Electricity, Up gradation of Existing Lines and Sub – Stations, Network Development, System Studies, Urban Distribution, Rural Electrification.

Reliability and Quality: Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Quality of Supply

Targeted Application & Tools that can be used:
Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards
Professionally Used Software: Mi Power/ PS CAD

Textbooks

1. "Power System Planning Technologies and Applications: Concepts, Solutions, and Management" Fawwaz Elkarmi Engineering Science Reference (an imprint of IGI), 2012.
2. "Power System Planning" by Udit Mamodiya, Dr.Piyush Kumar Shukla
3. "Electric Power Planning" A. S. Pabla , McGraw Hill, 2 nd Edition, 2016

Reference Books

1. "Power Systems Analysis and Design (Analysis and Design)" by Dr. B. R. Gupta.
2. "Operation and control in power system" by P S R Murthy, B S Publications

Online Resources:

1. https://www.youtube.com/watch?v=gqgKNVXLf7g&ab_channel=CUSP
2. https://www.pdfdrive.com/electric-power-system-planning-e39893329.html
3. https://nptel.ac.in/courses
4. https://puniversity.informaticsglobal.com

Topics relevant to " ENTREPRENEURIAL SKILLS ": Planning Principles, Planning Process, Project Planning Financial Planning, Techno – Economic Viability, Reliability and Quality for developing

Entrepreneurial Skills by using **Participative Learning techniques**. This is attained through assessment component mentioned in course handout. **Topics relevant to "HUMAN VALUES AND PROFESSIONAL ETHICS":** Transmission Planning Criteria, Right – of – Way, Network Studies, Distribution Deregulation, Planning Principles, Reliability and Quality	
Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: EEE3029	**Course Title: HVDC Transmission** **Type of Course: Discipline Elective & Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**1]** Transmission and Distribution 2] Power Electronics Concepts of transmission parameters and various Power Electronics circuits					
Anti-requisites	**Nil**					
Course Description	The purpose of this course is to explain the HVDC power transmission. The course also briefs the various converters used, their control aspects and modern trends in HVDC transmission. The course is both conceptual and analytical in nature and needs fair knowledge of Power electronics circuits and their working. The course develops the critical thinking and analytical skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of HVDC Transmission and attain **Employability Skills** through **Problem Solving** methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Explain the advantages of dc transmission over ac transmission. 2. Discuss the operation of Line Commutated Converters and Voltage Source Converters. 3. Summarize the control strategies used in HVDC transmission system. 4. Discuss the modern trends in HVDC transmission. 5. Analyze the requirement of protection circuit for different types of HVDC system.					
Course Content:						
Module 1	DC Transmission Technology	Assignment	Data Collection	**9 Sessions**		

<table>
<tr><td colspan="5">Topics:
DC Transmission Technology- Comparison of AC and DC Transmission. Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system, Modern trends in DC transmission</td></tr>
<tr><td>Module 2</td><td>Line Commutated Converter based systems</td><td>Assignment</td><td>Programming</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Line Commutated Converter based systems Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.</td></tr>
<tr><td>Module 3</td><td>Voltage Source Converter based systems</td><td>Assignment</td><td>Simulation</td><td>8 Sessions</td></tr>
<tr><td colspan="5">Topics:
Voltage Source Converter based systems- Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six-pulse converter. Real and Reactive power control using a VSC.</td></tr>
<tr><td>Module 4</td><td>Control of HVDC Converters</td><td>Assignment</td><td>Programming</td><td>9 Sessions</td></tr>
<tr><td colspan="5">Topics:
Control of HVDC Converters- Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers - Power control, Frequency Control, Stability Controllers. Reactive Power Control.</td></tr>
<tr><td>Module 5</td><td>Converter faults, protection and smoothing reactors</td><td>Assignment</td><td>Data Collection</td><td>9 Sessions</td></tr>
<tr><td colspan="5">Topics:
Converter faults, Protection against over-currents, Overvoltage’s in a converter station, Surge arresters, Protection against over-voltages, Smoothing reactors, DC line, Transient over voltages in DC line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC transmission lines.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Application Area is Power System, Electricity Transmission and Distributed companies, Power Grid Corporation and State Electricity Boards
Professionally Used Software: MATLAB/Mi Power.</td></tr>
</table>

Text Book(s)

1: K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011

2: HVDC Transmission, Second Edition by **S Kamakshaiah**, **V Kamaraju**

References Book(s)

1. Edwart, K., Direct Current Transmission (Vol. 1), John Wiley and Sons (2008)
2. HVDC Transmission: Power Conversion-Applications in Power Systems, Chan-Ki Kim. *et al*, Wiley(2009)
3. Arrillaga, J. and Smith, B.C., AC to DC Power System Analysis, IEE Press (2008).

Online Resources:

1. https://nptel.ac.in/courses/108/104/108104013/
2. https://www.youtube.com/watch?v=pRZ2ygbbyTg
3. https://studymaterialz.in/hvdc-power-transmission-systems-by-padiyar/
4. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=3&sid=15d54a1f-070b-4419-b1d2
5. https://ieeexplore.ieee.org/abstract/document/4745240
6. EBook: https://puniversity.informaticsglobal.com

Topics relevant to "EMPLOYABILITY SKILLS ": Application of DC Transmission, Voltage Source Converter based systems, Voltage Source Converter based systems for developing **Employability skills** through **Problem Solving Methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms Jisha L K
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/2/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/8/2022

Course Code: EEE3030	**Course Title: Energy Storage Systems** **Type of Course: Discipline 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 subject deals with various energy storage technologies, their configurations and working. The course also covers mobile and hybrid storage system used in Electric vehicles. The subject is conceptual and is directly related to Industrial applications. This course gives fair knowledge in various forms of energy and the need for the storage of energy. The course develops critical thinking and programming abilities of students.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Energy Storage Systems and attain **Employability Skills** through **Participative Learning** techniques.					

<table>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
1] Summarize various energy storage technologies.
2] Explain different electrical energy storage systems.
3] Discuss about mobile and hybrid energy storage devices.
4] Describe the energy management with storage systems.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to energy storage systems</td><td>Assignment</td><td>Data Collection</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Introduction to energy storage systems- Role of energy storage systems, applications. Overview of energy storage technologies: Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems.</td></tr>
<tr><td>Module 2</td><td>Electrical energy storage</td><td>Assignment</td><td>Data Collection</td><td>8 Sessions</td></tr>
<tr><td colspan="5">Electrical energy storage- Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques. Hydrogen production and storage, fuel cells. Numerical</td></tr>
<tr><td>Module 3</td><td>Mobile storage system & Hybrid Energy storage systems</td><td>Case Study</td><td>Data Collection</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Mobile storage system: electric vehicle, G2V, V2G.
Hybrid Energy storage systems: configurations and applications.</td></tr>
<tr><td>Module 4</td><td>Storage for renewable energy systems</td><td>Case Study</td><td>Data Collection</td><td>6Sessions</td></tr>
<tr><td colspan="5">Storage for renewable energy systems: Solar energy, Wind energy, pumped hydro energy, fuel cells.
Energy storage in Microgrid and Smart grid.</td></tr>
<tr><td>Module 5</td><td>Energy Management with storage systems</td><td>Assignment</td><td>Programming/Simulation/Data Collection/any other such associated activity</td><td>7Sessions</td></tr>
<tr><td colspan="5">Energy Management with storage systems - Increase of energy conversion efficiencies by introducing energy storage
Concept of Distributed Energy Storage System (DESS)</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used: Application areas are in Power sector, Portable electronic devises, Electric and Hybrid Electric Vehicles etc

Professionally Used Software: MATLAB/Mi Power.</td></tr>
<tr><td colspan="5">Textbooks
1. A. R. Pendse, “Energy Storage Science and Technology”, SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011.
2. Energy Storage: Fundamentals, Materials and Applications by Robert Huggins, Springer.
References Books
1. James M. Eyer, Joseph J. Iannucci and Garth P. Corey “, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.
Online Resources
1. https://www.youtube.com/watchv=j7RaL_XKywk&ab_channel=EnergyConservationandWastehe atRecovery
2. https://ieeexplore.ieee.org/document/4635523
3. https://www.worldenergy.org/publications/entry/innovation-insights-brief-five-steps-to-energy-storage</td></tr>
</table>

4. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=3&sid=15d54a1f-070b- 4419-b1d2. 5. https://energystorage.org/resources/industry-resources/case-studies/.
Topics relevant to "EMPLYOBILITY SKILLS": Role of energy storage systems, applications, Energy Management with storage systems for developing **Employability skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout. **Topics relevant to "ENVIRONMENT and SUSTAINABILITY":** Storage for renewable energy systems, Distributed Energy Storage System (DESS)

Catalogue prepared by	Ms. Jisha L K
Recommended by the Board of Studies on	12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3031	**Course Title: Electrical Power Utiliization** **Type of Course: Discipline Elective & Theory Only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	[1] EEE1001: Fundamentals of Electrical and Electronics Engineering Basics characteristics of Active and Passive elements, Ratings of various electrical appliances based on the residential and industrial usage.					
Anti-requisites	**Nil**					
Course Description	The purpose of this course is to enable the electrical power utilization. The course develops the ability to identify the importance of Electrical power in various utilities with illumination, heating and welding. The performance characteristics of electrical drives and their deployment with different loading environment. Also, the impact of acceleration, braking, retardation and adhesive weight in electric traction system is attained. The course aids the analytical skills in utility sector. The course also enhances the programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Utilization of Electrical Energy and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1.Illustrate the advantages of electric heating techniques for commercial consumers. Describe types of AC and DC Welding methods for domestic applications. 2.Relate by Identify different types of Electrical lamps for various electrical utilities and also make use of the principle of Illumination for designing of Electrical appliances. 3.Describe the Train Mechanics. 4.Illustrate the tractive effort of Traction motors.					

Course Content:				
Module 1	Electric Heating and Welding	Assignment	Data Collection	**6 Sessions**
Topics: Electric heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating: Electric welding: resistance and arc welding, electric welding equipment, comparison between AC and Welding.				
Module 2	Illumination	Assignment/Case Study	Data collection	**7 Sessions**
Topics: llumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere. Sources of light: Discharge lamps, MV and SV lamps , basic principles of light control, types and design of lighting and flood lighting.				
Module 3	Train Mechanics	Assignment/Case Study	Data collection	**7 Sessions**
Topics: System of electric traction and track electrification, special features of traction motor, methods of electric braking-plugging, rheostat braking and regenerative braking, mechanics of train movement, speed-time curves for different service.				
Module 4	Electric Traction	Assignment/Case Study	Simulation/Data Collection/	**7 Sessions**
Topics: Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.				

Targeted Application & Tools that can be used:

Application Area is Power System utilization in real time. Professionally Used Software: MATLAB.

Text Book

1. S Sivarnagaraju, D Srilatha, M Balasubbareddy, "Generation and Utilization of Electrical Energy", Pearson Education India, 1st Edition, 2010.
2. Utilization of Electric Power & Electric Traction. J. B. Gupta. S. K. Kataria & Sons, New Delhi, Latest edition.

References

1. N V Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction New Age International (P) Limited, Publishers, 1st Edition, 1996.
2. C L Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited, 1st Edition, 1997.
3. Partab, "Art & Science of Utilization of electrical Energy", Dhanpat Rai &Sons 2nd Edition, 2000.

4.E Openshaw Taylor, Orient Longman, "Utilizations of Electric Energy", 1st Edition, 2003.

Online Resources:

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_eee/Notes/NE2/BEC%20013
2. %20Automotie%20electronics.pdf
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee99/
4. **Seminar:**https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true& queryText=op%20amps
5. Case study https://puniversity.informaticsglobal.com:2282/ehost/viewarticle/render?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie45PFKs6yzSrOk63nn5Kx95uXxjL6srU6tqK5KsJayUq6quEmxls5lpOrwe ezp33vy3%2b
6. 2G59q7SbOts062q7JKtJzxgeKzs3nhqeNOtqqrUd%2bprkWyq99%2bq9eze7Kj30zhqrFP4qyzeb bZvorj2.

7. ueLpOLfhuWz44ak2uBV59%2fmPvLX5VW%2fxKR57LOvUbWntk6xraR%2b7ejrefKz7nzkvPOE6srjkPIA &vid=29&sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis. 8. https://puniversity.informaticsglobal.com:2098/science/article/pii/B9780128007822000099
Topics relevant to "EMPLOYABILITY SKILLS": **D**esign of lighting and flood lighting, methods of electric braking-plugging, rheostat braking and regenerative braking for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout. **Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS":** Standard Test methods, safety procedure.

Catalogue prepared by	**Dr. Nageswara Rao Atyam**
Recommended by the Board of Studies on	12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3032	**Course Title: Big Data Analytics in Power System** **Type of Course: Discipline Elective & Theory only**	**L-T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Electrical power generation from various sources, performance of various transmission lines, and concept of electrical power distribution. Knowledge of load flow studies and contingency analysis of power system. Basic knowledge of statistics.					
Anti-requisites	**Nil**					
Course Description	This course introduces power system developments that lead to high data collection. The internet of things relies on a vast number of smart machines connected without human intervention in a smart grid scenario. The course identifies and analyses the various sources of big data used in general and in power systems; the importance of data in analytics in smart grid communication; an emphasis on optimization techniques; data mining techniques used in distribution systems; and power system severity prediction using big data and machine learning. Critical thinking and analysis are taught. Assignments boost programming and simulation skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics in Power System and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Identify the various sources of data in power system. 2. Explain the role of big data in smart grid communications. 3. Explain the concept of optimization of big data in electric power systems. 4. Describe the various data mining techniques to optimize the big data in power system. 5. Describe the severity prediction of power system by using Big data and machine learning.					
Course Content:						
Module 1	Role of Big Data Analytics in Power	Assignment	QUIZ/True or FALSE Type			**8 Sessions**

	System Application			
Topics: Introduction Big Data, Big Data: Why and Where, General Applications of Big Data, Characteristics of Big Data and Dimensions of Scalability. Big Data Role in Power System, Sources of Big Data in Power System, Big Data Characteristics in Power System, Important applications of Big Data in Power System Sector.				
Module 2	Big Data in Smart Grid communications	Case Study	Data collection of Local distribution systems and data analysis.	**10 Sessions**
Topics: Introduction, The Grid Modernization, The Grid Interconnection with the Internet of Things, Data Traffic Pattern in a Smart Grid Environment, The Massive Flow of Information in a Smart Scenario, The Volume of Generated Data in a Smart Distribution System, Intelligent Data Collection Devices in Smart Grid: PMU: An Intelligent Data Collection Device in Smart Grid, Role of PMU in Smart Grid , Emerging Trends and BIg Data Analytics at Distribution level Grid , D PMUs: Design and Prototyping, Data Science Pertaining to field of Smart Grid , Smart Grid Use Cases, Analytics in Smart Grids. Tools and Technologies for Smart Grid.				
Module 3	Optimization Techniques of Big Data in Electric Power Systems	Assignment	Digital Report	**8 Sessions**
Topics: Big Data Optimization in Electric Power Systems: Introduction, Background, Scientometric Analysis of Big Data, Big Data and Power Systems, Optimization Techniques Used in the Big Data Analysis.				
Module 4	Data - Mining Methods in Distribution system.	Assignment	Technical Seminar	**8 Sessions**
Topics: Introduction, Transmission and Distribution System Losses, Electricity Theft Methods, Data Mining and Electricity Theft, Issues and Directions in Electricity Theft-Related Data-Mining Research.				
Module 5	Role of Big Data in Contingency Analysis	Case Study	Programming/ Simulation, Data Collection, Data analysis and prediction	**8 Sessions**
Topics: Introduction, Concept of Load Flow Studies, Contingency analysis, Data Processing and Preprocessing, Prediction of Severity of the System.				

Targeted Application & Tools that can be used:
Professionally Used Software: MATLAB/Simulink/MI-Power/Python/R/Excel/HADOOP/Weka/Tensor Flow/AML/BigML.

Text Book

1. Big Data Application in Power Systems, by Reza Arghandeh (Editor), Yuxun Zhou (Editor), Elsevier Science (27 November 2017)

References

1. Big Data Analytics in Future Power Systems, by Ahmed F. Zobaa, Trevor J. Bihl, 2020 by CRC Press.
2. Smart Electrical and Mechanical Systems, by Rakesh Sehgal, Neeraj Gupta, Anuradha Tomar, Academic Press, 2022, ISBN 978-0-323-90789-7

Online Resources:

1. EBook:https://energyinformatics.springeropen.com/articles/10.1186/s42162-018-0007-5
2. Seminar: https://puniversity.informaticsglobal.com/
3. Case study: https://www.sciencedirect.com/book/9780128119686/big-data-application-in-power-systems shorturl.at/lD089
4. https://www.sciencedirect.com/science/article/pii/B9780323907897010010

Topics relevant to development of " EMPLOYABILITY SKILLS": Smart Distribution System and interpret the collected data for the different time zones for developing **Employability skills** through

Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Ravi V Angadi
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/2/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE3033	**Course Title: Design of Reliability** **Type of Course: Discipline Elective & Theory only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Applied Statistics, Numerical Methods for Engineers					
Anti-requisites	**NIL**					
Course Description	This course describes the concept of technology and lifecycle expenditures, asset administration, industrial techniques, and risk engineering. The course encompasses various topics such as model product failure, examining and analyzing data to determine reliability traits, and other common data-driven conclusions to guarantee the manufacturing of reliable and safe products.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Design of Reliability and attain **Employability Skills** through **Participative Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Discuss the reliability of different types of equipment/machines and products. 2. Identify the tools and techniques of reliability and maintainability. 3. Demonstrate the root cause analysis and maintenance costs of different machines 4. Interpret for risk assessment for condition monitoring and analyze failure mode effect analysis of different machines and products.					
Course Content:						
Module 1	Concept of reliability	Assignment	Data Analysis	**8 Sessions**		
Topics: Reliability definitions and concepts, Basic probability theory, Probability concepts, Permutations and combinations, Application in probability evaluation, Practical engineering concepts, Venn diagrams, Rules for combining probabilities, Probability distributions.						
Module 2	Components of reliability	Assignment	Quiz	**7 Sessions**		
Topics: Component reliability, hazard function, failure laws, exponential failure law, wear-in and out period and its importance, Reliability Characterization, Bathtub Curve, Reliability indices.						
Module 3	Economics of reliability	Assignment	Problem Solving	**7 Sessions**		

Topics: Reliability evaluation techniques, Reliability improvements, Reliability economics, Reliability monitoring and growth, General reliability function, Exponential distribution, Mean time to failure and repair, MUT, MDT calculation.				
Module 4	Evaluation of reliability	Assignment	Case study	**11 Sessions**
Topics: Reliability evaluation of series, parallel, and series–parallel network. Dependent and independent system reliability assessment, Complex network reliability evaluation, Active and Standby Redundancy, Active Parallel, Standby Parallel, load sharing system, multi state models, Concept of frequency and durations.				

Targeted Application: Reliability engineering is used to test the life cycles of products such as smart phone, laptops and it involves the process that can determine whether the product you are about to purchase can works flawlessly for long hours or not.

Tools that can be used:

TextBooks

1. Introduction to reliability engineering – E.E. Lewis, John Wiley and Sons, 1994, 2nd Edition.
2. Reliability evaluation of engineering system: concept and techniques- R. Billinton, R.N.Allon, Pitman, 1984.
3. Reliability and maintainability engineering, C.E. Ebeling, TMH, 2006.

References

1. Reliability Engineering: Probability Models and maintenance methods –Joel A. Nochlas, Taylor and Francis 2005

Online resources:

1. https://nptel.ac.in/courses/105108128
2. https://www.youtube.com/watch?v=yfUVaZ_TOuc&ab_channel=ReliaSoftSoftware
3. Ebook:chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://ndesoneandik.files.wordpress.com/2 012/04/dimitri-kececioglu-reliability-engineering-handbook-vol-1.pdf
4. Seminar topic: https://presiuniv.knimbus.com/search/searchresult.jsp?newsearch=true&queryText=Digital%20signal%20processing%20applications.
5. Case study: https://www.reliableplant.com/Read/30719/reliability-case-studies.

Topics relevant to "EMPLOYABILITY SKILLS": Hazard function, failure laws, exponential failure law for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ramya k
Recommended by the Board of Studies on	BoS No: 15th BoS held on 27/7/2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/8/2022

Course Code: EEE3034	**Course Title: Smart Grid Technologies** **Type of Course: Discipline Elective & Theory only**	**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**[1] Electrical Power Generation Transmission and Distribution** **Basic concepts of Power Generation and transmission**					
Anti-requisites	**NIL**					

Course Description	The purpose of this course is to enable to realize the need for smart grid architecture and role of information and communication technology (ICT) in smart grid. The course needs basic knowledge of power generation, transmission and distribution scheme. The course is both conceptual and analytical in nature and help students to develop critical thinking abilities in building simulation models through projects and case studies/ Assignments.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Smart Grid Technologies and attain **Employability Skills** through **Participative Learning** techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1: Compare the concepts of traditional grid to Smart Grid. 2: Discuss the aspects of communication and information technologies in Smart grid 3: Explain the key components of Smart metering and related communication protocols. 4: Discuss the components of modern substation and Distribution management system 5: Distinguish different types of Energy storage Technologies in Smart Grid			
Course Content:				
Module 1	Basic Concepts of Smart Grid	Assignment	Data collection Task	**4 Sessions**
Topics: **Definitions of SG – SG Domains – Functionalities of SG –ICT in SG – Issues and Challenges in SG – Characteristics of SG – Overview of technologies required for smart grid**				
Module 2	Communication and information technology in Smart Grid and smart metering.	Assignment	Data collection task	**14 Sessions**
Topics: Data communication -Dedicated and shared communication channels -Switching techniques-Communication channels - Layered architecture and protocols. Smart metering – Smart Meters-Overview -Communications infrastructure and protocols for smart metering – Demand side Management				
Module 3	Distribution Automation and DMS	Simulation Project/ programming/Case study	Data Analysis	**10 Sessions**
Topics: Distribution automation equipment - Introduction -Substation automation equipment, Faults in distribution systems, Voltage regulation Distribution Management Systems –Introduction, SCADA, Modelling and analysis tools, Applications of DMS				
Module 4	Energy Storage Technologies in SG.	Case study / Presentation	Data collection	**4 Sessions**
Topics: Energy Storage system – Introduction –Application areas of Energy storage systems- Different Energy storage technologies.				
Targeted Application & Tools that can be used: Application Area is Power System Data collection, Electricity Transmission and Distributed companies, Power Grid and State Electricity Boards Professionally Used Software: Mi Power/ PS CAD, NexGrid				
Textbook Book(s) 1. "Smart Grid Technologies and Applications" Janaka Ekanayake et al, Wiley 2012 2. Smart Grid: Fundamentals Of Design And Analysis by James Momoh, John Wiley, 2015. **Reference Book(s)** 1. Kundur P., „Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010. 2. Pai M A, „Computer Techniques in Power System Analysis", Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007 "Gonen" **Web Resources:**				

1. https://onlinecourses.nptel.ac.in/noc19_ee64/preview 2. https://npti.gov.in/smart-grid-technologies 3. https://nmcdn.io/e186d21f8c7946a19faed23c3da2f0da/8273a55233334806bb7a7189b8794fba/files/e-learning-center/Smart-Grid-Curriculum-Unit1.pdf 4. **https://www.youtube.com/watch?v=KgVFJnmJvKk&list=PLLy_2iUCG87D59Bc8Jqfqt43LvPC0KqC&ab_channel=IITRoorkeeJuly2018** 5. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=3&sid=15d54a1f-070b-_4419-b1d2_ 6. https://www.cs.cmu.edu/~jmartins/smart.html **7.** Ebook: https://presiuniv.knimbus.com/user#/home
Topics relevant to "EMPLOYABILITY SKILLS": Substation automation equipment, Faults in distribution systems, Voltage regulation for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout. **Topics relevant to development of "ENIVIRONMENT AND SUSTAINABILITY":** Different Energy storage technologies.

Catalogue prepared by	Ms. Ramya N
Recommended by the Board of Studies on	12th. BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: EEE3027	**Course Title: Electric Vehicle Technology** **Type of Course: 1]. Discipline Elective,** **2]. Theory only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Electric circuits, Fundamentals of DC and AC motors					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. This course helps students to understand vehicle mechanics and working of Electric Vehicles and recent trends. The course enables them to analyze different power converter topology used for electric vehicle applications. Also, it provides the ability to develop the electric propulsion unit and its control for application of electric vehicles through assignments. 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.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Electric Vehicles and attain **Entrepreneurial Skills** through **Participative Learning** techniques.					

Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Describe the fundamental laws and vehicle mechanics. 2. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals. 3. Analyze DC and AC drive topologies used for electric vehicle application. 4. Discuss different energy storage technologies used for hybrid electric vehicles and their control.			
Course Content:				
Module 1	Introduction and Vehicle Fundamentals	Assignment	Computation and Data Analysis	**o. of Sessions: 6**
Introduction : Environmental Impact and History of Modern Transportation ,Vehicle fundamentals: General Description of Vehicle Movement, Vehicle Resistance, dynamic equation, tractive force Determination; vehicle parameters and performance metrics.				
Module 2	Electric and Hybrid Electric Vehicles	Quiz	Data collection and Analysis	**o. of Sessions: 10**
Electric Vehicles: Architecture of an electric vehicle, essentials and performance of electric vehicles – Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations Hybrid electric drivetrains: Concepts, architecture, design, control strategies, merits and demerits, Sizing of major components.				
Module 3	Electric Propulsion Systems	Case study	Simulation and data analysis	**No. of Sessions:8**
Electric Propulsion Systems: DC motor drives, induction motor drives and permanent magnet motor drives, switched and synchronous reluctance				
Module 4	Energy storage Devices	Assignment	Data collection	**No. of Sessions:8**
Energy storage Devices: Electrochemical batteries – Reactions, thermodynamic voltage, lead-acid batteries, nickel based batteries, lithium based batteries, flywheel and ultra-capacitors, Battery management systems.				
Targeted Application & Tools that can be used: Application: Automotive industry. Software tools: Matlab-Simulink				
Text Book 1.Mehrdad Ehsani, YiminGao, sebastien E. Gay and Ali Emadi, —Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design‖, CRC Press, 2009. 2. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011, Second Edition.				
References 1. James Larminie and John Loury, —Electric Vehicle Technology-Explained‖, John Wiley & Sons Ltd., 2003, Second Edition. 2. C.C. Chan and K.T. Chanu Modern Electric Vehicle Technology, OXFORD University, 2011 3. Sheldon S. Williamson,- Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer,2013 4. Chris Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011, Second Edition **Online resources:** 1. https://nptel.ac.in/courses/108/102/108102121/ 2. https://nptel.ac.in/courses/108/106/108106170/				

3. IEEE Explore - School of Engineering
4. https://www.coursera.org/learn/electric-vehicles-mobility
5. Seminar:https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=ELECTRIC%20VEHICLES
6. Video: https://www.youtube.com/watch?v=GHGXy_sjbgQ
7. Text book of Electric and Hybrid Vehicles : Power Sources, Models, Sustainability, Infrastructure and the Market, Gianfranco Pistoia, 1st ed. Amsterdam : Elsevier. 2010 https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=0&sid=52da4e6e-8813-45d5-87f9-73b9f493f358%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=342445&db=nlebk

Case Study:

I. https://www.simpli.com/answers
II. https://www.upgrad.com/ev_technology/iit-delhi
III. https://www.coursera.org/

Topics relevant to "ENTREPRENEURIAL SKILLS": Vehicle fundamentals, total tractive effort calculation and design of drive train for different vehicle architectures for developing **Entrepreneurial Skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/2/2022
Date of Approval by the Academic Council	18th Academic Council meeting held on 3/8/2022

Course Code: **EEE3042**	**Course Title:** **Automotive Embedded Systems** **Type of Course:** **Discipline Elective Theory**	**L- T-P-C**	2	0	2	3

Version No.	1.0
Course Pre-requisites	Microprocessor and Microcontrollers Knowledge of logic gates, sequential logic circuits and architecture, programming and interfacing of micro-controllers
Anti-requisites	**NIL**
Course Description	This course gives an introduction to embedded systems design and implementation and provides the fundamental skill to assemble the hardware components, program using software and interface with other devices. This course offers a range of topics of immediate relevance to industry.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Automotive Embedded Systems and attain **Employability Skills** through **Participative Learning** techniques.

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1. Identify the Embedded system components.
2. Discuss the various technological aspects of embedded systems.
3. Illustrate software aspects and programming concepts to the design of Embedded System.
4. Demonstrate the interfacing subsystems with external systems.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Concept of Embedded System Design</td><td>Assignment</td><td>Data Analysis</td><td>6 Sessions</td></tr>
<tr><td colspan="5">Topics: Components, classification, skills required. Embedded Micro controller cores: Architecture of 6808 and 6811. Embedded Memories ROM variants, RAM</td></tr>
<tr><td>Module 2</td><td>Technological Aspects of Embedded System</td><td>Assignment</td><td>Problem Solving</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics: Applications of embedded system: Examples of Embedded systems SOC for bar code scanner. Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, Sample & hold, multiplexer interface Internal ADC interfacing (excluding 6805 & 6812)</td></tr>
<tr><td>Module 3</td><td>Design Trade Offs</td><td>Assignment</td><td>Problem Solving</td><td>8 Sessions</td></tr>
<tr><td colspan="5">Topics: Data Acquisition System and Signal conditioning using DSP, Issues in embedded system design. Design challenge, design technology, trade-offs. Thermal considerations</td></tr>
<tr><td>Module 4</td><td>Embedded Systems and Subsystem interfacing</td><td>Assignment</td><td>Quiz</td><td>12 Sessions</td></tr>
<tr><td colspan="5">Topics: Real time programming Languages, operating systems. Programming concepts and embedded programming in C. Round Robin, Round Robin with interrupts, function queue-scheduling architecture. Subsystem interfacing: With external systems user interfacing, Serial I/O devices, Parallel port interfaces: Input switches, Key boards and Memory interfacing.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Application Area is Aerospace and defense electronics, Robotics, Automotive, broadcast and entertainment, consumer and internet appliances, Data Imaging, Data Communications, Telecommunications and Mobile data infrastructure Industries.
Professionally Used Software: MP LAB, Visual Studio, PROTEUS SOFTWARE,AVR STUDIO SOFTWARE,ATMEGA16</td></tr>
<tr><td colspan="5">TextBooks:
1. “Embedded Microcomputer systems: Real time interfacing” Valvano J.W, Cengage Learning, 2nd Edition.
2. “Embedded System, Architecture, Programming and Design” Raj Kamal TMH, 2nd Edition 2008.</td></tr>
<tr><td colspan="5">References
1. “The Art of Designing Embedded systems” Jack Ganssle Newnes 2 nd Edition, 2008.
2. A Unified Hardware/Software Introduction, Frank Vahid, Tony Givargis Wiley student edition 2002.
Online resources:
1. https://skill-lync.com/electrical-engineering-courses/introduction-automotive-embedded- systems-autosar/about
2. https://dl.acm.org/doi/10.5555/1523336
3. https://cse.buffalo.edu/~bina/cse321/fall2015/Automotive-embedded-systems.pdf</td></tr>
</table>

4. Seminar:https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&qu eryText=op%20amps 5. Video: https://www.youtube.com/watch?v=yfl7lSZU5pg. 6. Ebook: https://d1.amobbs.com/bbs_upload782111/files_38/ourdev_629261ASTZIF.pdf. 7. https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=0&sid=52da4e6e-8813- 45d5-87f9- 8. 73b9f493f358%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=342445&db=nlebk 9. Case Study: https://www.skill-lync.com/embedded 10. https://community.ruggedboard.com/embedded/training 11. https://in.seekweb.com/search/quick_results
Topics relevant to "EMPLOYABILITY SKILLS": Applications of embedded system, Embedded systems SOC for bar code scanner, Interfacing between analog and digital blocks for developing **Employability skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Snehaprabha T V
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: **EEE3043**	**Course Title: AI Techniques for EVs and HEVs** **Type of Course: Discipline Elective &Theory only**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Data structures and Algorithms					
Course Description	The purpose of this course is to introduce about the battery management techniques using IoT. This course helps students to understand different AI techniques and algorithms used for the control of Electric Vehicles. Each topic will be developed in logical progression with up-to-date information. The course is both conceptual and analytical in nature and needs basic knowledge of mathematics. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through projects**.**					
Course Objective	The objective of the course is to familiarize the learners with the concepts of AI Techniques for EVs and HEVs and attain **Employability Skills** through **Participative Learning**techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:**					

	1] Summarize IoT Based Battery Management System and type of batteries for EV and HEV. 2] Identify the features of different AI Techniques used for the control operation of EVs. 3] Explain AI Based BLDC drive for optimum operation of EV 4] Explain the Modelling of three phase converters for EV applications.			
Module 1	IoT-Based Battery Management System for Electric Vehicle	Assignment	Programming Task	**08 Sessions**
Topics: Introduction, Battery configuration, Types of batteries for HEV and Electric Vehicles (EV), Functional Blocks of Battery Management Systems, IoT based BMS.				
Module 2	AI Techniques	Quiz	Simulation / control algorithm implementation	**08 Sessions**
Topics: Basics of Artificial Intelligence, Advantages of Artificial Intelligence in EV, Fuzzy Control, Genetic Algorithm, Artificial Neural Network-Based Controller.				
Module 3	AI Techniques for optimum operation of EV.	Project work	Simulation	**09 Sessions**
Topics: Brushless DC Motor, Closed-Loop Model of BLDC Motor Drive, BLDC Motor Speed Controller with ANN Based PID Controller, Analysis of Different Speed Controllers, Basic Components of an Active Magnetic Bearing (AMB).				
Module 4	Modeling and Analysis of Three-Phase Power Converters for EV Applications	Project work	Simulation	**09 Sessions**
Topics: Introduction, Overall System Modeling, Mathematical Modeling and Analysis of Small Signal Modeling, Modeling of HESS and its Analysis.				
Targeted Application & Tools that can be used: Artificial intelligence is first reflected in the electrical design for electrical equipment, automation control, automotive Fault Diagnosis, EV manufacturing companies, state estimation of permanent magnet synchronous motors, harmonic reduction, research and development, image processing and signal processing. **Professionally Used Software:** MATLAB / Simulink				
Text Books:				

T1. Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles, Chitra A, P.Sanjeevikumar, and S. Himavathi, Wiley-2020.

T2.S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi,2003.

References

R1. Hybrid vehicles and hybrid electric vehicles new developments, energy management and emerging technologies, Hilda bridges, Nova Publishers, New York.

R2. D. E. Goldberg," Genetic Algorithms"- Addison Wesley 1999.

Web Resources:

1. https://www.researchgate.net/publication/342918764_Artificial_Intelligent_Techniques_for_Electric_and_Hybrid_Electric_Vehicles
2. https://www.mdpi.com/2076-3417/8/2/187/pdf
3. https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=op%20amps
4. Video: https://www.youtube.com/watch?v=DRvgoSFj0PE**.**
5. **https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=0&sid=52da4e6e881345d587f973b9f493f358%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=342445&db=nlebk**
6. **https://www.wiley.com/enus/Artificial+Intelligent+Techniques+for+Electric+and+Hybrid+Electric+Vehicles-p-9781119681908.**
7. **Case Study:**

https://www.ijcrt.org

Topics relevant to "EMPLOYABILITY SKILLS" : Fuzzy Control, Genetic Algorithm, Artificial Neural Network-Based Controller for developing **Employability skills** through **Participative Learning techniques.** This is attained through assessment component mentioned in course handout.

Topics relevant to "ENIVIRONMENT AND SUSTAINABILITY": Types of batteries for HEV and Electric Vehicles (EV)

Catalogue prepared by	Mr. K Sreekanth Reddy Mr. Sarin M V
Recommended by the Board of Studies on	12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3044	**Course Title: Automation of Electrical Systems** **Type of Course: Discipline Elective & Theory Only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Fundamentals of Electrical and Electronics Engineering Basics of electrical systems, installation.					
Anti-requisites	NIL					
Course Description	The purpose of the course is to give an overview of electrical wiring systems and it's components for residential and industrial consumers. The course is both conceptual and analytical in nature and needs basic knowledge of mathematics. The course develops the critical thinking and analytical skills. The course enables students to understand the complete industrial electrical systems and aids them in the selection of various electrical system components with proper estimation of specifications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Automation of Electrical Systems and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Discuss the major electrical system components 2. Classify the Electrical installation in residential and industrial electrical systems 3. Explain the lighting scheme in residential and commercial premises 4. Estimate the selection of various electrical system components with proper specifications					
Course Content:						
Module 1	Electrical System Components	Term paper	Data Collection	**12 Sessions**		
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, Electric shock and Electrical safety practices in industries.						
Module 2	Residential and industrial Electrical Systems	Assignment	Quiz	**12 Sessions**		
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, earthing of commercial installation, selection and sizing of components.						
Module 3	Illumination Systems	Assignment	Data Collection	**12 Sessions**		
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.						
Module 4	Electrical systems in industry	Case Study	Simulation	**9 Sessions**		

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation

Targeted Application & Tools that can be used:
Design and implementation of electric systems automation in the commercial and industrial sectors with software such as EPLAN electric software/ AUTOCAD electrical

Text Books:

1. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008 .
2. Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles, Chitra A, P.Sanjeevikumar, and S.Himavathi, Wiley-2020.

References

1. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007

Online resources:

1. https://www.se.com/ww/en/work/services/training/
2. https://www.eaton.com/us/en-us/products/utility-grid-solutions/grid-automation-system-solutions/fundamentals-of-substation-automation.html
3. https://electrical-engineering-portal.com/download-center/books-and-guides
4. Seminar: https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=op%20amps
5. Video: https://www.youtube.com/watch?v=l17oNw28Mo0.
6. Ebook: https://www.kobo.com/in/en/ebook/power-system-automation.
7. https://presiuniv.knimbus.com/user#/home
8. Case Study: https://www.zapmeta.co.in/search/quick_results

Topics relevant to "EMPLOYABILITY SKILLS": Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices for developing **Employability Skills** through **Participative Learning.** This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE3045	**Course Title: Introduction to Micro Electro Mechanical Systems** **Type of Course: Discipline Elective & Theory only**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					

Course Description	This course intends to provide basic knowledge of fabrication of different microelectronics system. The course deals with various sensors and actuators. It enhances mathematical modelling ability and programming skills to interface the hardware models of MEMS. The course develops the analytical thinking ability.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Introduction to Micro Electro Mechanical Systems and attain **Employability Skills** through **Participative Learning** techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the semiconductors and solid mechanics to fabricate MEMS devices. 2. Classify various sensors and actuators, 3. Describe different MEMS devices. 4. Associate MEMS sensors and actuators using Intelli-Site software.			
Course Content:				
Module 1	INTRODUCTION	Quiz	Data Analysis task	**08 Sessions**
Topics : Energy Domains and Transducers- Sensors and Actuators- Definition of MEMS.-MEMS devices. Silicon as a MEMS material - mechanical properties of silicon. Mechanical components in MEMS. Design concepts of mechanical components, Working Principles of Microsystems-Engineering Science for Microsystems design and Fabrication Technologies				
Module 2	**SENSORS AND ACTUATORS-I**	Case Study	Data Collection and Analysis	**08 Sessions**
Topics : Electrostatic sensors – Applications – Interdigitated Finger capacitor – Comb drive devices– Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators				
Module 3	**SENSORS AND ACTUATORS-II**	Assignment	Data Collection and Analysis	**08 Sessions**
Topics :Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators Applications to Inertia , Acoustic, Tactile and Flow sensors.				
Module 4	Electrostatic Actuation	Assignment	Modelling and Simulation	**09 Sessions**
Topics: Electrostatic Forces, Normal Force, Tangential Force, Fringe Effects, Electrostatic Driving of Mechanical Actuators: Parallel-plate Actuator, Capacitive sensors. Step and Alternative Voltage Driving: Step Voltage Driving, Negative Spring Effect and Vibration Frequency.				
Targeted Application & Tools that can be used: The applications areas include various design and manufacture jobs on various Electrical , mechanical and Electronics companies. **Software Tool- :** IntelliSuite Software				
Textbooks: 1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012, 2nd edition 2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000. 3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.				
References 1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000. 2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001. 3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002, 2nd edition 4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005, 1st edition.				

5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

Online Resources

1. https://nptel.ac.in/courses/117/105/117105082/
2. **Seminar:** https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=op%20amps
3. **Case Study:** https://ieeexplore.ieee.org/abstract/document/4745240.
4. **Ebook:** https://puniversity.informaticsglobal.com

Topics relevant to "EMPLOYABILITY SKILLS": Engineering Science for Microsystems design and Fabrication Technologies for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Ramya K
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/21
Date of Approval by the Academic Council	Academic counselling meeting No.16, Dated 23/10/2021

Course Code: EEE3046	**Course Title: Sensors and Transducers** **Type of Course: Discipline Elective, Theory Only**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	This course imparts the knowledge of fundamentals, classification and characterization of various sensors and transducers. It also develops knowledge in selection of suitable sensor based on requirement and application. The course is both conceptual and analytical in nature and needs basic knowledge of mathematical and computing. The course develops the critical thinking and analytical skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Sensors, Transducers and their applications and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1) Explain the usage of gauges and transducers to measure pressure, direction and distance. 2) Discuss the use of light transducers and other devices used for the measurement of electromagnetic radiations. 3) Explain the working of different temperature sensing devices. 4) Discuss the principles and applications of various electronic sensors					
Course Content:						

Module 1	Gauges & Transducers	Assignment	Quiz	**12 Sessions**
Resistance strain gauge, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications, Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup, devices, piezoelectric devices. Rotary encoders.				
Module 2	Light radiation	Assignment	Data collection	**12 Sessions**
Colour temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state, transducers liquid crystal devices.				
Module 3	Heat and Temperature	Assignment	Developing a measurement system	**11 Sessions**
Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.				
Module 4	Electronic Sensors	Case study	Application	**10 sessions**
Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.				

Targeted Application & Tools that can be used:

Application: Various types of Industries, Robotics, Automation of machines

List of Software/learning website: NPTEL, Multisim, PSpice, LabVIEW (NI)

Text Books

1. Doebelin E O, —Measurement Systems, Application and Design , McGraw Hill, Fifth Edition, 2004
2. Ian R Sinclair, —Sensors and Transducers‖, Third Edition, Newness publishers, 2001.

References

1. R 1. Jack P Holman, —Experimental Methods for Engineers‖, Seventh Edition, McGraw Hill, USA, 2001.
2. Robert G Seippel, —Transducers, Sensors and Detectors‖, Reston Publishing Company, USA, 1983.

Online resources

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://www.coursera.org/learn/sensors-circuit-interface
   https://www.udemy.com/course/sensors-sensor-fundamentals
3. **Seminar:**
   https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&qeryText=op%20amps
4. **Video:** https://www.youtube.com/watch?v=nSeW3R2hr1A.
5. **E-book:** https://puniversity.informaticsglobal.com

Topics relevant to "EMPLOYABILITY SKILLS": knowledge of various types of sensors for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout..	
Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 14th. BoS held on 22/2/2022
Date of Approval by the Academic Council	18th Academic Council meeting held on 3/8/22

Course Code: **EEE3047**	**Course Title: Automotive Electrical and Electronic systems for Two and Three Wheelers** **Type of Course: 1] Discipline Elective 2] Theory only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basics of Analog electronics circuits, Microprocessor and Microcontrollers, Power Electronics, Electrical Drives.					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to enable the importance of micro controller for vehicular systems and learn the programming skills of various controllers used in automotive sector. The course develops the logical thinking and analytical skills. Also, it provides the ability to develop the gate driver circuit interface with controller to control the switches of power converter application of electric vehicles through projects.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Automotive Electrical and Electronic systems for Two and Three Wheelers and attain **Employability Skills** through **Participative Learning** techniques					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Discuss the faults arising in automotive wiring and lighting system. 2. Describe transducers and sensors. 3. Explain various chassis electrical systems. 4. Summarize various engines used in two and three wheeler vehicles.					
Course Content:						
Module 1	Automotive Electrical Systems	Assignment	Quiz	**11 Sessions**		

Topics:
Ignition Systems: Types, Construction & working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems. Lighting System & Accessories: Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods.

Module 2	Automotive Electronics Systems	Test	Programming Task	**13 Sessions**

Topics:
Current trends in modern automobiles, Open and close loop systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control. Sensors and Actuators: Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor.

Module 3	Chassis and Sub-Systems	Case Study	Datasheets	**10 Sessions**

Topics:
Mainframe, its types, Chassis and shaft drive, Single, multiple plates and centrifugal clutches, Gear box and gear control, Front and rear suspension- systems, Shock absorbers, Panel meters and controls on handle bar, Brake and Wheels: Drum brakes, Disc brakes, front and rear brake links layouts.

Module 4	Two Wheelers & Three Wheelers	Case study	Data collection	**11 Sessions**

Topics:
SCOOTERS AND MOPEDS. Bajaj, Vespa, Lambretta scooters. Enfield, TVS-Suzuki, Hero-Honda, Yamaha RX-100, Kawasaki Bajaj Motor cycle. Kinetic Spark, Hero Majestic, TVS mopeds. Servicing and maintenance.

Targeted Application & Tools that can be used:
Application Area includes, Automotive braking systems, Powertrain solutions, Mass storage controller, automotive body electronics and airbags.
Professionally Used Software: Keil/MATLAB

Text Books

1. Automobile Electrical and Electronic systems - Tom Denton,SAE publication, Latest Edition.
2. Automotive Electrical Equipment - P.M. Kohli,Tata McGraw Hill, New Delhi.

References

1. Mechatronics – W.Bolton, Longman, 2Ed, Pearson publications, 2007.
2. Automotive Electronic Systems - Ulrich Adler, Robert Bosch, GMBH, 1995.
3. Bosch Technical Instruction Booklets.
4. Automobile Electrical Equipment - A.P. Young & Griffiths, ELBS &NewnesButterworths, London.

Online Resources

1. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_eee/Notes/NE2/BEC%20013
2. %20Automotie%20electronics.pdf
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee99/
4. **Seminar:**https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true& queryText=op%20amps
5. Case study
https://puniversity.informaticsglobal.com:2282/ehost/viewarticle/render?data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie45PFKs6yzSrOk63nn5Kx95uXxjL6srU6tqK5KsJayUq6quEmxls5lpOrweezp33vy3%2b
6. 2G59q7SbOts062q7JKtJzxgeKzs3nhqeNOtqqrUd%2bprkWyq99%2bq9eze7Kj30zhqrFP4qyzebbZvorj2
ueLpOLfhuWz44ak2uBV59%2fmPvLX5VW%2fxKR57LOvUbWntk6xraR%2b7ejrefKz7nzkvPOE6srjkPIA &vid=29&sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis

Topics relevant to "EMPLOYABILITY SKILLS": electronic ignition systems. Lighting System & Accessories: Insulated & earth return systems for **Employability Skills** through **Participative Learning Techniques.** This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	12th BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3048	**Course Title: Power Electronics Applications for Electrical Vehicles** **Type of Course: Discipline Elective & Theory only**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	ELECTRIC DRIVES					
Anti-requisites	**Nil**					
Course Description	The course includes an overview of system architectures of EV's and system dynamic modeling and control at levels appropriate to determine requirements, also this course introduces a concept of design and control of power converters for electric drive vehicles, also enables to know the various drives used for EV's and energy management in EV's. The course develops an analytical skills and enhances the programming/Simulink modeling abilities through assignments.					
Course Objectives	The objective of the course is to familiarize the learners with the Power Electronics applications of Electric Vehicles and attain Entrepreneurial Skills through Problem Solving methodologies.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1] Explain the various technologies are associated with EV's. 2] Describe the architectures of HEV, PHEV and EV's. 3] Analyze the modelling of DC-DC converter systems for EV's. 4] Describe the AC Motor drive operation for EV's 5] Analyze the electrical circuit modelling of Battery system.					
Course Content:						
Module 1	An Overview of Power Electronics in EV's	**Module 1**	An Overview of Power Electronics in EV's	**Module 1**		
Topics: Introduction, Multidisciplinary Technologies (Body Design, Batteries, Electric Propulsion, Intelligent Energy Management), EV Propulsion (Motors, Power Converters, Electronic Controllers), Battery Charging, Power Accessories (Temperature Control Unit, Power Steering, Auxiliary Power Converter Unit. Hybrid Electric Vehicles.						
Module 2	System overview	**Module 2**	System overview	**Module 2**		
Topics: Vehicle dynamics, Architectures of hybrid (HEV), plug-in hybrid (PHEV) and electric vehicles (EV), Rating and sizing of drivetrain components.						
Module 3	Bidirectional DC-DC converters	**Module 3**	Bidirectional DC-DC converters	**Module 3**		
Topics: Introduction, Introduction to switched-mode power converters, isolated and non-isolated converters, Steady-state operation, analysis and simulations, Modeling of losses and efficiency.						
Module 4	Inverter Based AC Motor Drives	**Module 4**	Inverter Based AC Motor Drives	**Module 4**		

Topics: An introduction to AC machine operation and models, Permanent magnet synchronous machine, Induction machine, DC-to-AC inverter operation and controls, advanced control techniques, AC drive modeling.				
Module 5	Energy Management Strategies	**Module 5**	Energy Management Strategies	**Module 5**
Topics: An introduction to battery electro- chemistry, Types and characteristics of battery cells, energy, power, cycle life, calendar life, cost, Cell charge/discharge characteristics, electrical circuit modeling, Battery management system, cell balancing, Modeling battery systems.				

Targeted Application & Tools that can be used:

The major targeted applications of the course is extended to various fields such as mainly Automotive electrical and electronic systems, commercial, industrial, residential, telecommunication, transportation, utility systems and Aerospace etc. In case of automotive electronics, the electrically-generated systems are used in automobiles such as road vehicles like telematics, in-car entertainment systems, and so on. The need to control engines of automobiles originated in automotive electronics for proper controlling and conversion. Professionally Used Software: MATLAB/Simulink

Text Book

1. Ehsani, Mehrdad, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi, "Modern electric, hybrid electric, and fuel cell vehicles", CRC press, 2018, 3rd Edition.
2. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications",Wiley Publishers, June 2014.

References

1. Yangsheng Xu, Jingyu Yan, Huiihuan Qian and Tin Lun Lam, "Hybrid Electric Vehicle Design and Control: Intelligent Omni directional Hybrids", Mc-Graw Hill Education, 2014.
2. R. Erickson, D. Maksimovic, Fundamentals of Power Electronics, Springer 2001 (Chapters 1-5); on-line access available from CU network.
3. Evaluation of the 2010 Toyota Prius Hybrid Electric Drive System, Oak Ridge National Lab report.
4. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House, 2010.
5. C.Mi, M.A.Masrur, D.W.Gao, Hybrid Electric Vehicles, Wiley 2011.

Online Resources:

1.Ebook:
https://puniversity.informaticsglobal.com:2282/ehost/ebookviewer/ebook/bmxlYmtfXzE2NjQ0OF9fQU41?sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis&vid=3&format=EB
2.Casestudy:
https://puniversity.informaticsglobal.com:2282/ehost/ebookviewer/ebook/bmxlYmtfXzE2NjYwNV9fQU41?sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis&vid=4&format=EB

3. Seminar: https://puniversity.informaticsglobal.com/menu
4. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee18/
5. https://www.elprocus.com/power-electronics-in-automotive-applications/
6. https://www.energy.gov/eere/vehicles/power-electronics-research-and-development

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Topics relevant to "ENTREPRENEURIAL SKILLS": Vehicle dynamics bidirectional converters, Energy Management Strategies for developing **Entrepreneurial Skills** through **Problem Solving methodologies.** This is attained through assessment component mentioned in the course handout.

Catalogue prepared by	Mr. Ravi V Angadi & Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3049	**Course Title: Automotive safety systems** **Type of Course: Discipline Elective and Theory Only**	**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 to be familiar with various systems that enhances vehicle safety and passenger comfort. The course is both conceptual and analytical in nature and needs basic knowledge of mathematical and computing. The course develops the critical thinking and analytical skills by designing a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment. The course also enhances the simulation abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Automotive safety systems and attain **Employability Skills** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Explain the steps involved in automotive body design to improve safety. 2. Distinguish the active and passive safety systems and their impact on passengers. 3. Explain the construction and working principle of various safety equipment employed in automobiles. 4. Identify the behavior of various safety systems on improving safety, comfort and convenience. 5. Interpret the performance of different testing procedures involved in passenger and occupant safety.					
Course Content:						
Module 1	Introduction to automotive safety	Assignment	Data Analysis	**11 Sessions**		
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.						
Module 2	Safety and Fatigue Concepts	Assignment	Problem Solving	**6 Sessions**		
Active safety: driving safety, conditional safety, perceptibility safety, operating safety, Passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Design of body, forces in roll over, head on impact, plastics collapse and analysis, fatigue and vibration, test on box sections, structural vibration.						
Module 3	Safety equipment's	Assignment	Problem Solving	**10 Sessions**		
Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.						

Module 4	Collision Warning and Avoidance	Assignment	Problem Solving	**6 Sessions**
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions				
Module 5	Comfort and Convenience System	Assignment	Problem Solving	**12 Sessions**
Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system, automatic climate control systems				

Targeted Application & Tools that can be used: Automotive Industry

Professionally Used Software: MATLAB- Simulink

TextBooks

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski. J., "Vehicle Body Engineering", Business books limited, London, 1969,second edition.

References

1. Ronald.K.Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.
2. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 –1448.

Online resources:

1. Case study: https://puniversity.informaticsglobal.com:2282/ehost/ebookviewer/ebook/bmxlYmtfXzEzNTY2MTdfX0FO0?sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis&vid=32&format=EB
2. Seminar: https://puniversity.informaticsglobal.com:2282/ehost/ebookviewer/ebook/bmxlYmtfXzE2NjYwNV9fQU41?sid=5ac3e684-9a30-45af-a5c4-a4c437d65a8c@redis&vid=4&format=EB
3. Ebook: https://puniversity.informaticsglobal.com/menu 4.
   https://nptel.ac.in/courses/107/106/107106088/
   https://nptel.ac.in/courses/107/103/107103084/
   https://www.udemy.com/course/functional-safety-iso26262/

Topics relevant to "EMPLOYABILITY SKILLS": Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, for developing **Employability Skills** through **Participative Learning techniques**. This is attained through the assessment component mentioned in course handout.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS": Speed and acceleration characteristics of passenger.

Catalogue prepared by	Ms. Ramya N
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: EEE3036	**Course Title: Battery Management Systems** **Type of Course: Discipline Elective & Theory only**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This course will provide a firm foundation on the architecture and functioning of battery-management-system, how Lithium-ion batteries work and how to model their behavior mathematically. It also gives an exposure to the role of battery management system in Electric Vehicles. The course is of analytic type which involves building the equivalent circuit models of batteries and learning various algorithms. The course develops analytical and problem-solving abilities.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Battery Management Systems and attain **Entrepreneurial Skills** through **Problem Solving** methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Summarize the basic components and functionality of the Battery Management System 2. Discuss various requirements and topologies of Battery Management System. 3. Explain various algorithms used in Battery Management System 4. Describe the Battery Management System of Electric Vehicles. 5. Describe the function of battery in electric vehicle application.					
Course Content:						
Module 1	Introduction to Battery Management Systems	Assignment	Data Analysis	**6 Sessions**		
Topics: Introduction to Battery Management Systems (BMS), important terminology used to describe battery cells, Architecture of BMS, Classification of BMS, principles of operation of standard electrochemical battery cells.						
Module 2	Lithium-ion cells			**8 Sessions**		
Topics: Lithium-ion cells - Advantages of Lithium-ion cells over standard electrochemical battery cells, primary components of Lithium-ion cells, and their working. Equivalent circuit model Lithium – ion cells and the simulation						
Module 3	BMS requirements & BMS Topologies	Assignment	Problem Solving	**6 Sessions**		
Topics: BMS requirements - Requirements for sensing and high-voltage control, requirements for protection, interface, performance management, and diagnostics, BMS Topologies - Distributed topology, modular topology and centralised topology						

Module 4	Algorithms used in BMS	Assignment	Problem Solving	**8 Sessions**
Topics: Algorithms used in BMS - Cell Balancing Algorithm, Communication Algorithms, Battery Pack Balancing and Power Estimation, numerical				
Module 5	BMS in Electric Vehicles	Assignment	Problem Solving	**6 Sessions**
Topics: BMS in Electric Vehicles- Functions of BMS in EVs and HEVs, IoT-Based Battery Management System for EVs				

Targeted Application & Tools that can be used:

BMS is an integral part of smart phones, EVs and HEVs, Laptops etc.

Software tools: Matlab/Simulink can be used to model and test BMS model.

TextBooks

1. Davide Andrea, "Battery management Systems for Large Lithium-Ion Battery Packs", Artech House, 2010.
2. Battery Management Systems, Volume I: Battery Modeling **by Gregory L. Plett**

References

1. Iqbal Hussain, "Electric and Hybrid Vehicles-Design Fundamentals", CRC Press, Second Edition, 2011.
2. Chris Mi, MA Masrur, and D W Gao, "Hybrid Electric Vehicles- Principles and Applications with Practical Perspectives", Wiley, 2011
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles; Fundamentals Theory and Design", Second Edition, CRC Press.

Online resources:

1. https://puniversity.informaticsglobal.com/openFullText.html?DP:2232/cgi-bin/koha/opac-detail.plbiblionumber=8072&query_desc=kw%2Cwrdl%3A%20Electronic%20Devices%20and%20Circuits
2. https://www.coursera.org/learn/battery-management-systems
3. https://www.youtube.com/watch?v=MZyY1dpka7c
4. https://www.youtube.com/watch?v=jFMvphaEiJs

Topics relevant to " ENTREPRENEURIAL SKILLS": BMS in Electric Vehicles, Functions of BMS in EVs and HEVs, IoT-Based Battery Management Systems for EVs for developing **Entrepreneurial Skills** through **Problem Solving** methodologies**.** This is attained through assessment components mentioned in the course handout.

Topics relevant to "ENVIRONMENT AND SUSTAINABILITY": Battery cells, Lithium-ion cells, Battery Pack Balancing and Power Estimation.

Catalogue prepared by	Ms. Ramya N
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/2021

Course Code: EEE3051	**Course Title: Microcontroller Applications** **Type of Course: Discipline Elective &Theory**	**L-T-P-C**	**2**	0	**2**	**3**
Version No.	**2.0**					
Course Pre-requisites	**NIL**					
Anti-requisites	**Nil**					
Course Description	The course introduces the microcontrollers' architecture, programming, interfacing and as well as their applications. The course requires the fundamental understanding of digital circuits and C programming. The course extends the experimental understanding of the same which enables to develop programming and interfacing skills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Microcontroller Applications and attain **Employability Skills** through **Experiential Learning** techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Identify the architectural features of microcontrollers. 2. Explain functions of each block of 8051 microcontroller. the addressing modes, instruction set and I/O port programming of microcontroller. 3. Discuss the programming and Interfacing of peripheral devices with microcontroller. 4. Employ Arduino board to interface with sensors.					
Course Content:						
Module 1	**Introduction of Microcontroller**	Assignment		Data Analysis		**7 Sessions**
Topics: Block diagram of microcontroller, CPU, input device, output device, memory and buses, common features of Microcontrollers: On-chip Oscillator, program and data memory, I/O Ports, Watchdog-timer reset, SFRs, Timers, Counters, Interrupts, microprocessor and microcontroller						
Module 2	**8051 Hardware**	Assignment		Programming		**10 Sessions**
Topics: Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports, Functions of each pin of 8051, Memory organization of 8051: Program and Data memory Map, External Memory Addressing and Decoding Logic of 8051.						
Module 3	**8051 Programming and Interfacing**	Assignment		Programming		**10 Sessions**
Topics: Addressing Modes: Immediate, Register, Direct, Indirect, Indexed, Relative and bit addressing, Instruction set: Data Transfer, Arithmetic, Logical. **Conditional programming, Configuration and programming of Timer/Counter using SFRs: TMOD, TCON, THx, TLx**, Assembly language program examples on subroutine and involving loops, Interfacing of DC Motor, Stepper motor, Serial communication.						
Module 4	**Applications based on IoT**	Assignment		Programming		**6 Sessions**
Topics: Introduction of the Internet of Things, Types of sensors, Types of actuators, Introduction of Arduino Interfacing of the sensors and actuators with Arduino.						
List of Laboratory Tasks:						

Experiment No 1: Arithmetic and logic operations using microcontrollers
Write a program to sort a given array of numbers logically in descending and ascending order.

Experiment No 2: Choose a microcontroller, write Delay and counter program using its instruction set.
write a Program to generate a delay of 20ms using timers.

Experiment No 3: Interfacing of ADC and DAC to microcontrollers

Write a program to generate square and triangular waveforms DAC interface.

Experiment No 4: Alphanumerical digits on an LCD panel interfacing with microcontroller.
write a Program to execute a running display of alphanumeric digits in clockwise direction.

Experiment No. 5: Control the dc motor by Interfacing it with a microcontroller
Execute unidirectional and bidirectional dc motor control.

Targeted Application & Tools that can be used:

- The course subject finds it application in many major areas of technologies like **Consumer Electronics Products**, **Instrumentation** and **Process Control**, **equipment**, **Medical Instruments**, **Communication**, **Multimedia Application**, **Automobiles and many more**.
- The tools that are used in this course are **8051 programming** and interfacing Kit, interfacing devices, PIC microcontroller kit.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course:

1. Develop a microcontroller interface for the speed and direction control of a D.C motor.

2. Develop a G.P.S bus tracking system using microcontrollers

Textbooks:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.
2.R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

References

1.D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
3. Raj Kamal ,"Microcontrollers: Architecture, Programming, Interfacing and System Design " Pearson 1st Edition, 2012
4.Datasheets of microcontrollers

Online learning resources:

1. https://www.tutorialspoint.com/microprocessor/microprocessor_useful_resources.htm
2. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
3. https://digitaldefynd.com/best-microcontroller-courses/
4. https://nptel.ac.in/courses/105108128
5. https://knimbus:2069/search/searchresult.jsp

Topics relevant to "EMPLOYABILITY SKILLS ": The assembly programming to perform mathematical operations and interfacing of microcontroller experiments for developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Kamalapathi K

Recommended by the Board of Studies on	15th BoS held on 27/7/22
Date of Approval by the Academic Council	18th Academic Council Meeting held on 03/08/2022

Course Code: EEE3052	**Course Title: Control Systems for Robotic Applications** **Type of Course: Discipline elective Theory & Integrated course**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to make the students familiar with the various control schemes of a robot 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 Mathematics and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming and simulation abilities through assignments and laboratory sessions using MATLAB/Simulink software tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Control Systems for Robotic Applications and attain **Employability Skills** through **Experiential Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** **1)** Summarize different methodologies of time and frequency domain analysis to infer about the stability of the system. **2)** Describe the importance of feedback controllers. **3)** Explain the importance of various State variable models. **4)** Discuss about non-linear control systems **5)** Analyse the time domain specifications for second order system. **6)** Explain the behaviour of lag, lead and lag - lead compensating networks					
Course Content:						
Module 1	Fundamentals of Control systems	Assignment	Data Collection			**8 sessions**
Topics: Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models. Transient response-steady state response-Measures of performance of the standard first order and second order system. Concepts of stability.						
Module 2	Feedback Controllers	Assignment	Programming			**6 sessions**
Topics: Effect on an additional zero and an additional pole-steady error constant and system- type number Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.						

Module 3	State Space Analysis	Assignment	Simulation	**6 sessions**
Topics: State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system.				
Module 4	Distributed Control Systems:	Assignment	Simulation	**6 sessions**
Topics: Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method. Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control.				

List of Laboratory Tasks:

Experiment No. 1: Time Response of Second Order System.

Level 1: To determine the time response characteristics of a second order system to a step input when the system is underdamped, over damped and critically damped and evaluation of time response specifications.

Level 2: To comment on the effect of additional poles and zeros on time response of second order system in MATLAB

Experiment No. 2: Effect of P, PI and PID on a Second Order System

Level 1: To study the steady state performance of an analog P, PI & PID controller using PID controller kit.

Level 2: To simulate the effect of P, PI, PD and PID Controllers on a given second order system for a unit step input by developing a MATLAB Code.

Experiment No. 3: Characteristics of Servo Motor.

Level 1: To study the Speed-Torque and Speed-Back e.m.f. characteristics of AC Servomotor.

Experiment No. 4: Stability Analysis (Bode, Root Locus) of LTI System using MATLAB.

Level 1: To analyze frequency response of a system by plotting Root locus, bode plot using MATLAB software.

Experiment No. 5: DC Position control System using MATLAB

Level 1: To simulate a DC position control system using MATLAB and obtain its step response.

Experiment No. 6 : RC Lead Compensating Network.

Level 1: To implement a passive RC lead compensating network for the given specifications and to obtain its frequency response.

Level 2: To implement a passive RC lead compensating network for the given specifications and to obtain its frequency response using MATLAB software.

Experiment No. 7: RC Lag Compensation Network.

Level 1: To project a passive RC lag compensating network for the given specifications and to obtain its frequency response.

Level 2: To implement a passive RC lag compensating network for the given specifications and to obtain its frequency response using MATLAB software.

Experiment No. 8: RC Lag-Lead Compensation.

Level 1: To study the Frequency Response of a given Lead-Lag Compensating Network.

Level 2: To study the Frequency Response of a given Lead-Lag Compensating Network using MATLAB software.

Targeted Application is Rockwell Automation Inc, Mitsubishi, Kawasaki Robotics Inc.

Tools that can be used: MATLAB, Lab-VIEW

Text Books

1. Benjamin C. Kuo and Farid Golnaraghi, "Automatic Control Systems", Wiley Publishers, 9th Edition.

References

1. Hasan Saeed, automatic control Systems with MATLAB programs, S K Kataria and sons, Latest ed.
2. K. Ogata, 'Modern Control Engineering', Pearson Education Asia / PHI, 4th Edition.

Online Learning Resources:

4. Seminar: https://presiuniv.knimbus.com/user#/home
5. Case study: https://people.disim.univaq.it/~costanzo.manes/Didattica_Teoria_dei_Sistemi/System_Theory_Web_Resources.html
6. https://nptel.ac.in/courses/107/106/107106081/
7. Ebook:Text book of Control systems Basu, SaurabhAhmad, Reyaz, First edition. New Delhi : Laxmi Publications Pvt Ltd. 2017 https://presiuniv.knimbus.com/user#/home

Topics relevant to development of "EMPLOYABILITY SKILLS": Mathematical modelling, Stability analysis, Compensators for developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	15th BoS held on 27/7/2022
Date of Approval by the Academic Council	Academic Council Meeting No 18., Dated 03/08/2022

Course Code: EEE3053	**Course Title: Electrical Drives systems for robotic applications.** **Type of Course: Discipline Elective Theory & Integrated Laboratory**	L-T- P- C	2	0	2	3
Version No.	**1.0**					
Course Pre-requisites	Basics of semiconductor physics and Basic terms used in electrical engineering like voltage, current etc.					
Anti-requisites	**NIL**					
Course Description	This course provides the basics knowledge of Electrical Drives systems used for robotic applications. It highlights the use of mathematical tools for analysis of speed and torque characteristics of various motors under steady state and dynamic conditions. The embedded lab provides insights in validating the theoretical concepts as well as 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 simulation tools like MATLAB and Caspoc etc.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Electrical Drives systems for robotic applications and attain **Employability Skills** through **Experiential Learning** techniques.					

Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the various power converters in robotic applications 2. Explain the dynamics of Electrical drive systems and four quadrant operation 3. Analyze the performance of servo motor drives 4. Analyse the stepper motor drive systems 5. Demonstrate the speed control of various motors in robotic applications 6. Interpret data from experimental results and to perform statistical analysis.			
Course Content:				
Module 1	Power Converters in Robotic Applications	Assignment	Data collection and Data analysis task	06 Sessions
Topics: Introduction to AC-DC Converters-Single Phase converters, DC-DC Converters-Buck, Boost, Buck-Boost converters. Single phase half and full wave AC voltage controller.				
Module 2	Dynamics of Drive Systems	Assignment	Hands on &Programming task.	7 Sessions
Topics: Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system.				
Module 3	Operation and Analysis of Servo-drive systems	Assignment	Simulation task Matlab	7 Sessions
Topics: Introduction to servo drive systems: Drive system configuration, characteristics of mechanical loads, velocity profiles, matching motor and load, and criteria for selecting drive components. D.C. machine drives: D.C. servo drive characteristics (4 quadrant operation), speed control ,development of transfer function for both motor and drive subsystems. A.C Servo drive				
Module 4	Operation and Analysis of Stepper motor drives	Mini Project	Developing a controller for stepper motor	9 Sessions
Topics: Principle of operation, Constructional features, Types of stepper Motors, Various modes of operation of Variable reluctance (VR) stepper motors, torque production in Variable Reluctance (VR) stepper motor , Construction and working of Permanent Magnet (PM) stepper motor, Construction and working of Hybrid stepper motor, Torque angle characteristics of the stepper motor.				
List of Laboratory Tasks:				
Experiment No 1: Stepper Motor Control Using the 8051 Microcontroller **Level 1**: To obtain the speed vs torque characteristics of the stepper motor at different step angles **Level 2**: To find out the critical load points of the stepper motor **Experiment No. 2** DC Motor Speed Control Using the 8051 Microcontroller **Level 1:** To obtain the speed characteristics of the DC Motor using PWM Method. **Level 2:** To obtain the critical speed of the DC Motor using graphical analysis. **Experiment No. 3** Modelling of a DC Servomotor using MATLAB Simulink. **Level 1**: To determine the electrical parameters of the DC Servomotor at different loads. **Level 2**: To examine 4 quadrant characteristics of the DC Servomotor. **Experiment No. 4** Study of Characteristics of AC Servomotor **Level 1:** To study the Speed-Torque characteristics of AC Servomotor. **Level 2:** To study the Speed-Back EMF characteristics of AC Servomotor at different supply voltages and loads. **Experiment No. 5**: Modelling of Variable Reluctance Stepper Motor using MATLAB Simulink **Level 1:** To determine the electrical parameters of Variable Reluctance Stepper Motor at different loads. **Level 2:** To analyze the dynamic and mechanical characteristics of Variable Reluctance Stepper Motor.				

Targeted Application & Tools that can be used:
The application areas of Electrical Drives are: Automation Industry, Robotics
Professionally Used Software: MATLAB/ Caspoc

Textbooks:

1. G.K DUBEY, "Fundamentals of Electrical Drives", Second edition, Narosa publishing house,2001
2. W. Shepherd, L. N. Hulley and D. T. Liang, "Power Electronics and motor control", Second Edition, Cambridge University Press, 1995.

References:

1. N.K De and P.K. Sen, "Electrical Drives", PHI.
2. S.K Pillai, "A First Course on Electric Drives", Wiley Eastern Ltd.
3. Bimal K Bose, "Modern Power Electronics and AC Drives" Pearson, 2015

Online resources:

1. noc19-ee65-lec01 - YouTube(NPTEL Video Lectures)
2. Dynamic Simulation of Electrical Machines and Drive Systems Using MATLAB GUI | IntechOpen
3. https://www.pdfdrive.com/advanced-electric-drive-vehicles-energy-power-electronics-and-machines-e175341454.html
4. https://www.sciencedirect.com/science/article/abs/pii/S1364032111004308
5. https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS": All the experiments which are listed are for developing **Employability Skills** through **Experiential Learning techniques.** This is attained through the assessment component mentioned in the course handout.

Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BoS No: 15 , held on 27/7/22
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: **EEE3054**	**Course Title: Semiconductor Devices and Its Applications** **Type of Course: Discipline Elective & Theory only**	**L- T-P- C**	**3**	**0**	**0**	**3**
Version No.	**1.0**					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					

Course Description	This course seeks to cover the basics of semiconductor devices including the physics of energy bands, doping and carrier statistics and transport leading up to the understanding of common semiconductor devices including p-n junctions and their applications, BJTs and MOSFETs. The course will also give a flavour of the basics of compound semiconductors and their devices, and also touch base with opto-electronic devices such as solar cells, photo detectors and LEDs. In parallel, the course will consistently seek to engage the audience by giving real-life examples pertaining to the content, and also seek to calibrate the content with respect to practical and commercial technologies.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Semiconductor Devices and attain **Employability Skills** by using **Problem Solving** methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1.Distinguish various semiconductor devices in diverse applications. 2.Explain compound semiconductors and alloys. 3.Describe the solar cells and LEDs. 4. Explain the construction and working of transistors			
Course Content:				
Module 1	Importance of semiconductor devices and their diverse applications.	Assignment	Data Collection	**11 Sessions**
Topics: Introduction to semiconductors, concept of energy bands and how bands form. Effective mass of electrons, E-k diagram. Concept of holes. Concept of Fermi level, Fermi-Dirac distribution. Doping (extrinsic & intrinsic semiconductor), density of states. Equilibrium electron-hole concentration, temperature-dependence. quasi-Fermi level, p-n junction: static behaviour (depletion width, field profile), p-n junction under forward & reverse bias, current equations, generation-recombination current and reference to typical devices.				
Module 2	MOSFET, Introduction to compound semiconductors & alloys	Case Study/ Assignment	Data Collection/ Design	**9 Sessions**
Topics: structure and operating principle, derivation of I-V, gradual channel approximation, substrate bias effects, sub-threshold current and gate oxide breakdown. Control of threshold voltage, short channel effects. Moore's Law and CMOS scaling, commonly used compound semiconductors, hetero structure band diagrams and basics of MOSFET & HEMT, introduction to quantum well, applications of hetero structure device technologies.				
Module 3	Solar Cells, LEDs	Case study	Data Collection	**11 Sessions**
Topics: Solar cells: principle, efficiency, Fill factor, Shockley-Quiesser limit, silicon solar cells, multi-junction solar cell, Photo detectors: operation, figures of merit (responsivity, QE, bandwidth, noise, Detectivity), examples from IR to UV detectors. LEDs: working principle, radiative/non-radiative recombination, various types of efficiencies (EQE, WPE, IQE), light extraction and escape cone. Blue LED and the Nobel Prize, visible LEDs and chromaticity.				
Module 4	Device Selection , Driving And Protecting Circuits	Assignment/	Data Collection / Estimation	**14 Sessions**

		Presentation		

Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers Integrated gate commutated thyristor (IGCT) - SiCbased unipolar devices-applications.

Targeted Application & Tools that can be used:

Application Area is Communication, ATM, Switch mode power supplies, automotive ignition system and AC and DC electric motor drives of all sizes.

Professionally Used Software: Computer aided engineering (CAE) software, Data analytics software

Textbooks:

1. Solid State Electronic Devices, by Ben Streetman and Sanjay Banerjee, Prentice Hall.
2. Introduction to Semiconductor Materials and Devices, by M. S. Tyagi, Wiley Publications.

References

1."Semicnductor Device Fundamentals", by Robert F. Pierret

Online resources:

6. **https://www.eletrica.ufpr.br/graduacao/ebooks/Principles%20Of%20Semiconductor%20Devices.pdf**
7. https://www.techtarget.com/whatis/definition/semiconductor
8. https://www.electronicsforu.com/technology-trends/learn-electronics/mosfet-basics-working-applications
9. Ebook: https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS": Device selection strategy, Gate drive integrated circuit Varactor diode, photodiode, LED for developing **Employability Skills** through **Problem Solving** methodologies**..** This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	Dr Priyanka Ray
Recommended by the Board of Studies on	BoS No: 18th BoS held on 29/12/2023
Date of Approval by the Academic Council	23rd Academic council Meeting held on 27/03/2024

Course Code: **EEE3055**	**Course Title: Photonic Integrated circuit** **Type of Course: Discipline Elective & Theory only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL.					
Anti-requisites	**NIL**					
Course Description	This is a graduate-level course which focus on the fundamentals of lightwave/photonic circuits. The course introduces essential concepts required to understand the operation of various integrated photonic components and draws a parallel with bulk components. This course will cover theory, fabrication, and application aspects of photonic materials and devices.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Photonic integrated circuit and attain **Employability Skills** by using **Problem Solving** methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 6. Describe the Electromagnetic wave propagation. 7. Explain lower and higher-order Hermite–Gaussian (HG) modes. 8. Discuss the optical fiber communication systems **9.** Explain the concept of Interference and Coherence					
Course Content:						
Module 1	Introduction to EM waves	Assignment	Data Collection	**9 Sessions**		
Topics: Maxwell's Equations of Isotropic Media, Electromagnetic Waves and Interfaces, lectromagnetic Waves and Interfaces.						
Module 2	Gaussian Beams and Paraxial Wave Equation	Case Study/ Assignment	Data Collection/ Design	**10 Sessions**		
Topics: Introduction, Zero-Order Gaussian Solution, High-Order Hermite-Gauss Solutions, High-Order Laguerre-Gauss Solutions, Orbital Angular Momentum.						
Module 3	Optical Fiber	Case study	Data Collection	**11 Sessions**		
Introduction-general optical fiber communication system- basic optical laws and definitions, optical modes and configurations -mode analysis for optical propagation through fibers modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables, classification of optical fiber-single mode fiber-graded index fiber.						
Module 4	Mirrors, Interferometers and Thin-Film Structures	Assignment/ Presentation	Data Collection / Estimation	**14 Sessions**		
Topic: Interference and Coherence, Mirrors, TEM-Waves and TEM-Transmission Lines, Scattering and Transfer Matrix, Properties of the Scattering Matrix, Beamsplitter, Interferometers, Fabry-Perot Resonator						

Targeted Application & Tools that can be used:

Application Area is design and manufacturing process for devices, systems, and ICs that are used in high-speed data communications, advanced sensing, and imaging.

Professionally Used Software: FIMMWAVE/FIMMPROP

Textbooks:

1. Fundamentals of Photonics, B.E.A Saleh and M.C. Teich, Wiley, New York, 1991
2. Photonic Devices. Cambridge, J. Liu, Cambridge University Press, 2005.

References

10. Diode Lasers and Photonic Integrated Circuits, Larry A. Coldren Scott W. Corzine Milan L. Mašanović, Wiley-Interscience.
11. Fundamentals of Optoelectronics, Clifford R. Pollock, Irwin, 1995..

Online resources:

12. https://www.academia.edu/44004638/Fundamentals_of_Photonics
13. https://opg.optica.org/abstract.cfm?uri=ETOP-1999-GP193#:~:text=The%20concept%20of%20modes%2C%20or,and%20interference%2C%20propagation%20and%20dispersion.
14. https://en.wikipedia.org/wiki/Optical_fiber#:~:text=An%20optical%20fiber%20is%20a,are%20made%20of%20dielectric%20materials.
15. Ebook:https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS": Optical Data Communication, Sensing, Bio – photonics for developing **Employability Skills** through **Problem Solving** methodologies**.** This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	Dr Priyanka Ray
Recommended by the Board of Studies on	BoS No: 18th BoS held on 29/12/2023
Date of Approval by the Academic Council	23rd Academic council Meeting held on 27/03/2024

Course Code: **EEE3056**	**Course Title:** Embedded Sensing, Actuation and Interfacing Systems **Type of Course: Discipline Elective & Theory only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	EEE2015, Digital Electronics					
Anti-requisites	**NIL**					
Course Description	This course is aimed at developing practical technical skills among the students to integrate various sensing, actuation units and other required accessories with embedded controller and build a complete modern embedded control system for intended applications. This will further enable the students to gather necessary concepts to develop and select suitable smart sensors, actuators, with associated knowledge of interface electronics and signal conditioning for cutting-edge applications. Further, micromachining technology for miniaturization of smart integrated MEMS devices and renewable energy harvesting based self-powered embedded system implementation are other important attributes of this course.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Embedded Sensing, Actuation and Interfacing Systems and attain **Employability Skills** by using **Problem Solving** methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain the working of various sensors and actuators. 2. Describe the interfacing of Sensors and Actuators to Embedded Controllers. 3. Explain various resistive sensors and interfacing systems. 4. Describe the working of capacitive sensors.					
Course Content:						
Module 1	**Introduction:** Embedded Sensors and Actuators:	Assignment	Data Collection	**11 Sessions**		
Topics: Overview of embedded system; Importance of sensors, actuators and interfacing circuits in embedded control system; Characteristics; Applications, Various types of important sensors, actuators and their working principles: e.g, thermal, mechanical, electrical, magnetic, optical, chemical, smart material and meta material based.						
Module 2	Interfacing Aspects of Sensors and Actuators to Embedded Controller and their Communication Protocols	Mini Project	Data Collection/ Design	**9 Sessions**		
Topics: Signal conditioning circuits; Various Op-Amp based interfacing circuit implementation: Amplifier, Filter, ADC, DAC etc.; Various Serial Communication protocols for interfacing.						

Module 3	Resistive Sensors for Linearity Improvement and Error Reduction, Embedded controller	Case study	Data Collection	**11 Sessions**
Topics: Resistive sensor examples; Non-idealities in basic interfacing circuits; Linearization techniques; Error reduction schemes due to environmental effects and remote communication, Embedded controller based excitation system; Direct interfacing schemes of various resistive sensors topologies (e.g., single, differential and bridge type) to microcontrollers; Interfacing scheme for sensor array.				
Module 4	**Capacitive Sensors**	Assignment/ Presentation	Data Collection / Estimation	**14 Sessions**
Topic: Capacitive sensor examples; Interfacing scheme for different capacitive sensor configurations; Direct interfacing schemes, Lossy Capacitive sensor characteristics; Various advanced interfacing schemes for lossy capacitive sensor, Various renewable energy harvesting techniques; Interfacing power management circuits; Applications towards development of self-powered smart system.				

Targeted Application & Tools that can be used:

Application Area is Actuation and Interfacing System in Automotives Domain and Health care, Sensors and actuators connect the analog real world with the embedded controller through hardware interfacing circuits**Professionally Used Software:** C, C++, ADA, Windows CE, LINUX, TreadX, Nucleus RTOS, OSE,

Textbooks:

1. Nathan Ida, 'Sensors, Actuators, and their Interfaces', 1st ed., SciTech Publishing, 2014.
2. Stuart R. Ball, 'Analog Interfacing to Embedded Microprocessor Systems', Elsevier, 2004.

References

1. Marc Madou, 'Fundamentals of Microfabrication and Nanotechnology', CRC press, 3rd ed., 2018.
2. S. Nihtianov, A. Luque, 'Smart Sensors and MEMS', 1st ed., Elsevier, 2014
3. Bela G Liptak, 'Instrument Engineers Handbook' CRC press, 4th ed., 2003.
4. William B. Ribbens, 'Understanding Automotive Electronics: An Engineering Perspective', Elsevier, 8th ed., 2017.

Online resources:

1. **https://www.youtube.com/watch?v=XPveMrXV82I**
2. **https://www.sciencedirect.com/topics/engineering/embedded-sensor**
3. **https://ptolemy.berkeley.edu/projects/chess/eecs124/lectures/InterfaceToSensorsActuators.pdf**
4. Ebook:https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS"": Interfacing Aspects of Sensors and Actuators to Embedded Controller and their Communication Protocolsfor developing **Employability Skills** through **Problem Solving** methodologies**.**This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	Mr Sunil Kumar AV

Recommended by the Board of Studies on	BoS No: 18th BoS held on 29/12/2023
Date of Approval by the Academic Council	23rd Academic council Meeting held on 27/03/2024

Course Code: EEE1002	**Course Title: IoT Based Smart Building Technology** **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	This Course intends to provide a basic understanding of IoT based building technology as all modern buildings will have a heavy focus on automation and efficient usage of energy through IOT. The course uses the fundamentals of mathematics and software tools and enhances the process of learning. The course is both conceptual and analytical in nature and imparts the basic skills of developing the IoT based systems through assignments and mini projects. Gaining knowledge in this field gives an experience to build innovative projects that enhances and improves the chances of a great career in IOT.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of IOT Based Smart Building Technology and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Summarize about IOT Concepts and Applications. 2. Explain about communication over internet. 3. Experiment with Arduino architecture and its Programming. 4. develop distinct models using PIR Sensors. 5. Interpret the knowledge about integration of cloud platform.					
Course Content:						
Module 1	Introduction to IoT	Assignment	Quiz	**6 Sessions**		
Topics: IOT an Introduction – Scope of IOT - Basics of Networking - Communication in Smart Buildings - Impact Of IOT On Smart Buildings - Energy and Cost Efficiency						
Module 2	Communication Over Internet	Assignment	Data Collection	**6 Sessions**		
Topics: How Internet works – understanding the Design of a Communication Network – Wireless Communication Devices – Concept of ESP 8266 and its powering up.						
Module 3	Arduino and its Interfacing	Assignment	Case study	**7 Sessions**		
Topics: An Introduction to Arduino and its architecture – Arduino UNO connection and Detection – Programming in Arduino - ESP 8266 AT Commands – Interfacing with Arduino – Debugging Techniques.						
Module 4	Sensing in IOT	Assignment	Simulation/Data Collection	**7 Sessions**		

Topics: Sensors and Data Acquisition – PIR Sensors – Interfacing Arduino with Sensors – Sensor Calibration – Reading data from PIR Sensor.				
Module 5	Control and design of smart buildings using PIR for electrical loads	Simple model based on Case Study	Simulation/Data Collection	**7 Sessions**
Topics: Relay and Electrical loads – interfacing relay drivers to Arduino – Programming logic – Thinkspeak API - Smart Building using PIR - Design the Arduino Sketch – Testing the model.				

Targeted Application & Tools that can be used:

Application: To assess and analyze various parameters involved in a smart building using IOT. Professionally Used Software: Arduino, Python Programming.

Text Book

1. Internet of Things: Principles and Paradigms by Raj kumar Buyya and Amir vahid
2. Foundational elements of an IOT by Joe Biron &Jonathan Follett.
3. Exploring Arduino: Tools and Techniques for Engineering Wizardry 1st Edition by Jeremy Blum

References

1. Gao, Xinghua, et al. "Internet of Things Enabled Data Acquisition Framework for Smart Building Applications." *Journal of Construction Engineering and Management* 147.2 (2021): 04020169.
2. Sivagami, P., et al. "Smart Home Automation System Methodologies-A Review." *2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV)*. IEEE, 2021.
3. Zahra, Syed Rameem, and Mohammad Ahsan Chishti. "Smart Cities Pilot Projects: An IoT Perspective." *Smart Cities: A Data Analytics Perspective*. Springer, Cham, 2021. 231-255.
4. Hu, Ming. "Smart Building and Current Technologies." *Smart Technologies and Design For Healthy Built Environments*. Springer, Cham, 2021. 75-91.
5. Deng, Der-Jiunn, and Abderrahim Benslimane. "Innovation and Application of Internet of Things for Smart Cities." *Mobile Networks and Applications*: 1-2.

Online Learning Resources

1. https://www.i-scoop.eu/internet-of-things-iot/facility-management-iot-smart-buildings/
2. Case study: https://www.hindawi.com/journals/js/2018/1757409/
3. Seminar:https://puniversity.informaticsglobal.com
4. Ebook:https://puniversity.informaticsglobal.com

Topics relevant to "SKILL DEVELOPMENT": Understanding the Design of a Communication Network – Wireless Communication Devices for developing **Skill Development** through **Participative Learning Techniques.** This is attained through assessment components mentioned in the course handout.

Catalogue prepared by	**Dr. Nageswara Rao Atyam**
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

Course Code: EEE1003	**Course Title: Basic Circuit Analysis** **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	This Course intends to provide a basic understanding of electrical circuits which are used in several applications like computer hardware, Automotive electronics, mobile communications and so on and its analysis using NI lab view. The course is both conceptual and analytical in nature and imparts the basic skills of developing the Simulink models, Programming and hardware interfacing through assignments and mini projects.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Basic Circuit Analysis** and attain **Skill Development** through **Problem Solving** methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Explain Kirchhoff's Voltage Law and Kirchhoff's Current Law 2. Describe Superposition theorem and Thevenin's theorem for DC excitation. 3. Discuss the behaviour of RL and RC circuits for DC and AC excitation. 4. Describe the concept of virtual Instrumentation using NI lab view 5. Demonstrate the Superposition theorem and Thevenin's theorem for DC excitation			
Course Content:				
Module 1	Basic concepts of circuits and AC fundamentals	Assignment	Data sheet collection of resistors and inductors and validation of parameters values using NI lab view	**08 Sessions**
Topics: Concept of Potential difference. Current and network elements, Ohm's law, Kirchhoff's laws, ideal and practical voltage and current sources, series and Parallel circuits , AC fundamentals				
Module 2	Mesh and Nodal analysis using NI lab View	Hands on Task & programming	Lab-VIEW program with data acquisition and to measure resistance of a thermistor with change in the temperature	**08 Sessions**
Topics: Basic Mesh and Nodal analysis for DC excitation only				
Module 3	Introduction to basic circuit theorems	Assignment	Development of Simulink model and Analysis using MATLAB & NI lab View	**10 Sessions**
Topics: Super position theorem, Maximum power Transfer theorem and Thevenin's theorem for DC excitation, Validation of Theorems with dependent sources, numerical on theorems.				
Module 4	Analysis of series RL and RC circuits with AC excitation using NI lab View	Assignment	Simulation using NI lab view and Analysis	**10 Sessions**
Topics: Analysis of series RL and RC circuits with AC excitation, voltage and current waveforms, Concept of leading, lagging and power factor.				

Targeted Application & Tools that can be used: The knowledge of basic circuit analysis is required in the fields of circuit design, computer hardware, Automotive electronics, mobile communications, power systems and power converter circuit analysis. Furthermore, the concepts of NI lab view will be helpful in data acquisition and analysis in several applications like process industries, Electric Vehicles, boiler operation and petrochemical industries. **Professionally Used Software:** NI Lab view /MATLAB
Textbooks 1. Ravish.R.Singh, "Electrical Networks", Mcgraw Hill company,2009, 2nd Edition. 2. D.P. Kothari and Nagrath "Theory and Problems in electrical Engineering", PHI edition 2011
References 1. V. N. Mittal and Arvind Mittal, "Basic Electrical Engineering" McGraw Hill, 2nd Edition 2. Vincent DelToro, "Electrical engineering Fundamentals", PHI second edition 2011 **Online resources** 1. https://www.youtube.com/results?search_query=Lecture+on+KVL 2. https://www.tutorialspoint.com/network_theory/index.htm 3. https://nptel.ac.in/courses/108/105/108105159/ 4. https://puniversity.informaticsglobal.com
Topics relevant to "SKILLS DEVELOPMENT": Analysis of series RL and RC circuits with AC excitation for developing **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Bishakh Paul
Recommended by the Board of Studies on	BoS No: 12th, held on 27/07/2021
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021

Course Code: **EEE1004**	**Course Title:** **Fundamentals of Industrial Automation** **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	This course deals with the PLC hardware/software and their importance in automation. SCADA deals with communication protocols and real time control of power systems using EMS. The course is both conceptual and analytical in nature. It develops programming and simulation skills.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of **Fundamentals of Industrial Automation** and attain **Skill Development** through **Participative Learning** techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** **1)** Evaluate network protocols that provide interoperability and communication technologies **2)** Write PLC codes for automation applications requiring special functions. **3)** Use PLC for an automatic control system confining to standards. **4)** Apply SCADA for various utilities.			
Course Content:				
Module 1	Introduction to Programmable Logic Controllers:	**Module 1**	Introduction to Programmable Logic Controllers:	**Module 1**
Topics: Advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.				
Module 2	PLC Programming Methodologies:	**Module 2**	PLC Programming Methodologies:	**Module 2**
Topics: Ladder diagram, STL, functional block diagram, SFC, Instruction List. Creating ladder diagram from process control descriptions, Introduction to IEC61131 international standard for PLC.				
Module 3	Introduction to SCADA	**Module 3**	Introduction to SCADA	**Module 3**
Topics: Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions.				
Module 4	Distributed Control Systems:	**Module 4**	Distributed Control Systems:	**Module 4**
DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC support, Security and Access Control etc. Performance Criteria for DCS and other automation tools.				
Targeted Application is **Siemens, ABB, Power-grid, Yokogawa Electric** **Tools that can be used:** **NI Lab-VIEW**				
Text Books 1. W.Boldon, 'Programmable logic controllers', 5th Edition, Elsevier India Pvt. Ltd., New Delhi, 2011. 2. Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.				
References 1. Robert Radvanovsky, Jacob Brodsky, "Handbook of SCADA/Control Systems Security", 2nd edition, CRC press, 2016. 2. G. K. McMillan, Douglas Considine, "Process/Industrial Instruments Hand book", 5th edition, McGraw Hill, New York, 2009. **Online learning resources** 1.Seminar https://electrical-engineering-portal.com/resources/plc-programming-training 2. Case Study: https://puniversity.informaticsglobal.com 3. Ebook:https://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering/plc-book				
Topics relevant to "SKILLS DEVELOPMENT": PLC programming, SCADA for developing **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Bishakh Paul			

Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	Academic Council Meeting No.16, Dated 23/10/21

Course Code: EEE1005	**Course Title: Electric Vehicles & Battery Technology** **Type of Course: Open Elective and Theory only**	**L- T- P- C**	3	0	0	3

Version No.	1.0
Course Pre-requisites	NIL
Anti-requisites	NIL
Course Description	The Course is designed with an objective of giving an overview of Electric Vehicles and battery technology. The Course discusses the history, configurations of Electric vehicles and the electrical characteristics of batteries. The Course is conceptual and analytical in nature and needs fair knowledge of mathematical computation. The course develops the critical thinking and analytical skills.
Course objective	The objective of the course is to familiarize the learners with the concepts of Electric Vehicles & Battery Technology and attain **Entrepreneurial Skills** through **Problem Solving** methodologies.
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the working of Electric Vehicles and recent trends 2. Explain the working of Hybrid Electric Vehicles and recent trends 3. Describe about the battery characteristic & parameters. 4. Summarize the importance of battery management system.
Course Content:	

Module 1	Electric Vehicles	Assignment	Computation and Data Analysis
Topics: History of Electric vehicles, Configuration of Electric Vehicles, Performance of Electric Vehicles,Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption.			
Module 2	Hybrid Electric Vehicles	Case Study	Data collection and Analysis
Topics: Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.			
Module 3	Energy storage for EV and HEV	Assignment	Any energy storage device
Topics: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells.			

Module 4	Battery Management Systems (BMS	Assignment	Case study

Topics:
Introduction to Battery Management Systems (BMS), important terminology used to describe battery cells, Architecture of BMS, Classification of BMS, principles of operation of standard electrochemical battery cells.

Targeted Application & Tools that can be used:
Application: Automotive industry.
Software tools: Matlab-Simulink

Text Book

1. Mehrdad Ehsani, YiminGao, sebastien E. Gay and Ali Emadi, —Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design‖, CRC Press, 2009.
2. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011.

References

1. James Larminie and John Loury, —Electric Vehicle Technology-Explained‖, John Wiley & Sons Ltd., 2003.

2.C.C. Chan and K.T. Chanu Modern Electric Vehicle Technology, OXFORD University, 2011

3.Sheldon S. Williamson,- Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer,2013

4. Chris Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

Online resources:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/courses/108/106/108106170/
3. Text book of Electric and Hybrid Vehicles : Power Sources, Models, Sustainability, Infrastructure and the Market, Gianfranco Pistoia, 1st ed. Amsterdam : Elsevier. 2010 https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=0&sid=52da4e6e-8813-45d5-87f9-73b9f493f358%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=342445&db=nl ebk
4. Seminar https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&queryText=electric%20vehicles
5. Case Study: Data collection/Quiz based on the basics of batteries and the characteristics of energy storage devices used in EVs.

Topics relevant to "ENTREPRENEURIAL SKILLS": Vehicle fundamentals, total tractive effort and design of drive train for different vehicle architectures for developing **Entrepreneurial Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.
Topics relevant to "ENVIRONMENT AND SUSTAINABILITY": Types of Batteries, Materials of battery used, Fuel cell.

Catalogue prepared by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No:14th BoS held on 22/2/2022
Date of Approval by	18th Academic Council meeting held on 03/8/2022

the Academic Council	

Course Code: EEE1006	**Course Title: Smart Sensors for Engineering Applications** **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	Nil					
Course Description	The course highlights the basics of sensors & transducers and on the integration of electronics and sensors to create a smart transducer or a system on a chip with multiple integrated devices. It also provides inputs in the selection of appropriate sensor based on requirement and application. The course is being analytical one it requires basic mathematical and computing knowledge.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Smart Sensors for Engineering Applications** and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Discuss the need of transducers, their classification and principle 2) Explain the principle of various types of sensors 3) Describe the fundamentals and general architecture of smart sensors. 4) Summarize the applications area of smart sensors.					
Course content:						
Module 1	Introduction to sensors & Transducers	Assignment	Quiz	**12 sessions**		
Introduction, Classification of transducers, Basic Principle, Different types of transducers: Resistive transducers, capacitive transducers, piezoelectric transducers, Temperature transducers						
Module 2	Sensor fundamentals	Assignment	Case study	**12 sessions**		
Sensor types and classification, Sensors parameters, Selection of sensors, Light sensing, technology, Proximity sensors: Inductive and capacitive, Pneumatic sensors, Motion sensors, Miscellaneous sensors						
Module 3	Components & Architecture of Smart Sensors	Mini project	Developing a measurement system /Programming task	**12 sessions**		
Smart Sensors, Components of Smart Sensors, General Architecture of Smart Sensors, Evolution of Smart Sensors, Advantages, Telemetry						
Module 4	Application area of Smart Sensors	Mini project continued	Developing a measurement system /Programming task	**9 sessions**		
Home Automation, Industrial, Medical, Robotics, Automobile, Aircrafts						

Targeted Application & Tools that can be used:
Application: Various types of Industries, Robotics, Automation of machines
List of Open Source Software/learning website: NPTEL, Matlab-Simulink, LabVIEW (NI),

Text Books

1. Sensor Systems: Fundamentals and Applications, Clarence W. De Silva, CRC press, 1st edition, 2016.
2. Understanding Smart Sensors- Randy Frank, 2nd Edition. Artech House Publications, 2013.
3. Lecture notes(L1) /PPT

References

1. A Course In Electrical And Electronic Measurements And Instrumentation, A. K. Sawhney, Dhanpat Rai publications, 4th edition
2. Smart sensor systems, Gerard C.M. Meijer, Willey Publications,2008, First Edition
3. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart
   Systems: Technology and modeling, Willey Publications,2012
4. Measurement and Instrumentation: Theory and Applicationc By Alan S Morris, Reza Langari, Academic press, Elsevier, 2015.
5. Data Acquisition and Signal Processing for Smart Sensors by Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynega, John Wiley & Sons Ltd

Online resources:

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://nptel.ac.in/courses/112/108/112108092/
3. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/2-4-sensors-0EIl
   https://puniversity.informaticsglobal.com

Topics relevant to "SKILLS DEVELOPMENT": Study of various types of smart sensors & transducers used for practical applications for developing **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/02/22
Date of Approval by the Academic Council	18th Academic council Meeting held on 03/08/2022