PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

Itgalpura, Rajankunte, Yelahanka, Bengaluru – 560064

PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Program Regulations and Curriculum

2022-2026

BACHELOR OF TECHNOLOGY (B.Tech.) in

Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

B. Tech. [CAI]

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

Regulations No.: PU/AC-18.08/CSE16/CAI/2022-2026

Resolution No. 8 of the 18th Meeting of the Academic Council held on 3rd August, 2022, and ratified by the Board of Management in its 19th Meeting held on 4th Aug 2022.

(As amended upto 26th Meeting of the Academic Council held on 25th July 2025, and ratified by the Board of Management in its 27th Meeting held on 28th July 2025.)

August 2022

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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 Computer Science and Engineering

To be a value based, practice-driven School of Computer Science and Engineering, committed to developing globally-competent Engineers, dedicated to developing cutting-edge technology, towards enhancing Quality of Life.

1.4 Mission of Presidency School of Computer Science and Engineering

- Cultivate a practice-driven environment, with computing-based pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the realm of Computing Sciences.
- Establish state-of-the-art computing facilities, for effective Teaching and Learning experiences.
- Promote Interdisciplinary Studies to nurture talent for global impact.
- Instill Entrepreneurial and Leadership Skills to address Social, Environmental and Community-needs.

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 2022-2023.

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 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, 2022-2026;*

ff. *"Program" means the Bachelor of Technology (B.Tech.) Degree Program;*

gg. "PSCS" means the Presidency School of Computer Science and Engineerin;

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 Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as CSE

2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as CBD

3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as CBC

4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as CDV

5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as CCS

6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as CIT

7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as CSD

8. Bachelor of Technology in Computer Science and Technology, abbreviated as CSG

9. Bachelor of Technology in Information Science and Technology, abbreviated as IST

10. Bachelor of Technology in Computer Engineering, abbreviated as COM

11. Bachelor of Technology in Information Science and Engineering, abbreviated as ISE and

12. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as CAI

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 consideration

6. Minimum and Maximum Duration

6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.

6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and

Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause:16.1**.** of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.

6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

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

7 Programme Educational Objectives (PEO)

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

PEO1. Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values

PEO2. Engage in lifelong learning through research and professional development

PEO3. Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship

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 modeling 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:

PSO1: Employability: Develop technical, managerial, and problem-solving skills for employability and career growth.

PSO2: Research: Apply theoretical knowledge to real-world challenges, fostering research and innovation.

PSO3: Entrepreneurship: Cultivate entrepreneurship, teamwork, and ethical AI/ML solutions for industrial and societal impact.

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, 2022-2026, 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. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 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 Computer Science and Engineering (Artificial Intelligence and Machine Learning)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:

The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3

10.2.1 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 Presidency 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.

10.2.2 The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.

10.2.3 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.

10.2.4 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 12.5 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 8.10 of Academics 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**
Lecture-based Course L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	Continuous Assessments	50%
	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	75%
	End Term Examination	25%
Skill based Courses like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure	Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable.	

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

Normally, for Practice/Skill based Courses, without a defined credit structure (L–T–P) [NTCC], but with assigned Credits (as defined in Clause 5.2 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 Clause 12.6.1 and 12.6.2) 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. ANNEXURE B 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 13.3(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 13.3 (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.

13.3.8 The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic Regulations

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

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 (13.0), shall not be included in the calculation of the CGPA.

PART B: PROGRAM STRUCTURE

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

The B.Tech. (Computer Science and Engineering (Artificial Intelligence and Machine Learning)) Program Structure (2022-2026) totalling 162 credits. Table 7 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. . Computer Science and Engineering (Artificial Intelligence and Machine Learning) 2022-2026: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets	
Baskets	**Credit Contribution**

SCHOOL CORE	61
PROGRAM CORE	60
DISCIPLINE ELECTIVE	30
OPEN ELECTIVE	9
TOTAL CREDITS	**160**

In the entire Program, the practical and skill based course component contribute to an extent of approximately 57% out of the total credits of 160 for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 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 Centers/ Departments of the University; and

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

PART C: CURRICULUM STRUCTURE

17. Curriculum Structure – Basket Wise Course List

Type of Skill
F - Foundation
S - Skill Development
EM – Employability
EN – Entrepreneurship

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability
HP - Human values and Professional Ethics

Table 3.1 : List of School Core Courses

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skill	Pre-requisites
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	F	-
2	MAT1002	Transform Techniques, Partial Differential Equations and their Applications	3	0	0	3	3	F	MAT1001
3	MAT1003	Applied Statistics	1	0	2	2	3	EM	-
4	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	S	-
5	CSE1001	Problem Solving using JAVA	2	0	2	3	4	S	-
6	CSE1005	Programming in Python	1	0	4	3	5	S	-
7	CSE2001	Data Structures and Algorithms	3	0	2	4	5	S	-
8	CSE1002	Innovative Projects - Arduino using Embedded 'C'	0	0	4	2	4	S	-
9	CIV1008	Basic Engineering Sciences	2	0	0	2	2	S	-
10	MEC1006	Engineering Graphics	2	0	0	2	2	S	-
11	ECE2011	Innovative Projects Using Raspberry Pi	-	-	-	1		S	-
12	CSE7101	Capstone Project	-	0	-	4		S/ EM / EN	-
13	CSE7302	Internship	-	-	-	8		S/ EM / EN	-
14	CSE3216	Mastering Object-Oriented Concepts in Python	0	0	2	1	2		-
15	CSE3217	Data Structure and Web Development with Python	0	0	2	1	2		-
16	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	F	-
17	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	F	-
18	ENG1001 / ENG1002	Foundation of English/ Technical English	1	0	2	2	3	F	-
19	ENG1002 / ENG2001	Technical English/ Advanced English	1	0	2	2	3	S	ENG1002

20	KAN1001 / KAN1002	Kali Kannada/ Thili Kannada	1	0	0	1	1	S	Non-Karnataka
21	PPS1001	Introduction to soft skills	0	0	2	1	2	S	-
22	PPS1002	Soft Skills for Engineers	0	0	2	1	2	S	-
23	PPS2002	Being Corporate Ready	0	0	2	1	2	S/ EM	-
24	PPS4002	Introduction to Aptitude	0	0	2	1	2		
25	PPS4006	Logical and Critical Thinking	0	0	2	1	2	S	-
26	PPS4005	Aptitude for Employability	0	0	2	1	2	S/ EM	-
27	PPS3018	Preparedness for Interview	0	0	2	1	2	S/ EM	-
28	CHE1018	Environmental Science	1	0	2	0	3	F	-
Total No. of Credits						**61**			

Table 3.2 : List of Program Core Courses

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skill	Pre-requisites
1	ECE2007	Digital Design	2	0	2	3	4	S	-
2	CSE2014	Software Engineering	3	0	0	3	3	S/EM	-
3	CSE2011	Data Communications and Computer Networks	3	0	0	3	3	S	-
4	CSE2009	Computer Organization and Architecture	3	0	0	3	3	S	ECE2007
5	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	S	MAT1001
6	CSE3001	Artificial Intelligence and Machine Learning	2	0	2	3	4	S	MAT1001
7	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	S	CSE2001
8	CSE2074	Database Management Systems	2	0	2	3	4	S	CSE2001
9	CSE2010	Operating Systems	3	0	0	3	3	S	CSE2001
10	CSE3016	Neural Networks and Fuzzy Logic	3	0	0	3	3	S	CSE3001
11	CSE2027	Fundamentals of Data Analytics	3	0	0	3	3	S	-
12	CSE2026	Data Handling and Visualization	2	0	2	3	4	S	CSE2027
13	CSE3087	Applied Machine Learning	2	0	2	3	4	S/EM/EN	CSE3001
14	CSE3078	Cryptography and Network Security	3	0	0	3	3	S	CSE2027
15	CSE2018	Theory of Computation	3	0	0	3	3	S	-
16	CSE3343	Cloud Computing	2	0	2	3	4	S	CSE2011
17	CSE3011	Reinforcement Learning	2	0	2	3	4	S	CSE3001
18	CSE3014	Fundamentals of Natural Language Processing	3	0	0	3	3	S	CSE3001
19	CSE3010	Deep Learning Techniques	3	0	0	3	3	S	CSE3001
20	CSE2067	Web Technologies	2	0	2	3	4	S	-

Total No. of Credits				60			

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

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

18.1 Internship

A student may undergo an Internship for a period of 10-12 weeks in an industry / company or academic / research institution during 8th Semester, 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.

18.1.4.1 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 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 Semester as applicable, subject to the following conditions:

18.2.1 The Capstone Project shall be in conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.

18.2.2 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;

18.2.3 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 18.2.2 above.

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

18.2.5 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.

18.3 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:

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

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.3.1). 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 3.3 : Discipline Electives Courses/Specialization Tracks - Minimum of 24 credits is to be earned by the student in a particular track and overall 30 credits

Artificial Intelligence and Machine Learning Basket

Sl.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Prerequisites
1	CSE3087	Applied Machine Learning	2	0	2	3	4	S	CSE3001
2	CSE3189	Deep Learning	2	0	2	3	4	S	CSE3008
3	CSE3011	Reinforcement Learning	2	0	2	3	4	S	CSE3008
4	CSE3012	Time Series Analysis	2	0	2	3	4	S	CSE3001
5	CSE3188	Natural Language Processing	2	0	2	3	4	S/ EM	CSE3008
6	CSE3015	Advanced Natural Language Processing	2	0	2	3	4	S	CSE3014
7	CSE3017	Autonomous Navigation and Vehicles	3	0	0	3	3	S/ EM	MAT1002
8	CSE3018	Digital Health and Imaging	3	0	0	3	3	S/ EM	CSE3008
9	CSE3019	Stochastic Decision Making	3	0	0	3	3	S/ EM	MAT1003
10	CSE3088	Business Intelligence and Analytics	3	0	0	3	3	S/ EM	CSE3008
11	CSE3103	Cognitive Science & Analytics	3	0	0	3	3	S/ EM	CSE3008

12	CSE3108	Expert Systems	3	0	0	3	3	S/EM	CSE3008
13	CSE3208	Artificial Intelligence in Practice	2	0	2	3	4	S/EM	CSE3001
14	CAI3406	Responsible AI	2	0	2	3	4	S/EM	CSE3001
15	CAI3402	Optimization Techniques for Machine Learning	2	0	2	3	4	S/EM	CSE3001
16	CAI3405	Explainable AI	2	0	2	3	4	S/EM	CSE3001
17	CAI3407	Agentic AI	2	0	2	3	4	S/EM	CSE3001
18	CAI3411	Generative AI	2	0	2	3	4	S/EM	CSE3001
Big Data Basket									
1	CSE2021	Data Mining	3	0	0	3	3	S/EM	MAT1001
2	CSE2022	Domain Specific Predictive Analytics	3	0	0	3	3	S/EM	CSE2027
3	CSE2023	Data Warehousing and its Applications	3	0	0	3	3	S/EM	MAT1001
4	CSE2024	No SQL Databases	2	0	2	3	4	S	CSE2012
5	CSE3002	Big Data Technologies	2	0	2	3	4	S	CSE2012
6	CSE3030	Mining Massive Datasets	2	0	2	3	4	S/EM	CSE2027
7	CSE3031	Web Intelligence and Analytics.	2	0	2	3	4	S	CSE2027
8	CSE3032	Streaming Data Analytics	2	0	2	3	4	S	CSE2027
9	CSE3033	Information Visualization	2	0	2	3	4	S/EM	CSE2027
10	CSE3034	Big Data Security and Privacy.	3	0	0	3	3	S	CSE3002
Block Chain Basket									
1	CSE3021	Blockchain for Public Sector	3	0	0	3	3	S/EM	CSE2020
2	CSE3022	Crypto Currency Technology	3	0	0	3	3	S/EM	CSE2019
3	CSE3024	Emerging Areas in Blockchain	3	0	0	3	3	S/EM	CSE2020
4	CSE3025	Industry Use Cases using Blockchain	3	0	0	3	3	S/EM	CSE2020
5	CSE2019	Foundations of Blockchain Technology	3	0	0	3	3	S	-
6	CSE2020	Blockchain Technology and Applications	3	0	0	3	3	S	-
7	CSE3020	Smart Contract and Solidity	2	0	2	3	4	S	CSE2019
8	CSE3023	Distributed Ledger Technology	2	0	2	3	4	S	CSE 2019

9	CSE3028	Blockchain Security and Performance	2	0	2	3	4	S	CSE2019
Cyber Security Basket									
1	CSE2037	Cyber Forensics	2	0	2	3	4	S	MAT1001
2	CSE2038	Privacy and Security in Online Social Media	3	0	0	3	3	S/EM	CSE1001
3	CSE3342	Ethical Hacking	1	0	4	3	5	S	CSE1001
4	CSE2040	Cyber Threats for IoT and Cloud	3	0	0	3	3	S	
5	CSE3145	Intrusion Detection and Prevention System	3	0	0	3	3	S	CSE2037
6	CSE3094	Cyber Security	3	0	0	3	3	S/EM	CSE3078
7	CSE3096	Cyber Digital Twin	3	0	0	3	3	S/EM	CSE2069
8	CSE3097	Web Security	2	0	2	3	4	S	CSE2011
9	CSE3098	Vulnerability Assessment and Penetration Testing	3	0	0	3	3	S/EM	CSE3078
10	CSE3099	Digital and Mobile Forensics	2	0	2	3	4	S/EM	CSE2011
11	CSE3100	Security Assessment and Testing	2	0	2	3	4	S/EM	CSE2011
12	CSE3101	Digital Watermarking and Steganography	3	0	0	3	3	S/EM	CSE3078
13	CSE3102	Malware Analysis	3	0	0	3	3	S/EM	CSE3078
Data Science Basket									
1	CSE2028	Statistical Foundations of Data Science	2	0	2	3	4	S/EM	MAT1003
2	CSE2029	Web Data Analytics	2	0	2	3	4	S/EM	CSE2027
3	CSE3035	R programming for Data Science	1	0	4	3	5	S/EM	CSE2027
4	CSE3038	Applied Data Science	2	0	2	3	4	S	CSE2027
5	CSE3039	Social Media Analytics	2	0	2	3	4	S	CSE3036
6	CSE3136	E-Business and Marketing Analytics	3	0	0	3	3	S	CSE2025
7	CSE3137	Text Mining and Analytics	3	0	0	3	3	S/EM	CSE3001
DevOps Basket									
1	CSE3040	Agile Structures and Frameworks	3	0	0	3	3	S	-
2	CSE3042	Applied DevOps	2	0	2	3	4	S/EM	CSE2014
3	CSE3043	Automated Test Management	2	0	2	3	4	S	CSE2014

4	CSE3044	Build and Release Management	3	0	0	3	3	S/EM	CSE2014
5	CSE3045	Development Automation	2	0	2	3	4	S	CSE2014
6	CSE3046	DevOps Tools Internals	2	0	2	3	4	S	-
7	CSE3050	Software Project Management	3	0	0	3	3	S/EM	CSE2014
8	CSE3051	System Monitoring	3	0	0	3	3	S/EM	CSE3120
9	CSE3052	System Provisioning and Configuration Management	3	0	0	3	3	S	CSE2014
IoT Basket									
1	CSE2032	Introduction to Fog Computing	3	0	0	3	3	S	CSE2011
2	CSE3053	Big Data Analytics for IoT	1	0	4	3	5	S	CSE3002
3	CSE3055	Wireless Communication in IoT	3	0	0	3	3	S	CSE2011
4	CSE3063	Privacy and Security in IoT	3	0	0	3	3	S	CSE3078
5	CSE3066	Mobile Application for IoT	3	0	0	3	3	S	CSE2011
6	ECE3075	IoT: Architecture and Protocols	3	0	0	3	3	S / EM	-
7	ECE3076	IoT Platforms and Application Development	2	0	2	3	4	S / EM	-
8	ECE3086	Industrial Internet of Things (IIoT)	3	0	0	3	3	S / EM	-
9	ECE3088	Internet of Medical Things (IoMT)	3	0	0	3	3	S / EM	-
General Basket									
1	CSE2033	Go Programming	3	0	0	3	3	S/ EM	CSE1002
2	CSE2066	Computer Graphics	3	0	0	3	3	S	-
3	CSE3146	Advanced Java Programming	1	0	4	3	5	S	CSE1001
4	CSE2036	Programming in C++	1	0	4	3	5	S/ EM	CSE1001
5	CSE3068	Advanced Database Management Systems	2	0	2	3	4	S/ EM	CSE2012
6	CSE3069	Introduction to Bioinformatics	3	0	0	3	3	S/ EM	-
7	CSE3070	Advanced Computer Networks	3	0	0	3	3	S/ EM	CSE2011
8	CSE3071	Computer Vision	2	0	2	3	4	S/ EM	MAT 1003
9	CSE3072	Wireless Sensor Networks	3	0	0	3	3	S/ EM	CSE 2011

10	CSE3073	Game Design and Development	3	0	0	3	3	S/EM	-
11	CSE3074	Microprocessors and Microcontrollers	3	0	0	3	3	S/EM	-
12	CSE3075	Mobile Application Development	1	0	4	3	5	S	CSE1001
13	CSE3077	Compiler Design	2	0	2	3	4	S	-
14	CSE3079	Parallel Computing	3	0	0	3	3	S/EM	CSE2009
15	CSE3080	Quantum Computing	3	0	0	3	3	S/EM	MAT1002
16	CSE3081	Digital Image Processing	2	0	2	3	4	S/EM	MAT1002
17	CSE3082	Object Oriented Analysis and Design	3	0	0	3	3	S	CSE1001
18	CSE3083	Advanced Computer Architecture	3	0	0	3	3	S/EM	CSE2009
19	CSE3084	Software Quality Assurance	2	0	2	3	4	S/EM	CSE2014
20	CSE3085	Real Time Operating System	3	0	0	3	3	S/EM	CSE2010
21	CSE3086	Information Theory and Coding	3	0	0	3	3	S/EM	MAT1002
22	CSE3089	Software Architecture	3	0	0	3	3	S/EM	CSE2009
23	CSE3090	5G Networking	3	0	0	3	3	S/EM	CSE2011
24	CSE3091	Programming in C# and .NET	1	0	4	3	5	S/EM	CSE1001
25	CSE2052	Distributed Systems	3	0	0	3	3	S/EM	CSE2010
26	CSE3152	.NET Full Stack Development	2	0	2	3	4	S/EM	-
27	CSE3150	Front End Full stack development	2	0	2	3	4	S/EM	-
28	CSE3151	Java Full Stack Development	2	0	2	3	4	S/EM	-
Cloud Computing Basket									
1	CSE2034	Edge Computing	3	0	0	3	3	S/EM	CSE2011
2	CSE3095	Cloud Security	3	0	0	3	3	S/EM	CSE2069
3	CSE3054	Data Center Design	3	0	0	3	3	S/EM	CSE2069
4	CSE3127	Cloud Application Development	3	0	0	3	3	S/EM	CSE2069
5	CSE3129	Middleware Technologies	3	0	0	3	3	S/EM	CSE2011
Information Science & Engineering Basket									
1	CSE2050	System Software	3	0	0	3	3	S	CSE2009
2	CSE2051	Information Retrieval	3	0	0	3	3	S	CSE2011

3	CSE2053	Enterprise Network Design	3	0	0	3	3	S	CSE2011
4	CSE3120	Operating System with Linux Internals	2	0	2	3	4	S/EM	
5	CSE3122	Pattern Recognition	2	0	2	3	4	S	CSE2007
6	CSE3123	Search Engine Optimization	3	0	0	3	3	S	CSE2007
7	CSE3125	Service Oriented Architecture	3	0	0	3	3	S/EM	CSE2001
8	CSE3126	E-Commerce	3	0	0	3	3	S/EM	CSE2007
Information Science & Technology Basket									
1	CSE2054	Storage Area Networks	3	0	0	3	3	S	CSE2011
2	CSE2055	Information Systems Audit	3	0	0	3	3	S	CSE2011
3	CSE2056	Web 2.0	2	0	2	3	4	S/EM	CSE2007
4	CSE2057	Cloud Computing and Virtualization	3	0	0	3	3	S/EM	CSE2011
5	CSE2058	Firewall and Internet Security	2	0	2	3	4	S	CSE2011
6	CSE2059	Mobile Networking	2	0	2	3	4	S	CSE2011
7	CSE2060	Information Security and Management	3	0	0	3	3	S/EM	CSE2011
8	CSE3128	Human Computer Interaction	3	0	0	3	3	S/EM	CSE2007
9	CSE3143	Infrastructure Management	3	0	0	3	3	S/EM	CSE2011
10	CSE3132	Network Management Systems	3	0	0	3	3	S	CSE2011
Special Basket									
1	CAI3427	Language Models for Text Mining	2	0	2	3	4	S/EM	CSE3001
2	CAI3428	Practical Deep Learning with TensorFlow	2	0	2	3	4	S/EM	CSE3001
3	CAI3429	Deep Learning Techniques for Computer Vision	2	0	2	3	4	S/EM	MAT1003
Total # of Credits to be earned from DE = 30									

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

Type of Skill
F - Foundation
S - Skill Development

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability

EM – Employability EN – Entrepreneurship	HP - Human values and Professional Ethics

Table 3.4 : Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 09

Sl. No.	Course Code	Course Name	L	T	P	C	Type of Skill/ Focus	Course Caters to	Prerequisites/ Corequisites	Antirequisites	Future Courses that need this as a Prerequisite
Chemistry Basket											
1	CHE1003	Fundamentals of Sensors	3	0	0	3	S	ES	-	-	-
2	CHE1004	Smart materials for IOT	3	0	0	3	S	ES	-	-	-
3	CHE1005	Computational Chemistry	2	0	0	2	S	ES	-	-	-
4	CHE1006	Introduction to Nano technology	3	0	0	3	S	ES	-	-	-
5	CHE1007	Biodegradable electronics	2	0	0	2	S	ES	-	-	-
6	CHE1008	Energy and Sustainability	2	0	0	2	S	ES	-	-	-
7	CHE1009	3D printing with Polymers	2	0	0	2	S	ES	-	-	-
8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES	-	-	-
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES	-	-	-
10	CHE1012	Introduction to Composite materials	2	0	0	2	S	ES	-	-	-
11	CHE1013	Chemistry for Engineers	3	0	0	3	S	ES	-	-	-
12	CHE1014	Surface and Coatings technology	3	0	0	3	S	ES	-	-	-
13	CHE1015	Waste to Fuels	2	0	0	2	S	ES	-	-	-
14	CHE1016	Forensic Science	3	0	0	3	S	ES	-	-	-
Civil Engineering Basket											
1	CIV1001	Disaster mitigation and management	3	0	0	3	S	-	-	-	-
2	CIV1002	Environment Science and Disaster Management	3	0	0	3	FC	-	-	-	-
3	CIV2001	Sustainability Concepts in Engineering	3	0	0	3	S	-	-	-	-
4	CIV2002	Occupational Health and Safety	3	0	0	3	S	-	-	-	-
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	-	-	-	-
6	CIV2004	Integrated Project Management	3	0	0	3	EN	-	-	-	-
7	CIV2005	Environmental Impact Assessment	3	0	0	3	EN	-	-	-	-
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	-	-	-	-
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	-	-	-	-
10	CIV2045	Environmental Meteorology	3	0	0	3	S	-	-	-	-
11	CIV3046	Project Problem Based Learning	3	0	0	3	S	-	-	-	-
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	-	-	-	-
Commerce Basket											
1	COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS	-	-	-
2	COM2002	Finance for Non Finance	2	0	0	2	S	-	-	-	-

3	COM2003	Contemporary Management	2	0	0	2	F	-	-	-	-
4	COM2004	Introduction to Banking	2	0	0	2	F	-	-	-	-
5	COM2005	Introduction to Insurance	2	0	0	2	F	-	-	-	-
6	COM2006	Fundamentals of Management	2	0	0	2	F	-	-	-	-
7	COM2007	Basics of Accounting	3	0	0	3	F	-	-	-	-
Computer Science Basket (not to be offered for CSE Department students)											
1	CSE2002	Programming in Java	2	0	2	3	S/EM	-	-	-	-
2	CSE2003	Social Network Analytics	3	0	0	3	S	GS	-	-	-
3	CSE2004	Python Application Programming	2	0	2	3	S/EM	-	-	-	-
4	CSE2005	Web design fundamentals	2	0	2	3	S/EM/EN	-	-	-	-
5	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	0	3	S/EM/EN	-	-	-	-
6	CSE3112	Privacy And Security In Online Social Media	3	0	0	3	S/EM/EN	-	-	-	-
7	CSE3113	Computational Complexity	3	0	0	3	S/EM/EN	-	-	-	-
8	CSE3114	Deep Learning for Computer Vision	3	0	0	3	S/EM/EN	-	-	-	-
9	CSE3115	Learning Analytics Tools	3	0	0	3	S/EM/EN	-	-	-	-
Design Basket											
1	DES1001	Sketching and Painting	0	0	2	1	S	-	-	-	-
2	DES1002	Innovation and Creativity	2	0	0	2	F	-	-	-	-
3	DES1121	Introduction to UX design	1	0	2	2	S	-	-	-	-
4	DES1122	Introduction to Jewellery Making	1	0	2	2	S	-	-	-	-
5	DES1124	Spatial Stories	1	0	2	2	S	-	-	-	-
6	DES1125	Polymer Clay	1	0	2	2	S	-	-	-	-
7	DES2001	Design Thinking	3	0	0	3	S	-	-	-	-
8	DES1003	Servicability of Fashion Products	1	0	2	2	F	ES	-	-	-
9	DES1004	Choices in Virtual Fashion	1	0	2	2	F	ES, GS, HP	-	-	-

10	DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2	F	ES, GS, HP	-	-	-
11	DES1006	Colour in Everyday Life	1	0	2	2	F	ES	-	-	-
12	DES2080	Art of Design Language	3	0	0	3	S	-	-	-	-
13	DES2081	Brand Building in Design	3	0	0	3	S	-	-	-	-
14	DES2085	Web Design Techniques	3	0	0	3	S	-	-	-	-
15	DES2089	3D Modeling for Professionals	1	0	4	3	S	-	-	-	-
16	DES2090	Creative Thinking for Professionals	3	0	0	3	S	-	-	-	-
17	DES2091	Idea Formulation	3	0	0	3	S	-	-	-	-
Electrical and Electronics Basket											
1	EEE1002	IoT based Smart Building Technology	3	0	0	3	S	-	-	-	-
2	EEE1003	Basic Circuit Analysis	3	0	0	3	S	-	-	-	-
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3	S	-	-	-	-
4	EEE1005	Electric Vehicles & Battery Technology	3	0	0	3	S	-	-	-	-
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	S	-	-	-	-
Electronics and Communication Basket											
1	ECE1003	Fundamentals of Electronics	3	0	0	3	F	-	-	-	-
2	ECE1004	Microprocessor based systems	3	0	0	3	F	-	-	-	-
3	ECE3089	Artificial Neural Networks	3	0	0	3	S	-	-	-	-
4	ECE3097	Smart Electronics in Agriculture	3	0	0	3	F/ EM	-	-	-	-
5	ECE3098	Environment Monitoring Systems	3	0	0	3	F/ EM	-	-	-	-
6	ECE3102	Consumer Electronics	3	0	0	3	F/ EM	-	-	-	-
7	ECE3103	Product Design of Electronic Equipment	3	0	0	3	S/ F/ EM / EN	-	-	-	-
8	ECE3106	Introduction to Data Analytics	3	0	0	3	F/ EM	-	-	-	-
9	ECE3107	Machine Vision for Robotics	3	0	0	3	F/ EM	-	-	-	-
English Basket											
1	ENG1008	Indian Literature	2	0	0	2	-	GS / HP	-	-	-
2	ENG1009	Reading Advertisement	3	0	0	3	S	-	-	-	-
3	ENG1010	Verbal Aptitude for Placement	2	0	2	3	S	-	-	-	-
4	ENG1011	English for Career Development	3	0	0	3	S	-	-	-	-
5	ENG1012	Gender and Society in India	2	0	0	2	-	GS / HP	-	-	-
6	ENG1013	Indian English Drama	3	0	0	3	-	-	-	-	-
7	ENG1014	Logic and Art of Negotiation	2	0	2	3	-	-	-	-	-
8	ENG1015	Professional Communication Skills for Engineers	1	0	0	1	-	-	-	-	-
DSA Basket											
1	DSA2001	Spirituality for Health	2	0	0	2	F	HP	-	-	-

2	DSA2002	Yoga for Health	2	0	0	2	S	HP	-	-	-
3	DSA2003	Stress Management and Well Being	2	0	0	2	F	-	-	-	-
Kannada Basket											
1	KAN1001	Kali Kannada	1	0	0	1	S	-	-	-	-
2	KAN1003	Kannada Kaipidi	3	0	0	3	S	-	-	-	-
3	KAN2001	Thili Kannada	1	0	0	1	S	-	-	-	-
4	KAN2003	Pradharshana Kale	1	0	2	2	S	-	-	-	-
5	KAN2004	Sahithya Vimarshe	2	0	0	2	S	-	-	-	-
6	KAN2005	Anuvadha Kala Sahithya	3	0	0	3	S	-	-	-	-
7	KAN2006	Vichara Manthana	3	0	0	3	S	-	-	-	-
8	KAN2007	Katha Sahithya Sampada	3	0	0	3	S	-	-	-	-
9	KAN2008	Ranga Pradarshana Kala	3	0	0	3	S	-	-	-	-
Foreign Language Basket											
1	FRL1004	Introduction of French Language	2	0	0	2	S	S	-	-	-
2	FRL1005	Fundamentals of French	2	0	0	2	S	S	-	-	-
3	FRL1009	Mandarin Chinese for Beginners	3	0	0	3	S	S	-	-	-
Law Basket											
1	LAW1001	Introduction to Sociology	2	0	0	2	F	HP		-	-
2	LAW2001	Indian Heritage and Culture	2	0	0	2	F	HP/GS		-	-
3	LAW2002	Introdcution to Law of Succession	2	0	0	2	F	HP/GS		-	-
4	LAW2003	Introduction to Company Law	2	0	0	2	F	HP		-	-
5	LAW2004	Introduction to Contracts	2	0	0	2	F	HP	-	-	-
6	LAW2005	Introduction to Copy Rights Law	2	0	0	2	F	HP	-	-	-
7	LAW2006	Introduction to Criminal Law	2	0	0	2	F	HP	-	-	-
8	LAW2007	Introduction to Insurance Law	2	0	0	2	F	HP	-	-	-
9	LAW2008	Introduction to Labour Law	2	0	0	2	F	HP	-	-	-
10	LAW2009	Introduction to Law of Marriages	2	0	0	2	F	HP/GS	-	-	-
11	LAW2010	Introduction to Patent Law	2	0	0	2	F	HP	-	-	-
12	LAW2011	Introduction to Personal Income Tax	2	0	0	2	F	HP	-	-	-
13	LAW2012	Introduction to Real Estate Law	2	0	0	2	F	HP	-	-	-
14	LAW2013	Introduction to Trademark Law	2	0	0	2	F	HP	-	-	-
15	LAW2014	Introduction to Competition Law	3	0	0	3	F	HP	-	-	-
16	LAW2015	Cyber Law	3	0	0	3	F	HP	-	-	-
17	LAW2016	Law on Sexual Harrassment	2	0	0	2	F	HP/GS	-	-	-
18	LAW2017	Media Laws and Ethics	2	0	0	2	F	HP/GS	-	-	-
Mathematics Basket											
1	MAT2008	Mathematical Reasoning	3	0	0	3	S	-	-	-	-
2	MAT2014	Advanced Business Mathematics	3	0	0	3	S	-	-	-	-
3	MAT2041	Functions of Complex Variables	3	0	0	3	S	-	-	-	-
4	MAT2042	Probability and Random Processes	3	0	0	3	S	-	-	-	-
5	MAT2043	Elements of Number Theory	3	0	0	3	S	-	-	-	-
6	MAT2044	Mathematical Modelling and Applications	3	0	0	3	S	-	-	-	-
Mechanical Basket											

1	MEC1001	Fundamentals of Automobile Engineering	3	0	0	3	F	-	-	-	-
2	MEC1002	Introduction to Matlab and Simulink	3	0	0	3	S/ EM	-	-	-	-
3	MEC1003	Engineering Drawing	1	0	4	3	S	-	-	-	-
4	MEC2001	Renewable Energy Systems	3	0	0	3	F	ES	-	-	-
5	MEC2002	Operations Research & Management	3	0	0	3	F	-	-	-	-
6	MEC2003	Supply Chain Management	3	0	0	3	S/ EM / EN	-	-	-	-
7	MEC2004	Six Sigma for Professionals	3	0	0	3	S/ EM	-	-	MEC2008	-
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3	F	-	-	-	-
9	MEC2006	Safety Engineering	3	0	0	3	S/ EM	ES	-	-	-
10	MEC2007	Additive Manufacturing	3	0	0	3	F/ EM	-	-	-	-
11	MEC3069	Engineering Optimisation	3	0	0	3	S/ EM	-	-	-	-
12	MEC3070	Electronics Waste Management	3	0	0	3	F/ S	ES	-	-	-
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	S/ EM	ES	-	-	-
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	S/ EM	-	-	-	-
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3	S/ EM	-	-	-	-
16	MEC3201	Industry 4.0	3	0	0	3	S/ EM	-	-	-	-
Petroleum Basket											
1	PET1011	Energy Industry Dynamics	3	0	0	3	FC	ES	-	NIL	-
2	PET1012	Energy Sustainability Practices	3	0	0	3	FC	ES	-	NIL	-
Physics Basket											
1	PHY1003	Mechanics and Physics of Materials	3	0	0	3	FC / SD				
2	PHY1004	Astronomy	3	0	0	3	FC				
3	PHY1005	Game Physics	2	0	2	3	FC / SD				
4	PHY1006	Statistical Mechanics	2	0	0	2	FC				
5	PHY1007	Physics of Nanomaterials	3	0	0	3	FC				
6	PHY1008	Adventures in nanoworld	2	0	0	2	FC				
7	PHY2001	Medical Physics	2	0	0	2	FC	ES			
8	PHY2002	Sensor Physics	1	0	2	2	FC / SD				
9	PHY2003	Computational Physics	1	0	2	2	FC				
10	PHY2004	Laser Physics	3	0	0	3	FC	ES			
11	PHY2005	Science and Technology of Energy	3	0	0	3	FC	ES			
12	PHY2009	Essentials of Physics	2	0	0	2	FC				
Management Basket- I											

1	MGT2007	Digital Entrepreneurship	3	0	0	3	S/EM/EN	-	-	-	-
2	MGT2015	Engineering Economics	3	0	0	3	S	-	-	-	-
3	MGT2023	People Management	3	0	0	3	S/EM/EN	HP	-	-	-
Management Basket- II											
1	MGT1001	Introduction to Psychology	3	0	0	3	F	HP	-	-	-
2	MGT1002	Business Intelligence	3	0	0	3	EN	-	-	-	-
3	MGT1003	NGO Management	3	0	0	3	S	-	-	-	-
4	MGT1004	Essentials of Leadership	3	0	0	3	EM/EN	GS/HP	-	-	-
5	MGT1005	Cross Cultural Communication	3	0	0	3	S/EM/EN	HP	-	-	-
6	MGT2001	Business Analytics	3	0	0	3	S/EM/EN	-	-	-	-
7	MGT2002	Organizational Behaviour	3	0	0	3	F	HP	-	-	-
8	MGT2003	Competitive Intelligence	3	0	0	3	S	-	-	-	-
9	MGT2004	Development of Enterprises	3	0	0	3	S/EM/EN	-	-	-	-
10	MGT2005	Economics and Cost Estimation	3	0	0	3	S/EM	-	-	-	-
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3	S	-	-	-	-
12	MGT2008	Econometrics for Managers	3	0	0	3	S	-	-	-	-
13	MGT2009	Management Consulting	3	0	0	3	S/EM/EN	-	-	-	-
14	MGT2010	Managing People and Performance	3	0	0	3	S/EM/EN	HP/GS	-	-	-
15	MGT2011	Personal Finance	3	0	0	3	F	-	-	-	-
16	MGT2012	E Business for Management	3	0	0	3	S/EM	-	-	-	-
17	MGT2013	Project Management	3	0	0	3	EN/EM	GS/HP/ES	-	-	-
18	MGT2014	Project Finance	3	0	0	3	EN/EM	HP	-	-	-
19	MGT2016	Business of Entertainment	3	0	0	3	EM/EN	-	-	-	-

20	MGT2017	Principles of Management	3	0	0	3	S/EM/EN	-	-	-	-
21	MGT2018	Professional and Business Ethics	3	0	0	3	S/EM/EN	HP	-	-	-
22	MGT2019	Sales Techniques	3	0	0	3	S/EM/EN	HP	-	-	-
23	MGT2020	Marketing for Engineers	3	0	0	3	S/EM/EN	HP	-	-	-
24	MGT2021	Finance for Engineers	3	0	0	3	S/EM/EN	HP	-	-	-
25	MGT2022	Customer Relationship Management	3	0	0	3	S/EM/EN	HP	-	-	-
Media Studies Basket											
1	BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2	EM	HP	-	-	-
2	BAJ3051	Digital Photography	2	0	2	3	EM	HP	-	-	-
3	BAJ3055	Introduction to News Anchoring and News Management	0	0	2	1	EM	-	-	-	-
Research URE Basket											
1	URE2001	University Research Experience	-	0	-	3					
2	URE2002	University Research Experience	-	0	-	0					

21.List of MOOC Courses

Presidency University students are given the opportunity to study abroad in International Universities through a selection process coordinated by the Office of International Affairs (OIA). Such selected students need to complete their credits for the semester that they are abroad in the following way:

21.1 The student needs to study and complete School Core and Program Core Courses in offline mode only.

21.2 Massive Open Online Course (MOOC) courses maybe given for Open Elective and Discipline Elective Courses. These courses need to be approved by the concerned BOS and Academic Council from time to time.

21.3 SWAYAM/NPTEL/ other approved MOOCs shall be approved by the concerned Board of Studies and placed in the concerned PRC.

21.4 Student shall register for these courses in the ERP of Presidency University.

21.5 For these MOOC courses faculty coordinators are identified. These faculty should have undergone similar MOOC courses and therefore should be familiar with the mode of class conduction, types of assessments and evaluation procedures.

21.6 Study materials shall be provided to the students as video lectures shared by the MOOCs Coordinator(s), or the students may access the approved MOOCs Portal directly. The mode of class conduction is determined by the MOOCs coordinator(s) as detailed in the Course Catalogue and Course Plan.

21.7 The question paper shall be prepared by the MOOCs coordinator(s).

21.8 Students write the exams in online mode. These exams are scheduled and conducted by the School.

21.9 Results are evaluated by School and given to the Office of the Controller of Examinations (CoE).

21.10 The details of the duration, credits and evaluation are given below:

Sl#	Duration	Credits
1.	12 weeks	3
2.	8 weeks	2
3	4 weeks	1

21.1 MOOC – Discipline Elective Courses for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Program

Table 3.5 : MOOC Discipline Elective Courses **Discipline Elective Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)**				
Sl.No	**Course Code**	**Course Name**	**Credits**	**L-T-P-C**
1	CSE3111	Artificial Intelligence: Search Methods for Problem Solving	3	3-0-0-3
2	CSE3112	Privacy and Security in Online Social Media	3	3-0-0-3
3	CSE3113	Computational Complexity	3	3-0-0-3
4	CSE3114	Deep Learning for Computer Vision	3	3-0-0-3
5	CSE3115	Learning Analytics Tools	3	3-0-0-3
6	CSE505	The Joy of Computing Using Python	3	3-0-0-3
7	CSE3119	Coding Skills in Python	3	3-0-0-3
8	CSE3121	Parallel Computer Architecture	3	3-0-0-3
9	CSE3124	Games and Information	3	3-0-0-3
10	CSE3140	Introduction to Industry 4.0 and Industrial Internet of Things	3	3-0-0-3
11	CSE3142	Affective Computing	3	3-0-0-3
12	CSE3196	Foundations of Cyber Physical Systems	3	3-0-0-3
13	CSE3197	Getting Started with Competitive Programming	3	3-0-0-3
14	CSE3198	GPU Architectures and Programming	3	3-0-0-3
15	CSE3199	Artificial Intelligence: Knowledge Representation and Reasoning	3	3-0-0-3
16	CSE3200	Programming in Modern C++	3	3-0-0-3
17	CSE3201	Circuit Complexity Theory	3	3-0-0-3
18	CSE3202	Basics of Computational Complexity	3	3-0-0-3
19	CSE3212	Introduction to Computer and Network Performance Analysis using Queuing	1	1-0-0-1

20	CSE3213	C Programming and Assembly Language	1	1-0-0-1
21	CSE3214	Python for Data Science	1	1-0-0-1
22	CSE3215	Software Conceptual Design	1	1-0-0-1
23	CSE3117	Industrial Digital Transformation	3	3-0-0-3
24	CSE3118	Blockchain for Decision Makers	3	3-0-0-3
25	CSE3349	Technology for Lawyers	3	3-0-0-3
26	CSE3430	Deep Learning for Natural Language Processing	3	3-0-0-3
27	CSE3431	Machine Learning for Engineering and Science Applications	3	3-0-0-3
28	CSE3432	Algorithms in Computational Biology and Sequence Analysis	3	3-0-0-3
29	CSE3433	Introduction to Large Language Models (LLMs)	3	3-0-0-3
30	CSE3434	Quantum Algorithms and Cryptography	3	3-0-0-3

21.2 MOOC - Open Elective Courses for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Program

Table 3.6: MOOC Open Elective Courses Open Elective Courses Duration is 12 weeks				
Sl. No.	**Course Code**	**Course Name**	**Total Credits**	**L-T-P-C**
1	BBA2022	Supply Chain digitization	3	3-0-0-3
2	BBA2021	E Business	3	3-0-0-3
3	BBB2016	Business Analytics for Management Decisions	3	3-0-0-3
4	BBB2015	Artificial Intelligence for Investments	3	3-0-0-3

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

SEMESTER-1								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE							
			L	T	P	C	CONTACT HOURS	

1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	School Core
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	School Core
3	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	School Core
4	ENG1001/ ENG1002	Foundation of English/ Technical English	1	0	2	2	3	School Core
5	PPS1001	Introduction to soft skills	0	0	2	1	2	School Core
6	CSE1002	Innovative Projects - Arduino using Embedded 'C'	0	0	4	2	4	School Core
7	CHE1018	Environmental Science	1	0	2	0	3	School Core
		TOTAL	10	0	16	16	26	
SEMESTER-2								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE		L	T	P	C	CONTACT HOURS	
1	MAT1003	Applied Statistics	1	0	2	2	3	School Core
2	ECE2007	Digital Design	2	0	2	3	4	Program Core
3	CIV1008	Basic Engineering Sciences	2	0	0	2	2	School Core
4	MEC1006	Engineering Graphics	2	0	0	2	2	School Core
5	CSE1006	Problem Solving using JAVA	1	0	4	3	5	School Core

6	ENG1002/ ENG2001	Technical English/ Advanced English	1	0	2	2	3	School Core
7	CSE2014	Software Engineering	3	0	0	3	3	Program Core
8	PPS1002	Soft Skills for Engineers	0	0	2	1	2	School Core
9	KAN1001/	Kali Kannada / Thili Kannada	1	0	0	1	1	School Core
		TOTAL	13	0	12	19	25	
SEMESTER-3								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE		L	T	P	C	CONTACT HOURS	
1	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	3	School Core
2	CSE1005	Programming in Python	1	0	4	3	5	School Core
3	CSE2001	Data Structures and Algorithms	3	0	2	4	5	School Core
4	CSE2011	Data Communications and Computer Networks	3	0	0	3	3	Program Core
5	CSE2009	Computer Organization and Architecture	3	0	0	3	3	Program Core
6	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	Program Core
7	CSE3001	Artificial Intelligence and Machine Learning	2	0	2	3	4	Program Core
8	CSEXXXX	Discipline Elective - I	3	0	0	3	3	Discipline Elective

9	PPS4002	Introduction to Aptitude	0	0	2	1	2	School Core
		TOTAL	21	0	10	26	31	
SEMESTER-4								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE		L	T	P	C	CONTACT HOURS	
1	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	School Core
2	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	Program Core
3	CSE2074	Database Management Systems	2	0	2	3	4	Program Core
4	CSE2010	Operating Systems	3	0	0	3	3	Program Core
5	CSE3016	Neural Networks and Fuzzy Logic	3	0	0	3	3	Program Core
6	CSE2027	Fundamentals of Data Analytics	3	0	0	3	3	Program Core
7	CSEXXXX	Discipline Elective - II	2	0	2	3	4	Discipline Elective
8	XXXXXXX	Open Elective – I	3	0	0	3	3	Open Elective
9	PPS4004	Aptitude Training - Intermediate	0	0	2	1	2	School Core
10	ECE2011	Innovative Projects Using Raspberry Pi	-	0	-	1	0	School Core
		TOTAL	19	0	10	25	29	

SEMESTER-5								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE L	T	P	C	CONTACT HOURS	BASKET
1	CSE2026	Data Handling and Visualization	2	0	2	3	4	Program Core
2	CSE3087	Applied Machine Learning	2	0	2	3	4	Program Core
3	CSE3078	Cryptography and Network Security	3	0	0	3	3	Program Core
4	CSE2018	Theory of Computation	3	0	0	3	3	Program Core
5	CSE3343	Cloud Computing	2	0	2	3	4	Program Core
6	CSEXXXX	Discipline Elective - III	3	0	0	3	3	Discipline Elective
7	CSEXXXX	Discipline Elective - IV	3	0	0	3	3	Discipline Elective
8	PPS4006	Logical and Critical Thinking	0	0	2	1	2	School Core
9	CSE3216	Mastering Object-Oriented Concepts in Python	0	0	2	1	2	School Core
		TOTAL	18	0	10	23	28	
SEMESTER-6								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET

	CODE		L	T	P	C	CONTACT HOURS	
1	CSE3011	Reinforcement Learning	2	0	2	3	4	Program Core
2	CSE3014	Fundamentals of Natural Language Processing	3	0	0	3	3	Program Core
3	CSE3189	Deep Learning	2	0	2	3	3	Program Core
4	CSE2067	Web Technologies	2	0	2	3	4	Program Core
5	CSEXXXX	Discipline Elective - V	3	0	0	3	3	Discipline Elective
6	CSEXXXX	Discipline Elective - VI	3	0	0	3	3	Discipline Elective
7	XXXXXXX	Open Elective – II	3	0	0	3	3	Open Elective
8	PPS4005	Aptitude for Employability	0	0	2	1	2	School Core
9	CSE3217	Data Structure and Web Development with Python	0	0	2	1	2	School Core
		TOTAL	20	0	6	23	26	
SEMESTER-7								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE		L	T	P	C	CONTACT HOURS	
1	XXXXXXX	Open Elective – III	3	0	0	3	3	Open Elective

2	CSEXXX X	Discipline Elective –VII	3	0	0	3	3	Discipline Elective
3	CSEXXX X	Discipline Elective – VIII	3	0	0	3	3	Discipline Elective
4	CSEXXX X	Discipline Elective – IX	3	0	0	3	3	Discipline Elective
5	CSEXXX X	Discipline Elective – X	3	0	0	3	3	Discipline Elective
6	CSE7101	Capstone Project	-	-	-	4	0	School Core
7	PPS3018	Preparedness for Interview	0	0	2	1	2	School Core
		TOTAL	15	0	2	20	17	
SEMESTER-8								
S. NO.	COURSE	COURSE NAME	CREDIT STRUCTURE					BASKET
	CODE		L	T	P	C	CONTACT HOURS	
1	CSE7302	Internship	-	-	-	8	0	School Core
		TOTAL	0	0	0	8		

23.Course Catalogue

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

The Course Catalogues for the Courses offered in each basket are attached below:

<table>
<tr><td>Course Code: MAT1001</td><td colspan="3">Course Title: Calculus and Linear Algebra

Type of Course: School Core Lab Integrated</td><td>L-T- P-C</td><td>2</td><td>1</td><td>2</td><td>4</td></tr>
<tr><td>Version No.</td><td colspan="8">3.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Basic Concepts of Limits, Differentiation, Integration</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">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.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is <u>Skill Development</u> of student by using <u>Problem Solving Techniques.</u></td></tr>
<tr><td>Course Out Comes</td><td colspan="8">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.
5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Linear Algebra</td><td colspan="4"></td><td>10 Classes</td></tr>
<tr><td colspan="9">Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) AX = O and AX = B using rank method.

Linear Algebra:
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.</td></tr>
</table>

Module 2	**Partial Derivatives**			**10 CLASSES**

Review: Differential calculus with single variable.

Partial Derivatives:
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	**Advanced Integral calculus**			**12 Classes**

Review: Integral calculus for single integrals.

Advanced Integral calculus:
Beta and Gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. 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.
Engineering applications of partial derivatives.

Module 4	**Ordinary Differential Equations**	**Assignment**	**Programming**	**12 Classes**

Review: First order and first-degree Ordinary Differential Equations, Method of separation of variables, Homogeneous and Non- Homogeneous Equations reducible to Homogeneous form.

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 e^{ax}, sinax, cosax, $e^{ax}f(x)$, $x^nf(x)$ etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, D-operators and Inverse D- operators, Method of Variation of Parameters.
Engineering applications of differential equations.

List of Laboratory Tasks:
Introductory Task: Introduction to usage of the software and simple programming tasks. [3 Sessions]
Experiment N0 1: Solution of Simple differentiation with single variable and use of chain Rule.
Experiment No. 2: Solution based on application of Tailors' Series using software
Experiment No. 3: Application of Maxima and Minima condition using software.

Experiment No. 4 Computation of different functions for a specific problem
Experiment No. 5 Computation of Area under a curve.
Experiment No. 6 Solution of a set of simultaneous equations in matrix method
Experiment No. 7 Computation of Eigen Values and Eigen Vectors.
Experiment No. 8 Solution of Partial Differential equation
Experiment No. 9 solution using Cauchy Equation and Lagrange's Equation

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: MatLab, Zylink.

Assignment:

1. List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using MATLAB.
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, Mickhail Khenner, 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 the development of Foundation Skills: All solution methods **Topics relevant to development of Employability skills: Use of Matlab software.**

Course Code: PHY1002	**Course Title: Optoelectronics and Device Physics** **Type of Course: 1] School Core & Laboratory integrated**	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 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, Magnetic materials, Superconductors:			
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. Schrodinger time independent wave equation. Particle in a box			
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: 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. 12: 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=153091 0&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. for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Course Code: **ENG1002**	**Course Title:** **Technical English** **Type of Course:** **1] School Core** **2] Laboratory integrated**	**L-T-P-C**	1-0-2-2
Version No.	1.0 V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.**		

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of the course, the students shall be able to:
1. Develop proficiency in using technical vocabulary and terminology.
2. Apply language skills for better speaking skills in technical fields.
3. Write technical descriptions
4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Technical Communication</td><td>Worksheets& Quiz</td><td>Vocabulary building</td><td>9 Classes</td></tr>
<tr><td colspan="5">Introduction to Technical English
Differences between Technical English and General English
Technical Writing Basics
Technical Vocabulary</td></tr>
<tr><td>Module 2</td><td>Technical Presentation</td><td>Presentations</td><td>Speaking Skills</td><td>12 Classes</td></tr>
<tr><td colspan="5">Introduction
Planning the Presentation
Creating the Presentation
Giving the Presentation</td></tr>
<tr><td>Module 3</td><td>Technical Description</td><td>Assignment</td><td>Group Presentation</td><td>12 Classes</td></tr>
<tr><td colspan="5">Product Description
Process Description
User Manuals
Transcoding: Diagrams, charts and images</td></tr>
<tr><td>Module 4</td><td>Technical Writing</td><td>Assignment</td><td>Writing Skills</td><td>12 Classes</td></tr>
<tr><td colspan="5">Email Writing
Persuasive and Descriptive Language
Professional Email Etiquette
Writing clear and concise technical emails
Communicating technical information effectively
Technical Report Writing
Types of technical reports (Lab reports, research reports, etc.)</td></tr>
</table>

Components of technical reports

Writing an abstract and executive summary

Structure and content organization

Transcoding: diagrams, charts and images

List of Laboratory Tasks:

1. Module-1

Level 1: Worksheets
Level 2: Worksheets

2. Module 2

Level 1: Preparing Presentation
Level 2: Giving Presentation (Individual)

3. Module-3

Level 1: Product Description & User Manual
Level 2: Process Description & Transcoding

4. Module 4

Level 1: Email Writing
Level 2: Report Writing

Targeted Applications & Tools that can be used:

1. Flipgrid
2. Quizzes
3. Youtube Videos
4. Podcast

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1. **Bring out the essence of technical communication with reference to the conventions of technical communication, with examples**
2. **Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.**

The following individual, as well as group Assignments, will be given to the students.

1. **Presentation**
2. **Describing a product/process**
3. **Individual Reports**

Text Books

1. Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers.* Oxford University Press. 2018.
2. Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf

Reference Book:

1. Chauhan, Gajendra Singh, and Kashmiramka, Smita, ***Technical Communication.*** Cengage Publication. 2018.
2. Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.
3. John Bowden. “Writing a Report: How to Prepare, Write & Present Really Effective Reports?”. 9th Edition 2011

Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

4. Sharma, R.C. and K. Mohan. 2011. Business Correspondence and Report Writing, Fourth Edition. Tata McGraw Hill.

Web Resources:
1:https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307. 2;https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdcb8f4a5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih 3: Last,Suzan, et. al. ***Technical Writing Essentials.*** University of Victoria, British Columbia, 2019 (E- Book) 4 Wambui, Tabita Wangare, et al. ***Communication Skills- Volume 1,*** LAP LAMBRET, USA, 2012 (E Book)
Topics Relevant to the Development of Employability Skills: **Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.**

Course Code: CSE1004	Course Title: Problem Solving Using C Type of Course: School Core Lab Integrated.	L-T-P-C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. ACAlso by learning the basic programming constructs they can easily switch over to any other language in future.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using C and attain Employability through Problem Solving Methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: Write algorithms and to draw flowcharts for solving problems Demonstrate knowledge and develop simple applications in C programming constructs Develop and implement applications using arrays and strings Decompose a problem into functions and develop modular reusable code Solve applications in C using structures and Union Design applications using Sequential and Random Access File Processing.					

Course Content:				
Module 1	Introduction to C Language	Quiz	Problem Solving	9 Hrs.
Topics: Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping.				
Module 2	Introduction to Arrays and Strings	Quiz	Problem Solving	9 Hrs.
Topics: Arrays: Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. Strings: Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions.				
Module 3	Functions and Pointers	Quiz	Problem Solving	9 Hrs.
Topics: Functions: Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. Pointers: Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.				
Module 4	Structures and Union	Quiz	Problem Solving	9 Hrs.
Topics: Structures: Introduction – Defining a Structure – Declaring Structure Variable – Accessing Structure Members – Array of Structures – Arrays within Structures – Union: Introduction – Defining and Declaring Union – Difference Between Union and Structure.				
Module 5	File handling	Case Study	Problem Solving	9 Hrs.
Topics: Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files				
List of Practical Tasks Lab Sheet 1 (Module I) Programs using IO Statements, Conditional Statements and Looping Statements Lab Sheet 2 (Module II) Programs using Arrays and Strings Lab Sheet 3 (Module III) Programs using Functions and Pointers Lab Sheet 4 (Module IV) Programs using Structures and Unions Lab Sheet 5 (Module V) Programs using Files				
Text Book(s): 1. E. Balaguruswamy, “Programming in ANSI C”, 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316- 513-0.				
Reference Book(s): Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.				

Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015 Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.
Web Links and Video Lectures: 1. https://nptel.ac.in/courses/106/105/106105171/ 2. https://archive.nptel.ac.in/courses/106/104/106104128/

Topics:

Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Water resources**: Types of water resources- fresh water and marine resources;

Soil and mineral resources: Important minerals; Mineral exploitation Soil as a resource and its degradation.

Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages.

Self- learning topics: Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)- targets, indicators, and challenges for SDGs.

Module 3	**Environmental Issues: Local, Regional and Global**	Case study		**02 Classes**

Topics:

Environmental Pollution: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans- boundary air pollution; Acid rain; Smog.

Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change

Self -learning topics: Environmental issues and scales

Module 4	**Conservation of Biodiversity and Ecosystems**	Assignment		**02 Classes**

Topics:

Biodiversity-Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities.

Self-learning topics: Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.

Module 5	**Environmental Pollution and Health**	Case study		**03 Classes**

Topics:

Pollution, Definition, point and nonpoint sources of pollution, **Air pollution**- sources, major air pollutants, health impacts of air pollution.

Water pollution– Pollution sources, adverse health impacts on human and aquatic life and mitigation, Water quality parameters and standards.

Soil pollution and solid waste- Soil pollutants and their sources, solid and hazardous waste, Impact on human health.

Self-learning topics: Noise pollution, Thermal and radioactive pollution.

Module 6	**Climate Change: Impacts, Adaptation and Mitigation**	Assignment/case		**02 Classes**

Topics:

Understanding climate change: Natural variations in climate; Projections of global climate change with special reference to temperature, rainfall and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Impacts

Vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Indigenous knowledge for adaptation to climate change.

Self-learning topics: Mitigation of climate change: Synergies between adaptation and mitigation measures; National and international policy instruments for mitigation.

Module 7	**Environmental Management**	Case study	Data analysis	**02 Classes**

Topics:

Environmental management system: ISO 14001; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability.

Self-learning topics: Environmental audit and impact assessment; Eco labeling /Eco mark scheme

Module 8	**Environmental Treaties and Legislation**	Case study	Data analysis	**01 Classes**

Topics:

Major International Environmental Agreements: Convention on Biological Diversity (CBD), Major Indian Environmental Legislations: Environmental Protection Act, Forest Conservation Act, Public awareness.

Self-learning topics: Paris Agreement, Conference of the Parties (COP), India's status as a party to major conventions: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act.

List of laboratory tasks : Any eight experiments will be conducted

1. Determination of total alkalinity of a water sample (knowledge)
2. Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
3. Estimation of copper from industrial effluents by colorimetric method (Comprehensive)
4. Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)

5. Estimation of nickel from industrial effluents by titrimetric method (Comprehensive)
6. Estimation of chloride in drinking water by titrimetric method (Comprehensive)
7. Estimation of fluoride in ground water by colorimetric method (Comprehensive)
8. Determination of calcium in aqueous solution (Comprehensive)
9. Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
10. Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
11. Biological oxygen demand of waste water sample (Comprehensive)
12. Determination of dissolved oxygen of an industrial effluent (Comprehensive)
13. Quality monitoring analysis of a soil sample (knowledge)
14. Flame photometric estimation of Sodium and potassium (Application)
15. Gas Chromatographic analysis of volatile organic compounds (Application)

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:

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.)
- Lab evaluation/Assignment
- End Term Exam
- Self-learning

Assignment 1: Write a Statement of Environment report of your town/city/state/country

Assignment 2: Individual students will carry out the analyses of polluted solid, liquid, and gaseous samples and propose suitable mitigation measures. 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 support is given in the form of lab manual and reference links to e-books.

Text Book

1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
2. Krishnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.
3. Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

Reference Books

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.
3. Sinha N., (2020) Wild and Wilful. Harper Collins, India.
4. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/
5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
6. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

E-resources:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_18126
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_8761
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AJ_1_02082022_3333
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_3063
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_20719
6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_16824
7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_3954
8. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_491
9. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488
10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583
11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SP RINGER_INDEST_1_171
12. https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129
13. https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979
14. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECAT

ALOGUE_BASED&unique_id=TE XTBOOK_LIBRARY01_06082022_395&xIndex=4 15.https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf
Topics relevant to Skill Development: Industrial revolution and its impact on the environment, Environmental impact of over-exploitation of water resources, pollution and ill effects, lab experiments for Skills development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. All topics in theory component are relevant to Environment and Sustainability.

Course Code: PPS 1001	**Course Title: Introduction to Soft Skills** **Type of Course: Practical Only Course**	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others		

	CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity			
Course Content:				
Module 1	INTRODUCTION TO SOFT SKILLS		**Classroom activity**	**04 Hours**
Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality				
Module 2	EFFECTIVE COMMUNICATION		**Individual Assessment**	**10 Hours**
Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email- writing, Resume Building- Digital, Video, Traditional.				
Module 3	HABIT FORMATION		**Worksheets & Assignment**	**4 Hours**
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right				
Module 4	Goal setting & Time Management		**Goal sheet**	**8 Hours**
A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity				
Targeted Application & Tools that can be used: LMS				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
1) Individual Assessment 2) LMS MCQ				
The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE1004	Course Title: Problem Solving Using C Type of Course: School Core Lab Integrated.		L- T-P-C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. AC Also by learning the basic programming constructs they can easily switch over to any other language in future.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using C and attain Employability through Problem Solving Methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Write algorithms and to draw flowcharts for solving problems 2. Demonstrate knowledge and develop simple applications in C programming constructs 3. Develop and implement applications using arrays and strings 4. Decompose a problem into functions and develop modular reusable code 5. Solve applications in C using structures and Union 6. Design applications using Sequential and Random Access File Processing.					
Course Content:						
Module 1	Introduction to C Language	Quiz	Problem Solving	9 Hrs.		
Topics: Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping.						
Module 2	Introduction to Arrays and Strings	Quiz	Problem Solving	9 Hrs.		
Topics: Arrays: Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. Strings: Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions.						
Module 3	Functions and Pointers	Quiz	Problem Solving	9 Hrs.		

Topics:
Functions: Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. Pointers: Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.

Module 4	Structures and Union	Quiz	Problem Solving	9 Hrs.

Topics:
Structures: Introduction – Defining a Structure – Declaring Structure Variable – Accessing Structure Members – Array of Structures – Arrays within Structures – Union: Introduction – Defining and Declaring Union – Difference Between Union and Structure.

Module 5	File handling	Case Study	Problem Solving	9 Hrs.

Topics:
Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files

List of
Practical
Tasks Lab
Sheet 1
(Module I)
CHE1018
Lab Sheet 2 (Module II)
Programs using Arrays and Strings
Lab Sheet 3 (Module III)
Programs using Functions and Pointers
Lab Sheet 4 (Module IV)
Programs using Structures and Unions
Lab Sheet 5 (Module V)
Programs using Files

Text Book(s):

1. E. Balaguruswamy, “Programming in ANSI C”, 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316- 513-0.

Reference
Book(s):

1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015
4. Schildt Herbert, “C: The Complete Reference”, Tata McGraw Hill Education, 4th Edition, 2014.
5. Stephen G. Kochan, “Programming in C”, Addison-Wesley Professional, 4th Edition, 2014.

Web Links and Video Lectures:

1. https://nptel.ac.in/courses/106/105/106105171/
2. https://archive.nptel.ac.in/courses/106/104/106104128/

<table>
<tr><td>Course Code:
MAT1003</td><td colspan="3">Course Title: Applied Statistics

Type of Course: School Core</td><td>L T P C</td><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Version No.</td><td colspan="8">3.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">None</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">None</td></tr>
<tr><td>Course Description</td><td colspan="8">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 mind the 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.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of “Applied Statistics” and attain <u>Skill Development</u> Through <u>Problem Solving</u> techniques.</td></tr>
<tr><td>Expected Outcome:</td><td colspan="8">At the end of this course, students will be in a position to

1. apply the techniques of descriptive statistics effectively
2. interpret the ideas of probability and conditional probability
3. demonstrate the knowledge of probability distributions
4. Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.</td></tr>
<tr><td>Module 1</td><td colspan="2">Descriptive Statistics</td><td>Assignment</td><td>Coding needed</td><td colspan="4">10 classes</td></tr>
<tr><td colspan="9">Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson’s Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression .</td></tr>
<tr><td>Module 2</td><td colspan="2">Probability</td><td></td><td></td><td colspan="4">6 classes</td></tr>
<tr><td colspan="9">Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye’s theorem with examples</td></tr>
<tr><td></td><td colspan="2"></td><td></td><td></td><td colspan="4"></td></tr>
</table>

Module 3	**Random Variables and Probability Distributions**		Coding needed	**14 classes**
Introduction to Random variables, 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 mind the 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.

Course Code: ECE2007	**Course Title:** Digital Design **Type of Course:** Theory &Integrated Laboratory	**L- T-P- C**	**2**	**0**	**2**	**3**
Version No.	2.0					
Course Pre-requisites	**[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra**					
Anti-requisites	**NIL**					
Course Description	**The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.** The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through** EXPERIENTIAL **LEARNING.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** i. **Describe** the concepts of number systems, Boolean algebra and logic gates. ii. **Apply** minimization techniques to simplify Boolean expressions. iii. **Demonstrate** the Combinational circuits for a given logic iv. Demonstrate the Sequential and programmable logic circuits v. **Implement** various combinational and sequential logic circuits using gates.					
Course Content:						
Module 1	**Fundamentals of Number systems- Boolean algebra and digital logic**	Application Assignment	Data Analysis task			**06 classes**
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS-Universal Gates (NAND & NOR) Implementations. Introduction to HDL.						

Module 2	**Boolean function simplification**	Application Assignment	Data Analysis task	**08 Classes**
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.				
Module 3	**Combinational Logic circuits:**	Application Assignment	Programming Task & Data Analysis task	**08 Classes**
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. HDL Models of Sequential circuits.				

List of Laboratory Tasks:

Experiment N0 1: Verify the Logic Gates truth table
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 2: 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. 3: 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. 4: Design and Implementations of HS/FS
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 5: Design and Implementations of combinational logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No. 6: Study of Flip flops

Experiment No. 7: Design and Implementations of sequential logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No.8: HDL coding for basic combinational logic circuits
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Experiment No.9: HDL coding for basic sequential logic circuit
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Targeted Application & Tools that can be used:

Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, Home Automation, Communication in systems in industries

Professionally Used Software: HDL/VHDL/Verilog HDL/ OOPS

Text Book(s):

1. Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education, 6th edition
2. Thomas L. Floyd "DIGITAL LOGIC DESIGN" , Pearson Education, fourth edition.

Reference(s):

Reference Book(s):

R1. Jain, R. P., "Modern Digital Electronics", McGraw Hill Education (India), 4th Edition

R2. Roth, Charles H., Jr and Kinney Larry L., "Fundamentals of logic Design", Cengage Learning, 7th Edition

Online Resources (e-books, notes, ppts, video lectures etc.): Book Free Download (studymaterialz.in)

1. **eBook1**: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download

}

3. **eBook2:**Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.
4. NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
5. Digital Logic Design PPT Slide 1 (iare.ac.in)
6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video

CircuitVerse - Digital Circuit Simulator online

Learn Logisim➠ Beginners Tutorial | Easy Explanation! - Bing video

Digital Design 5: LOGISIM Tutorial & Demo

7. https://presiuniv.knimbus.com/user#/home

E-content:

1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168.
2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase2010 13th International Conference on Computer and Information Technology (ICCIT)
3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029.
4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," *2019 IEEE East-West Design & Test Symposium (EWDTS)*, 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.

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

Course Code: CIV1008	**Course Title:** Basic Engineering Sciences **Type of Course:** Theory Only	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.					
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering 2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.					
Course Content:						
Module 1	**Introduction to various fields in Civil Engineering**	Assignment	Case studies on different Civil Engineering Projects	**6 Sessions**		

Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.				
Module 2	**Current Trends and Evolution in Civil Engineering**	Assignment	Article Review	**6 Sessions**
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.				
Module 3	**Power Production and Consumption Machinery**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.				
Module 4	**Overview of Petroleum Engineering**	Assignment & Quiz	Article Review	**6 Sessions**
Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	**Industry 4.0**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				
Project work/Assignment:				
Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering Assignment 2: Review Articles on current evolutions in Civil Engineering. Assignment 3: Collect data related to renewable energy generation (Wind, Solar) Assignment 4: Prepare an energy consumption chart for a compressor or pumps. Assignment 5: Prepare a report on role of 3D printing across various industries. Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.				
Text Book: T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers T2. Elements of Mechanical Engineering, by VK Manglik T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition				

References

1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters and Publishers Pvt Ltd, Mumbai.
2. Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production by Norman J. Hyne, PennWell Books; 3rd Revised edition

Web-resources:

1. Basic Civil Engineering

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live

2. Post-parametric Automation in Design and Construction

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live

3. Smart Cities : Introducing Digital Innovation to Cities

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live

4. Innovation Energy: Trends and Perspectives or Challenges of Energy Innovation

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2323766&site=ehost-live

5. Mechanical Engineering
   https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705
6. Additive Manufacturing: Opportunities, Challenges, Implications
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live
7. Society of Petroleum Engineers (SPE)
   https://www.spe.org/en/
8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering.
   https://petrowiki.spe.org/PetroWiki
9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends.
   https://www.rigzone.com/

Topics relevant to the development of SKILLS:

Engines-Turbines and their applications.
Mechanization in Construction.
Digitization in Petroleum Industries

<table>
<tr><td>Course Code:
MEC1006</td><td colspan="3">Course Title: Engineering Graphics
Type of Course: School Core & Theory Only</td><td>L- T-P-C</td><td>2-0-0-2</td></tr>
<tr><td>Version No.</td><td colspan="5">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">The course is designed with the objective of giving an overview of engineering graphics. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings. The course emphasizes on projection of points, lines, planes and solids and isometric projections.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is to familiarize the learners with the concepts of “Engineering Graphics” and attain SKILL DEVELOPMENT through Problem solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">On successful completion of this course the students shall be able to:

(1) Demonstrate competency of Engineering Graphics as per BIS conventions and standards.
(2) Comprehend the theory of projection for drawing projections of Points, Lines andPlanes under different conditions.
(3) Prepare multiview orthographic projections of Solids by visualizing them indifferent positions.
(4) Prepare pictorial drawings using the principles of isometric projections to visualizeobjects in three dimensions.</td></tr>
<tr><td colspan="6">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to Drawing</td><td>Assignment</td><td>Standard technical drawing</td><td colspan="2">02 Sessions</td></tr>
<tr><td colspan="6">Topics:
Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Lineconventions, dimensioning, Selection of drawing sheet size and scale.
[02 Hours: Comprehension Level]</td></tr>
<tr><td>Module 2</td><td>Orthographic projections of Points, Straight Lines and Plane Surfaces</td><td>Assignment</td><td>Projection methods Analysis</td><td colspan="2">10 Sessions</td></tr>
</table>

Topics:
Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points inall 4 quadrants.
Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.

[10 Hours: Application Level]

Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	**10 Sessions**

Topics:
Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron indifferent positions (Problems resting on HP only and First angle projection).

[10 Hours: Application Level]

Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	**8 Sessions**

Topics:
Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.

[8 Hours: Application Level]

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

References:

1. K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.

2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

3. D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.

Web resources:

https://nptel.ac.in/courses/112103019

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

ENG2001	**Advanced English**	**L- T- P- C**	1	0	2	2
Version No.	1.3					
Course Pre-requisites	ENG1002 Technical English					
Anti-requisites	**NIL**					
Course Description	The course emphasizes on technical communication at advanced level by exploring critical reading, technical presentation and review writing. The purpose of the course is to enable learners to review literature in any form or any technical article and deliver technical presentations. Extensive activities in practical sessions equip to express themselves in various forms of technical communications. Technical presentations and the module on career setting focus on learners' area of interests and enhance their English language writing skills to communicate effectively.					
Course Out Come	On successful completion of the course the students shall be able to: 1. Develop a critical and informed response reflectively, analytically, discursively, and creatively to their reading. 2. Communicate effectively, creatively, accurately and appropriately in their writing. 3. Deliver technical presentations 4. Design resume and create professional portfolio to find a suitable career					

Course Content: Theory

Module 1	**Critical Reasoning and Writing**	**Writing Essays**	**Critical Reading**	**4 Classes**

Topics:

- A Catalog of Reading Strategies
- The Myth of Multitasking
- A Guide to Writing Essays Speculating about Causes or Effects
- Is Google Making Us Stupid (Self Study)

Module 2	**Technical Presentation**	**Presentation**	**Oral Skills**	**3 Classes**

Topics:

- Planning the presentation

- Creating the presentation
- Giving the presentation

Module 3	**Writing Reviews**	**Prezi**	**Review Writing**	**4 Classes**

Topics:

- Review Writing
- Short film reviews
- Advanced English Grammar (Self Study)

Module 4	**Starting your Career**	**Online Writing Lab**	**Writing Skills**	**4 Classes**

Topics**:**

- Preparing a Resume
- Writing Effective Application Letter
- Creating a Professional Portfolio

Course Content: Practical Sessions

Module 1	**Critical Reasoning and Writing**	**8 Classes**

1. Reading and Analyzing
   Level 1 – Annotation
   Level 2 - Assumptions
2. Writing Narrative Essays
   Level 1 – Draft 1
   Level 2 – Draft 2

Module 2	**Technical Presentation**	**10 Classes**

3. Fishbowl
   In Fishbowl, students form concentric circles with a small group inside and a larger group outside. Students in the inner circle engage in an in-depth discussion, while students in the outer circle listen and critique content, logic, and group interaction.
   Level 1 – within group
   Level 2 – Among 2 group
4. Technical Group Presentation

Module 3	**Writing Reviews**	**4 Classes**

5. Practice Worksheets
   Level 1 – Eliminating the Passive Voice
   Level 2 – Simple, compound and complex sentences
6. Writing Short Film Reviews

Module 4	**Starting your Career**	**6 Classes**

7. Collaborative Project
   Job search and writing report

Writing Resume		
Module 1-4	**Academic Journal**	**2 Classes**
8. Academic Journal Writing Level 1- Mid Term Level 2 – End Term		
Targeted Application & Tools that can be used: Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com		
Project work/Assignment:		
Academic Journal – Assignment In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.		
References 1. Hering, Heik. *How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation*. Springer. 2. Johnson, Richard. (2010) *Technical Communication Today.* Pearson, 2015 3. Rice B. Adelrod, Charles R. Cooper and Ellen C. Carillo. (2020) *Reading Critically Writing Well: A Reader and Guide*. Beford/St. Martin's Macmillan Learning, New York. 4. The Princeton Review. (2010) *MCAT Verbal Reasoning & Writing.* The Princeton Review, Inc. 5. https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021 6. https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021		
Topics Relevant to "employability": Critical Reasoning, Presentation, Review Writing and Starting Career **Topics Relevant to "Human Values and Professional Ethics":** Critical reasoning		

Course Code: ECE2010	**Course Title: Innovative Projects using Arduino**	**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 Arduino microcontrollers and their application in various real time projects involving sensors. Throughout the course, students will learn the fundamentals of Arduino programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Arduino boards, read sensor data, and use it to control various output devices This course is suitable for beginners who are interested in exploring the world of electronics and developing practical applications using Arduino and sensors.					
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) Explain the main features of the Arduino prototype board 2) Demonstrate the hardware interfacing of the peripherals to Arduino system. 3) Understand the types of sensors and its functions 4) Demonstrate the functioning of live projects carried out using Arduino system.					
Course Content:						
Module 1	**Basic concepts of Arduino**	Hands-on	Interfacing Task and Analysis	**4 Sessions**		
Topics: Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, API's ,						

Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables, Arduino i/o Functions, Arduino Communications, Arduino IDE, Various Cloud Platforms.				
Module 2	**Sensory Devices**	Hands-on	Interfacing Task and Analysis	**4 Sessions**
Arduino 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.				
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): **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.

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.

<table>
<tr><td>Course Code:
CSE2001</td><td colspan="3">Course Title: Data Structures and Algorithms
Type of Course: Integrated</td><td>L- T-P- C</td><td>3-0-2-4</td></tr>
<tr><td>Version No.</td><td colspan="5">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">Problem Solving Using Java</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is to familiarize the learners with the concepts of Data Structures and Algorithms and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="5">On successful completion of the course the students shall be able to:
CO1: Implement program for given problems using fundamentals of data structures. [Application]
CO2: Apply an appropriate linear data structure for a given scenarios. [Application]
CO3: Apply an appropriate non-linear data structure for a given scenarios. [Application]
CO4: Explain the performance analysis of given searching and sorting algorithms.</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Introduction to Data Structure and Linear Data Structure – Stacks and Queues</td><td>Assignment</td><td colspan="2">Program activity</td><td>18 Sessions</td></tr>
<tr><td colspan="6">Introduction – Introduction to Data Structures, Types and concept of Arrays.
Stack - Concepts and representation, Stack operations, stack implementation using array and Applications of Stack.
Queues - Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.</td></tr>
<tr><td>Module 2</td><td>Linear Data Structure- Linked List</td><td>Assignment</td><td colspan="2">Program activity</td><td>17 Sessions</td></tr>
<tr><td colspan="6">Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list.
Recursion - Recursive Definition and Processes, Programming examples.</td></tr>
</table>

Module 3	**Non-linear Data Structures - Trees and Graph**	Assignment	Program activity	**15 Sessions**
Topics: **Trees** - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post - Order traversal. **Graph** - Basic Concept of Graph Theory and its Properties, Representation of Graphs.				
Module 4	**Searching & Sorting Performance Analysis**	Assignment	Program activity	**14sessions**
Topic: **Sorting & Searching** - Sequential and Binary Search, Sorting – Selection and Insertion sort. **Performance Analysis** - Time and space analysis of algorithms – Average, best and worst case analysis.				

List of Laboratory Tasks:

Lab sheet -1

Level 1: Prompt the user, read input and print messages. Programs using class, methods and objects

Level 2: Programming Exercises on fundamental Data structure - Arrays based on Scenario.

Lab sheet -2

Level 1: Programming Exercises on Stack and its operations

Level 2: Programming Exercises on Stack and its operations with condition

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming Exercises on Queues and its operations with conditions

Level 2: -

Lab sheet -5

Level 1: Programming Exercises on Linked list and its operations.

Level 2: Programming Exercises on Linked list and its operations with various positions

Lab sheet -6

Level 1: -

Level 2: Programming scenario based application using Linked List

Lab sheet -7

Level 1: Programming Exercises on factorial of a number

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -8

Level 1: -

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9

Level 1: Programming Exercise on Doubly linked list and its operations

Level 2: -

Lab sheet -10

Level 1: Program to Construct Binary Search Tree and Graph

Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and post-order) and implement BFS and DFS

Lab sheet -11

Level 1: Program to Implement the Linear Search & Binary Search

Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -12

Level 1: Program to Implement and Estimate the Time complexity of Insertion Sort
Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -13

Level 1: Program to Implement and Estimate the Time complexity of Selection Sort
Level 2: Program to Implement and Estimate the Time complexity of Selection Sort

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Ubuntu for lab programs to execute. Tool is Codetantra tool.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text Book

T1 Narasimha Karumanchi: *"Data Structures and Algorithms Made Easy in Java",* 5th Edition, CareerMonk Publications, 2017.

References

R1 Mark Allen Weiss: *"Data Structures and Algorithm Analysis in Java",* 4th Edition, Pearson Educational Limited, 2014.

R2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: *"Data Structures and Algorithms in Java"*, 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014.

R3 Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: *"Introduction to Algorithms",* 3rd Edition, PHI Learning Private Limited.

Web resources:

1. For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview
2. For Lab : codetantra tool
3. https://puniversity.informaticsglobal.com/login

Topics relevant to "SKILL DEVELOPMENT": Linked list and its type, Tree traversal and hashing tables for Skill Development through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3155	Course Title: Data Communications and Computer Networks Type of Course: Program Core Theory–Laboratory integrated	L-T-P-C 3-0-2-4	3	0	2	4
Version No.	1.0					
Course Pre-requisites	Digital Design					
Anti-requisites	NIL					
Course Description	The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. . The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course, the students shall be able to: 1] I llustrate the Basic Concepts Of Data Communication and Computer Networks. 2] Analyze the functionalities of the Data Link Layer. 3] Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks. 4] Demonstrate the working principles of the Transport layer and Application Layer.					
Course Content:						

Module 1	Introduction and Physical Layer-CO1	Assignment	Problem Solving	07 Classes
Introduction to Computer Networks and Data communications, Network Components – Topologies, Transmission Media –Reference Models -OSI Model – TCP/IP Suite. Physical Layer -Analog and Digital Signals – Digital and Analog Signals – Transmission - Multiplexing and Spread Spectrum.				

Module 2	Reference Models and Data Link Layer – CO2	Assignment	Problem Solving	**7 Classes**

Data Link Layer - Error Detection and Correction – Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and Wait, ARQ, Sliding Window, Multiple Access Protocols, CSMA/CD,CSMA/CA, IEEE 802.3, IEEE 802.11 Ethernet.

Module 3	Network Layer – CO 3	Assignment	Problem Solving	**10 Classes**

Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods- IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing – RIP-BGP-Link State Routing –OSPF-Multi cast Routing-MOSPF- DVMRP – Broad Cast Routing. EVPN-VXLAN, VPLS, ELAN.

Module 4	Transport and Application Layer -CO3	Assignment	Problem Solving	**10 Classes**

Transport Layers - Connection management – Flow control – Retransmission, UDP, TCP, congestion control, – Congestion avoidance (DECbit, RED)
The Application Layer: Domain Name System (DNS), Domain Name Space, SSH, FTP, Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – – SNMP, Web Services, Virtual Networking.

List of Laboratory Tasks:

Lab sheet -1, M-1, 3 [2 Hours]
Experiment No 1:
Level 1: Study of basic network commands and network configuration commands.

Lab sheet -2, M-1[2 Hours]
Experiment No 1:
Level 1: Identify and explore Network devices, models and cables. Introduction to Cisco packet tracer.
Experiment No. 2:
Level 2 – Create various network topologies using a cisco packet tracer.

Lab sheet -3, M-2,3 [2 Hours]
Experiment No. 1:
Level 2 - Basic Configuration of switch/router using Cisco packet tracer.
Experiment No. 2:
Level 2 -Configure the privilege level password and user authentication in the switch/router.

Lab sheet – 4, M-3 [2 Hours]
Experiment No. 1:
Level 2 - Configure the DHCP server and wireless router and check the connectivity

Lab sheet – 5, M-3 [2 Hours]
Experiment No. 1:
Level 2 - Configure the static routing in the Cisco packet tracer.
Experiment No. 2:
Level 2 - Configure the dynamic routing protocol in the Cisco packet tracer.

Lab sheet – 6, M-4 [2 Hours]
Experiment No. 1: Configuration of DNS Server with Recursive & Integrative approach in Cisco packet tracer.

Lab sheet – 7, M-4 [2 Hours]
Experiment No. 1:
Configure the telnet protocol in the router using the Cisco packet tracer.
Lab sheet – 8, M-4[2 Hours]
Experiment No. 1:
Level1- Introduction to NS2 and basic TCL program.
Lab sheet – 9, M-4 [2 Hours]
Experiment No. 1:
Level 1: Simulate three node Point to point network using UDP in NS2.
Experiment No. 2:
Simulate transmission of Ping message using NS2.
Lab sheet – 10, M-4[2 Hours]
Experiment No. 1:
Simulate Ethernet LAN using N-node in NS2.
Experiment No. 2:
Simulate Ethernet LAN using N-node using multiple traffic in NS2
Lab sheet –11, M-3,4 [2 Hours]
Experiment No. 1:
Level 1- Introduction to Wire Shark.
Experiment No. 2:
Level 2- Demonstration of packet analysis using wire shark.

Lab sheet –12, M-1,2,3 [2 Hours]
Experiment No. 1:
Level 2- Demonstration of switch and router configuration using real devices

Targeted Application & Tools that can be used: Cisco Packet Tracer, Wireshark, and NS2.

Case Study/Assignment: Choose and analyze a network from any organization/Assignment proposed for this course in CO1-CO4

1. **Problem Solving: Choose and appropriate devices and implement various network concepts.**
2. **Programming: Simulation of any network using NS2.**

Text Book

1. **Behrouz A. Forouzan, "Data Communications and Networking 5E", 5th Edition, Tata McGraw-Hill, 2017.**
2. **Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022**

References

1. **"Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.**

2. **William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.**

3. **Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.**

E-Resources:

1.https://archive.nptel.ac.in/courses/106/105/106105183/

2. http://www.nptelvideos.com/course.php?id=393

3.https://www.youtube.com/watch?v=3DZLItfbqtQ

4.https://www.youtube.com/watch?v=_fIdQ4yfsfM

5. https://www.digimat.in/keyword/106.html

https://puniversity.informaticsglobal.com/login

Course Code: CSE2009	**Course Title: Computer Organization and Architecture**		**L-T- P- C**	3-0-0-3
Version No.	2.0			
Course Pre-requisites	CSE 2015 Digital Design			
Anti-requisites	**NIL**			
Course Description	This course introduces the core principles of computer architecture and organization from basic to intermediate level. This theory based course emphasizes on understanding the interaction between computer hardware and software. It equips the students with the intuition behind assembly-level instruction set architectures. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Computer Organization and Architecture** and attain **Skill Development** through **Participative Learning** techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: 1] Describe the basic components of a computer, their interconnections, and instruction set architecture [Comprehension] 2] Apply appropriate techniques to carry out selected arithmetic operations 3] Explain the organization of memory and processor sub-system			
Course Content:				
Module 1	Basic Structure of computers	Assignment	Data Analysis task	**12 Classes**
Topics: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Computer systems RISC & CISC, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Arithmetic Operations on Signed numbers. Instructions and Instruction Sequencing, Instruction formats, Memory Instructions.				
Module 2	Instruction Set Architecture and Memory Unit	Assignment	Analysis, Data Collection	**12 Classes**
Topics: **Instruction Set Architecture:** Addressing Modes, Stacks and Subroutines. **Memory System:** Memory Location and Addresses, Memory Operations, Semiconductor RAM Memories, Internal Organization of Memory chips, Cache memory mapping Techniques.				
Module 3	Arithmetic and Input/output Design	Case Study	Data analysis task	**10 Classes**
Topics: **Arithmetic:** Carry lookahead Adder, Signed-Operand Multiplication, Integer Division, and Floating point operations. Input/output Design: Accessing I/O Devices, I/O communication, Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits				

Module 4	BPU and Pipelining	Assignment	Analysis, Data Collection	**11 Classes**

Topics:
Basic Processing Unit: Fundamental Concepts, Single Bus organization, Control sequence, Execution of a Complete Instruction, Multiple Bus Organization.
Pipelining: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Hazards.

Targeted Application & Tools that can be used:

Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc.

Tools:

- Virtual Lab, IIT KGP
- Tejas – Java Based Architectural Simulator, IIT Delhi

Text Book

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", Fifth Edition, McGraw-Hill Higher Education, 2016 reprint.

References

1. William Stallings, "Computer Organization & Architecture – Designing for Performance", 11th Edition, Pearson Education Inc., 2019

2. David A. Patterson & John L. Hennessy, "Computer Organization and Design MIPS Edition- The Hardware/Software Interface", 6th Edition, Morgan Kaufmann, Elsevier Publications, November 2020.

Web References:

1. NPTEL Course on "Computer architecture and organization" IIT Kharagpur By Prof. Indranil Sengupta, Prof. Kamalika Datta. https://nptel.ac.in/courses/106105163
2. NPTEL Course on "Computer Organization", IIT Madras By Prof. S. Raman. https://nptel.ac.in/courses/106106092
3. https://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to "SKILL DEVELOPMENT": Generation of Computers, CISC and RISC processors, Bus Arbitration, Collaboration and Data collection for Term assignments and Case Studies for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: MAT2004	**Course Title: Discrete Mathematical Structures** **Type of Course: Program Core**	**L-T- P-C**	3	0	0	3
Version No.	1.0					

Course Pre-requisites	**Nil**			
Anti-requisites	**Nil**			
Course Description	The course provides insights into the fundamental aspects of mathematical logic and predicate calculus. The course delves deeply into the concepts of algebraic structures, lattices and Boolean algebras which are widely used in computer science and engineering. It also highlights the principles of counting techniques and their applications.			
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**			
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain logical sentences through predicates, quantifiers and logical connectives. CO2: Comprehend the basic principles of set theory and different types of relations. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Deploy the counting techniques to tackle combinatorial problems.			
Course Content:				
Module 1	**Mathematical Logic and Predicate Calculus**			**12 classes**
Propositional Logic, Propositional Logic Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus.				
Module 2	**Algebraic Structures**			**10 classes**
Sets and set-operations, functions, relations and their properties & representations of relation by matrix, closure of different type of relations, equivalence relations, primitive recursive function.				
Module 3	**Lattices and Boolean Algebra**			**11 classes**
Partial ordering, Posset, Lattices & Algebraic structures, Sub lattice, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra, cancellation laws and unique complement theorem.				
Module 4	**Principles of Counting Techniques**			**12 classes**
Chinese Remainder Theorem, pigeonhole principle, generalized pigeonhole principle, Generalized Permutations and Combinations, Recurrence Relations.				

Targeted Application & Tools that can be used:

Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Assignment 1: Logic Equivalences and Predicate calculus.
Assignment 2: Equivalence Relations and Lattices
Assignment 3: Recurrence Relations

Text Books

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill's 7th Edition, 2011.
2. Kolman, Bernard; Busby, Robert C; Ross, Sharon Cutler," Discrete mathematical structures", Pearson India, 6th Edition, 2015.
3. Liu, C L Mohapatra, D P.," Elements of Discrete Mathematics a Computer oriented approach", New Delhi McGraw Hill Education, 4th Edition, 2015.
4. Mott, Joe L; Kandel, Abraham; Baker, Theodore P, "Discrete Mathematics for Computer Scientists and Mathematicians", Pearson India, 2nd Edition, 2015.
5. Epp, Susanna S, "Discrete Mathematics with applications", New Delhi Cengage Learing, 4th Edition, 2016.

References:

1. Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
2. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.

Course Code: **CSE3190**	**Course Title: Fundamentals of Data Analytics** **Type of Course: Theory-embedded Lab**	**L-T- P- C**	2	0	2	3
Version No.	3.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Fundamentals of Data Analytics is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an intuitive way to analysis the data. This course will help the students to apply the knowledge on data analysis to a wide range of applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Fundamentals of Data Analytics** and attain **SKILL DEVELOPMENT** through **PROBLEM SOLVING** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) **Explain different types of data and variables.** 2) **Interpret data using appropriate statistical methods.** 3) **Demonstrate the collection, processing and analysis of data for any given application and Illustrate various charts using visualization methods.** 4) **Apply the Data Analysis techniques by R Programming**					
Course Content:						
Module 1	Introduction to Data Analysis	Assignment	Data Collection, data analysis, Programming			**8 Sessions**
Topics: Introducing Data, overview of data analysis: Data in the Real World, Data vs. Information, The Many "Vs" of Data, Structured Data and Unstructured Data, Types of Data, Data Analysis Defined, Types of Variables, Central Tendency of Data, Scales of Data, Sources of Data. Data preparation. **R Studio:** Base R-R Studio IDE-Introduction to R Projects and R Markdown. Basic R: R as a Calculator-Scripts and Comments-R Variables. Data I/O: Working Directories-Importing Data Exporting Data-More ways to save-Data I/O in Base R.						
Module 2	Data Analysis and Visualization	Case studies	Programming			**8 Sessions**
Topics: Data Summarization: One Quantitative and Categorical Variable. Data Classes: One Dimensional Data Classes-Data Frames and Matrices-Lists. Data Cleaning: Dealing with Missing Data-						

Strings and Recoding Variables. Manipulating Data in R: Reshaping Data-Merging Datasets. Data Visualizations: Plotting with ggplot2- Plotting with Base R

Module 3	Statistical Analysis	Case studies	R programming	**7 Sessions**

Topics: Proportion tests-Chi squared test-Fisher exact test-Correlation-T test-Wilcoxon Rank sum tests-Wilcoxon signed rank test- one-way ANOVA test- Kruskal Wallis test

Module 4	Predictive Analysis	Case studies	Programming	**8 Sessions**

Topics: Linear least-squares – implementation – the goodness of fit – testing a linear model – weighted resampling. Regression using Stats models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – accuracy. Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis

List of Laboratory Tasks:

Experiment No. 1: Introduction to R and RStudio

Level 1: Getting Started with R and RStudio

- Installing R and RStudio.
- Basic R syntax and commands.

Level 2: Working with RStudio

- Understanding the RStudio interface.
- Creating and managing R scripts.

Experiment No. 2: Basic Data Handling in R

Level 1: Data Types and Structures in R

- Vectors, matrices, and data frames.
- Lists and factors.

Level 2: Data Import and Export

- Reading data from CSV, Excel, and text files.
- Exporting data to different formats.

Level 3: Exploring Datasets

- Using functions like head(), summary(), and str().

Experiment No. 3: Basic Data structure in R

Level 1: a. Demonstrate a program to join columns and rows in a data frame using cbind() and rbind() in R.

b.Implement different data structures in R (Vectors, Lists, Data Frames)

Level 2: R AS CALCULATOR APPLICATION a. Using with and without R objects on console

a. Using mathematical functions on console
b. Write an R script, to create R objects for the calculator application

Experiment No. 4: Data Cleaning and Preprocessing

Level 1: Handling Missing Data in R

- Identifying missing values.
- Imputing missing values using mean, median, or other methods.

Level 2: Data Transformation in R

- Standardizing and normalizing data.
- Log-transformations and scaling.

Experiment No. 5: Exploratory Data Analysis (EDA) with R

Level 1: Descriptive Statistics

- Calculating mean, median, and standard deviation.
- Visualizing data using histograms, box plots, and scatter plots.

Experiment No. 6: Data Visualization with ggplot2

Level 1: Demonstrate various graphs that can be made and altered using the ggplot2 package.

Level 2: Create 500 random temperature readings for six cities over a season and then plot the generated data using ggplot2 packages in R

Experiment No. 7: Perform Tests of Hypotheses hypothesis test (parametric)

Level 1: How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value.

Level 2: A teacher claims that people who work for only five hours per week will score significantly lower than people who work for ten hours per week on a quantitative abilities test. He brings twenty people and randomly assigned them to one or two groups. In one group he has participants who work for ten hours and in another group, he has participants who work for five hours. He conducts the test for all participants. Scores on the test range from one to ten with higher scores representing better performance. Test if there is any significant difference between those who work for five hours per week versus those who work for ten hours per week based on the test performance.

Experiment No 8: Hypothesis – Non-Parametric Test

Level 1: A car manufacturing company like to find the sales of three types of cars produced by them in three regions and is given. Test if there is an association between the regions and types of cars purchased.

Experiment No 9: Correlation and Covariance

Level 1: Using the iris data set in R

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

Level 2 : Ramesh is doing a statistics paper in his post-graduation course. He met his friend Amal who is a textile engineer. Ramesh, who is doing his internship at ABC Researchers, is interested in a question. He poses this question to Amal and tries to find if he can answer. The question is as follows: The data regarding sales of soft- drinks and sales of cotton clothes in a place during the last 12 months are given. Find if there is any association between sales of soft drinks and sales of cotton clothes. Also explain the reason if there is any relationship.

Experiment No 11: Regression Model

Level 1: Import data from web storage (http://www.ats.ucla.edu/stat/data/binary.csv). Name the dataset and now do Logistic Regression to find out the relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained, and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS).

Level 2: Demonstrate multiple regressions, if data have a continuous Independent variable. Apply on the above dataset

Experiment No. 12: Time Series Analysis in R

Level 1: Demonstrate Time series analysis using Time Series Data Library at http://robjhyndman.com/TSDL/.

Targeted Application & Tools that can be used:

Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc.

Text Books

2. Glenn J. Myatt and Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback", Import, 22 July 2014.
3. Introduction to statistics and Data analytics, Christian H, Michael S, Springer,2016
4. Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020 (E-resource)
5. Introduction to Time Series and Forecasting (Springer Texts in Statistics), Peter Brockwell, Richard A. Davis, Springer, 2016.

References

1. Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback, Glenn J. Myatt and Wayne P. Johnson, Import, 22 July 2014.
2. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet, Springer 2013.

Online resources:

http://www.modernstatisticswithr.com/solutions.html#solutionsch3

https://johnmuschelli.com/intro_to_r/

https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/

Topics relevant to development of "FOUNDATION SKILLS":

1. Statistical Concepts for data, visualization techniques.
2. Data collection for project based assignments.
3. Inferential Statistics (T test, Z test)
4. Probability Calculation

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

Course Code: ECE2001	**Course Title: Innovation Project-Raspberry Pi Using Python**	**L- T-P-C**	0	4	2

	Type of Course: School Core & Practical Only.			This includes few lecture sessions	
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	The Raspberry Pi is an amazing single board computer (SBC) capable of running Linus and a whole host of applications. Python is a beginner-friendly programming language that is used in schools, web development, scientific research, and in many other industries. This course will enable students in writing own programs with Python to blink lights, respond to button pushes, read sensors, log data on the Raspberry Pi and many more. The course also offers in-depth knowledge of designing, developing, coding and implementing projects using Raspberry Pi.				
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Write a program in Python. 2. Explain the main features of the Raspberry Pi board 3. Demonstrate the hardware interfacing of the peripherals to Raspberry Pi system. 4. Demonstrate the functioning of live various projects carried out using Raspberry Pi system.				
Course Content:					
Module 1	Basics of Python, functions	Quiz	Problem Solving	**4 Lab Sessions**	
Topics: Introduction, Structure of Python Program, Data Types and Variables, Input and Output, Operators, Importing libraries, Functions, Development Tool. **Concepts will be taught by solving problems through programs.**					
Module 2	**Python Programming**	Quiz	Problem Solving	**4 Lab Sessions**	
Control statements, Lists and Dictionaries, Problem solving using Python. **Concepts will be taught by solving problems through programs.**					
Module 3	**Overview of Raspberry Pi**	Project Development	System Design Task and Analysis	**4 Lab Sessions**	
Topics: An exploration of GPIO pins, LED and switch control. Installation of libraries, PuTTY SSH. Raspberry Pi to interface with more complicated sensors and actuators like Pi Camera, servo motor ADS51115 through PIP libraries. Arduino with Raspberry-pi					
Module 4	**Interaction with API Services**	Project Development	Modeling and Simulation task	**3 Lab Sessions**	
Topics: Raspberry Pi interact with online API services through the use of public APIs and SDKs using Firebase, Gspread API. Node-RED – a programming tool for wiring together hardware devices, MQTT. Android/Case study.					
Targeted Application & Tools that can be used: Making it a reality (Raspberry Pi Projects) :					

Projects will include but not limited to : 1) Intelligent home locking system. 2) Intelligent water level management system. 3) Home automation using RFID. 4) Real time clock-based home automation. 5) Intelligent Automatic Irrigation System **Professionally Used Software: Raspberry Pi.**
Project work/Python Lab Test:
Project work **Python test.**
Text Book(s): **1) Ashok Namdev Kamthane, Amit Ashok Kamthane, *"Problem Solving and Python Programming"*, Mc Graw Hill Education, 2018.**
Reference(s): 1. **https://github.com/thibmaek/awesome-raspberry-pi** 2. MagPi magazine
Topics relevant to development of "Foundation Skills": Basic Concepts of Python-Programming, and Raspberry Pi. Topics related to development of "Employability Skills": Problem solving, Creative Thinking, Team work, Prototype Development. Topics related to development of "Entrepreneurship": Effective Communication, Strategic Thinking, Creative Thinking.

Evaluation:	Review-1-20%, Review-2-25%, Python test-25%, Project Expo-30%

Course Code: CSE2014	**Course Title: Software Engineering** **Type of Course: School Core [Theory Only]**	**L-T- P-C**	**3-0-0-3**
Version No.	1.0		
Course Pre-requisites	**NIL**		
Anti-requisites	**NIL**		
Course Description	The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles. The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course covers software quality, configuration management and maintenance.		
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Participative Learning techniques.		

Course Out Comes	On successful completion of this course the students shall be able to: 1] Describe the Software Engineering principles, ethics and process models(Knowledge) 2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension) 3] Understand the Agile Principles(Knowledge) 4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application)			
Module 1	**Introduction to Software Engineering and Process Models (Knowledge level)**	Quiz		**09 Hours**
Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle **Models:** Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.				
Module 2	**Software Requirements, Analysis and Design (Comprehension level)**	Assignment	Development of SRS documents for a given scenario	**11 Hours**
Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, Software Requirements Specification (SRS), Requirement Analysis and validation. Requirements modelling- Introduction to Use Cases, Activity diagram and Swim lane diagram. CASE support in Software Life Cycle, Characteristics of CASE Tools, Architecture of a CASE Environment. **Design:** Design concepts, Architectural design, Component based design, User interface design.				
Module 3	**Agile Principles & Devops (Knowledge level)**	Quiz		**09 Hours**
Agile: Scrum Roles and activities, Sprint Agile software development methods - Scaling, User Stories, Agile estimation techniques, Product backlogs, Stake holder roles, Dynamic System Development Method. **Devops:** Introduction, definition, history, tools.				
Module 4	**Software Testing and Maintenance (Application Level)**	Assignment	Apply the testing concepts using Programing	**12 Hours**
Software Testing-verification and validation, Test Strategies - White Box Testing, Black box Testing. Automation Tools for Testing. **Software Quality Assurance**-Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management- SCM process, SCM Tools (GitHub). **Maintenance-** Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models.				
Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
Text Book 1] Roger S. Pressman, "Software Engineering – A Practitioner's Approach", VII Edition, McGraw-2017. 2] Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-2018.				
References				

Rajib Mall, “Fundamentals of Software Engineering”, VI Edition, PHI learning private limited, 5. Ian Sommerville, “Software Engineering”, IX Edition, Pearson Education Asia, 2011. Agile Software Development Principles, Patterns and Practices.1st Edition, Wiley, 2002
Topics Relevant to “Skill Development: Balck box Testing, White box Testing, Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout

Course Code: CSE1005	**Course Title:** Programming in Python **Type of Course:** School Core Lab Integrated	**L- T-P-C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	Basic knowledge of Computers and Mathematics					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to enable the students to develop python scripts using its basic programming features and also to familiarize the Python IDLE and other software’s. This course develops analytical skills to enhance the programming abilities. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to build real time applications.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Programming in Python and attain **Employability** through **Problem Solving** Methodologies.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Summarize the basic Concepts of python. 2. Demonstrate proficiency in using data structures. 3. Illustrate user-defined functions and exception handling. 4. Identify the various python libraries.					
Course Content:						
Module 1	Basics of Python programming	Assignment	Programming		**14 Classes**	
Topics: Data types, operators and Expressions, Input and Output Statements. Control Structures – Selective and Repetitive structures						
Module 2	Indexed and Associative Data Structures	Simple applications	Programming		**20 Classes**	
Topics: Strings, Lists, Sets, Tuples, Dictionaries						

Module 3	Functions, Exception handling and libraries	Case study	Programming	**10 Classes**

Topics: User defined functions, exception handling, Introduction to python built-in libraries

Targeted Application & Tools that can be used:

Targeted Application : Web application development, AI, Operating systems

Tools: Python IDLE, ANACONDA

- **Application Areas:**
- Web Development
- Game Development
- Scientific and Numeric Applications
- Artificial Intelligence and Machine Learning
- Software Development
- Enterprise-level/Business Applications
- Education programs and training courses
- Language Development
- Operating Systems
- Web Scrapping Applications
- Image Processing and Graphic Design Applications

Professionally Used Software: Python IDLE, Spyder, Jupyter Notebook, Google Colab

Project work/Assignment:

Project Assignment: Developing python scripts using built in methods and functions

Text Books:

- Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education, Forth edition (20 March 2018).
- Alex Campbell, "Python for Beginners: Comprehensive Guide to the Basics of Programming, Machine Learning, Data Science and Analysis with Python", August 29, 2021.
- Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India Edition,2015.

References:

1. E. Balagurusamy, "Introduction to Computing and Problem Solving Using Python", Tata McGraw-Hill, 2016
2. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 2017
3. Brady Ellison, "Python for Beginners: A crash course to learn Python Programming in 1 Week (Programming Languages for Beginners)", August 25, 2021.
4. Python Tutor - Visualize Python, Java, C, C++, JavaScript, TypeScript, and Ruby code execution
5. https://practice.geeksforgeeks.org/courses/Python-Foundation

Topics relevant to development of "FOUNDATIONS SKILLS"- Solve the real time problems by analyzing and visualizing the data.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS"- Data collection and its arrangement

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 course focuses 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, differentiation and Integration**			**15 Classes**		
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 Engineering Computations, 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: This course focuses 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.

Course Code: CSE2007	**Course Title:** **Design and Analysis of Algorithms** **Type of Course:** **Program Core & Theory only**	**L- T- P- C**	3	0	0	3

Version No.		2.1
Course Pre-requisites		CSE2001, Data Structure and Algorithms
Anti-requisites		**NIL**
Course Description		This intermediate course enables students to design and analyze efficient algorithms to solve problems. This course covers typical design methods such as divide-and-conquer, dynamic programming and greedy method to solve problems. The students shall develop strong analytical skills as part of this course.
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.
Course Outcomes		**On successful completion of the course the students shall be able to:** **1] Identify the efficiency of a given algorithm. [Comprehension]** **2] Employ divide and conquer approach to solve a problem. [Application]** **3] Illustrate dynamic programming approach to solve a given problem. [Application]** **4] Solve a problem using the greedy method. [Application]** **5] Discuss the techniques to solve a real-world problem based on its complexity classes. [Comprehension]**
Course Content:		

Module 1	Introduction to Algorithms	Assignment		Problem Solving	**06 Sessions**
	Topics: Algorithm Design and efficiency, measuring of running time of algorithms. Insertion sort and merge sort, Asymptotic Growth and Notations. Recurrences--Masters method. **Assignment:** Comparatively evaluate bubble sort, insertion sort and mergesort.				

Module 2	Review of Searching and Sorting techniques	Assignment		Programming/ Problem Solving	**12 Sessions**
	Topics: **Divide and Conquer:** Examples. Strassen's Matrix multiplication. **Sorting:** Quicksort, Heapsort, Lower bound of comparison-based sorting, non-comparison-based sorting: Radix sort. **Search:** Review of Linear Search and Binary Search, Hashing and hash tables. **Assignment:** Design and develop an algorithm using Divide and Conquer technique for a given scenario.				
Module 3	Greedy Algorithms	Assignment		Programming/ Problem Solving	**09 Sessions**
	Topics: Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm. Huffman Codes. **Assignment:** Design and Develop a solution to a given scenario using greedy method.				
Module 4	Dynamic Programming	Assignment		Programming/ Problem Solving	**09 Sessions**
	Topics: Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Optimal Binary Search Trees, Chain Matrix Multiplication. **Assignment:** For a given scenario, attempt the three design paradigms learned so far and argue the best approach to solve the problem				
Module 5	Complexity Classes and Heuristics	Assignment		Programming/ Problem Solving	**09 Hours**
	Topics: plexity classes: P, NP, and NP-Complete Problems. Backtracking: n-Queens. Branch and bound: Travelling Salesman Problem. **Assignment:** Apply backtracking algorithmic designing technique for solving queen's problems for 4, 8 and 16 inputs.				
	Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.** **Professionally Used Software: GCC compiler.**				
	Project work/Assignment:				
1.	**2. Problem Solving: Design of Algorithms and implementation of programs.** **3. Programming: Implementation of given scenario using Java.**				

	Text Book: T1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *'Introduction to Algorithms'*, MIT Press, 2022. T2. J. Kleinberg and E. Tardos, *'Algorithm Design'*, Addison-Wesley, 2005.
	References R1. Anany Levitin, *'Introduction to the Design and Analysis of Algorithms'*, Pearson Education, 2003. R2. Tim Roughgarden, *'Algorithms Illuminated'* (books 1 through 3), Soundlikeyourself Publishing, 2017,18,19 respectively. R3. AV Aho, J Hopcroft, JD Ullman, *'The Design and Analysis of Algorithms'*, Addison-Wesley, 1974.

Course Code: CSE3156	**Course Title: Database Management Systems** **Type of Course: 1) School Core** **2) Laboratory Integrated**	**L-T-P-C**	3	0	2	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve information efficiently. It helps the students to learn and practice data modeling anddatabase designs. The course also introduces the concept of object oriented and object relational databases. The associated laboratory is designed to implement database design using MySQL DATABASE in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course OutComes	On successful completion of the course the students shall be able to: 1] Demonstrate a database system using ER model and relational algebra. [Understanding]2] Build databases using SQL queries query processing. [Applying] 3] Apply the functional dependencies and design the database using normalization. [Applying] 4] Interpret the concept of object-oriented databases and object-relational databases. [Understanding]					
Course Content:						

Module 1	**Introduction to Database Modelling and Relational Algebra (Understanding)**	Assignment	**Problem Solving**	**8 Classes**
Topics: **Introduction to Database:** Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model. **Relational Algebra** with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.				
Module 2	**Fundamentals of SQL andQuery Optimization (Applying)**	Assignment	**Programming**	**8 Classes**
Topics: **SQL Database Querying,** DDL, DML, Constraints, Operators, Set Operators, Aggregate Functions, Joins, Views, Procedures, Functions and Triggers. **Database programming issues and techniques:** Embedded SQL, Dynamic SQL; SQL / PSM and NoSQL. **Query Optimization:** Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.				
Module 3	**Relational Database Design & Transaction Management(Applying)**	Assignment	**Problem Solving**	**12 Classes**
Topics: **Relational database design:** Problems in schema design, redundancy and anomalies, Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), JoinDependencies (Fifth Normal Form), lossy and lossless decompositions, Database De-normalization. **Transaction Management:** The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; The write-ahead log protocol; Check pointing; Recovering from a System Crash; Media Recovery; Other approaches and interaction with concurrency control.				
Module 4	**Advanced DBMS Topics(Understanding)**	Assignment	**Case Study**	**8 Classes**
Topics: **Advanced topics:** Object oriented database management systems, Deductive database management systems, Spatial database management systems, Temporal database management systems, Constraint database management systems. **New database applications and architectures** such as Data warehousing, Multimedia, Mobility, NoSQL, NativeXML databases (NXD), Document-oriented databases, Statistical databases.				

List of Laboratory Tasks:

Create Employee, Student, Banking and Library databases and populate them with required data. Do thefollowing experiments of different lab sheets on those databases.

Labsheet-1 [3 Practical Sessions]Experiment No 1: [1 Session]

1. **To study and implement the different language of Structured Query Language.**

Level 1: Perform operations using Data Definition Language and Data Manipulation Language commands including different variants of SELECT on Student DB.

Level 2: Identify the given requirements; valid attributes and data types and Perform DDL and DML operations on a given scenario. [Banking Databases]

Experiment No. 2: [2 Sessions]

2. **To study and implement the concept of integrity constraints in SQL.**

Level 1: Create tables on Banking database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Student Database.

Level 2: Enforce different types of data and referential integrity constraints. Then try queries with special operators based on the student database. [Banking Database].

Labsheet-2 [3 Practical Sessions]Experiment No. 3: [1 Session]

3. **Implement complex queries in SQL.**

Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database**.**

Level 2: Implement MySQL DB queries on library database using appropriate clauses and aggregate functions**.** Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4: [2 Session]

4. **To study and implement different types of Set and Join Operations [2 Slots]**

Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Airline Database. **Level 2:** Use Set and Join operations to retrieve the data from two or more relations(tables) as per the given
scenario. [Airline Database]

Labsheet-3 [2 Practical Sessions]Experiment No. 5: [2 sessions]

5. **To study and implement Views, and Procedures in MySQL DB.**

Level 1: Implement MySQL Views, and Procedures in ORACLE DB on Employee database.
Level 2: Analyze the requirement and construct views, and Procedures on Mini Project Domain. [Banking Database]

Labsheet-4 [2 Practical Sessions]Experiment No. 6: [2 Sessions]

6. **To study and implement Functions, and Triggers in MySQL DB.**

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.
Level 2: Analyze the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-5 [2 Practical Sessions]Experiment No. 7: [2 Sessions]

To implement the concept of forms and reports.
Level 1: Implement the concept of forms and reports.
Level 2: Analyze the schema relationship.

Labsheet-6 [2 Practical Sessions]Experiment No. 8: [2 Sessions]

Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.
Level 1: Implement the real time database.
Level 2: Analyze the working of database in real time.

Targeted Application & Tools that can be used:
Application Area: Relational database systems for Business, Scientific and Engineering Applications.
Tools/Simulator used: MySQL DB for student practice.
Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

Percentage of changes in this version: 50% of changes from earlier version. New topics are highlighted initalic.

1. Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra.
2. Programming: Implementation of any given scenario using MySQL.

Text Book

1] RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.
2] Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.
3] W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.

References

1] Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.
2] M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.

Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database designusing ER- Relational mapping, Implementation of given database scenario using MYSQLDB.
Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications
Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil

Course Code: CSE3351	**Course Title: Operating Systems** **Type of Course: Program Core and Theory Only**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization, Problem solving using C Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					
Anti-requisites	**NIL**					
Course Description	This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the fundamental concepts of operating Systems and case studies. [**Knowledge**] 2] Demonstrate various CPU scheduling algorithms. .[**Application**] 3] Apply various tools to handle synchronization problems.[**Application**] 4] Demonstrate deadlock detection and recovery methods **[Application]** 5] Illustrate various memory management techniques.[**Application**]					
Course Content:						
Module 1	Introduction to Operating System	Assignment	Programming		**9 Hours**	
Topics: Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system						
Module 2	Process Management	Assignment/Case Study	Programming/Simulation		**11 Hours**	
Topics: Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority.						

Module 3	Process Synchronization and Deadlocks	Assignment	Programming	**11 Hours**
Topics: The Critical-Section Problem- Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher's Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock.				
Module 4	Memory Management	Assignment	Programming/Simulation	**10 Hours**
Topics: Introduction to Memory Management, Basic hardware-Base and Limit Registers, Memory Management Unit(MMU), Dynamic loading and linking, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Virtual Memory and Demand Paging – Page Faults and Page Replacement Algorithms, Copy-on-write, Allocation of Frames, Thrashing Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.				

Targeted Application:

Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.

Software Tools:

1. Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install and work on multiple guest Operating Systems on top of a host OS.

2. Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.

Project work/Assignment

1. **Demonstrate process concepts in LINUX OS.**
2. **Simulation of CPU scheduling algorithms.**
3. **Develop program to demonstrate use of Semaphores in threads.**
4. **Develop program to demonstrate use of deadlock avoidance algorithms.**
5. **Develop program to demonstrate use of page replacement algorithms.**
6. **Simulation of memory allocation strategies [first fit, best fit and worst fit].**

Text Book

1. Silberschatz A, Galvin P B and Gagne G , "Silberschatz's Operating System Concepts", Paperback, Global Edition Wiley, 2019

References

1. Silberschatz A, Galvin P B and Gagne G, "Operating System Concepts", 10th edition Wiley, 2018.
2. William Stallings, "Operating Systems",Ninth Edition, By Pearson Paperback ,1 March 2018.
3. Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, " Cracking the Operating System skills", Dreamtech, paperback, 2020
4. Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , "Operating Systems: Three Easy Pieces, Amazon digital Services", September 2018.

E-resources/Weblinks

5. https://www.os-book.com/OS9/
6. https://pages.cs.wisc.edu/~remzi/OSTEP/
7. https://codex.cs.yale.edu/avi/os-book/OS10/index.html

<table>
<tr><td>Course Code:
CSE 3078</td><td colspan="3">Course Title: Cryptography and Network Security

Type of Course: Program Core & 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">1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">“Data Communications and Computer Networks”.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The Course covers the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet. Topics: The cryptographic tools such as shared key encryption, public key encryption, key exchange, and digital signature are explored. The use and utilization of the internet protocols and applications such as SSL/ TLS, IPSEC, Kerberos, PGP, and S/ MIME, SET are reviewed. System security issues such as viruses, intrusion and firewalls are also explored.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
CO1: Identifies the basic concept of Cryptography (Knowledge)
CO2: Express the different types of Cryptographic Algorithms. (Comprehension)
CO3: Recognize the Public key Cryptographic Techniques for various applications. (Comprehension)
CO4: Apply the network security concepts during their implementation of network security application developments. (Application)</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Cryptography</td><td>Assignment</td><td colspan="3">Identify the Concepts</td><td colspan="2">08 Sessions</td></tr>
<tr><td colspan="9">Topics:
Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: active attacks, passive attacks, services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution Ciphers : Caesar, Mono alphabetic, Polyalphabetic, Play-fair and Hill Cipher, Introduction to Block Cipher and Stream Cipher, Festal Structure.</td></tr>
<tr><td>Module 2</td><td colspan="2">Private Key Cryptography and Number Theory</td><td>Assignment</td><td colspan="3">Analysis of requirement of complexity in cryptography</td><td colspan="2">13 Sessions</td></tr>
</table>

Topics:
Symmetric Encryption Algorithms : Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, brief about primality testing and factorization, Discrete Logarithmic Problem, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese Remainder Theorem

Module 3	**Public Key Cryptography and its Applications**	Assignment	Recognize the importance of various security concepts to achieve sufficient solutions	10 Sessions

Topics:
Overview of Public Key Cryptography, RSA, Diffie - Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Discussion on real time practices of Cryptography.

Module 4	**Network Security**	Assignment	Implement the advanced network security algorithms in recent applications.	07 Sessions

Topics:
Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IP Sec architecture, Network Security applications: Web Security.

Targeted Application & Tools that can be used:
Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.

Assignment:

Assignment 1: Solve the problems of basic encryption techniques.
Assignment 2: Solve and analyze the problems on symmetric and asymmetric encryption.

Textbooks:

1.William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall, 8th Edition, 2019.

2. Wade Trappe and Lawrence C Washington, "Introduction to Cryptography with Coding Theory", Pearson, 2020.

Reference Books:

1.Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, third edition, 2010.

2. R.Rajaram, "Network Security and Cryptography" SciTech Publication.3rd Edition, 2014.

3. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2nd Edition, 2019.
4. BruceSchneier, "Applied Cryptography", John Wiley and Sons Inc. Second Edition, 2015.

Web references:

1.https://onlinecourses.nptel.ac.in/noc22_cs90/preview

2.e-pgpathshala UGC lecture series : E-Series and Self learning Materials.

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ==

3. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=10133&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security 4.http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5875&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security.
Topics relevant to "Skill Development": Symmetric and Asymmetric Encryption Algorithms and its problems.

Course Code: **CSE3216**	**Course Title:** Mastering Object- Oriented Concepts in Python **Type of Course:** Lab	**L- T- P- C**	0-0-2-1
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.

Course Code: CSE2037	**Course Title:** Cyber Forensics **Type of Course:** Program Core	**L-T- P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**Cryptography and Network Security**					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce to the students Cyber Forensic concepts. The course is both conceptual and analytical and is understood with various open-source software's. The course develops critical thinking like correctly collect and analyze computer forensic evidence, analyze and validate Forensics Data, study the tools and tactics associated with Cyber Forensics. The course involves quizzes, assignments with various open-source software.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cyber Forensics** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1) understand** various digital investigation terminologies and methods (knowledge) **(2) understand** various file formats (knowledge) **(3) Recognize** the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications (Comprehension) **(4) Apply** techniques for forensic investigation (Application)					
Course Content:						
Module 1	**DIGITAL INVESTIGATION**	Quiz		MCQ/Based on Investigation process		**No. of Sessions: 09**
Digital Evidence and Computer Crime - History and Terminology of Computer Crime Investigation - Technology and Law - The Investigative Process -Investigative Reconstruction - Modus Operandi, Motive and Technology -Digital Evidence in the Courtroom.						
Module 2	**UNDERSTANDING INFORMATION**	Quiz		MCQ/Based on file format		**No. of Sessions: 09**
Methods of storing data: number systems, character codes, record structures, file formats and file signatures - Word processing and graphic file formats - Structure and Analysis of Optical Media Disk Formats - Recognition of file formats and internal buffers - Extraction of forensic artifacts–understanding the dimensions of other latest storage devices – SSD Devices.						
Module 3	**COMPUTER BASICS FOR DIGITAL INVESTIGATORS**	Assignment		Writing task		**No. of Sessions: 09**

Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology -Steps taken by computer forensic specialists.

Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime-Identity Theft and Identity Fraud – Organized Crime &Terrorism.
Computer forensic cases: Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.
Assignment: Computer Crime

Module 4	**Computer Forensic Evidence and Data Recovery**	Assignment		Writing task	**No. of Sessions: 09**

Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data.
Data Collection and Data seizure: why collect evidence? - Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody. Reconstructing the Attack.
Assignment: Data Recovery

Targeted Application & Tools that can be used:

1. **FTK Forensic Toolkit**
2. **Encase**
3. **Kali Linux- Vinetto, galatta**
4. **Autopsy – Disk Forensics**

Project work/Assignment:
Each batch of students (self-selected batch mates) will identify projects based on the content and implement with the most suitable 2 or 3 antecedents.

Textbook(s):

1. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2019

References

1. Ravi Kumar & B Jain,2006," Cyber Forensics - Concepts and Approaches", icfai university press
2. ChristofPaar, Jan Pelzl," Understanding Cryptography: A Textbook for Students and Practitioners", Springer's, Second Edition, 2010,
3. Ali Jahangiri," Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts", First edition, 2009
4. Computer Forensics: Investigating Network Intrusions and Cyber Crime", Ec-Council Press, 2010.

5. C. Altheide& H. Carvey," Digital Forensics with OpenSource Tools, Syngress", 2011, ISBN: 781597495868.,https://esu.desire2learn.com

NPTEL: https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
Udemy: https://www.udemy.com/topic/digital-forensics/
E-book Link(PU):
Links
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14073&query_desc=ti%2Cwrdl%3A%20CYBER%20FORENSIC

Topics relevant to "Skill Developemnt":

Cyber Forensics techniques for **Skill development** through **Experiential Learning techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: **CSE2037**_P	**Course Title:** **Cyber Forensics** Lab **Type of Course:** **Program Core**	**L- T-P- C**	0-0-2-1
Version No.	1.0		
Course Pre-requisites	**Cryptography and Network Security**		
Anti-requisites	NIL		
Course Description	The purpose of this course is to introduce to the students Cyber Forensic concepts. The course is both conceptual and analytical and is understood with various open-source software's. The course develops critical thinking like correctly collect and analyze computer forensic evidence, analyze and validate Forensics Data, study the tools and tactics associated with Cyber Forensics. The course involves quizzes, assignments with various open-source software.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cyber Forensics** and attain **Skill Development** through **Experiential Learning** techniques.		
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1) understand** various digital investigation terminologies and methods (knowledge) **(2) understand** various file formats (knowledge) **(3) Recognize** the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications (Comprehension) **(4) Apply** techniques for forensic investigation (Application)		
Course Content:			

List of Laboratory Tasks:

1. Case Studies of Opensource Forensic Tools
2. FTK Forensic Tool kit for taking mirror image

Disk Forensics-

3. Identify digital evidences
4. Acquire the evidence
5. Authenticate the evidence
6. Preserve the evidence
7. Analyze the evidence
8. Report the findings

Network Forensics:

9. Intrusion detection
10. Logging
11. Correlating intrusion detection and logging

Device Forensics

12. Mobile phone
13. Digital Music
14. Printer Forensics
15. Scanner Forensics
16. Credit Card Forensics
17. Telecommunications Forensics
18. Forensic Analysis of a Virtual Machine
19. Forensic analysis of Cloud storage and data remnants
20. RAM Dumping Tool

Targeted Application & Tools that can be used:

2. **FTK Forensic Toolkit**
3. **Encase**
4. **Kali Linux- Vinetto, galatta**
5. **Autopsy – Disk Forensics**

Project work/Assignment:

Each batch of students (self-selected batch mates) will identify projects based on the content and implement with the most suitable 2 or 3 antecedents.

Textbook(s):

2. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2019

References

1. Ravi Kumar & B Jain,2006," Cyber Forensics - Concepts and Approaches", icfai university press
2. ChristofPaar, Jan Pelzl," Understanding Cryptography: A Textbook for Students and Practitioners", Springer's, Second Edition, 2010,
3. Ali Jahangiri," Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts", First edition, 2009
4. Computer Forensics: Investigating Network Intrusions and Cyber Crime", Ec-Council Press, 2010.
5. C. Altheide& H. Carvey," Digital Forensics with OpenSource Tools, Syngress", 2011, ISBN: 781597495868.,https://esu.desire2learn.com

NPTEL: https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
Udemy: https://www.udemy.com/topic/digital-forensics/
E-book Link(PU):

Links

http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14073&query_desc=ti%2Cwrdl%3A%20CYBER%20FORENSIC

Topics relevant to "Skill Developemnt": Cyber Forensics techniques for **Skill development** through **Experiential Learning techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: **CSE3342**	**Course Title: Ethical Hacking** **Type of Course: Core Subject**		**L-T- P- C**	1	0	4	3

Version No.	1.3
Course Pre-requisites	Basic networking tools knowledge and Cryptography & Network Security
Anti-requisites	NIL
Course Description	This course introduces students to a wide range of topics related to ethical hacking. It also provides an in-depth understanding of how to effectively protect computer networks. These topics cover some of the tools and penetration testing methodologies used by ethical hackers and provide a thorough discussion of what and who an ethical hacker is and how important they are in protecting corporate and government data from cyber-attacks
Course Objective	The objective of the course is to familiarize the learners with the concepts of Ethical Hacking and attain to improve the learners' Employability Skills by using Experiential Learning techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 1] Extrapolate the importance of ethical hacking. 2] Determine the various techniques for performing reconnaissance 3] Categorize various types of system scanners and their functions. 4] Identify the function of sniff on a network.
Course Content:	

Module 1	**Introduction to Hacking**	Assignment		Programming activity	**12 Hours**

Topics:

Introduction to Hacking-Important Terminologies - Asset - Vulnerability - Penetration Test - Vulnerability Assessments versus Penetration Test - Penetration Testing Methodologies - Categories of Penetration Test.

Assignment: Different phase methodologies on penetration testing

Module 2	**Linux Basics**	Assignment		Programming activity	**10 Hours**
Topics: Major Linux Operating Systems - File Structure inside of Linux - BackTrack - Changing the Default Screen Resolution - Some Unforgettable Basics. **Assignment:** Penetration testing distribution					
Module 3	**Information Gathering Techniques**	Assignment		Programming activity	**11 Hours**
Topics: Sources of Information Gathering - Copying Websites Locally - NeoTrace - Xcode Exploit Scanner - Interacting with DNS Servers - DNS Cache Snooping - DNS Lookup with Fierce - SNMP - SMTP. **Assignment:**Domain internet groper					
Module 4	**Target Enumeration and Port Scanning Techniques**	Assignment		Programming activity	**13 Hours**
Topics: Target Enumeration and Port Scanning Techniques - Host Discovery - Scanning for Open Ports and Services - Types of Port Scanning - Vulnerability Assessment. **Assignment:** Demonstrations for port scanning					

List of Laboratory Tasks:

Experiments:

1. Command Prompt
2. Wireshark
3. Netscantool
4. OWZAP
5. Neotrace
6. NMAP
7. AngryIPScanner
8. Maltigo
9. Readnotify
10. HTTRACK
11. Yougetsignal
12. CAPSA Portable Network Analyzer
13. Samspade
14. Shodan
15. Oputils

16. Brupsuit
17. Zenmap
18. OSINT
19. John the ripper

Targeted Application & Tools that can be used: Application Software and open source tools like SQL Injection and NIDS,HIDS.

Text Book

1.Rafay Baloch, 2014: "Ethical Hacking and Penetration Testing Guide" Apple Academic Press Inc.

References

1.Gary Hall, Rrin Watson, 2016: "Hacking: Computer Hacking, Security Testing,Penetration Testing, and Basic Security".

2.James Corley, Kent Backman, Michael Simpson, 2010: "Hands-On Ethical Hacking and Network Defense", 2nd Edition, Cengage Learning.

E-Resources:

(1) Ethical Hacking in 12 Hours - Full Course - Learn to Hack! - YouTube

Topics relevant to "EMPLOYABILITY SKILLS": CEH Certification

Ethical hacking techniques for **Employability skills** through **Experiential Learning techniques**. This is attained through the assessment component mentioned in course handout.

Course Code: CSE2018	**Course Title:** Theory of Computation **Type of Course:** Theory Only	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	The students should have the Knowledge on Set Theory					
Anti-requisites	Nil					
Course Description	The course deals with introduction of formal languages and the correspondence between language classes and the automata that recognize them. Topics include: Formal definitions of grammars and acceptors, Deterministic and Nondeterministic systems, Grammar ambiguity, finite state and push-down automata; normal forms; Turing machines and its relations with algorithms.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Theory of Computation as mentioned above** and attain **Skill Development** through **Problem Solving** Methodologies.					

<table>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
1. Describe various components of Automata. (Knowledge)
2. Illustrate Finite Automata for the given Language. (Application)
3. Distinguish between Regular grammar and Context free grammar. (Comprehension)
4. Construct Push down Automata. (Application)
5. Construct Turing machine for a Language. (Application)</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to automata theory</td><td>Assignment</td><td>Problems on Strings and Language operations</td><td>06 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to Automata Theory, Applications of Automata Theory, Alphabets, Strings, Languages & operations on languages, Representation of automata, Language recognizers, Finite State Machines (FSM): Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs</td></tr>
<tr><td>Module 2</td><td>Finite Automata</td><td>Assignment</td><td>Problems on DFA, NFA’s</td><td>13 Sessions</td></tr>
<tr><td colspan="5">Topics:
Basic concepts of Finite automata, DFA- definitions of DFA, Deterministic Accepters Transition Graphs and Languages and DFA's, Regular Languages, NFA- Definition of a Nondeterministic Accepter, Languages and NFA’s Why Non-determinism? Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata.</td></tr>
<tr><td>Module 3</td><td>Regular Expressions & Context Free Grammar</td><td>Assignment</td><td>Problems on RE, CFG, PT, PL and Ambiguity</td><td>12 Sessions</td></tr>
<tr><td colspan="5">Topics:
Formal Definition of a Regular Expression, Languages Associated with Regular Expressions, Languages, Regular Languages (RL) and Non-regular Languages: Closure properties of RLs, to show some languages are
not RLs, Closure Properties of Regular Context Free Grammars-Examples of Context-Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity, Chomsky Normal Form, Gribiche Normal Form.</td></tr>
<tr><td>Module 4</td><td>Push down Automata</td><td>Assignment</td><td>Problems on pushdown Automaton</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Topics:
Definition of a Pushdown Automaton, Language Accepted by a Pushdown Automaton, Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack Equivalence of PDA’s and CFG’s: From Grammars to Pushdown Automata.</td></tr>
<tr><td>Module 5</td><td>Turing Machine</td><td>Assignment</td><td>Problems on Turning Machine</td><td>07 Sessions</td></tr>
<tr><td colspan="5">Topics:
Definition of a Turing Machine, Turing Machines as Language Accepters, Example Languages to construct Turing machine, Turing Machines as Transducers, Halting Programming Techniques for Turing Machines</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Targeted Application:
1. Text Processing
2. Compilers
3. Text Editors
4. Robotics Applications
5. Artificial Intelligence
Tools:</td></tr>
</table>

1. JFLAP (Java Formal Language and Automata Package) Software simulation tool. It's interactive educational software written in Java to experiment topics in automata theory. 2. Turing machine Online simulators.
Text Book 1. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6th Ed, 2018.
References 1. Aho, Ullman and Hopcroft, "Theory of Computation", Pearson India 3rd Edition 2008. 2. Michael Sipser, "Theory of Computation", Cengage India 3rd Ed, 2014. **E-Resources** NPTEL course – https://onlinecourses.nptel.ac.in/noc21_cs83/preview
Topics relevant to "SKILL DEVELOPMENT": Deterministic and Non-Deterministic Automaton, Regular Expressions, CFGs, Turning Machine and Pushdown automaton for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE2067	**Course Title: Web Technology** **Type of Course: Program core** **Theory Only**		**L- T-P- C**	2-0-0-2
Version No.	2.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This course highlights the basic web design using Hypertext Markup Language and Cascading Style Sheets. Students will be trained in planning and designing effective web pages by writing code using current leading trends in the web domain, enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia. The focus is on popular key technologies that will help students to build Internet- and web-based applications that interact with other applications and with databases.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.**			
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1:** Implement web-based application using client-side scripting languages. **(Application level)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Application level)** **CO3**: Illustrate java-script concepts to demonstration dynamic web site**(Application level)** **CO4:** Apply server-side scripting languages to develop a web page linked to a database. **(Application level)**			
Course Content:				
Module 1	**Introduction to XHTML**	Quizzes and Assignments	Quizzes on various features of XHTML, simple applications	**8 Sessions**

Topics:
Basics: Web, WWW, Web browsers, Web servers, Internet.
XHTML: Origins and Evolution of HTML and XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic Differences between HTML and XHTML.

Module 2	**Advanced CSS**	Quizzes and assignments	Comprehension based Quizzes and assignments; Application of CSS in designing webpages	**8 Sessions**

Topics:
CSS: Introduction to CSS, Defining & Applying a style, Creating style sheets, types of style sheet, selectors, CSS font properties, border properties, Box model, opacity, CSS pseudo class and pseudo-elements.
Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Responsive Design, CSS Frameworks **XML:** Basics, demonstration of applications using XML

Module 3	**Fundamentals of JavaScript**	Quizzes and assignments	Application of JavaScript for dynamic web page designing	**7 Sessions**

Topics:

JavaScript: Introduction to JavaScript, Basic JavaScript Instructions, Functions, Methods & Objects, Decisions and Loops, Document Object Model, Event handling, handling window pop-ups, JavaScript validation.

Module 4	**PHP – Application Level**	Quizzes and assignments	Application of PHP in web designing	**7 Sessions**

Topics:
PHP: Introduction to server-side Development with PHP, Arrays, $GET and $ POST, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP.

Targeted Application & Tools that can be used:
Xampp web server to be used to demonstrate PHP.

Project work/Assignment:

Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Textbook(s):

1] Robert. W. Sebesta, "*Programming the World Wide Web*", Pearson Education, 8th Edition, 2015.
2] *CSS Notes for Professionals*, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
3] Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.

References

1] Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st. Edition.2016.
2] Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.

Topics related to development of "FOUNDATION":

1. Web, WWW, Web browsers, Web servers, Internet.

2. CSS, PHP.
3. Designing for healthcare.

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

E-References

pu.informatics.global, https://sm-nitk.vlabs.ac.in/

Course Code: CSE2067_P	**Course Title: Web Technologies Lab** **Type of Course: Program core lab course**	**L-T-P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Database Management Systems-CSE3156					
Anti-requisites	**NIL**					
Course Description	This course highlights the comprehensive introduction to scripting languages that are used for creating web-based applications. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1:** Implement web-based application using client-side scripting languages. **(Apply)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Apply)** **CO3:** Apply server-side scripting languages to develop a web page linked to a database. **(Apply)**					
Course Content:						

List of Laboratory Tasks:

Experiment No. 1: Demonstration of XHTML features

Level 1: Demonstration of various XHTML Tags (Level 1)
Level 2: Design and develop static web pages for an online Book store (Level 2).

Experiment No. 2: Application of CSS in web designing

Level 1: Design a document using XHTML and CSS to create a catalog of items for online electronic shopping.
Level 2: Create and save XML document for students' information and display the same using cascaded style sheet.

Experiment No. 3: Application of PHP in web designing.

Level 1: Write a PHP program to read the personal information of a person such as first name, last name, age, permanent address, and pin code entered by the user into a table created in MySQL. Read the same information from the database and display it on the front end.

Level 2: Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition, and publisher and store information submitted through the web page in MySQL database.

Experiment No. 4: Building a website.

Build a website for organizing an International Conference. The conference website must be able to collect the author's details and upload a file.

Targeted Application & Tools that can be used:

Xampp web server to be used to demonstrate
PHP.

Project work/Assignment:

Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Textbook(s):

1. Robert. W. Sebesta, "*Programming the World Wide Web*", Pearson Education, 9th Edition, 2016.
2. Paul Deitel, Harvey Deitel, Abbey Deital,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.
3. *CSS Notes for Professionals*, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
4. Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.

Reference Book(s):

R1. Randy Connolly, Ricardo Hoar,"Fundamentals of Web Development", Pearson Education India, 1st. Edition.2016.

R2. Jeffrey C. Jackson,"Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.

Additional web-based resources

W1. W3schools.com
W2. Developer.mozilla.org/en-US/docs/Learn
W3. docs.microsoft.com
W4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking
https://presiuniv.knimbus.com/user#/home

Topics related to development of "FOUNDATION":

1. Web, WWW, Web browsers, Web servers, Internet.
2. CSS, PHP.
3. Designing the website for healthcare.

The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.

Course Code: CSE2040	**Course Title:** Cyber threats for IOT and Cloud **Type of Course:1] Program Core** **2] Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Cyber Security, Information Security and Networks					
Anti-requisites	**NIL**					
Course Description	Objective of the course is to understand the most important cyber threats for IOT and Cloud. Cyber attackers discover new possibilities in the areas of Internet of Things and cloud services. It mainly focuses on multiple security challenges facing the IoT and cloud computing especially concerns surrounding privacy and cyber security threats of the users and the how can the cyber risks relating to them be mitigated.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Cyber threats for IOT and Cloud and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: • Understand the different types of cyber threats for IOT and cloud • Develop a deeper understanding and familiarity with various types of cyber-attacks, cybercrimes, vulnerabilities and remedies thereto. • Plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.					
Course Content:						

Module 1	**Introduction to IOT and Cloud computing**	Assignment	Programming Task		**12 Sessions**

Topics

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IOT Architecture and protocols, Various platforms for IoT, Real-Time examples of IoT, Overview of IoT components and IoT communication Technologies. Introduction to Cloud Computing, The Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Distributed Systems, Virtualization, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies.

Assignment:

Module 2	**Cyber Threats**	Assignment	Programming Task	**8 Sessions**

Topics:

What are Cyber Security Threats? Common Sources of Cyber Threats, Types of Cyber security Threats-Malware attacks, Social Engineering attacks, Supply chain attacks, Man-in-the middle Attack, Threat Detection Tools, Cyber Defense for Individuals.

Assignment:

Module 3	**Cyber Threats in Internet of Things**	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:

IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats-Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats.

Assignment:

Module 4	**Cyber Threats in Cloud computing**	Assignment	Programming/Data analysis task	**9 Sessions**

Topics:

Cybersecurity Threats to Cloud Computing-Identity First Security, Cloud misconfiguration, Denial of Service, Insider Threats, Reduced Infrastructure Visibility, Unauthorized use of Cloud workloads, Insecure API's, Compliance and regulation issues, Mitigating cyber risks in cloud computing

Assignment:

Text Books

T1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives" ,Wiley India Pvt Ltd,2013
T2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
T3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education

References

R1. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons,2018

R2. Ollie Whitehouse, “Security of Things: An Implementers’ Guide to Cyber-Security for Internet of Things Devices and Beyond”, NCC Group, 2014 R3. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9 **Weblinks:** https://www.coursera.org/learn/cloud-security-basics https://www.imperva.com/learn/application-security/cyber-security-threats/ https://presiuniv.knimbus.com/user#/home
Topics relevant to “SKILL DEVELOPMENT”: Cyber threats in IoT and Cloud Computing for **skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3145	**Course Title: Intrusion Detection and Prevention System** **Type of Course:1] Program Core** **2] Theory Only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Fundamental knowledge in Operating Systems, Information Security and Networks					
Anti-requisites	**NIL**					
Course Description	Objective of the course is to Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise. Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems and Analyze intrusion detection alerts and logs to distinguish attack types from false alarms.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Intrusion Detection and Prevention System** and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: • Understand about the intruders. • Define intrusion detection and prevention policies • Explain the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets. • Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.					
Course Content:						

Module 1	**Introduction to Intrusion Detection and Prevention System**	Assignment		Programming Task	**10 Sessions**

Topics

Understanding Intrusion Detection – Intrusion detection and prevention basics – IDS and IPS analysis schemes, Attacks, Detection approaches –Misuse detection – anomaly detection – specification based detection – hybrid detection. Internal and external threats to data, Need and types of IDS, Information sources,Host based information sources, Network based information sources.

Assignment: Demonstrating the skills to capture and analyze network packets using network packet analyzer.

Topics:

Intrusion Prevention Systems, Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques, Responses, requirement of responses, Types of responses, mapping responses to policy Vulnerability analysis, credential analysis, non-credential analysis. Architecture models of IDs and IPs.

Assignment: Applying Intrusion detection in security applications.

Topics:

Tool Selection and Acquisition Process – Bro Intrusion Detection – Prelude Intrusion Detection – Cisco Security IDS – Snorts Intrusion Detection – NFR security. Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

Assignment: Demonstrate the working with Snort Rules, Rule Headers, Rule Options and The Snort Configuration File.

Module 4	Legal issues and organizations standards	Assignment	Programming/Data analysis task	**9 Sessions**

Law Enforcement / Criminal Prosecutions – Standard of Due Care – Evidentiary Issues, Organizations and Standardizations.

Assignment: Addressing common legal concerns and myths about Intrusion Detection system

Textbooks

T1. Carl Endorf, Eugene Schultz and Jim Mellander " Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
T2. Earl Carter, Jonathan Hogue, "Intrusion Prevention Fundamentals", Pearson Education, 2006.

References
R1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003. R2. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005. R3. Paul E. Proctor, "The Practical Intrusion Detection Handbook ",Prentice Hall , 2001. **Weblinks:** https://www.youtube.com/watch?v=RYB4cG8G2xo https://www.coursera.org/lecture/detecting-cyber-attacks/intrusion-detection-systems-UeDqJ
Topics relevant to "SKILL DEVELOPMENT": Agent development for intrusion detection for Skill Development through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE3097	**Course Title:** Web Security **Type of Course:** Theory course	**L- T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**Data Communication and Computer Networks (CSE3011)**					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to introduce you to the field of web security by understanding web functionality and various security validations. The web is our gateway to many critical services and is quickly evolving as a platform to connect all our devices. Web vulnerabilities are growing on a year-to-year basis and designing secure web applications is challenging. The course covers fundamental concepts of web security principles, web vulnerability and exploitation, various attacks on web applications, and a few basic topics on web encryption.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Web Security and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Define** the fundamentals of Web applications and validation. (Remember) 2. **Recognize** the significance of password and authentication in web applications. (Understand) 3. **Explain** the importance of session management in web.					

	(Understand) 4. **Apply** web attack techniques to find vulnerabilities in web applications. (Apply)
Course Content:	

Module 1	**Introduction to Web Security**	Quiz	Knowledge		**08 Sessions**
Topics: Web Functionality, Encoding Schemes, Mapping the Application - Enumerating the Content and Functionality, Analyzing the Application Bypassing, Client-Side Controls: Transmitting Data Via the Client, Capturing User Data, Handling Client-Side Data Securely - Input Validation, Blacklist Validation, Whitelist Validation. The Defense in-Depth Approach - Attack Surface Reduction, Rules of Thumb, Classifying and Prioritizing Threats.					
Module 2	**Web Application Authentication**	Assignments	Comprehension		**08 Sessions**
Topics: Authentication Fundamentals- Two Factor and Three Factor Authentication - Password Based, Built-in, HTTP, Single Sign-on Custom Authentication- Secured Password Based Authentication: Attacks against Password, Importance of Password Complexity, Design Flaws in Authentication Mechanisms - Implementation, Flaws in Authentication Mechanisms - Securing Authentication.					
Module 3	**Session Management &Web Security Principles**	Quiz	Comprehension		**08 Sessions**
Topics: Need for Session Management, Weaknesses in Session Token Generation, Weaknesses in Session Token Handling, Securing Session Management; Access Control: Access Control Overview, Common Vulnerabilities, Attacking Access Controls, Securing Access Control. Origin Policy, Exceptions, Browser security Principles- Cross Site Scripting and Cross Site Request Forgery, File Security Principles: Source Code Security, Forceful Browsing, Directory Traversals.					
Module 4	**Web Application Vulnerability**	Assignment	Application		**06 Sessions**

Topics:

Attacking data-stores and backend components- Injecting into Interpreted Contexts, injecting into SQL, NoSQL, XPath, LDAP, Injecting OS Commands, Manipulating File Paths, Injecting into XML Interpreters, Injecting into Back-end HTTP Requests, Injecting into Mail Services, Attacking application logic-real world logic flaws, Attacking users-Cross site scripting-varieties of XSS,XSS attacks in action, finding and exploiting XSS vulnerabilities, preventing XSS attacks, Other techniques-cookie based Attacks, HTTP Header Injection

Textbook(s):

T1. Dafydd Stuttard, Marcus Pinto, "The Web Application Hacker's Handbook", Willey Publishing Inc. ,2008

References:

R1. B. Sullivan, V. Liu, and M. Howard, *"Web Application Security"*, A B Guide. New York: McGraw-Hill Education, 2011.

R2. *Web Application Security:* Exploitation and Countermeasure for Modern Web Applications, byAndrew Hoffman.

E-book Links

T1: https://www.oreilly.com/library/view/web-application-security/9780071776165/

T2: https://www.oreilly.com/library/view/web-application-security/9781492053101/

Web links-

1. **NPTEL course** : Introduction to Information Security I, IIT Madras https://nptel.ac.in/courses/106106129
2. **Coursera Link** : https://www.coursera.org/learn/security-and-authentication

Topics related to development of "Skills":

Web technology fundamentals, web security measures and webvulnerability/attacks.

Topics related to development of "Experimental Learning":

Writing different web exploits to demonstratevulnerabilities in web applications.

Course Code: CSE3097_P	Course Title: Web Security Lab Type of Course: Lab Course	L- T-P-C	0	0	2	1

Version No.		1.0
Course Pre-requisites		**Data Communication and Computer Networks**
Anti-requisites		**NIL**
Course Description		The purpose of this course is to introduce you to the field of web security by understanding web functionality and various security validations. The web is our gateway to many critical services and is quickly evolving as a platform to connect all our devices. Web vulnerabilities are growing on a year-to-year basis and designing secure web applications is challenging. The course covers fundamental concepts of web security principles, web vulnerability and exploitation, various attacks on web applications, and a few basic topics on web encryption.
Course Objective		The objective of the course is to familiarize the learners with the concepts of Web Security and attain Skill Development through Experiential Learning techniques.
Course Outcomes		**On successful completion of this course the students shall be able to:** 5. **Define** the fundamentals of Web applications and validation. (Remember) 6. **Recognize** the significance of password and authentication in web applications. (Understand) 7. **Explain** the importance of session management in web. (Understand) 8. **Apply** web attack techniques to find vulnerabilities in web applications. (Apply)
Course Content:		

List of Laboratory Tasks:

1. Practical knowledge of known vulnerabilities in CGI, LAMP stacks, REST APIs cross-site scripting

Practical knowledge of known vulnerabilities in CGI, LAMP stacks, REST APIs cross-site scripting: Use the **Nessus tool** to scan the network for vulnerabilities.

i. Basic Network scanning

ii. Advanced scanning in general search
iii. Ntstat port scanning:
iv. Vulnerability Mapping
v. Policies:
vi. Plugins:
vii. General Scanning
viii. Port Scanning

Level 1: Identification of vulnerabilities

Level 2: Apply the concept

2. HTTP and setting up stacks, the various types of databases Access Controls, Vulnerabilities

HTTP and setting up stacks

i. Create a simple web application that can store information sent to it. For example, you could create a web application that will store to a text file anything provided in a URL parameter
ii. Write or modify an existing application that legitimately needs access to a sensitive resource ,but uses it at a time when it does not actually need it

Various types of databases Access Controls

i. Role-Based Access Control (RBAC)
iii. Mandatory Access Control (MAC)

Vulnerability: Study and work with KF Sensor

STEP1: Download **KF** Sensor tool Evaluation Setup File from KF Sensor Website.

STEP-2: Install with License Agreement and appropriate directory path.

STEP-3: Reboot the Computer now. The KF Sensor automatically starts during Windows boot.

STEP-4: Click Next to setup wizard.

STEP-5: Select all port classes to include and Click Next.

STEP-6: "Send the email and Send from email", enter the ID and Click Next.

STEP-7: Select the options such as Denial of Service[DOS], Port Activity, Proxy Emulsion, Network Port Analyzer, Click Next.

STEP-8: Select Install as System service and Click Next.

Level 1: Identification of vulnerabilities
Level 2: Apply the concept

3. Study of web authoring tools (any 2-3 tools)

i. Study and work with Net Stumbler tool
ii. Study and work with Snort
iii. Study and work with Nmap

Level 1: Install the tools required

Level 2: Apply the concept

4. Testing web applications

Study and work with Word press tool

i. Create an Online Community website and test the website
ii. Showcase Your Work Online and test its worth
iii. Create a Local Business Website and test the website.

Level 1: Define the test cases

Level 2: Apply the concept to test the web application

5. SQL injection and prevention

From the given data set ,

i. Put limits on all result sets
ii. Cleanse and Validate Freeform User Input
iii. Remove Freeform User Input When Possible
iv. Validate Data Prior to Processing
v. Ensure Errors are Not User-Facing
vi. Use Stored Procedures to Abstract Business Logic and Control parameters
vii. Use LIKE Operators Carefully
viii. Limit Use of xp_cmdshell and Other Extended Stored Procedures
ix. Perform Penetration Tests
x. Code Review
xi. Minimizing the Impact of SQL Injection
xii. Principle of Least Privilege & Login Security
xiii. Secure Linked Servers and Data Sources

Level 1: Recognize and acquire the data

Level 2: Apply the concept

6. Cross site request forgery attack lab

With the usage of Virtual Machines

i. Configure the Virtual Machines:
ii. Observing HTTP Request in Victim VM
iii. CSRF Attack using GET Request
iv. CSRF Attack using POST Request
v. Implementing a countermeasure

Level 1: Identify and acquire the data
Level 2: Apply the concept

	7. Web tracking Tracking the Web based scenario by • Environment Configuration • clear history and cookies • open a new private window in Firefox Task 1: Understand the basic working of the web tracking Task 2: Importance of cookie in Web tracking Task 3: Tracked user interests and data Task 4: How ads are displayed in a website Task 5: Tracking in a Private browser window Task 6: Real world tracking Task 7: Countermeasures **Level 1: Identify and acquire the data logs** **Level 2: Apply the concept**
	Targeted Application & Tools that can be used: **(1) Word press tool can be used for building websites with possible vulnerabilities.** **(2) Tools such as Nmap and Nessus can be used for web attack demonstration.** **(3) KF Sensor advanced 'honeypot' intrusion and insider threat detection system for Windows networks** **(4) Snort can be used for network intrusion detection system and intrusion prevention system** **(5) Net Stumbler tool for Windows that facilitates detection of Wireless LANs using the 802.11b, 802.11a and 802.11g WLAN standards.**
	Textbook(s): T1. Dafydd Stuttard, Marcus Pinto, "The Web Application Hacker's Handbook", Willey Publishing Inc. ,2008

Course Code: CSE3343	**Course Title: Cloud Computing Type of Course: Theory**	**L- T-P-C**	2	0	0	2
Version No.	1.0					

Course Pre-requisites	**Data Communication and Computer Networks (CSE2011)**				
Anti-requisites	Nil				
Course Description	Cloud Computing provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **CLOUD COMPUTING** and is designed to improve the learners' **SKILL DEVELOPMENT** through **PARTICIPATIVE LEARNING TECHNIQUES.**				
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe the fundamental components and layers of Cloud Computing Architecture. [Remember] 2. Identify appropriate Virtualization techniques to virtualize infrastructures [Understand] 3. Summarize various Cloud mechanisms to optimize the QoS parameters [Understand] 4. Apply cloud platforms to develop various applications [Apply]				
Course Content:					
Module 1	**Introduction to Cloud services**	Assignment	Theory		**L: 10**
Evolution of cloud computing, Computing Platforms and Technologies, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Cloud Computing Environments. [Understanding]					
Module 2	**Virtualization Techniques**	Assignment	Theory		**L: 10**
Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization. [Understanding]					
Module 3	**Cloud QoS and Management**	Assignment	Theory		**L: 10**
Cloud Infrastructure Mechanisms- Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Ready-Made Environment, SLAs, Specialized Cloud Mechanisms- Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Cloud Security Mechanisms. [Understanding]					
Module 4	**Cloud Application development in Cloud**	Assignment	Theory		**L: 10**
Programming Models for Cloud Computing – MapReduce, CGL Mapreduce, Cloud Haskell, Development environments for service development (Demonstration using AWS Cloud/Saturn Cloud); Dockers and Containers. [Apply]					

Targeted Application & Tools that can be used :

Applications:

Cloud Platform, Use of cloud technology in different applications like healthcare, agriculture etc.

Tools:

1. Google App Engine
2. AWS, Saturn Cloud etc.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

- **Students can design and implement dynamic resource allocation for virtual machine using cloud computing environment.**
- **Design and Implementation of a Scalable Cloud-Based Data Storage System**
- **Development of a Multi-Cloud Management Platform**

Text Book

1. **Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, 2013 edition.**

2. **John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press, 2010 edition.**

References

1. **Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", PHI publisher 2013 edition.**

2. **K. Chandrasekaran, "Essentials of CLOUD COMPUTING", CRC Press, 2015 edition.**

3. **David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press, 2018 edition.**

4. **Manvi, Sunilkumar, and Gopal K. Shyam. "Cloud Computing: Concepts and Technologies". CRC Press, 2021.**

Web Based Resources and E-books:

W1. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519 W2. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc
W3. CloudSim Resources
https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html
W4. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer- applications

Topics relevant to "Skill Development": AWS, Azure, APIs, Aneka Cloud Platform, Virtualization, Cloud Platforms in Industry, EC2, Installation of VM Workstation, Cloud Infrastructure and Challenges for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3343_P	Course Title: Cloud Computing Lab	L- T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	**Data Communication and Computer Networks (CSE2011)**					
Anti-requisites	Nil					
Course Description	Cloud Computing provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **CLOUD COMPUTING** and is designed to improve the learners' **SKILL DEVELOPMENT** through **PARTICIPATIVE LEARNING TECHNIQUES.**					
Course Content:						

Targeted Application & Tools that can be used :

Applications:

Cloud Platform, Use of cloud technology in different applications like healthcare, agriculture etc.

Tools:

1. Google App Engine
2. AWS, Saturn Cloud etc.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

- **Students can design and implement dynamic resource allocation for virtual machine using cloud computing environment.**
- **Design and Implementation of a Scalable Cloud-Based Data Storage System**
- **Development of a Multi-Cloud Management Platform**

List of Laboratory Tasks:

Experiments:

1. **Create a simple cloud software application and provide it as a service using any Cloud Service Provider to demonstrate Software as a Service (SaaS).**
2. **Create a Virtual Machine with 1 vCPU, 2GB RAM and 15GB storage disk using a Type 2 Virtualization Software**
3. **Create a Virtual Hard Disk and allocate the storage using VM ware Workstation**
4. **Create a Snapshot and Cloning of a VM and Test it by loading the Previous Version/Cloned VM**
5. **Demonstrate Infrastructure as a Service (IaaS) by Creating a Virtual Machine using a Public Cloud Service Provider (Azure/GCP/AWS), configure with minimum CPU, RAM, and Storage and Launch the VM image.**
6. **Create a Simple Web Application using Java or Python and host it in any Public Cloud Service Provider (Azure/GCP/AWS) to demonstrate Platform as a Service (PaaS)**

7. Create a Storage service using any Public Cloud Service Provider (Azure/GCP/AWS) and check the public accessibility of the stored file to demonstrate Storage as a Service
8. Create a SQL storage service and perform a basic query using any Public Cloud Service Provider (Azure/GCP/AWS) to demonstrate Database as a Service (DaaS)
9. Perform the basic configuration setup for Installing Hadoop 2.x like Creating the HDUSER and SSH localhost
10. Install Hadoop 2.x and configure the Name Node and Data Node.
11. Launch the Hadoop 2.x and perform MapReduce Program for a Word Count problem

Text Book

3. **Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, 2013 edition.**

4. **John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press, 2010 edition.**

References

Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", PHI publisher 2013 edition.

K. Chandrasekaran, "Essentials of CLOUD COMPUTING", CRC Press, 2015 edition.

David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press, 2018 edition.

Manvi, Sunilkumar, and Gopal K. Shyam. "Cloud Computing: Concepts and Technologies". CRC Press, 2021.

Web Based Resources and E-books:

W1. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519 W2. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc
W3. CloudSim Resources
https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html
W4. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer- applications

Topics relevant to "Skill Development": AWS, Azure, APIs, Aneka Cloud Platform, Virtualization, Cloud Platforms in Industry, EC2, Installation of VM Workstation, Cloud Infrastructure and Challenges for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3102	**Course Title:** Malware Analysis	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Should Have the knowledge of Cryptography and Network Security					
Anti-requisites	**NIL**					
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of MalwareAnalysis and attain **Employability** through **Participative Learning** techniques.					
Course OutComes	On successful completion of this course the students shall be able to: 1. Understanding the nature of malware, its capabilities, and how it is combatedthrough detection and classification. 2. Apply the methodologies and tools to perform static and dynamic analysis onunknown executables. 3. Analyze scientific and logical limitations on society's ability to combat malware.. 4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new antianalysis techniques in future malware samples.					
Course Content:						

Module 1	**Introduction to MALWARE ANALYSIS**		Assignment		Programming activity	**12 Hours**

Topics:
Introduction to malware, OS security concepts, malware threats, evolution of malware, malware typesviruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis.
Assignment: Brief study on types of spyware

Module 2	**Static Analysis**		Assignment		Programming activity	**11 Hours**

Topics:
X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, ReverseEngineering- x86 Architecture
Assignment: Static analysis on malware (PeStudio & ProcMon)

Module 3	**Dynamic Analysis**		Assignment		Programming activity	**11 Hours**

Topics:
Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark
Assignment: Demonstration of wireshark

Module 4	**Malware Functionality and Detection Techniques**		Assignment		Programming activity	**12 Hours**

Topics:
Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.
Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences
Assignment: Packet malware signature

Targeted Application & Tools that can be used: eCMAP (Certified Malware Analysis Professional)

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Any appropriate tool can be given to demonstrate.

Text Book

1. Michael Sikorski and Andrew Honig, 2012: " Practical Malware Analysis", No Starch Press.

E-Resources
W1. https://www.geeksforgeeks.org/introduction-to-malware-analysis/
W2. https://ine.com/learning/courses/malware-analysis
W3: https://sm-nitk.vlabs.ac.in/

References

1. Jamie Butler and Greg Hoglund, 2005: "Rootkits: Subverting the Windows Kernel", Addison-Wesley.
2. Dang, Gazet and Bachaalany, 2014: "Practical Reverse Engineering",Wiley.
3. Reverend Bill Blunden, 2012: "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of theSystem" Second Edition,Jones& Bartlett.

Topics relevant to "EMPLOYABILITY SKILLS": X86 Architecture, Packet Sniffing, Wireshark, for development of Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.

Course Code: CSEXXXX	**Course Title: Internet of Things** **Type of Course: Integrated**	**L- T-P- C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	1. Students should know basic python programming. 2. Students have basic knowledge basic electronic components such as sensors – temperature, motion, pressure, and actuators etc. 3. Students should have basic idea about Cloud and its uses.					

Anti-requisites	NIL			
Course Description	The Internet of Things (IoT) is an emerging paradigm combining heterogeneous devices at an unprecedented scale, thereby enabling individuals and organizations to gain greater value from networked connections among people, processes, data, and things. The Internet of Things (IoT) is a course of objects interacting with people, with information systems, and with other objects. The course will focus on creative thinking, IoT concepts & IoT technologies.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet of Things and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the application areas of IoT 2. Understand building blocks of Internet of Things and characteristics 3. Describe IoT Protocols 4. Demonstrate use of IoT devices for simple application			
Course Content:				
Module 1	INTRODUCTION TO INTERNET OF THINGS	Assignment	Simulation/Data Analysis	**18 Sessions**
Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless sensor networks, Cloud computing, Big data Analytics				
Module 2	IOT COMMUNICATION MODEL AND PROTOCOLS	Assignment	Numerical from E-Resources	**18 Sessions**
Connectivity Protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100,NFC, RFID. Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol				
Module 3	IOT COMMUNICATION MODEL AND PROTOCOLS	Term paper/Assignment	Simulation/Data Analysis	**19 Sessions**
Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol. RFID: Introduction, Principle of RFID, Components of an RFID system.				
List of Laboratory Tasks 1 Installation of arduino IDE & Arduino program to implement scrolling LED, to glow even/odd LED 2 Arduino program to demonstrate usage of push button to control the LED 3 Arduino program to demonstrates traffic control system 4 Arduino program to demonstrates usage of servo motor with potentio meter. 5.Arduino program to Control an LED using Bluetooth. 6.Arduino program to implement RFID reader for security access. 7. Arduino Program to detect obstacle using IR sensor. 8.Arduino Program to detect motion using PIR sensor. 9.Installation of Raspberry pi software 10. Working basic commands on Raspberry pi & to demonstrate remote logging in raspberry pi 11.Raspberry pi program to implement blinking LED 12. Raspberry pi program to implement camera module for video 13. Raspberry pi program to obtain the temperature using DHT sensors 14.Using a Raspberry Pi with distance sensor (ultrasonic sensor HCSR04)				

15. Raspberry pi program to implement Garage spot light
Targeted Application & Tools that can be used: **Interfacing of ARDUINO and Raspberry pi for developing smart CITIES** **Tools:** Tinker cad Cooja simulator Contiki Thingspeak
Text Book T1 Arshdeep Bagha, Vijay Madisetti, Internet of Things A hands on approach, First Edition, Universities Press, 2018 T2 Hakima Chaouchi, The internet of Things Connecting Objects to web Wiley 2017
References R1 Vinit Kumar Gunjan, MohdDilshad Ansari,Mohammed Usman, ThiDieuLinh Nguyen Internet of Things Technology, Communications and Computing Springer January 2023 R2 Dr. Hassan Internet of Things A to Z: Technologies and Applications IEEE Press 2018 **E-Resources** NPTEL course – a) https://onlinecourses.nptel.ac.in/noc22_cs53/preview b) https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/ c) https://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to "SKILL DEVELOPMENT": Case studies of water supply projects – Design criteria through group discussion. Interpolation of sensors through group presentation for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3132	**Course Title: Network Management Systems** **Type of Course: Theory Only Course**	**L- T-P- C**	3 -0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	To understand the principles of network management, different standards and protocols used in managing complex networks and the Automation of network management operations and making use of readily available network management systems.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Network Management Systems** and attain **Skill Development** through **Participative Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** 1]Acquire the knowledge about network management standards (OSI and TCP/IP). 2]Acquire the knowledge about various network management tools and the skill to use them in monitoring a network. 3]Analyze the challenges faced by Network managers.		

	4]Evaluate various commercial network management systems and open network management systems. 5]Analyze and interpret the data provided by an NMS and take suitable actions.			
Course Content:				
Module 1	DATA COMMUNICATION AND NETWORK MANAGEMENT	Assignment	Data Collection/Interpretation	**12 Sessions**
Topics: OVERVIEW : Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.				
Module 2	Simple Network Management Protocol	Case studies / Case let	Case studies / Case let	**12 Sessions**
Topics: SNMPV1 NETWORK MANAGEMENT MANAGED NETWORK: Organization and Information Models MANAGED NETWORK: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The Information Model. SNMPV1 NETWORK MANAGEMENT: Communication and Functional Models The SNMP Communication Model, Functional model. SNMP MANAGEMENT: SNMPv2 Major Changes in SNMPv2, SNMPv2 System architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility with SNMPv1.				
Module 3	Remote Monitoring	Quiz	Case studies / Case let	**14 Sessions**
Topics: RMON : What is Remote Monitoring? ,RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, A Case Study of Internet Traffic Using RMON TELECOMMUNICATIONS MANAGEMENT NETWORK: Why TMN? , Operations Systems, TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN, Implementation Issues.				
Module 4	NETWORK MANAGEMENT TOOLS AND SYSTEMS	Quiz	Case studies / Case let	**14 Sessions**
Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management, Enterprise Management Solutions.				
Module 5	WEB-BASED MANAGEMENT	Quiz	Case studies / Case let	**14 Sessions**
NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network , Future Directions. Case Studies.				
Targeted Application & Tools that can be used: Kiwi CatTools, SolarWinds Network Configuration Manager.				
Project work/Assignment:				
Assignment: Simulation of NMS using any of the tools mentioned above.				

Text Book **T1.** Mani Subrahmanian, "Network Management Principles and Practice", 2nd Edition, Pearson Education, 2010.
References **R1**. Morris, "Network management", 1st Edition, Pearson Education, 2008. **R2.** Mark Burges, "Principles of Network System Administration", 1st Edition, Wiley DreamTech, 2008. **E book link R1.** https://documentation.solarwinds.com/en/success_center/kct/content/kct_documentation.htm **E book link R2.** https://documentation.solarwinds.com/ **E book link R3.** https://www.youtube.com/watch?v=liBB_Q7Go5k **NPTEL Course: https://onlinecourses.nptel.ac.in/noc22_cs98/course**
Topics relevant to "SKILL DEVELOPMENT": Telephony network management and SNMPV1 for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE 2058	**Course Title: Firewall and Internet security** **Type of Course: Integrated**	**L- T-P- C**	2-0-2-3
Version No.	1		
Course Pre-requisites	Computer Networks		
Anti-requisites			
Course Description	This course provides an in-depth study of various network attacks techniques and methods to defend against them. A number of threats and vulnerabilities of the Internet will be covered, including various vulnerabilities of TCP/IP protocols, denial of service (DOS), attacks on routing, attacks on DNS servers, TCP session hijacking, and so on. This course will also cover defending mechanisms, including intrusion detection, firewalls, tracing the source of attacks, anonymous communication, IPsec, virtual private network, and PKI. To make it easy for students to understand these attacks, basics of the TCP/IP protocols will also be covered in the course.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Firewall and Internet security** and attain **Skill Development** through **Problem Solving** Methodologies.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • To identify elements of firewall design, types of security threats and responses to security attacks. • Examine security incident postmortem reporting and ongoing network security activities. • Construct code for authentication algorithms. • Develop a signature scheme using Digital signature standard. • Demonstrate the network security system using open source tools		

Course Content:				
Module 1	Introduction to Firewall	Assignment	Data Collection/Interpretation	**12 Sessions**
Introduction of Firewall in computer network,Categories of firewall,How firewall works,Types of firewall, Firewall location and Configuration,Firewall Policies,Firewall Biasing,Network Architecture,Net masks,Packet filters,Stateful firewalls,Resources				
Module 2	**Computer security**	Case studies / Case let	Case studies / Case let	**12 Sessions**
Topics: Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)				
Module 3	**Network Security**	Quiz	Case studies / Case let	**10 Sessions**
Topics: Overview of Network Security:Elements of Network Security , Classification of Network Attacks ,Security Methods ,Symmetric-Key Cryptography :Data Encryption Standard (DES),Advanced Encryption Standard (AES) , Public-Key Cryptography :RSA Algorithm ,Diffie-Hellman Key-Exchange Protocol , Authentication :Hash Function , Secure Hash Algorithm (SHA) , Digital Signatures.				
Module 4	Cyber laws and Compliance Standards	Quiz	Case studies / Case let	**11 Sessions**
Topics: Kerberos:Working ,ASS,TGS,SS-Internet security protocols-AH,ESP,Models-Transport and tunnel-Email security,Public key Infrasturcture,Certificates,certificates authority.Cyber Crime: Introduction,Hacking,Digital forgery,Cyber Stalking,Identify theft and Fraud,Cyber terrorism,Cyber defamation,Crime against individual,Government,Property.				

List of Laboratory Tasks:

1. Perform encryption, decryption using the following substitution techniques
(i) Ceaser cipher, (ii) playfair cipher iii) Hill Cipher iv) Vigenere cipher
2. Perform encryption and decryption using following transposition techniques
i) Rail fence ii) row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the SIGNATURE SCHEME – Digital Signature Standard.
9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other s/w.
10. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool
11. Defeating Malware
i) Building Trojans ii) Rootkit Hunter

Targeted Application & Tools that can be used

Text Book

T1 : Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill, Indian Edition

T2: James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017
References **R1:** Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson Edition **R2**: Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014. **Web resources:** 1. https://networklessons.com/cisco/asa-firewall 2. https://www.udemy.com/course/cisco-asa-firewall-lab-guide 3. https://geekflare.com/learn-network-security
• **Topics relevant to development of "Skill Development": AES, Network Security for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**

Course Code: CSE3123	**Course Title: Search Engine Optimization** **Type of Course: Program Core & Theory Only**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	**NIL**		
Anti-requisites	**NIL**		
Course Description	Objective of this course is to make students learn the basics of Search Engine and develop ability to optimize the searching based on the key words so that the business can be improved. The search engine optimization is the skill of improving a website to upsurge its visibility when people search for products or services. The more visible a website has on search engines, the more likely it is that brand captures business. The students should have prior knowledge of WWW to pursue the Course. After successful completion of the Course, the students would acquire knowledge to comprehend the Search Engine Optimization algorithms, SEO tools and Reporting methods to analyze the web sites.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Search Engine Optimization** and attain **Skill Development** through **Participative Learning** techniques.		

Course Out Comes	On successful completion of the course the students shall be able to: 1. Outline the basic concepts of SEO (Knowledge) 2. Discuss the content necessary for On-page & Off-Page SEO (Comprehension) 3. Illustrate Technical SEO (Application) 4. Analyse the Report of SEO to measure the performance (Analysis)			
Course Content:				
Module 1	**Introduction to SEO**			**10 Sessions**
Topics: Search Engine – works- SEO vs SEM- need – history- works- Googlebot (Google Crawler)- Types of SEO technique- Search Engine Algorithm- Google Algorithm- Key word search- Types of key words- Competition analysis- Page ranking technology				
Module 2	**On-Page and Off-Page SEO**	Assignment		**12 Sessions**
Topics: Introduction to On-Page SEO, Basics of website designing/development, HTML Basics for SEO, Meta Tag, Title Tag, Image Tag and H Tag Optimization- Link building- Optimizing SEO content- Key word search and Analysis. Introduction to Off-Page optimization- Local marketing of website as per the location- Page ranking- Building back links- Type of links – Natural Link, manually built link & Self-created link- White hat, grey hat and Black hat SEO- Social Media optimization technique.				
Module 3	**Technical SEO**			**10 Sessions**
Basics of Technical SEO- Crawling and Indexing- HTML Sitemap vs. XML Sitemap, The robots.txt File protocol, Overcoming Error codes, Technical Analysis connected with Redirection, Broken Links - Redirects, Best Practices, Analysis of Crawl Errors				
Module 4	**SEO Reporting**	Assignment		**08 Sessions**
Website position analysis in various search engine- Analyzing performance of the website using Google analytics- Goals and conversion- Tracking and report- Reports submission- Securing Ranks.				
Targeted Application & Tools that can be used: Applications: Online Business models such as e-Commerce, Digital Marketing, Health Care **Professionally used softwa**re – Google Analytics				
Text Book T1 - *"Search engine optimization all-in-one for dummies",* Clay, B ,3rd ed., John Wiley & Sons, Inc., 2015. T2 -*"Google AdWords: A beginner's guide to Google. Use Analytics, SEO, and AdWords. Become an influencer on social media"*, Wally Bax , Notion Press Media Pvt Ltd., 2022.				
References R1 – "*Introduction to search engine optimization: A guide for absolute beginners"*, Kelsey, T, Apress. (2017). R2 - *"Step By Step Guide to SEO"*, Upendra Rana, Ocean Books Pvt Ltd.R-Tech Offset Printers, 2018. R3 - "*Search Engine Optimization (SEO).Grow the Audience"*, Clark, Hack Book Works, 2022. **Weblinks:** W1: https://puniversity.informaticsglobal.com/login				

W2:https://essentials.ebsco.com/search?query=Search+Engine+Optimization
Topics relevant to "SKILL DEVELOPMENT": Development basic using HTML and Search engine optimization tools **for** Skill Development **through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE2051	**Course Title:** Information Retrieval **Type of Course: Theory Only Course**	**L-T- P- C**	3	0	0	3
Version No.	1					
Course Pre-requisites	Basic Knowledge in Data Structures and algorithms and probability and statistics, background in machine learning					
Anti-requisites	NIL					
Course Description	The course studies the theory, design and implementation of Text- based information systems. The Information Retrieval core concepts of the course include statistical characteristics of text, representation of information needs and documents. Topics Include Several important retrieval models (Basic IR Models, Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model, Latent Semantic Indexing Model, Neural Network Model). Retrieval Evaluation, Retrieval Metrics, Text Classification and Clustering algorithms, Web Retrieval and Crawling. Recommender Systems: Basics of Content-based Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models.					
Course Objective	The objective of the course is to familiarize the learners with the concepts Information Retrieval and attain Skill Development through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval. [Knowledge] CO2: Evaluate the effectiveness and efficiency of different information retrieval methods. [Application] CO3: Explain different indexing methodology requirements and the concept of web retrieval and crawling. [Comprehension] CO4: Classify different recommender system and its aspect. [Comprehension]					
Course Content:						
Module 1	**Introduction to Information Retrieval**	Assignment	Data collection		**7 Sessions**	
Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes						

Module 2	**Modeling and Retrieval Evaluation**	Assignment	Problem solving		**10 Sessions**
Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.					
Module 3	**Indexing & Web-Retrieval**	Term paper/Assignment	Data analysis		**8 Sessions**
Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing. The Web – Search Engine Architectures – Cluster based Architecture - Search Engine Ranking – Link based Ranking – Simple Ranking Functions, Evaluations — Search Engine Ranking – Applications of a Web Crawler.					
Module 4	**Recommender System**	Term paper/Assignment	Problem solving		**8 Sessions**
Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models.					

Targeted Application & Tools that can be used:

Information Retrieval System, Collaborative Filtering System, Feedback System, Evaluation Metrics

Assignment:

Group assignment, Quiz

Text Book

T1 Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —" Modern Information Retrieval: The Concepts and Technology behind Search", Third Edition, ACM Press Books, 2018. Link: https://people.ischool.berkeley.edu/~hearst/irbook/

T2 Ricci, F, Rokach, L. Shapira, B.Kantor, —"Recommender Systems Handbook", Fourth Edition, 2018.

References

R1 Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —"*Information Retrieval: Implementing and Evaluating Search Engines*", The MIT Press, 2017.

R2 Jian-Yun Nie Morgan & Claypool –" *Cross-Language Information Retrieval*", Publisher series 2011.

R3 Stefan M. Rüger Morgan & Claypool – "*Multimedia Information Retrieval*", Publisher series 2014.

R4 B. Liu, Springer, - "*Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data*", Second Edition, 2013.

R5 C. Manning, P. Raghavan, and H. Schütze, —"Introduction to Information Retrieval", Cambridge University Press, 2015. Link: https://nlp.stanford.edu/IR-book/

Web Based Resources and E-books:

https://puniversity.informaticsglobal.com/login

- **Topics relevant to the development of SKILLS:** Recommendation Techniques, Content-based Filtering for **Skill Development** through **Participative Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3002	**Course Title: Big Data Analytics** **Type of Course: Laboratory Integrated**		**L- T-P- C**	2	0	2	3
Version No.	2.0					
Course Pre-requisites	DDL, DML of SQL Queries and Creation of Class & object, interface, reading & writing a file, control statements in java programming.					
Anti-requisites	NIL					
Course Description	This course is designed to provide the fundamental knowledge to equip students being able to handle real world big data problems including the three key resources of Big Data: people, organizations, and sensor. With the advancement of IT storage, processing, computation and sensing technologies, big data has become a novel norm of life.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics 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 fundamental concepts of big data analytics (Knowledge) 2: Apply Map-Reduce programming on the given datasets to extract required insights. (Application). 3: Employ appropriate Hadoop Ecosystem tools such as Hive, Hbase to perform data analytics for a given problem (Application) 4: Use Spark and nosql tool to analyse the given dataset for a given problem. (Application).					
Course Content:						
Module 1	**Introduction to Big data Analytics**	Assignment	Case study on Real time applications	**10 Sessions**		
Introduction to Big Data: Basics of Distributed File System, Four Vs, Drivers for Big data, Big data applications, Structured, unstructured, semi-structured and quasi structured data. Big data Challenges-Traditional versus big data approach. The Hadoop: History of Hadoop-Hadoop use cases, The Design of HDFS, Blocks and replication management, Rack awareness, HDFS architecture, HDFS Federation, Name node and data node, Anatomy of File write, Anatomy of File read. Role of Data Scientist - Role of Data Analyst – Data Analytics in Product development - Business Intelligence vs Data analytics - Real time Business Analytical ProcessCase studies related to big data applications						
Module 2	**Hadoop MapReduce Framework**	Assignment	Installation of multimode cluster	**10 Sessions**		
MapReduce : Overview and Need of Distributed processing for big data- Introduction to hadoop framework and MapReduce programming - HDFS design and its goals - Master-Slave Architecture of hadoop – Working with hadoop daemons-Installation of hadoop single node cluster and multi node clusters - Working with MapReduce programming.						
Module 3	**Hive and Hbase Analytical tools**	Term paper/Assignment	Hive joins	**10 Sessions**		
Hive : Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, and Hive sort by vs. order by, Hive Joining tables, Hive bucketing. **Hbase** : Introduction to HBase and its working architecture- Commands for creation and listing of tables-disabled and is disabled of table - enable and is enabled of table- describing and dropping of table-Put and Get command - delete and delete all command-commands for scan, count, truncate of tables.						
Module 4	**Data Analytics with Spark**	Term paper/Assignment	Spark RDD	**10 Sessions**		

Spark: Spark: Apache Spark's Philosophy, History of Spark, Running Spark, A Gentle Introduction to Spark, Spark's Basic Architecture, Spark Applications, DataFrames, Partitions, Transformations, Lazy Evaluation, Actions, Spark UI, An End-to-End Example, Integration of Hive and spark.
Nosql: Mongo DB: Introduction ,Features ,Data types , Mongo DB Query language , CRUD operations ,Arrays , Functions: Count ,Sort , Limit , Skip , Aggregate , Cursors – Indexes , Mongo Import , Mongo Export.

List of Laboratory Tasks

1. Introduction to Hadoop Ecosystem tools
2. Introduction to Hadoop distributed file System.
3. Installation of Hadoop single node cluster using Ubuntu operating system.
4. Working with Hadoop Commands
5. Introduction to Mapreduce framework
6. Word Count analysis using sample data set (MapReduce)
7. Stock analysis using sample data set (MapReduce)
8. Web log analysis using sample data set (MapReduce)
9. Temperature analysis using sample data set .(MapReduce)
10. Working on basic hive commands
11. Working on basic hbase commands
12. Install, Deploy & configure Apache Spark
13. Word count analysis using RDD and FlatMap
14. Working with MongoDB using restaurant data.

Targeted Application & Tools that can be used:

Apache Hadoop-

HDFS – for data storage
Map reduce – Mapping and reducing.
Hive – Structured data,HQl
Hbase, MongoDB – No SQL
Apache Spark – SCALA LANGUAGE

Text Book

1. Big Data and Analytics- Seema Acharya, Subhashini Chellappan-2019, 2nd Edition, Wiley Publication.
2. Analytics in a Big data world- Bart Baesens- 2nd Edition, Wiley Publication. 2018

Reference

1. Big data Analytics, Radha Shankarmani and vijayalakshmi second edition wiley publication 2016
2. Big Data, Anil Maheshwari , McGraw Hill education 2019
3. Hadoop: The Definitive Guide, Tom White , 3rd Edition, O'reilly. 2016

E-Resources

1.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii
2.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live

Topics relevant to SKILL DEVELOPMENT: Hadoop ecosystem tools, HDFS, Mapreduce, Hive, Hbase, MongoDB,NoSQL, Spark for **Skill Development** through **Experiential Learning** techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE2034	Course Title: Edge Computing	L-T-P-C	3-0-0-3

	Type of Course: Theory Only **Course Discipline Elective**			
Version No.	1.0			
Course Pre-requisites	Distributed Systems and Algorithms			
Anti-requisites	**Nil**			
Course Description	In this course, we will study significant tools and applications that comprise today's cloud computing platform, with a special focus on using the cloud for big data applications. The course covers various topics such as the evolution of computing industry, cloud computing basics and edge computing. The course provides information on the different types of edge compute deployments, different types of edge compute services (such as CDN Edge, IOT Edge, and Multi-access Edge (MEC)). The course also educates the students on the different vendor platforms, software services, standard bodies and open source communities available for edge computing. Students will also create a research project of their choosing.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Edge Computing and attain **Employability** through **Problem Solving** Methodologies.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1 Understand the principles, architectures of edge computing (Knowledge) CO2 Describe IoT Architecture and Core IoT Modules (Comprehension) CO3 Summarize edge to Cloud Protocols (Comprehension) CO4 Describe Edge computing with RaspberryPi (Comprehension)			
Course Content:				
Module 1	IoT and Edge Computing Definition and Use Cases	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	**9 Sessions**
Topics: Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.				
Module 2	IoT Architecture and Core IoT Modules	Term paper/Assignment/**Case Study**	Programming/Simulation/Data Collection/any other such associated activity	**9 Sessions**
Topics: A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.				

Module 3	RaspberryPi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**10 Sessions**
Topics: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.				
Module 4	Edge to Cloud Protocols	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	**7 Sessions**
Topics: Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols- Protocols,MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions,MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.				
Module 5	Edge computing with RaspberryPi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**7 Sessions**
Topics: Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.				

Targeted Application & Tools that can be used:

- **Application** : Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking.
- **Tools** :Eclipse ioFog : An integrated development environment built by the Eclipse Foundation, backed by IBM. Eclipse ioFog is the organization's open-source edge computing platform.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Exploring topics such as developing scalable architectures, moving from closed systems to open systems, and ethical issues rising from data sensing, addresses both the challenges and opportunities of Edge computing presents. Students can harness federating Edge resources, middleware design issues, data management and predictive analysis, smart transportation and surveillance applications, and more. A coordinated and integrated solutions can be provided by thorough knowledge of the foundations, applications, and issues that are central to Edge computing.

Text Book

1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806
2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.

Topics relevant to "EMPLOYABILITY SKILLS": Implementation of Microcomputer RaspberryPi and device Interfacing for developing **Employability Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSE3021	**Course Title: BLOCKCHAIN FOR PUBLIC SECTOR** **Type of Course: Theory**		**L-T-P-C**	3-0-0-3
Version No.	1.0			
Course Pre-requisites	Foundations of Blockchain Technology			
Anti-requisites	NIL			
Course Description	Blockchain Technology is being increasingly employed in the public sector, specifically where trustworthiness and security are of importance. This course discusses about the blockchain technology and its potential applications, emerging technologies and their role in the implementation of blockchain technologies in the digital government and the public sector particularly in Smart City, Electronic Health Care monitoring and Digital Certificates. It also analyses effects, impacts, and outcomes from the implementation of blockchain technologies in the public sector in the selected case studies.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Blockchain For Public Sector** and attain **Employability** through **Participative Learning** techniques..			
Course Out Comes	**On successful completion of the course the students shall be able to:** 1] Understand the Standards and Protocols of Blockchain and data management in the public sector [COMPREHENSION] 2] Apply Artificial intelligence and machine learning approaches for implementation of Smart cities using blockchain architecture [APPLICATION] 3] Discuss about Electronic Healthcare Records Monitoring using Blockchain Technology [COMPREHENSION] 4] Describe the Blockchain Technology use cases in Indian and Foreign Countries [KNOWLEDGE]			
Course Content:				
Module 1	**Blockchain in Government and the Public Sector**	Quiz	Data Collection	**9 Sessions**
Blockchain in Government and the Public Sector use cases – Benefits – Standards and Protocols of Blockchain - data management in the public sector - Building networked public services - Understanding and addressing risks and challenges. Blockchain Applications to Public Sector Governance. Case Study – Keyless Signature Infrastructure (KSI)				
Module 2	**Blockchain in Smart City Applications**	Assignment	Data Collection	**9 Sessions**

The Application of Blockchain Technology to Smart City Infrastructure - Artificial intelligence and machine learning approaches for smart transportation in smart cities using blockchain architecture - Blockchain architecture for intelligent water management system in smart cities - Blockchain-based energy-efficient smart green city in IoT environments - Citizen e-governance using blockchain - Cloud/edge computing for smart cities.				
Module 3	**Blockchain in Healthcare**	Case Study	Data Collection	**9 Sessions**
Blockchain in Healthcare Applications – Use cases - Blockchain and Data Security – Blockchain Medical Records - Healthcare Blockchain Use Case: Supply Chain Transparency – Electronic Health Records, A novel Blockchain-based Access Control Manager to Electronic Health Records. Case Study – Avaneer Health, MEDICALCHAIN, BurstIQ, Guardtime				
Module 4	**Implementation of Blockchain in Indian System and Foreign Countries**	Case Study	Data Collection	**9 Sessions**
Implementation of Blockchain in India - land registration - Blockchain Fit Assessment: Digital certificates, SuperCert: Anti certificates fraud identity intelligence blockchain solution for educational certificates. Case study- Implementation of Blockchain in Foreign Countries - Vehicle Wallet – BenBen – Project Ubin				
Targeted Application & Tools that can be used: **Remix IDE - Solidity Programming**				
Project Work / Assignment / Case Study				
Assignment 1: Blockchain architecture for intelligent water management system in smart cities. **Case Study:** Blockchain-based health care monitoring for privacy preservation of COVID-19 medical records. **Case Study:** Implementation of Blockchain in Government of Estonia - Digital Certification by DNV GL.				
Text Books 1. Saravanan Krishnan, Valentina Emilia Balas, Raghvendra Kumar, "*Blockchain for Smart Cities*", Elsevier, 2021. https://doi.org/10.1016/C2020-0-01958-4 2. Christopher G. Reddick, Manuel Pedro Rodríguez-Bolívar, Hans Jochen Scholl, "*Blockchain and the Public Sector Theories, Reforms, and Case Studies*", Stanford University Press, 2021. Blockchain and the Public Sector: Theories, Reforms, and Case Studies (Public Administration and Information Technology Book 36) eBook : Reddick, Christopher G., Rodríguez-Bolívar, Manuel Pedro, Scholl, Hans Jochen: Amazon.in: Kindle Store				
References 1. Sheikh Mohammad Idrees, Parul Agarwal, M. Afshar Alam, "*Blockchain for Healthcare Systems: Challenges, Privacy, and Securing of Data*", CRC Press, 2021 . https://books.google.co.in/books/about/Blockchain_for_Healthcare_Systems.html?id=hiU7EAAAQBAJ&redir_esc=y				

Web Resources:

1. https://link.springer.com/book/10.1007/978-3-030-55746-1
2. https://consensys.net/blockchain-use-cases/government-and-the-public-sector/
3. https://www.oecd.org/gov/innovative-government/oecd-guide-to-blockchain-technology-and-its-use-in-the-public-sector.htm
4. https://www2.deloitte.com/in/en/pages/public-sector/articles/blockchain-in-public-sector.html
5. https://www.ibm.com/in-en/blockchain/industries/government
6. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/using-blockchain-to-improve-data-management-in-the-public-sector
7. https://www.frontiersin.org/articles/10.3389/fbloc.2022.869665/full
8. https://www.settlemint.com/government-blockchain-use-cases/
9. https://stlpartners.com/articles/digital-health/5-blockchain-healthcare-use-cases/
10. https://www.oecd.org/finance/Opportunities-and-Challenges-of-Blockchain-Technologies-in-Health-Care.pdf
11. https://builtin.com/blockchain/blockchain-healthcare-applications-companies
12. https://www.hhs.gov/sites/default/files/blockchain-for-healthcare-tlpwhite.pdf
13. https://healthitanalytics.com/features/3-use-cases-for-blockchain-in-healthcare
14. https://www2.deloitte.com/us/en/pages/public-sector/articles/blockchain-opportunities-for-health-care.html
15. https://www.niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_I.pdf
16. https://www.bigchaindb.com/usecases/government/benben/

Topics relevant to "EMPLOYABILITY SKILLS": Keyless Signature Infrastructure **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE2025	**Course Title:** **Business Continuity and Risk Analysis** **Type of Course:** **Theory**	**L- T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		

Course Description	Through the study of incident response and contingency planning, including incident response plans, disaster recovery plans, and business continuity plans, this course aims to help students comprehend the principles of risk management.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Business Continuity and Risk Analysis** and attain **Employability** through **Participative Learning** techniques.
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Describe concepts of risk management [Knowledge] 2. Define and be able to discuss incident response options [Comprehension] 3. Design an incident response plan for sustained organizational operations [Comprehension] 4. Discuss and recommend contingency strategies, including data backup and recovery and alternate site selection for business resumption planning. [Knowledge]
Course Content:	

Module 1 Sources of disaster and types of disasters	**10 Sessions**
Disaster Recovery Operational cycle of disaster recovery, disaster recovery cost, incidents that requires disaster recovery plans, **evaluating disaster recovery** - methods, team, phases, objectives, checklist. Best practices for disaster recovery - **Business continuity** - Business continuity vs. disaster recovery	
Module 2 Business continuity management:	**10 Sessions**
Introduction - Elements of business continuity management. **Business continuity plan – Business continuity planning and strategies - BCP standards and guidelines - BCP Project Organization - Crisis communication plan - Emergency response plan - Contingency planning**	
Module 3 Managing, assessing and evaluating risks:	**09 Sessions**
Importance of risk management - Risk management methodology - Attack methods and Countermeasures - **Cost benefits analysis of risk management** - Risk assessment responsibilities - Responsibilities of security professional - Information system auditing and monitoring – **Verification tools and techniques.**	
Module 4 Risk control policies and Counter measures	**09 Sessions**
Introduction - Counter measures - Risk control policy development factors-Development of information assurance principles and practices - Laws and procedures in information assurance policy implementation, Security test and evaluation, Automated security tools, Cost benefit analysis, Developing a risk assessment methodology, Security requirements, Information categorization, Risk management methodologies to develop life cycle management policies and procedures, Education, training and awareness. Policy development Information security policy, change control policies, system acquisition policies and procedures, Risk analysis policies and General risk control policies.	

Text Book

1. John W. Rittinghouse and James F. Ransome, Business Continuity and Disaster Recovery for Info Sec Managers. Elsevier: Elsevier Digital Press, 2005. (ISBN: 978-0-52-119019-0)
2. EC Council Press. Disaster Recovery, 1st Ed. Course Technology, 2011. (ISBN: 978-1-55558-339-2)

References

1. ISO 27001:2013 A specification for an information security management system
2. David Alexander, Amanda Finch, David Sutton, Andy Taylor. Information Security Management Principles, 2nd Ed. BCS Shop, 2013. (ISBN: 9781780171753)
3. Mark Talabis, Jason Martin. Information Security Risk Assessment Toolkit Practical Assessments through Data Collection and Data Analysis. Syngress Imprint, 2013. (ISBN: 978-1-59-749735-0).

Web resources: http://pu.informatics.global

Topics relevant to "EMPLOYABILITY SKILLS": Business continuity vs. disaster recovery , risk management, Storage disaster recovery services tools, Verification tools and techniques **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE3095	**Course Title:** Cloud Security **Type of Course:** Theory	**L-T- P- C**	3 -0-0-3
Version No.	1.0		
Course Pre-requisites	**Cloud Computing and Services (CSE322)**		
Anti-requisites	**NIL**		
Course Description	This course provides ground-up coverage on the high-level concepts of cloud landscape, architectural principles, and techniques. It describes the Cloud security architecture and explores the guiding security for Infrastructure and Softwares.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cloud Security** and attain **Employability** through **Participative Learning** techniques.		
Course Outcomes	On successful completion of this course the students shall be able to: 1. **Describe** fundamentals of cloud computing [**Knowledge].** 2. **Explain** cloud computing security architecture and associated challenges **[Comprehension].** 3. **Discuss** cloud computing software security essentials **[Comprehension].**		

	4. **Apply** infrastructure security and data security in cloud computing enviroment. **[Application].**			
Course Content:				
Module 1:	**Fundamentals of Cloud Computing**	**Quiz**	Knowledge based Quiz	**10 Sessions**
Topics: Cloud Computing at a Glance, Building Cloud Computing Environments, Computing Platforms and Technologies, Cloud Computing Architecture: Cloud Delivery Models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud Deployment Models, Expected Benefits.				
Module 2:	**Cloud Security Challenges and Cloud Security Architecture**	**Quiz**	Comprehension based Quiz	**10 Sessions**
Topics: Security Policy Implementation, Computer Security Incident Response Team, Virtualization Security Management. Architectural Considerations, Identity Management and Access Control, Autonomic Security**.**				
Module 3	**Cloud Computing Software Security Essentials**	**Assignment**	Batch-wise Assignments	**9 Sessions**
Topics: Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Secure Cloud Software Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery.				
Module 4:	**Infrastructure Security and Data Security**	Assignment and Presentation	Batch-wise Assignment and Presentations	**9 Sessions**
Topics: Infrastructure Security: The Network Level, The Host Level, The Application Level. **Data Security :** Aspects of Data Security, Data Security Mitigation, Provider Data and its Security.				
Targeted Application & Tools that can be used: Use of CloudSim simulator.				
Project work/Assignment: **Survey on Cloud Service Providers**				
Text Book 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill Education, July 2017. 2. Roland L Krutz and Russell Dean Vines, "*Cloud Security - A Comprehensive Guide to Secure Cloud Computing*", Wiley Publishing, Inc. 2010.				
References 1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, "*Secure Cloud Computing*", Springer, ISBN 978-1-4614-9278-8 (eBook). 2. John Rittinghouse and James Ransome, "*Cloud Computing, Implementation, Management and Security*", CRC Press, 2010. 3. Tim Mather, Subra Kumaraswamy and Shahed Latif", "Cloud Security and Privacy – An Enterprise Perspective on Risks and Compliance", Oreily Publication, 2009. **WEB RESOURCES:** **https://presiuniv.knimbus.com/user#/home**				
Topics relevant to "EMPLOYABILITY SKILLS": Cloud computing architecture, Security policy implementation, Infrastructure security and Data security **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**				

Course Code: CSE3096	**Course Title: Cyber Digital Twin** **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	**CSE2013**		
Anti-requisites	**NIL**		
Course Description	This course is designed to improve the learners 'Skill Development' by using modeling, optimizing, and risk management approach. The course objective is to get familiar with the Cyber digital twin-working principal, Development considerations, Data-Modelling Environment, Digital Twin Optimization, Risk Management and Applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cyber Digital Twin** and attain **Employability** through **Participative Learning** techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the basic concepts of Cyber Digital twin, and its working principle. **[KNOWLEDGE]** 2. Explain Data modeling and development consideration in digital twin model for cloud and IoT technology.**[COMPREHENSION]** 3. Observe digital twin-human behavior modeling in digital twin-optimization **[COMPREHENSION]** 4. Show Risk Assessment-Digital twin reference model-Implementation. **[APPLICATION]** 5. Apply Digital twin in various area like Manufacturing, Automotive and Healthcare.**[APPLICATION]**		
Course Content:			

Module 1	Introduction	Assignment	Theory	**No. of Classes:09**
Introduction- Cyber Digital twin-definition-uses and benefits-need for digital twin-working principal Technology Digital thread-digital shadow-building blocks of digital twin-digital twin technology drivers and enablers.				
Module 2	Data Modelling Environment	Assignment	Theory	**No. of Classes:10**
Types of digital twin-Based on Product and Process-Based on Functionality-Based on Maturity. Development considerations-Overview of Data-Modelling Environment. Modelling-model and data management-Managing data-implementing the model- Cloud and IOT technologies.				
Module 3	Digital Twin Optimization	Assignment	Theory	**No. of Classes:10**
Cyber range vs digital twin-human behavior modeling in digital twin-optimization using digital twin-digital twin and cyber security-Techniques. Technologies-Industrial IOT and Digital Twin-simulation and digital twin-Machine learning and digital twin-virtual reality and digital twin-cloud technology and digital twin.				

Module 4	Risk Management and Applications	Assignment	Case Study	**No. of Classes:10**

Digital twin and Risk Assessment-Digital twin reference model-Implementation-Development of risk assessment plan-Development of communication and control system-Development of digital twin tools-Integration-platform validation-Difficulties-Practical implications. Applications: Digital Twin in Manufacturing-Digital Twin in Automotive-Digital Twin in Healthcare-Digital Twin in Utilities-Digital Twin in Construction

Targeted Application & Tools that can be used:

Ansys Twin Builder is a powerful solution for building, validation and deploying simulation-based systems and digital twins: Build, validate, and deploy digital twins. Digital twin models integrate real-world data. Increase efficiency with digital twins.

Project work/Assignment:

Project Assignment:

Text Book

1. Clint Bodungen, Bryan Singer, Aaron Shbeeb, Kyle Wilhoit, and Stephen Hilt," Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions",1st Edition, ISBN: 978-1259589713.

2. Eric D. Knapp and Raj Samani," Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure ",1st Edition. Kevin Mitnick," The Art of Invisibility",2017.

References

1. Michael E. AuerKalyan Ram B. Digital," Cyber-physical System and Digital Twins - Part of the Lecture Notes in Networks and Systems book series".

2. Nassim Khaed, Bibin Pattel and Affan Siddiqui," Development and Deployment on the Cloud", Elsevier, 2020.

Weblinks:

3. https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-live%26ebv%3dEB%26ppid%3dpp_xiii

4. https://www.udemy.com/course/digital-twin-a-comprehensive-overview/

Topics relevant to "EMPLOYABILITY SKILLS": Digital thread-digital shadow-building blocks of digital twin, Digital Twin in Manufacturing-Digital Twin in Automotive, Cyber range vs digital twin-human behavior modeling in digital twin-optimization **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE3094	**Course Title:** Cyber Security **Type of Course:1] Discipline Elective** **2] Theory Only**	**L- T-P- C**	3 -0-0-3
Version No.	1.1		
Course Pre-requisites	Fundamental knowledge in Information Security and Networks		
Anti-requisites	**NIL**		
Course Description	This is a foundation program geared towards generating and enhancing awareness about cyber security challenges and the concept of Cyber Security and Cyber Ethics among the stakeholders to help them become responsible Cyber Citizens and participate safely and securely in the rapidly evolving information-age society. The important topics include: Network Security model, attacks, malware, firewall, IT act and Cyber forensics		
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Cyber Security** and attain **Employability** through **Participative Learning** techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: 1) Describe the basic concept of Cyber Security **[Knowledge]** 2)Classify different types of attacks for a scenario **[Comprehension]** 3) Prepare a mitigation policy for security threat **[Comprehension]** 4) Demonstrate Cyber Security tools **[Application]**		
Course Content:			

Module 1	**Introduction to Cyber Security**	Quiz	**Knowledge**	**10 Sessions**

Topics

History of Internet, Cyber Crime, Information Security, Computer Ethics and Security Policies, Guidelines to choose web browsers, Securing web browser, Antivirus, Email security, Guidelines for setting up a Secure password , Cyber Security Threat Landscape, Emerging Cyber Security Threats, Cyber Security Techniques

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Module 2	**Security in Networks**	Assignment	**Comprehension**	**10 Sessions**

Topics:

Security in Networks – Concepts, threats in Network, website vulnerabilities, man in the middle attack, denial of Service attack, distributed denial of service attack, Firewalls – introduction and design, types of firewalls, personal firewalls, Program Security – non malicious program errors, malicious program flaws, virus and other malicious code, prevention of virus infection.

Assignment: Program Security – non malicious program errors.

Module 3	**Smartphone Security**	Assignment	**Comprehension**	**12 Sessions**

Topics:

Introduction to mobile phones, Smartphone Security, Android Security, IOS Security, Cyber Security Exercise, Cyber Security Incident Handling, Cyber Security Assurance, Guidelines for social media security, Tips and best practices for safer Social Networking ,Basic Security for Windows, User Account Password

Assignment: Social Media Security

Module 4	Ethical Issues in Cyber Security	Assignment	Programming/Data analysis task	**9 Sessions**

Legal and ethical issues in Cyber Security – protecting program and data, copyright, patents and trade secrets, IT Act, EDP audit, Overview of CISA, Privacy in computing, Cyber Forensic Tools – types and categories, Cyber forensic suite. Forensic tools: types, categories, open source proprietary

Assignment: Cyber Forensic Tools

Textbooks

T1. Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", Pearson Education, 5th Edition,2012

T2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018 .

T3. Dejey and Murugan, "Cyber Forensics", Oxford University Press, 2018.

References

R1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5th Ed, Pearson Education, 2015.

R2. Behrouz A Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill Publication, ISBN 13: 978-93-392-2094-5.2008.

Web links:

W1. https://www.youtube.com/watch?v=RYB4cG8G2xo

W2. https://www.coursera.org/lecture/detecting-cyber-attacks/Cyber Security-UeDqJ ,https://presiuniv.knimbus.com/user#/home

Topics relevant to "EMPLOYABILITY SKILLS": Mobile Security for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2060	**Course Title:** Information Security and Management **Type of Course:** **Theory Only Course**	**L-T- P-C**	3-0-0-3
Version No.	1		
Course Pre-requisites	Data Communication and Computer Networks, Information Security, Database Management Systems and Concepts of cryptography.		
Anti-requisites			

Course Description	The course explores information security through some introductory material and helps gain an appreciation of the scope and context of information security. It includes a brief introduction to cryptography, security management, network and computer security. It allows a student to begin a fascinating journey into the study of information security and develop an appreciation of some key security concepts. The course concludes with a discussion of a simple model of the information security in industry and explores skills, knowledge and roles required for employability. A student will be able to determine and analyze potential career opportunities in this profession.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Information Security and Management and attain **Employability** through **Participative Learning** techniques.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • Describe the basic concept of information security. (Knowledge) • Explain the concepts and methods of cryptography. (Comprehension) • Demonstrate the aspects of risk management. (Application)			
Course Content:				
Module 1	**Information Security Management:**	Assignment	Data Collection/Interpretation	**10 Sessions**
Topics: Information Security Overview, Threat and Attack Vectors, Types of Attacks, Common Vulnerabilities and Exposure (CVE), Security Attacks, Fundamentals of Information Security, Computer Security Concerns, Information Security Measures.				
Module 2	**Fundamentals of Information Security and Data Leakage**	Case studies / Case let	Case studies / Case let	**13 Sessions**
Topics: Key Elements of Networks, Logical Elements of Networks, Critical Information Characteristics, Information States. What is Data Leakage and Statistics, Data Leakage Threats, Reducing the Risk of Data Loss, Key Performance Indicators (KPI), Database Security.				
Module 3	**Information Security Policies and Management**	Case studies / Case let	Case studies / Case let	**14 Sessions**
Topics: Information Security Policies-Necessity-Key Elements and Characteristics, Security Policy Implementation, Configuration, Security Standards-Guidelines and Frameworks, Security Roles and Responsibilities, Accountability, Roles and Responsibilities of Information Security Management, Team Responding to Emergency Situation- Risk Analysis Process.				
Targeted Application & Tools that can be used: An ISMS is a systematic approach to managing sensitive company information so that it remains secure. It includes people, processes and IT systems by applying a risk management process. It can help small, medium and large businesses in any sector keep information assets secure. The ISO 27000 family of standards helps organizations keep information assets secure.				

Using this family of standards will help your organization manage the security of assets such as financial information, intellectual property, employee details or information entrusted to you by third parties.

ISO/IEC 27001 is the best-known standard in the family providing requirements for an information security management system (ISMS).

Project work/Assignment:

Assignment:

Text Book

T1 Management of Information Security by Michael E.Whilman and Herbert J.Mattord

T2 Information Security: The Complete Reference, Second Edition, 2nd Edition. by Mark Rhodes-Ousley. Released April 2013. Publisher(s): McGraw-Hill.

.

References

R1 Title, Cryptography & Network Security (Sie) 2E. Author, Forouzan. Publisher, McGraw-Hill Education (India) Pvt Limited.

R2 Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices. Nina Godbole.

E book link R1: http://www.iso.org/iso/home/standards/management-standards/iso27001.html

E book link R2: http://csrc.nist.gov/publications/nistpubs/800-55-Rev1/SP800-55-rev1.pdf

BLINKS: pu.informatics.global , https://sm-nitk.vlabs.ac.in.

Topics relevant to development of "SKILL DEVELOPMENT": Security Policy Implementation, Security Roles, for development of Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3102	**Course Title:** Malware Analysis **Type of Course:** Discipline Elective in Cyber Security Basket	**L-T P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	Should Have the knowledge of Cryptography and Network Security		
Anti-requisites	**NIL**		
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.		

Course Objective	The objective of the course is to familiarize the learners with the concepts of Malware Analysis and attain **Employability** through **Participative Learning** techniques.				
Course OutComes	On successful completion of this course the students shall be able to: 1. Understanding the nature of malware, its capabilities, and how it is combated through detection and classification. 2. Apply the methodologies and tools to perform static and dynamic analysis on unknown executables. 3. Analyze scientific and logical limitations on society's ability to combat malware.. 4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.				
Course Content:					
Module 1	**Introduction to MALWARE ANALYSIS**		Assignment	Programming activity	**12 Hours**
Topics: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware typesviruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. **Assignment:** Brief study on types of spyware					
Module 2	**Static Analysis**		Assignment	Programming activity	**11 Hours**
Topics: X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, ReverseEngineering- x86 Architecture **Assignment:** Static analysis on malware (PeStudio & ProcMon)					
Module 3	**Dynamic Analysis**		Assignment	Programming activity	**11 Hours**
Topics: Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark **Assignment:** Demonstration of wireshark					
Module 4	**Malware Functionality and Detection Techniques**		Assignment	Programming activity	**12 Hours**
Topics: Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection. Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences **Assignment:** Packet malware signature					

Targeted Application & Tools that can be used: eCMAP (Certified Malware Analysis Professional)
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Any appropriate tool can be given to demonstrate.
Text Book 1. Michael Sikorski and Andrew Honig, 2012: " Practical Malware Analysis", No Starch Press. E-Resources **W1.** https://www.geeksforgeeks.org/introduction-to-malware-analysis/ **W2.** https://ine.com/learning/courses/malware-analysis W3: https://sm-nitk.vlabs.ac.in/
References 1. Jamie Butler and Greg Hoglund, 2005: "Rootkits: Subverting the Windows Kernel", Addison-Wesley. 2. Dang, Gazet and Bachaalany, 2014: "Practical Reverse Engineering",Wiley. 3. Reverend Bill Blunden, 2012: "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" Second Edition,Jones& Bartlett.
Topics relevant to "EMPLOYABILITY SKILLS": X86 Architecture, Packet Sniffing, Wireshark, for development of Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.

Course Code: **CSE3063**	**Course Title: Privacy and Security in IoT** **Type of Course: Program Core & Theory only**	**L- T- P-C**	3 -0	0	3
Version No.	1.0				
Course Pre-requisites	[1] The primary prerequisite is a working knowledge of basic algebraic number theory, which includes number fields, rings of integers, factorization of ideals into primes [2] A working knowledge of basic algebraic number theory. [3] Basic concepts of cryptography like encryption decryption, Signature generation and verifications.				
Anti-requisites	NIL				
Course Description	The purpose of this course is to enable the students to appreciate the need for cryptography and to identify the applications of cryptography in Internet of Things (IoT). 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 abilities through assignments.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Privacy and Security in IoT** and attain **Skill Development** through **Problem Solving** Methodologies.				
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Explain** benefits of modern cryptographic algorithms 2. **Apply** the Elliptic curve Diffie Hellman and digital signature algorithms to encrypt-decrypt , generate and verify the signatures				

	3. **Estimate** the performance of ECC with other traditional cryptography algorithms.			
Course Content:				
Module 1	**Introduction to Elliptic Curves**	Quiz	Comprehension based Quizzes and assignments;	**15 Classes**
Topics: **Elliptic Curve Cryptosystems (ECC):** Introduction to ECC, Method of Diophantus, Elliptic curves in Cryptography, Discrete Logarithms in Finite Fields, Elliptic Curve on a finite set of Integers, Definition of Elliptic curves,General form of a EC, Weierstrass Equation, Points on the Elliptic Curve (EC),The Abelian Group, Operations on ECC- Point addition, Point doubling.				
Module 2	**Elliptic Curve Cryptosystems**	Quizzes and assignments	Comprehension based Quizzes and assignments;	**15 Classes**
Topics: E**lliptic Curve Cryptosystems (ECC):** Public-Key Cryptosystems, Public-Key Cryptography, What Is Elliptic Curve Cryptography (ECC)?,Using Elliptic Curves In Cryptography, Generic Procedures of ECC, Example – Elliptic Curve Cryptosystem Analog to El Gamal, Diffie-Hellman (DH) Key Exchange, ECC Diffie-Hellman, Example – Elliptic Curve Diffie-Hellman Exchange, Elliptic Curve Digital Signature Algorithm (ECDSA) Why use ECC?, Security of ECC, Applications of ECC, Benefits of ECC.				
Module 3	IOT Protocols	Assignment and Lab projects with presentation	Project implementations in software, batch wise presentations	**10 Classes**
Topics: **IoT Communication model and Protocols :** Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (COAP), Advanced Message Queuing Protocol (AMQP), Extensible Messaging and Presence Protocol (XMPP), Introduction, Principle of RFID, Components of an RFID system.				
Targeted Application & Tools that can be used: **Application areas are to secure crypto currency- Bitcoin, Ethereum and Ripple using ECC in key agreement, digital signatures.** **Professionally Used Software:** elliptic2 : https://www.graui.de/code/elliptic2/				
Project work/Assignment:				
Each batch of students (self-selected batch mates) will identify projects from searching on Google, and implement with the most suitable 2 or 3 NIST /SECP curves **Project Assignment:** **Assignment: 1] Collect the running time of ECC on different standard NIST curves.** **Assignment 2: Prepare a compressive report on the efficiency of NIST Vs SECP curves.**				
Textbook(s): 1. **I. Blake, G. Seroussi, N. Smart, Elliptic Curves in Cryptography , Cambridge University 2020** 2. **Arshdeep Bagha, Vijay Madisetti, "Internet of Things - A hands on approach", Universities Press, 2021.**				
References 1. **Joseph H Silver man The Arithmetic of Elliptic Curves: Springer; 2nd Edition April 2016**				

2. **Darrel Hankerson, Scott Vanstone, Alfred J. Menezes Guide to Elliptic Curve Cryptography Springer 2018**
Topics related to development of **"SKILL DEVELOPMENT":** IOT Protocols, Elliptic Curve Cryptosystem, for **Skill Development through Participative Learning Techniques.** This is attained through assessment components as mentioned in the course handout.

Course Code: CSE2038	**Course Title: Privacy and Security in Online Social Media** **Type of Course: Program Core & Theory Only**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**Basic of Network security and cryptography.**					
Anti-requisites	**NIL**					
Course Description	Objective of this course is to make students learn the basics of privacy and security in online social media and develop ability to understand the importance of privacy in anyone's life and their consequences if it is in peril. This course is both conceptual and analytical in nature that would help the student to predict the effects of any activity on Social Media. The students should have prior knowledge of some Social media platforms. After successful completion of the Course, the students would acquire knowledge to protect themselves from the online data theft on social media from attacker.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Privacy and Security in Online Social Media** and attain **Employability** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Recognize the significance of the Privacy and how to protect it **[Knowledge]** 2] Summarize the privacy and security Encryption for Peer to Peer Social Networks. **[Comprehension]** 3] Understand the function of stealing Reality and K-Anonymity. **[Knowledge]** 4]Use the Link Reconstruction attack in privacy Social Networks. **[Application]**					
Course Content:						
Module 1	ANALYSIS OF PRIVACY IN SOCIAL NETWORKS	Assignment	Knowledge		**8 Sessions**	

Topics: Three-Layered Framework-Characteristics Used to Analyze Social Web Privacy-Privacy Issues Related to Social Web Users-Privacy Issues Related to Service Providers-Security and Privacy for Digital Facets-Identifiable Facets-Private Facets. **Assignment:** Find real world problems and suggest solutions.

Module 2	ENCRYPTION FOR PEER-TO-PEER SOCIAL NETWORKS	Assignment	Comprehension	**8 Sessions**
Topics: Essential Criteria for the P2P Encryption Systems-Existing P2P OSN Architectures-Evaluations of Existing Encryption Schemes Based on Our Criteria-Broadcast Encryption-Predicate Encryption. **Assignment: -** Survey of Unethical Behavior and Influencing factors.				
Module 3	STEALING REALITY AND K-ANONYMITY	Quiz	Comprehension	**11 Sessions**
Topics: Stealing Reality- Social Attack Model- Social Learnability- k-Anonymity- k-Degree Anonymity- k-Neighborhood Anonymity- k- Automorphism- k-Isomorphism-L-diversity- Attack Model and Privacy Guarantee-Insights from an ℓ-Diversified Graph.				
Module 4	PRIVACY IN SOCIAL NETWORKS- LINKS RECONSTRUCTION ATTACK	Assignment/Case study	Application	**11 Sessions**
Privacy in Social Networks- Link Prediction- Feature Extraction- Communities Datasets- Electronic Currencies- Anonymity- The Bit coin System- The Transaction Network- The User Network- Anonymity Analysis- Integrating Off-Network Information. Use Case and the Threat Model- Use Case for Private Record Linkage- Use Case for Privacy-Preserving Record Linkage- **Assignment: -** The Bit coin Faucet- Voluntary Disclosures- TCP/IP Layer Information- Context Discovery-Flow and Temporal Analyses**.**				
Text Book / References T1. Yaniv Altshuler, Yuval Elovici, Armin B. Cremers Nadav Aharony, Alex Pentland," Security and Privacy in Social Networks", Springer Publisher,2012,1st Edition **Online Resources: -** W1: https://presiuniv.knimbus.com/user#/searchresult?searchId=Privacy%20and%20Security%20in%20Online%20Social%20Media%20&curPage=0&layout=list&sortFieldId=none&topresult=false W2: https://onlinecourses.nptel.ac.in/noc21_cs28/preview				

Topics relevant to "EMPLOYABILITY SKILLS": Link Prediction, features extraction, for developing Employability Skills through Participative Learning Techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 2028	**Course Title:** Software Project Management **Type of Course: Theory Only Course**		**L-T- P- C**	3-0 -0-3
Version No.	1			
Course Pre-requisites	Basics of Programming			
Anti-requisites				
Course Description	Effective software project management is crucial to the success of any software development or maintenance project. The roles and responsibilities of the project manager is numerous and varied. However, at the broad level, these can be classified in to the project planning and monitoring and control activities. Project planning involves making cost, effort, and duration estimation and preparing various types of plans such as schedule, configuration management, risk management, quality management. Staffing plan etc. The monitoring and control activities encompass keeping track of progress and removing bottlenecks using techniques such as PERT, GANTT, and also effective risk management, team building etc.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Software Project Management and attain **Employability** through **Participative Learning** techniques.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the different project contexts and appropriate management strategy. • Practice the role of professional ethics in successful software development. • Identify the key phases of project management. • Determine an appropriate project management approach through an evaluation of the business context and scope of the project.			
Course Content:				
Module 1	**Conventional & Modern Software Management**	Assignment	Case studies	**9 Sessions**
Topics:				

Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, Reducing software product size, Improving software processes. Principles of Conventional Software Engineering, Principles of Modern Software Management, Transitioning to an interactive Process.				
Module 2	**Software Management Process Framework**	Case studies / Case let	Case studies	**9 Sessions**
Topics: Life cycle phases, The artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; ModelBased Software Architectures - A management perspective and A technical perspective.				
Module 3	**Project Organization and Planning**	Quiz	Case studies	**10 Sessions**
Topics: Work breakdown structures, Planning guidelines, The cost and schedule estimating process, The iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.				
Module 4	**Project Control and Process Instrumentation**	Quiz	Case studies	**10 Sessions**
Topics: PROJECT CONTROL AND PROCESS INSTRUMENTATION :The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.				
Targeted Application & Tools that can be used:				
Project work/Assignment:				
Assignment:				
Text Book **T1.** Walker Royce, "Software Project Management : A unified Framework", 1st Edition, Pearson Education, 2021				
References **R1.** Bob Hughes and Mike Cotterell, "Software Project Management", 3rd Edition, Tata McGraw Hill Edition, 2005. **R2.** Joel Henry, "Software Project Management", 1st Edition, Pearson Education, 2006. **E book link T1:** **https://www.edutechlearners.com/download/Software%20Project%20Management.pdf** **Web resources:** https://onlinecourses.nptel.ac.in/noc19_cs70/preview **brary resources:** https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=doc_title_str&topresult=false&content=*software%20project%20management*&sub_category_name=Computer%20Science%20and%20IT				
Topics relevant to development of "EMPLOYABILITY SKILLS": Life cycle Phases, Seven Core Metrics, for development of Employability Skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in the course handout.				
Catalogue prepared by	Mr. Sunil Sahoo			

Recommended by the Board of Studies on	(BOS NO: SOCSE1st. BOS held on 22 / 12 / 2022)
Date of Approval by the Academic Council	(Academic Council Meeting No.20.3 , Dated 15 /02 /23)

Course Code: CSE257	**Course Title:** **Network Programming** **Type of Course:** **Laboratory only**	**L-T-P-C**	0 -0-4-2
Version No.	2.0		
Course Pre-requisites	C language		
Anti-requisites	**NIL**		
Course Description	Network Programming intends to explore the opportunities for developing, maintaining and supporting distributed and network applications. The Course covers the basics of computer networks to designing and implementing networks.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Network Programming and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques		
Course Outcomes	On successful completion of this laboratory based course the students will be able to: 1. Outline the basic network troubleshooting commands in windows/Linux. 2. Configure various networks using cisco packet tracer tool. 3. Demonstrate the working of client-server TCP/IP socket programming. 4. Demonstrate the usage of Wireshark tool in networking. 5. Simulate networking scenarios using NS2 simulator.		
Course Content:			

List of Laboratory Tasks

Task 1: Troubleshoot using network DOS command

Task 2: Demonstration of Cisco Packet Tracer Tool

2.1: Introduction to Cisco Packet Tracer

2.2: User interface and simulation view

2.3: Configure user name and password for the three modes in router

2.4: Configure the DHCP Server using 2 wireless router

2.5: Configure the TELNET Service for 2 different network

2.6: Demonstrate the static routing with multiple networks using serial port and interface

2.7: Demonstrate the RIP routing with multiple networks using serial port and interface

2.8: Configure the Static and dynamic NAT for private network

Task 3: Demonstrate the working of client-server TCP/IP socket programming Task 4: Demonstrate the Wireshark tool Usage Task 5: Demonstration of Network Simulator Version 2
Targeted Application & Tools that can be used: Simulate networking scenarios using Cisco Packet Tracer. Demonstrate the usage of Wireshark tool in networking. Practice the simulation-based network performance evaluation techniques using NS2.
Textbooks: 1. Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2017.
References R1. "Network Simulation Lab Manual" Presidency University. **E-Resource** 18 Most Popular Network Simulation Software Tools in 2022 (networkstraining.com) Virtual Labs (vlab.co.in) NPTEL course- Computer Networks and Internet Protocol - Course (nptel.ac.in) By Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty | IIT Kharagpur https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/
Topics relevant to "SKILL DEVELOPMENT": Troubleshoot using network DOS command, Demonstration of Cisco Packet Tracer Tool for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE1001	**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	Basic Programming knowledge.		
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 object oriented programming to build applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques		

Course Out Comes	**On successful completion of the course the students shall be able to:** **C.O. 1:** Describe the basic programming concepts. [Knowledge] **C.O. 2:** Apply the concept of classes, objects and methods to solve problems. [Application] **C.O. 3:** Apply the concept of arrays and strings. [Application] **C.O. 4:** Implement inheritance and polymorphism building secure applications. [Application] **C.O. 5:** Apply the concepts of interface and error handling mechanism. [Application]			
Course Content:				
Module 1	**Basic Concepts of Programming and Java**	Assignment	Data Collection/Interpretation	**12 Sessions**
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**	Case studies / Case let	Case studies / Case let	**12 Sessions**
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**	Quiz	Case studies / Case let	**14 Sessions**
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**	Quiz	Case studies / Case let	**14 Sessions**
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**	Quiz	Case studies / Case let	**14 Sessions**
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.				
List of Laboratory Tasks: P1 - Problem Solving using Basic Concepts. P2 - Problem Solving using Basic Concepts and Command Line Arguments. P3 - Programming assignment with class, objects, methods and Constructors. P4 - Programming assignment with method overloading. P5 - Programming assignment with constructor overloading. P6 - Programming assignment with Static members and static methods. P7 - Programming assignment with Nested classes.				

P8 - Programming assignment using Arrays.
P9 - Programming assignment using Strings.
P10 - Programming assignment using String Builder.

P11 - Programming assignment using Inheritance and super keyword.
P12 - Programming assignment using Method overriding and Dynamic method invocation.
P13 - Programming assignment using Final keywords.
P14 - Programming assignment using Abstract keywords.
P15 - Programming assignment using Interface.
P16 - Programming assignment using Interface.
P17 - Programming assignment CharacterStream Classes
P18 - Programming assignment 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.

References

R1: Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Pearson
R2: James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.

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.

Course Code: CSE3099	**Course Title:** **Digital and Mobile Forensics** **Type of Course:** **Integrated**	**L- T-P- C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	**Data Communications and Computer Networks (CSE3155)**					
Anti-requisites	Nil					

Course Description	This course demonstrates the use of Mobile phones and digital devices across the globe has increased dramatically. These devices are more susceptible to information security attacks and thus they also possess huge evidences which shall be used during crime scene investigation. This makes the Course on mobile and digital forensics an inevitable one for the security professionals. This Course on mobile and digital forensics will provide a better understanding on different forms of evidences in many digital devices, collection and interpretation of the same. Topics include: Wireless technologies and security-wireless protocols, wireless threats, cell phones and GPS, SMS and data interception in GSM. Mobile phone forensics - files present in SIM card, device data, external memory dump, Android forensics. Digital forensics: - evaluating digital evidence, Digital forensics examination principles.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain EMPLOYABILITY SKILLS through PARTICIPATIVE Learning techniques				
Course Outcomes	On successful completion of this course the students shall be able to: CO 1: Outline the basic concepts of Cybercrime and digital Forensics. (Remember) CO 2: Employ various digital Forensic tools to perform Forensic investigation (Apply) CO 3: Interpret security challenges and Forensic examination process of wireless devices. (Understand) CO 4: Produce digital evidence through the usage of mobile device Forensic tools (Understand)				
Course Content:					
Module 1	Cybercrime and Digital Forensic Principles	Assignment	Cybercrime	Bloom's level selected: Remember	**13 Sessions - L[07] + P[06]**
	Cybercrime: Definition, Nature and Scope of Cybercrime, Types of cybercrime, Categories of cybercrime, Investigating Cybercrime, Digital Evidence, Prevention of cybercrime, Case studies on Cyber Crimes. **Overview of Digital Forensics:** Phases of Digital Forensics, Digital devices in society, Evidential Potential of Digital Devices, closed and open systems.				
Module 2	Digital Forensics examination process	Case Studies	Digital Evidence	Bloom's level selected: Apply	**16 Sessions - L[08] + P[08]**
	Language of Computer crime investigation, preparing a Digital Forensics Investigation, challenging aspects of digital evidence, presenting digital evidence, Device usage. **Digital forensics examination principles**: Previewing, Imaging, Continuity and hashing, Evidence locations, A seven-element security model.				
Module 3	Wireless technologies and Wireless threats	Certification	GSM, Paraben's Cell Seizure	Bloom's level selected: Understand	**15 Sessions - L[07] +P[08]**
	Overview of Modern Wireless Technology: Wireless Crime Prevention Techniques, War-Driving, War-Chalking, War Flying, Voice SMS, GSM and Identification, Cell Phone Hacking and Phreaking, Cell Phone Forensics, Forensic Rules for Cellular Phones.				
Module 4	Mobile phone Forensics	Presentation	Forensic Tools	Bloom's level selected: Understand	**16 Sessions - L[08]]+P[08]**

	Importance and Motivation behind Mobile Forensics, Mobile Phone Forensics: Crime and Mobile Phones, Evidence, Forensic Procedures of mobile phones, The SIM Card, Files Present in SIM Card, SMS Spam, Mobile Phone Forensics Tools and Methods, Social Media Forensics on Mobile Devices.
	Targeted Application & Tools that can be used: • Wireless Security • Digital Forensics • Android Forensics
	Textbooks: **T1:** Gregory Kipper, "Wireless Crime and Forensic Investigation", Auerbach Publications, 1st Edition, September 19, 2019.
	References: **R1:** Losif I. Androulidakis, "Mobile phone security and forensics: A practical approach", Springer publications, 2nd Edition, 2016. **R2:** Andrew Hoog, "Android Forensics: Investigation, Analysis and Mobile Security for Google Android", Elsevier publications, 1st Edition, 15th June 2011. **R3:** Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, November 2008, p 180. **Web references:** https://presiuniv.knimbus.com/user#/home
	Topics relevant to "Employability": 1. Prevention of cybercrime 2. preparing a Digital Forensics Investigation 3. Mobile Phone Forensics: Crime and Mobile Phones. 4. Mobile Phone Forensics Tools for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3066	**Course Title: Mobile Application for IoT** **Type of Course: Program Core& Theory Only**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	**NIL**		
Anti-requisites	**NIL**		
Course Description	Mobile Application is the essential part for IoT infrastructure, which helps in understanding the architectural overview of IOT. The purpose of this course is to expose the students to understand the IoT Reference Architecture and Real World Design Constraints along with various IOT protocols. This course is both conceptual and analytical in nature that would help the student to predict the effects of forces and its motion while carrying out creative design functions.		

Course Objective	The objective of the course is to familiarize the learners with the concepts of **Mobile and Application for IoT** and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Able to understand the application areas of IOT 2. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks 3. Able to understand building blocks of Internet of Things and characteristics. 4. Learn about android application development			
Course Content:				
Module 1	Overview	Assignment	Programming Task	**9 Sessions**
Topics: IoT-An Architectural Overview Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management				
Assignment: Case study on Business processes in IoT.				
Module 2	Basic Design	Assignment	Data Collection/Excel	**10 Sessions**
Topics: Introduction Basics of embedded systems design Embedded OS - Design constraints for mobile applications, both hardware and software related Architecting mobile applications user interfaces for mobile applications touch events and gestures Achieving quality constraints performance, usability, security, availability and modifiability. **Assignment:** Recent trends In mobile application development				
Module 3	IOT mobile apps	Assignment	Programming/Data analysis task	**9 Sessions**
Topics: IoT Mobile App Development Trends In 2020 - Role of Mobile Apps in revolutionizing the world of IoT - UX / UI design for IoT Mobile apps - challenges of UX/UI design for IoT applications - practice tips on design for IoT mobile apps IoT App Design Solutions **Assignment:** Challenges faced during mobile application development				
Module 4	TECHNOLOGY I-ANDROID	Assignment	Programming/Data analysis task	**10 Sessions**
Topics: Introduction Establishing the development environment Android architecture Activities and views Interacting with UI Persisting data using SQLite Packaging and deployment Interaction with server side applications Using Google Maps, GPS and Wifi Integration with social media applications.				

Targeted Protocols & Tools that can be used: Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread
Text Book T1: "From machine to machine to the internet of things: Introduction to the new age of intelligence", 1st edition, Academic press, 2014. T2: Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
References R1: Bernd Scholz- -3-642-19156-5 e-ISBN 978-3- 642-19157-2, Springer R2: Andrea Goldsmith, "Android in practice," Cambridge University Press, 2005 **Weblinks:** W1: https://relevant.software/blog/mobile-iot-apps/ W2: https://medium.com/@its.mattfitzgerald/top-14-iot-mobile-app-development-trends-to-expect-in-2020-7fd7718155dc W3:https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-%2520live%26ebv%3dEB%26ppid%3dpp_xiii
Topics relevant to "SKILL DEVELOPMENT": Wifi integration and social media analysis for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: **CSE3055**	**Course Title: Wireless communication in IOT** **Type of Course: Program Core& Theory Only**	**L-T-P-C**	3 -0-0-3
Version No.	1.0		
Course Pre-requisites	**NIL**		
Anti-requisites	**NIL**		
Course Description	Wireless communication system is the essential part for IoT infrastructure, which acts as the bridge for dual directional communication for data collection and control message delivery. The purpose of this course is to expose the students to understand the fundamentals of wireless network and problems related to real-world scenarios. This course is both conceptual and analytical in nature.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Wireless communication in IOT** and attain **Skill Development** through **Participative Learning** techniques.		

Course Out Comes	On successful completion of the course the students shall be able to: 1. To understand the fundamentals of wireless networks 2. Analyze the standards of IoT which employed for wireless networks 3. Explain the use of various wireless technologies in IoT 4. Design and develop various applications of IoT			
Course Content:				
Module 1	Cellular standards	Assignment	Programming Task	**9 Sessions**
Topics: Cellular carriers and Frequencies, Channel allocation, Cell coverage, Cell Splitting, Microcells, Picocells, Handoff, 1st, 2nd, 3rd and 4th Generation Cellular Systems (GSM, CDMA, GPRS, EDGE,UMTS), Mobile IP, WCDMA				
Assignment: Case study on generation cellular systems.				
Module 2	Radio Frequency (RF) Fundamentals	Assignment	Data Collection/Excel	**10 Sessions**
Topics: Introduction to RF & Wireless Communications Systems, RF and Microwave Spectral Analysis, Communication Standards, Understanding RF & Microwave Specifications. Spectrum Analysis of RF Environment, Protocol Analysis of RF Environment, Units of RF measurements, Factors affecting network range and speed, Environment, Line-of-sight, Interference, Defining differences between physical layers- OFDM. **Assignment:** Determination of RF and Microwave spectral Analysis				
Module 3	WLAN: Wi-Fi Organizations and Standards	Assignment	Programming/Data analysis task	**9 Sessions**
Topics: IEEE, Wi-Fi Alliance, WLAN Connectivity, WLAN QoS & Power-Save, IEEE 802.11 Standards,802.11- 2007,802.11a/b/g, 802.11e/h/I,802.11n **Assignment:** Protocols on WLAN connectivity				
Module 4	Wi-Fi Hardware & Software	Assignment	Programming/Data analysis task	**10 Sessions**
Topics: Access Points, WLAN Routers, WLAN Bridges, WLAN Repeaters, Direct-connect Aps, Distributed connect Aps, PoE Infrastructure, Endpoint, Client hardware and software, Wi-Fi Applications				
Targeted Protocols & Tools that can be used: Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread				

Text Book T1: Wireless Communications – Principles and Practice; by Theodore S Rappaport, Pearson Education Pte. Ltd. T2: Wireless Communications and Networking; By: Stallings, William; Pearson Education Pte. Ltd.
References R1:Bluetooth Revealed; By: Miller, Brent A, Bisdikian, Chatschik; Addison Wesley Longman Pte Ltd., Delhi 4. R2:Wilson , "Sensor Technology hand book," Elsevier publications 2005. 5. R3: Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005 **Weblinks:** W1: https://pianalytix.com/wireless-communication-protocols-in-iot/ W2: https://behrtech.com/blog/6-leading-types-of-iot-wireless-tech-and-their-best-use-cases/
Topics relevant to "SKILL DEVELOPMENT": GSM, CDMA for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3053	**Course Title:** **Big Data Analytics for IoT** **Type of Course:** **Program Core** **Theory with embedded lab**	**L- P- C**	1	4	3
Version No.	1.0				
Course Pre-requisites					
Anti-requisites	**NIL**				
Course Description	The course covers basic concepts for IOT Analytics, collection of data for IOT, Integration of IOT with Cloud, Big Data Environments. Students can learn about applying geospatial analytics and applying machine learning to the IOT data. The course also covers the organization of the IOT data, cost benefits of using IOT and review of IOT in various sectors.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics for IoT and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.				
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Demonstrate IOT Data Analytics and machine learning application in IOT (Apply) CO2: Apply appropriate Hadoop Ecosystem tools to perform data analytics for a given problem (Apply) CO3: Examine concepts of cloud based IOT, Big data and IOT (Apply) CO4: Illustrate techniques and strategies for data collection and Geospatial Analytics to IOT Data (Apply)				
Course Content:					

Module 1	IOT Analytics	Assignment		**5 sessions**
Introduction – IOT Data, Challenges of IOT analytics Applications – IOT analytics Lifecycle and Techniques. IOT Cloud and Big Data Integration – Cloud based IOT platform – Data Analytics for IOT, IOT devices in different domains. IOT Analytics for the Cloud.				
Module 2	Hadoop Ecosystem Tools			**5 sessions**
Introduction – Big Data and Big Data Analytics – Hadoop Ecosystem – Hadoop Distributed File System (HDFS) – MapReduce – YARN Architecture – PIG Architecture – Apache HIVE – Mahout – Apache Spark – Apache HBase –Apache Zookeeper.				
Module 3	Overview of AWS and Thingworx	Assignment		**5 sessions**
AWS overview - AWS key services for IOT analytics. Thingworx overview. Creating an AWS Cloud Analytics environment.				
Module 4	Geospatial Analytics to IOT Data	Case Study	Data Collection and Analysis	
Strategies and Techniques in Data collection: Designing data processing for analytics – Applying big data to storage for Geospatial.				

List of Practical Tasks:

Experiment 1:[Module 1]

Level 1: Installation of Raspbian OS,working basic commands on raspberry pi

Level 2: Demonstrate to obtain the temperature using DHT22 sensors .

Experiment 2: [Module 1]

Level 1: Design and Simulate the RADAR SYSTEM Using Arduino and display on the serial monitor using ultrasonic sensor/PIR WITH &WITH OUT BUZZER/Servo motor

Level 2: using a raspberry pi to Demonstrate to find the distance using ultrasonic sensor hc-sr04

Experiment 3: [Module 1]

Level 1 : using a raspberry pi Set the connections of healthcare sensors

Level 2: using a raspberry pi to Demonstrate to find the ECG, Temperature, etc using Healthcare sensors

Experiment 4: [Module 2]

Level 1: Hadoop Single node cluster installation on ubuntu

Level 2: Hadoop Multiple node cluster installation, windows installation

Experiment 5: [Module 2]

Level 1: Basic hadoop commands and Word count analysis for given dataset

Level 2: Analysis on particular matching word on huge dataset

Experiment 6: [Module 2]

Level 1: Basic hadoop commands and Stock analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 7: [Module 2]

Level 1: Basic hadoop commands and Temperature analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 8: [Module 3]

Level 1: Working on hive commands

Level 2: Apply bucketing technique to bring out the difference between partitioning and bucketing

Experiment 9: [Module 3]

Level 1: Working on Hbase commands .

Level 2: Apply Hbase commands on Insurance database/employee dataset.

Experiment 10: [Module 3]

Level 1: Installation of spark and word count analysis

Level 2: Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark

Experiment 11: [Module 4]

Level 1: Temperature Data stored in cloud through IoT devices

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Experiment 12: [Module 4]

Level 1: Healthcare Data stored through IoT sensors in Cloud

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Targeted Application & Tools that can be used:

Hadoop ecosystem tools, Thingworx , AWS Cloud

Project work/Assignment:

Student will be asked to carry out a mini project integrating IoT & data Analytics.

Text Book

T1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, Wiley., 2nd Edition, 2019.
T2. Analytics for the Internet of things,Andrew Minteer. Packt publishing, 1st Edition,2017.
T3. Big Data and the Internet of Things, Robert Stackowiak, Art Licht, Venu Mantha and Louis Nagode, Apress, 2nd Edition, 2020

References

R1. IOT and Analytics in Agriculture.,Prasant Kumar Pattnaik, Raghvendra Kumar, Souvik Pal, S. N. Panda. Springer, First Edition, 2020.
R2. Building blocks for IOT Analytics. Internet-of-Things Analytics. John Soldatos (Editor). River Publisher Series in Signal Image and Speech Processing.2020

(iii) web resources

W1. NPTEL: https://onlinecourses.nptel.ac.in/noc20_cs92/preview
W2. Coursera: https://www.coursera.org/learn/big-data-introduction
W3. EDX: https://www.edx.org/course/big-data-fundamentals
W4. E-book Link : https://www.wiley.com /en-us/Internet+of+Things+and+ Data+ Analytics + Handbook -p-9781119173625
https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": Organize IOT data – Linked analytics datasets – Managing data lakes for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2032	**Course Title: Introduction to Fog Computing** **Type of Course:1] Discipline Elective**	**L- T-P- C**	**3** -0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		

Course Description	The course will provide a solid base for understanding the challenges and problems underlying the design and development of fog computing systems and applications. Thus, this course will teach how to specify, design, program, analyze and implement such systems and applications. Fog computing is a decentralized computing infrastructure in which data, compute, storage and applications are located somewhere between the data source and the cloud. Like edge computing, fog computing brings the advantages and power of the cloud closer to where data is created and acted upon. Many people use the terms fog computing and edge computing interchangeably because both involve bringing intelligence and processing closer to where the data is created. This is often done to improve efficiency, though it might also be done for security and compliance reasons.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Introduction to Fog Computing** and attain **SKILL DEVELOPMENT** through **Problem Solving** techniques.			
Course Out Comes	On successful completion of this course the students shall be able to: 1. Understand the basic principles and concepts of fog computing systems and their relation to other models such as Cloud Computing and Near-Far computing. 2. Understand the challenges of developing fog based applications and middleware, and the possible solutions. 3. Specifically, understand the issues mostly related to fog computing, namely: introduction to the fog programming model and related models, security, offloading, Software Defined Network, load balancing, communication, containers and orchestration, application areas. 4. Able to decide which is the best approach for a particular problem regarding the design and development of a fog computing system. 5. Able to design and implement an application using containers. 6. Able to measure and analyze the performance of a fog computing application.			
Course Content:				
Module 1	INTRODUCTION TO FOG COMPUTING	Assignment	Programming activity	**11 Sessions**
Topics: Fog Computing, Characteristics, Application Scenarios, Issues and challenges. Fog Computing, Internet of Things-Pros and Cons-Myths of Fog Computing -Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT , FOG, CloudBenefits.				
Module 2	ARCHITECTURE	Assignment	Programming activity	**10 Sessions**
Topics: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction ,IEEE 802.11,4G,5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.				
Module 3	FOG PROTOCOLS AND COMMUNICATION TECHNOLOGIES	Assignment	Programming activity	**10 Sessions**

Topics:
Fog Protocol-Fog Kit- Proximity Detection Protocols- DDS/RTPS computing protocols, Introduction ,IEEE 802.11,4G,5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range

Module 4	MANAGEMENT AND ORCHESTRATION	Assignment	Programming activity	**11 Sessions**

Topics:
Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background , Network Slicing in 5G , Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog , Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds , IoT Integration , Security Management for Edge Cloud Architectures. Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.

Module 5	FOG COMPUTING REQUIREMENTS WHEN APPLIED TO IOT	Assignment	Programming activity	**11 Sessions**

Topics:
Fog computing requirements when applied to IoT: Scalability,Interoperability,Fog-IoT: architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, DataManagement,filtering,EventManagement,DeviceManagement,cloudification,virualization, security and privacy issues. Integrating IoT,Fog, Cloud Infrastructures: Methodology , Integrated C2F2T Literature by Modeling Technique re by Use-Case Scenarios , Integrated C2F2T Literature by Metrics.

Targeted Application & Tools that can be used: Case Study: Wind Farm - Smart Traffic Light System, Wearable Sensing Devices, Wearable Event Device ,Wearable System, Demonstrations , Post Application Example . . Event Applications Example.

Text Book

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya.
2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by RajkumarBuyya and Satish Narayana Srirama.
3. Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things Paperback by SudipMisra , Subhadeep Sarkar , Subarna Chatterjee.

Web Links:

Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya.
Fog Computing | Wiley Online Books

Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by RajkumarBuyya and Satish Narayana Srirama.
Fog and Edge Computing: Principles and Paradigms | Wiley

Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things Paperback by SudipMisra , Subhadeep Sarkar , Subarna Chatterjee.

Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of (routledge.com)

References

1. FlavioBonomi, Rodolfo Milito, Jiang Zhu, SateeshAddepalli, —Fog Computing and Its Role in the Internet of Things‖, MCC'12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978-1-4503-1519-7/12/08... $15.00.
2. Shanhe Yi, Cheng Li, Qun Li, —A Survey of Fog Computing: Concepts, Applications and Issues‖, Mobidata'15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China..
3. Amir M. Rahmani ,PasiLiljeberg, Preden, Axel Jantsch, —Fog Computing in the Internet of Things - Intelligence at the Edge‖, Springer International Publishing, 2018.
4. Ivan Stojmenovic, Sheng Wen, "The Fog Computing Paradigm: Scenarios andSecurity Issues", Proceedings, Federated Conference on Computer Science and Information Systems, pp. 1–8, 2014
5. Fog Computing: Helping the Internet of Things Realize its Potential Amir VahidDastjerdi and RajkumarBuyya, University of Melbourne.
6. Multi-Dimensional payment Plan in Fog Computing with Moral Hazar,YanruZhang,Nguyen H. Tran,DusitNiyato, and Zhu Han,IEEE,2016

Topics relevant to "SKILL DEVELOPMENT":

Fog Computing requirements for **SKILL DEVELOPMENT** through **Problem Solving Techniques**. This is attained through the assessment component mentioned in course handout.

Course Code: CSE3046	**Course Title:** DevOps Tools And Internals **Type of Course:** Theory & Integrated Laboratory	**L-T-P-C**	**2-0-2-3**
Version No.	1.2		
Course Pre-requisites	**Fundamentals of Devops**		
Anti-requisites	**NIL**		
Course Description	This course is designed to offer profound perceptions and knowledge in various tools like Git, Ansible, Selenium and Jekins. With the proficient learning of DevOps course, a student will be able to work in all the above tools and become a trained practitioner in the integration and monitoring of software. **DevOps Tool** is an application that helps the software development process to industrialize. It mainly focuses on communication and collaboration between product management, software development, and operations professionals. The objective of this course is to discuss and implement the various tools usage and internals practically.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **DevOps Tools And Internals** and attain **Skill Development** through **Experiential Learning** techniques.		

Course Out Comes	On successful completion of this course the students shall be able to: **1] Apply** the features and common Git workflow. [Application] 2] **Practice** the filters and plugins to populate, manipulate, and manage data used by Ansible Playbooks. [Application] 3] **Compute** the features of selenium IDE. [Application] 4] **Interpret** the installation and features of Jenkins and build jobs. [Application]

Course Content:				
Module 1	**Git**	Quiz	Quiz on Git commands	**5L +4P Classes**
Topics: Introduction to Git, Features of Git, Benefits, Workflow, Git vs GitHub, Installation of Git on Windows/Linux and Environment set up, All Git Commands-Working with local and remote repositories, Running first Git command, Fundamentals of Repository structure and file status life cycle, Working locally with staging, unstaging and commit.				
Module 2	Containerization Using Docker	Quiz	Quiz on Ansible tool usage	**5L +4P Classes**
Topics: Docker Life Cycle,Docker Installation, Docker Operations,Docker Concepts - Registry, Repository, Tag, Image and Containers, Create A Docker Hub Account, Docker Images and Containers, Pushing Docker To Container Hub, Docker File.				
Module 3	**Ansible**	Assignment	Assignments on Selenium tool usage and test case	**5L +4P Classes**
Topics: Ansible Workflow, Architecture, Installation in Linux/Windows, ad-hoc Commands, Playbooks, Tower, Roles, Variables open link, Tags, Galaxy, Commands Cheat Sheets, Modules, Shell, Templates, YAML, Inventory, Debug, Apt, Lineinfile, Copy, Command, File, Vault, Windows, Yum, AWX, Unarchive, Ansible Pip				
Module 4	**Jenkins**	Assignment	Assignments on Jenkins tool usage and Build jobs	**5L +4P Classes**
Topics: Introduction To Continuous Integration, Jenkins Architecture, Managing Nodes On Jenkins, Jenkins Master Node Connection, Jenkins Integration With Devops Tools, Understanding CI/CD Pipelines, Creating A CI/CD Pipeline				

List of Laboratory Tasks:

Git

1. Level 1: Installation of Git on windows
   Level 2: Git commands-Local repositories

Level 2: Git commands-Remote repositories

2. How Git can handle automatically file modifications when they are not related to the same lines of text.

Level 1: You are in a new repository located in C:\Repos\Exercises\Ch2-1.

Level 1: You have a master branch with two previous commits: the first commit with a file1.txt file and the second commit with a file2.txt file.

Level 2: After the second commit, you created a new branch called File2Split. You realized that file2.txt is too big, and you want to split its content by creating a new file2a.txt file. Do it, and then commit the modifications.

3. How to resolve conflicts when Git cannot merge files automatically.

Level 1: You are in the same repository used earlier, C:\Repos\Exercises\Ch2-1. On the master branch, you add the file3.txt file and commit it.

Level 2: Then, you realize that it is better to create a new branch to work on file3.txt, so you create the File3Work branch. You move in this branch, and you start to work on it, committing modifications.

Level 2: The day after, you accidentally move to the master branch and make some modifications on the file3.txt file, committing it. 5. Then, you try to merge it.

4. Level 1: Installation of Ansible

Level 2: Create a basic inventory file

Level 2: Running your first Ad-Hoc Ansible command.

Ansible

5. Ansible Archive

Level 1: Compressing the Directory with TAR and tar and gz

Level 1: Compress the file – Default File Compress format and Remove the Source files after archiving

Level 2: Create a ZIP file archive – File and Directory

Level 2: Create a BZIP archive – File and Directory

6. A Quick Syntax of Ansible Shell module – ADHOC

Level 1: A Quick Syntax of Ansible Shell module in a Playbook

Level 1: Ansible Shell Examples

Level 2: Execute a Single Command with Ansible Shell

Level 2: Execute a Command with Pipe and Redirection

7. Level 1: Run playbook

Level 2: Create the file on the target machines or servers as mentioned in the inventory file and the webserver's group, save the below code with .yml extension and run the playbook.

Level 2: Create multiple directories. To create multiple directories with one single task you can use the loop **with_items** statement. So when you run the below playbook it is interpreted as 3 different tasks.

Selenium

8. Level 1: Selenium IDE Download and Install

Level 2: Selenium IDE - First Test Case, Login Test and command usage

9. Level 1: Write a script to open google.co.in using chrome browser (ChromeDriver).

Level 2: Write a script to open google.com and verify that title is Google and also verify that it is redirected to google.co.in.

10. Level 1: Write a script to open google.co.in using internet explorer (InternetExplorerDriver).
Level 2: Write a script to create browser instance based on browser name.

11. Level 1: Write a script to close all the browsers without using quit() method.
Level 2: Write a script to search for specified option in the listbox

Jenkins

12. Level 1:
Environment Setup
Level 2:
Jenkins downloading and installation

13. Level 1:
1. Setup a Jenkins Job with Apache Ant Build Tool
2. Setup a Jenkins Job with Apache Maven

Level 2 :
1. Setup a Jenkins Job with Batch Script.

14. Level 1: Add a Linux Node (Also Check SSH Slaves plugin plugins)
Level 1: Add a Windows Node
Level 2: Assign a Java Based Job to Linux and Build it
Level 2: Assign a MSBuild Based to Windows and Build it

Targeted Application & Tools that can be used:

Tracking changes in the source code and source code management
Automates web browsers
Configuration Management and IT automation.
Integration of Individual Jobs and Effortless Auditing
Tools: Git, Ansible, Selenium and Jekins

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Each batch of students (self-selected batch mates) will identify projects from searching on Google and implement with the most suitable 2 or 3 antecedents.

Text Book

1. Craig Berg, "*DevOps For Beginners: A Complete Guide to DevOps Best Practices (Including How You Can Create World-Class Agility, Reliability, And Security In Technology Organizations With DevOps) (Code tutorials)*", Paperback – June 12, 2020.
2. Ferdinando Santacroce, "*Git Essentials*", Packt Publishing, April 2015, ISBN: 9781785287909
3. John Ferguson Smart. "*Jenkins: The Definitive Guide*", O'Reilly Media, Inc., July 2011, ISBN: 9781449305352

References

1. Jeff Geerling, "*Ansible for DevOps: Server and configuration management for humans*", Leanpub, August 5, 2020
2. Unmesh Gundecha, Carl Cocchiaro, "*Learn Selenium*", Packt Publishing, July 2019, ISBN: 9781838983048

3. Gaurav Agarwal, "*Modern DevOps Practices: Implement and secure DevOps in the public cloud with cutting-edge tools, tips, tricks, and techniques*", July 2021.
4. Mikael Krief, "*Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps*", October 2019

Weblinks:

1. https://git-scm.com/book/en/v2
2. https://www.simplilearn.com/tutorials/git-tutorial/git-tutorial-for-beginner
3. **https://www.javatpoint.com/selenium-tutorial**
4. **https://www.javatpoint.com/ansible**
5. https://www.tutorialspoint.com/jenkins/jenkins_managing_plugins.htm
6. https://nptel.ac.in/courses/128106012

Topics relevant to "SKILL DEVELOPMENT": Git&Junit, Ansible, Selenium, Jenkins for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2040	**Course Title:** Cyber threats for IOT and Cloud **Type of Course:1] Program Core** **2] Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Cyber Security, Information Security and Networks					
Anti-requisites	**NIL**					
Course Description	Objective of the course is to understand the most important cyber threats for IOT and Cloud. Cyber attackers discover new possibilities in the areas of Internet of Things and cloud services. It mainly focuses on multiple security challenges facing the IoT and cloud computing especially concerns surrounding privacy and cyber security threats of the users and the how can the cyber risks relating to them be mitigated.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Cyber threats for IOT and Cloud and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: • Understand the different types of cyber threats for IOT and cloud • Develop a deeper understanding and familiarity with various types of cyber-attacks, cybercrimes, vulnerabilities and remedies thereto. • Plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.					
Course Content:						

Module 1	**Introduction to IOT and Cloud computing**	Assignment	Programming Task		**12 Sessions**

Topics

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IOT Architecture and protocols, Various platforms for IoT, Real-Time examples of IoT, Overview of IoT components and IoT communication Technologies. Introduction to Cloud Computing, The Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Distributed Systems, Virtualization, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies.

Assignment:

Module 2	**Cyber Threats**	Assignment	Programming Task	**8 Sessions**

Topics:

What are Cyber Security Threats? Common Sources of Cyber Threats, Types of Cyber security Threats-Malware attacks, Social Engineering attacks, Supply chain attacks, Man-in-the middle Attack, Threat Detection Tools, Cyber Defense for Individuals.

Assignment:

Module 3	**Cyber Threats in Internet of Things**	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:

IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats-Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats. **Assignment:**

Module 4	**Cyber Threats in Cloud computing**	Assignment	Programming/Data analysis task	**9 Sessions**

Topics:

Cybersecurity Threats to Cloud Computing-Identity First Security, Cloud misconfiguration, Denial of Service, Insider Threats, Reduced Infrastructure Visibility, Unauthorized use of Cloud workloads, Insecure API's, Compliance and regulation issues, Mitigating cyber risks in cloud computing

Assignment:

Text Books

T1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives" ,Wiley India Pvt Ltd,2013

T2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
T3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education

References

R1. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons,2018
R2. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014
R3. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9

Weblinks:
https://www.coursera.org/learn/cloud-security-basics
https://www.imperva.com/learn/application-security/cyber-security-threats/
https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT":
Cyber threats in IoT and Cloud Computing for **skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3034	**Course Title:** BIG DATA SECURITY AND PRIVACY **Type of Course: Elective in Big Data Basket** **Theory**	**L-T-P-C**	3 -0-0-3
Version No.	1.0		
Course Pre-requisites	CSE219 Big Data Analytics		
Anti-requisites	**NIL**		
Course Description	The purpose of this course is to sensitize security in Big Data environments. This course will discover cryptographic principles, mechanisms to manage access controls in Big Data system. This course teaches the principles and practices of big data for improving the privacy and the security of computing systems. Big data is being applied in areas where there is great commercial advantage to be had, and consequently, attacks and failures have become a serious concern. It delves into a set of techniques for defending big data techniques against breaching of bigdata (the privacy aspect) and against malicious attacks (the security aspect).		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **BIG DATA SECURITY AND PRIVACY** and attain **Skill Development** 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:
i.Define cryptographic principles and mechanisms to manage access controls in Big Data system.[Knowledge]
ii.Explain security risks and challenges for Big Data system.[Knowledge]
iii.Recognize all security related issues in big data systems .[Comprehension]
iv.Apply Kerberos configuration for Hadoop ecosystem components.[Application]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Big Data Privacy, Ethics And Security</td><td>Assignment/Quiz</td><td>Big data security-organizational security</td><td>08 classes</td></tr>
<tr><td colspan="5">Topics:
Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security.
Assignment: Big data security-organizational security</td></tr>
<tr><td>Module 2</td><td>Security, Compliance, Auditing, And Protection</td><td>Assignment</td><td>communication protocols for each of the Hadoop ecosystem components</td><td>08 classes</td></tr>
<tr><td colspan="5">Topics:
Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems.
Assignment: communication protocols for each of the Hadoop ecosystem components</td></tr>
<tr><td>Module 3</td><td>Hadoop Security Design, Hadoop Ecosystem Security</td><td>Case study</td><td>Kerberos configuration for ecosystem tools</td><td>08 classes</td></tr>
<tr><td colspan="5">Topics:
Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop.
Assignment: Kerberos configuration for Hadoop ecosystem tools</td></tr>
<tr><td>Module 4</td><td>Data Security & Event Logging</td><td>Case study</td><td>Event monitoring in Hadoop cluster</td><td>08 classes</td></tr>
<tr><td colspan="5">Topics:
Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in hadoop cluster
Assignment: Event monitoring in Hadoop cluster</td></tr>
<tr><td colspan="5">Assignment:</td></tr>
<tr><td colspan="5">1. 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 .

2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.</td></tr>
<tr><td colspan="5">Text Book(s):
1. Sudeesh Narayanan, “Securing Hadoop”, Packt Publishing, 2013.
2. Ben Spivey, Joey Echeverria, “Hadoop Security Protecting Your Big Data Problem”, O’Reilly Media, 2015.</td></tr>
</table>

Reference(s):

Reference Book(s):

1. Mark Van Rijmenam, "Think Bigger: Developing a Successful Big Data Strategy for Your Business", Amazon, 1 edition, 2014.
2. Frank Ohlhorst John Wiley & Sons, "Big Data Analytics: Turning Big Data into Big Money", John Wiley & Sons, 2013.
3. SherifSakr, "Large Scale and Big Data: Processing and Management", CRC Press, 2014.

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

1. Top Tips for Securing Big Data Environments: e-book (http://www.ibmbigdatahub.com/whitepaper/top-tips-securing-big-data-environments-ebook)
2. http://www.dataguise.com/?q=securing-hadoop-discovering-and-securing-sensitive-datahadoop-data-stores
3. Gazzang for Hadoop http://www.cloudera.com/content/cloudera/en/solutions/enterprisesolutions/security-for-hadoop.html
4. eCryptfs for Hadoop https://launchpad.net/ecryptfs.
5. Project Rhino - https://github.com/intel-hadoop/project-rhino .

Weblinks:
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live

Topics relevant to "SKILL DEVELOMENT": Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: **CSE 3028**	**Course Title: Blockchain security and performances** **Type of Course: Program Core** **Theory and Laboratory Integrated**	**L-T-P-C**	2 -0-2-3
Version No.	1.0		
Course Pre-requisites	Blockchain Technology and Applications		
Anti-requisites	NIL		

Course Description	The purpose of this course is to introduce the students to security and privacy techniques in blockchain based systems. The course provides a comprehensive understanding of blockchain security, risks, methods, and best practices. The course develops critical thinking skills by augmenting the student's ability to tackle security related issues of blockchain The associated laboratory provides an opportunity to validate the concepts taught as well as enhances the ability to visualize the real-world problems in order to provide a solution using various tools and techniques.
Course Out Comes	On successful completion of the course the students shall be able to: CO1:Comprehend security and performance perspective of blockchain technology. CO2: Apply cryptographic techniques to enhance security in blockchain based systems CO3: Implement secure transaction models. CO4: Apply security techniques to blockchain systems that provide solutions to some real world problems
Course Outcome	The objective of the course is to familiarize the learners with the concepts of **CSE3028_BLOCKCHAIN SECURITY & PERFORMANCE** and attain **Employability** through **Experiential Learning** techniques.
Course Content:	

Module 1	**Fundamentals of Privacy And Security Techniques In Blockchain**	Assignment	Programming	**9 Sessions**

Introduction to Blockchain Technology, Cyber Security Threats and incidents on blockchain networks, Categorization of blockchain threats and vulnerabilities: Client vulnerabilities, Consensus Mechanism vulnerabilities, Mining Pool vulnerabilities, Network vulnerabilities, Smart Contract vulnerabilities; Privacy and security techniques: Mixing, Anonymous Signatures, Homomorphic Encryption, Attribute-Based Encryption, Secure Multi-Party Computation, Non-Interactive Zero-Knowledge (NIZK) Proof, TEE Based Smart Contracts, Game-Based Smart Contracts.

Module 2	**Cryptography**	Assignment	Programming	**12 sessions**

Cryptography, Public Key Cryptography and Cryptocurrency, Private Keys, Generating a Private Key from a Random Number, Public Keys, Elliptic Curve Cryptography, Elliptic Curve Arithmetic Operations, Generating a Public Key, Elliptic Curve Libraries, Cryptographic Hash Functions, Ethereum's Cryptographic Hash Function: Keccak-256, Ethereum Address and Formats, Inter Exchange Client Address Protocol

Module 3	**Transaction Model**	Assignment	Programming	**9 sessions**

Topics: Blockchain Level Transaction Models : UTXO, Account-Based Online Transaction Model, CAP Properties in Blockchain, Security and Privacy Requirements of Online Transactions, Basic Security Properties: Consistency, Tamper-Resistance, Resistance to DDoS attacks, Resistance to Double-Spending attacks, Resistance to the Consensus attacks, Pseudonymity; Additional Security and Privacy Properties of Blockchain: Unlinkability, Confidentiality of Transactions and Data Privacy, Consensus Algorithms, BFT based Consensus Algorithms, Sleepy Consensus, Proof of Elapsed Time, Proof of Authority, Proof of Reputation, Comparison of Consensus Algorithms

List of Laboratory Tasks:
Targeted Application & Tools that can be used:
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

After completion of each module a programming based Assignment/Assessment will be conducted. On completion of Module 3, student will be asked to develop a Project.

Textbook(s):

T1.Antonopoulos, Andreas M., and Gavin Wood. *Mastering ethereum: building smart contracts and dapps*. O'reilly Media, 2018.

T2. Howard E. Poston, Blockchain Security from the Bottom Up: Securing and Preventing Attacks on Cryptocurrencies, Decentralized Applications, NFTs, and Smart Contracts, John Wiley & Sons, 2022.

References

R1. Parisi, Alessandro. *Securing Blockchain Networks like Ethereum and Hyperledger Fabric: Learn advanced security configurations and design principles to safeguard Blockchain networks*. Packt Publishing Ltd, 2020.

Web Based Resources and E-books:

Digital Learning Resources (Library Resources)

W1: NPTEL : https://nptel.ac.in/courses/106/104/106104220/#

W2: UDEMY : https://www.udemy.com/course/build-your-blockchain-az/

W3 : Book https://www.google.co.in/books/edition/Blockchain_By_Example/ci59DwAAQBAJ?hl=en&gbpv=1

W4 : Book https://www.insiderintelligence.com/insights/blockchain-technology-applications-use-cases/

W6: https://www.analyticsinsight.net/real-world-applications-of-blockchain-technologies/

W7:PU Library Link : https://puniversity.informaticsglobal.com/login Or : http://182.72.188.193/

Topics relevant to "SKILL DEVELOPMENT": Real time data analysis used for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code:CSE2019	**CourseTitle: Foundations of Blockchain Technology** **TypeofCourse:ProgramCore& Theory only**	**L-T-P-C**	3-0-0-3
Version No.	1.1		
Course Pre-requisites	Networks		
Anti-requisites	NIL		

CourseDescription	The purpose of the course is to provide the fundamental knowledge onBlockchaintechnologyand explore various aspects of Blockchain technology like types of Blockchain, Bitcoin and EthereumBlockchain platform. With a good knowledge of block chain technology, the student can understand the mechanism of Bitcoin and able to write simple smart contracts			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Foundations of Blockchain Technology** and attain **Skill Development** through **Participative Learning** techniques.			
Course OutComes	Onsuccessfulcompletionofthiscoursethestudentsshallbeableto: 1. **Understand** the concepts of anemerging blockchain technology(Knowledge). 2. **Infer** the knowledge about consensus protocols (comprehension). 3. **Explore** Bitcoin payment methods(comprehension). 4. **Develop simple** smart contract(comprehension).			
CourseContent:				
Module 1	BlockchainBasics	Quiz	Knowledge based quiz on distributed ledger	**10 Sessions**
Topics: The history of Blockchain: Blockchain, Generic elements of a blockchain, Benefits and limitations of Blockchain, Tiers of Blockchain technology, Features of Blockchain. Types of Blockchain: Distributed ledgers, Public Blockchain, private Blockchain, shared ledger. **Quiz:**Knowledge based quiz on distributed ledger				
Module 2	Distributed Consensus	Assignment	PoW	**08 Sessions**
Topics: Consensus: Consensus mechanism, Types of consensus mechanisms, Consensus in Blockchain. **Assignment:** Write an assignment on PoW consensus mechanism				
Module 3	Introducing Bitcoin	Case study	Bitcoin network wallets	**10 Sessions**
Topics: Bitcoin definition, Digital keys and addresses, Transactions, mining, Bitcoin network wallets, Bitcoin payments. **Case Study:** Conduct a study about hot bitcoin wallets				
Module 4	Smart contracts	Case study	how to execute smart contract	**10 Sessions**
Topics:History, Definition, Introduction to Ethereum,Ethereum network,Components of Ethereum ecosystem, Smart contracts. **Case Study:** Create a simple smart contract for User identity management using Solidity language and show how to execute.				

Targeted Application & Tools that can be used:

- Ethereum Remix
- MetaMask
- Truffle
- Ganache

Textbook

T1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
Weblinks: Mastering Blockchain - Google Books

References

R1. Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015.
R2. Blockchain by Melanie Swa, O'Reilly .

Weblinks:

1. Blockchain A-Z™: Learn How To Build Your First Blockchain | Udemy
2. https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency
3. https://www.coursera.org/specializations/introduction-to-blockchain
4. https://presiuniv.knimbus.com/user

Text book of Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained, 2nd Edition, Packt Publishing Ltd, March 2018.

https://www.google.co.in/books/edition/Mastering_Blockchain/3ZlUDwAAQBAJ?hl=en&gbpv=1

Topics relevant to "SKILL DEVELOPMENT":
Bitcoin and Smart Contracts for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3152	**Course Title:** .NET Full Stack Development	**L- T-P- C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**Nil**		
Anti-requisites	**CSE3151 Java Full Stack Development**		
Course Description	This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on		

	using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **DotNET FULL STACK Development** and attain **Employability Skills** through **Experiential Learning** techniques.			
Course Outcomes	**On successful completion of the course the students shall be able to:** **1] Practice the use of C# for developing a small application [Application]** **2] Show web applications using Entity Framework. [Application]** **3]Solve simple web applications that use SQL and ASP.NET [Application]** **4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]**			
Course Content:				
Module 1	C# Programming for Full Stack Development	Project	Programming	**10 Sessions**
Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework **Assignment:** Develop a small application for managing library using C#.				
Module 2	Entity Framework Core 2.0	Project	Programming	**06 Sessions**
Topics: Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET **Assignment:** Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project	Programming	**06 Sessions**
Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; **Assignment:** Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project	Programming	**08 Sessions**
Topics:				

Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application
Assignment: Develop a software tool to do inventory management in a warehouse.

Targeted Application & Tools that can be used:

Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.

Professionally Used Software: Visual Studio

Project work/Assignment:

1. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using .NET.**
3. Assignment: Case study on Web sites development

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015
T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.

References

R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021.
R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017.
R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018.
R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017.

Topics relevant to development of "Employability": C#, ASP.NET & SQL for developing Employability **Skill Development** through **Experiential Learning** techniques.. This is attained through assessment component mentioned in course handout.

Course Code: CSE2015	**Course Title: Data Analysis and Visualization** **Type of Course:1] Program core** **2] Lab Integrated Course**	**L-T-P- C**	**2** -0-**4**-**4**
Version No.	1.0		
Course Pre-requisites	**Python Programming**		
Anti-requisites	**NIL**		

Course Description	The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts. The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization. With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data Analysis and Visualization** and attain EMPLOYABILITY through Experiential Learning techniques.			
Course Out Comes	**On successful completion of this course the students shall be able to:** 1. Understand the various types of data, apply and evaluate the principles of data visualization. 2. Acquire skills to apply visualization techniques to a problem and its associated dataset. 3. Create interactive visualization for better insight using various visualization tools. 4. Handle data occurring in large volumes 5. Implement the visualization concepts practically using Python			
Course Content:				
Module 1	**Introduction to Data Visualization** (Comprehension)	Assignment	Programming activity	**10 Hours**
Topics: Data collection, Data Preparation Basic Models- Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Interacting with Databases, Data Cleaning and Preparation, Handling Missing Data, Data Transformation. **Python Libraries**: NumPy, pandas, matplotlib, GGplot,Introduction to pandas Data Structures				
Module 2	**Data Visualization Techniques** (Application)	Assignment	Programming activity	**10 Hours**
Topics: Scalar and point techniques – vector visualization techniques – matrix visualization, Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data, Visual Variables- Networks and Trees - Map Color and Other Channels- Manipulate View- Heat Map.				
Module 3	**Visual Analysis of data from various domain** (Application)	Assignment	Programming activity	**10 Hours**

Topics:
Time-oriented data visualization – Spatial data visualization, Text data visualization – Multivariate data visualization and case studies, Finance- marketing-insurance-healthcare etc.

Module 4	**Visualization of Streaming Data** (Application)	Assignment	Programming activity	**10 Hours**

Topics:
Guidelines for designing successful visualizations, Data visualization dos and don'ts, Best practices of Data Streaming, processing streaming data for visualization, presenting streaming data, streaming visualization techniques, streaming analysis.

List of Laboratory Tasks:

Labsheet -1 [4 Practical Sessions]
Working with Numpy Functions and Pandas functions
Acquiring and plotting data.

Labsheet -2 [4 Practical Sessions]
Practicals based on Data Cleaning and Preparation
Practicals based on Data Wrangling
Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance

Labsheet – 3 [4 Practical Sessions]
Practicals based on Data Visualization using matplotlib
Visualization of various massive dataset - Finance - Healthcare - Census

Labsheet – 4 [4 Practical Sessions]
Practical based on Time Series Data Analysis-stock market
Market-Basket Data analysis-visualization
Text visualization using web analytics

Labsheet -5 [4 Practical Sessions]
Financial analysis using Clustering, Histogram and HeatMap
Visualization on Streaming dataset (Stock market dataset, weather forecasting)

Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1. Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard.
2. Programming: Implementation of the chosen dashboard

Text Book

1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.
2. Tamara Munzer, Visualization Analysis and Design, CRC Press 2014.
3. Aragues, Anthony. Visualizing Streaming Data: Interactive Analysis Beyond Static Limits. O'Reilly Media, Inc., 2018
4. Dr. OssamaEmbarak,"Data Analysis andVisualization Using Python", Apress,(2018)

References

R1. Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.

R2. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020 3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.

R3. García Salvador, LuengoJulián, & Herrera, F. "Data preprocessing in Data Mining", Springer,(2015)

R4. Stephen Few, "Information Dashboard Design: the effective visual communication of data", Oreilly, 2006

R5. Belorkar, A, "Interactive Data Visualization with Python" - [S.l.]: Packt Publishing, Second Edition. (2018)

Web links

R1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/

R2. Google Data Analytics Professional Certificate | Coursera

R3. Learning Python for Data Analysis and Visualization Ver 1 | Udemy

R4. Data Science, Analytics and Visualization (DS) Courses | Chaminade University - PROD [Integrated] Catalog

R5. Data Visualization Training and Certification Courses | Koenig Solutions (koenig-solutions.com)

Topics relevant to "Employability": Visual Analysis and Streaming of Data for **Employability** through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3002	**Course Title:** Big Data Technologies **Type of Course: Program Core** **Theory and Lab Integrated Course**	**L-T- P- C**	2 -0-2-3
Version No.	1.0		
Course Pre-requisites	CSE2012-Database Management System, CSE1001- Problem solving using Java.		
Anti-requisites	**NIL**		
Course Description	The purpose of the course is to provide the fundamentals of Big data technology, to emphasize the importance of choosing suitable tools for processing and analyzing big data to gain insights. The student should have knowledge and skill to select and use most appropriate big data tools to solve business problems. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills. With a good knowledge in the fundamentals of Big data technology, the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volume of data.		
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Big Data Technologies and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.		

Course Outcomes	On successful completion of the course the students shall be able to: • Apply Map-Reduce programming on the given datasets to extract required insights. (Application). • Employ appropriate Hadoop Ecosystem tools such as scoop, Hbase, Hive, to perform data analytics for a given problem. (Application). • Use Spark tool to analyze the given dataset for a given problem. (Application).			
Course Content:				
Module 1	Introduction to Hadoop	Programming Assignment	Data Collection and Analysis	**10 Classes**
Introduction to Big Data and its importance: Basics of Distributed File System, Four Vs, Drivers for Big data, Big data applications, Structured, unstructured, semi-structured and quasi structured data. Big data Challenges-Traditional versus big data approach, The Big Data Technology Landscape: No-SQL. **The Hadoop**: History of Hadoop-Hadoop use cases, The Design of HDFS, Blocks and replication management, Rack awareness, HDFS architecture, HDFS Federation, Name node and data node, Anatomy of File write. Anatomy of File read, Hadoop Map Reduce paradigm, Map and reduce tasks, Job Tracker and task tracker, Map reduce execution pipeline, Key value pair, Shuffle and sort, Combiner and Partitioner, APIs used to Write/Read files into/from Hadoop, Need for Flume and Sqoop. **Anatomy of a YARN:** Hadoop 2.0 Features, Name Node High Availability, YARN Architecture, Introduction to Schedulers, YARN scheduler policies, FIFO, Fair And Capacity scheduler.				
Module 2	Hadoop Ecosystem Tools	Programming Assignment	Data Collection and Analysis	**8 Classes**
Introduction to SQOOP: SQOOP features, Sqoop Architecture, Sqoop Import All Tables, Sqoop Export All Tables, Sqoop Connectors, Sqoop Import from MySQL to HDFS, Sqoop vs flume. **Hive:** Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, and Hive sort by vs. order by, Hive Joining tables, Hive bucketing. **Hbase:** Introduction to HBase and its working architecture- Commands for creation and listing of tables- disabled and is disabled of table - enable and is enabled of table- describing and dropping of table-Put and Get command - delete and delete all command-commands for scan, count, truncate of tables.				
Module 3	Spark	Programming Assignment	Data analysis	**8 Classes**
Introduction to Apache Spark A unified Spark, Who uses Spark and for what?, A Brief History of Spark, Spark version and releases, Storage layers for Spark. Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. Spark SQL: Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-defined functions, Spark SQL Performance. Scala: The Basics, Control Structures and functions, Working with arrays, Maps and Tuples.				
List of Laboratory Tasks: 1. **Level 1:** To install the Hadoop in pseudo cluster mode. **Level 1:** HDFS Shell Commands – Files and Folders. **Level 2:** HDFS Shell Commands – Management. 2. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. **Level 1:** Find the number of occurrence of each word appearing in the input file(s)				

Level 2: Performing a Map Reduce Job for word search count (look for specific keywords in a file).

3. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with Map Reduce, since it is record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all.

Level 1: Find average, max and min temperature for each year in NCDC data set?

Level 2: Programming assignment to analyze the social media data for business analytics.

4. **Level 1:** Finding out Number of Products Sold in Each Country using map reduce with sample dataset

Level 2: Find matrix multiplication using map reduce

5. **Level 1:** Installation of Hive, working on basic hive commands. (Create, Alter and Drop tables)

Level 2: Apply Hive commands to student database/employee database.

6. **Level 1:** Working on advance hive commands. (Static Partitioning & Dynamic partitioning)

Level 2: Continue the previous experiment, select and apply suitable partitioning technique.

7. **Level 1:** Working on advance hive commands-2. (Bucketing)

Level 2: Continue the previous experiment, apply bucketing technique to bring out the difference between partitioning and bucketing.

8. **Level 1:** Installing Ecosystem tools such as Scoop, Hbase.

Level 2: Scoop – Move Data into Hadoop.

9. **Level 1:** Working on basic Hbase commands (General commands, DDL Commands)

Level 2: Apply Hbase commands on Insurance database/employee dataset.

10. **Level 1:** Working on advanced Hbase commands. (DML).

Level 2: Continue the previous experiment to demonstrate CRUD operations.

11. **Level 1:** Install, Deploy & configure Apache Spark.

Level 2: Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark

12. **Level 1:** Write a program in Apache spark to count the occurrences words in a given text file and display only those words starting with 'a' in ascending order of count.

Level 2: Apache access logs are responsible for recording data for all web page requests processed by the Apache server. An access log record written in the Common Log Format will look something like this: 127.0.0.1 - Scott [10/Dec/2019:13:55:36 – 0700] "GET /server-status HTTP/1.1" 200 2326 Where, HTTP 200 status response code indicates that the request has succeeded. Write a program to read the records of access log file log.txt and display the number of successful requests using Spark.

13. **Level 1:** Chess king moves horizontally, vertically or diagonally to any adjacent cell. Given two different cells of the chessboard, determine whether a king can go from the first cell to the second in one move.

Write a scala program that receives input of four numbers from 1 to 8, each specifying the column and row number, first two - for the first cell, and then the last two - for the second cell. The program should output YES if a king can go from the first cell to the second in one move, or NO otherwise.

Level 2: Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

- Transposes the original Amazon food dataset, obtaining a Pair RDD of the type:
- Counts the frequencies of all the pairs of products reviewed together;
- Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Targeted Application & Tools that can be used:

- **Business Analytical Applications**
- **Social media Data Analysis**
- **Predictive Analytics**

Tools: Hadoop Framework tools like map reduce, Hive, Hbase, Scoop, Spark.

Text Book

Seema Acharya, Subhashini Chellappan. 2015. *Big Data and Analytics*. Wiley Publication.
Matei Zaharia, Bill Chambers. 2018. *SPARK: The Definitive Guide*. Oreilly.

References

Tom White. 2016. *Hadoop: The Definitive Guide*. O'Reilley.
Cay S. Horstmann. 2017. *Scala for the Impatient*. Wesley.

Topics relevant to development of "Skill Development": Real time application development using Hadoop Ecosystem tools through Experiential Learning as mentioned in the course handout.

Course Code: CSE3125	**Course Title:** Service Oriented Architecture **Type of Course:** Program Core	**L-T-P-C**	3-0-0-3
Version No.	2.0		
Course Pre-requisites	CSE207-Data Base Management System, CSE264 -Web Technology		
Anti-requisites	NIL		
Course Description	The study of the course is to enable the students to understand the different architectural styles and XML based web applications which is required to explore the basics of service-oriented Architecture(SOA) in two approaches i.e. Web Services (WS) and Representational State Transfer (REST) architecture.		

Course Objective	The objective of the course is to familiarize the learners with the concepts of Service Oriented Architecture and attain Skill Development through Participative Learning techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 1. Discuss the XML Fundamentals and to manipulate the data using XML. [Comprehension] 2.Define the key principles of SOA [Knowledge] 3.Discuss the web services technology elements for realizing SOA[Comprehension] 4. Illustrate the various Web Service Standards[Application]
Course Content:	
Version No.	2.0

Module 1	**Introduction to XML**	**Assignment**	**Programming Task**	**08 Sessions**
Topics: XML document structure ,Well formed and valid documents ,Namespaces – DTD – xml Schema – X-Files,Parsing XML – using DOM, SAX – XML Transformation and XSL Formatting – Modelling Databases in XML.				
Module 2	**Service Oriented Architecture**	**Assignment**	**Architectural study**	**10 Sessions**
Topics: Types of Architecture, Objectives of Software architecture, SOA Planning and analysis, Architecture patterns and styles ,Characteristics of SOA, Comparing SOA with Client-Server and Distributed architectures – Benefits of SOA ,Security and implementation ,Principles of Service orientation ,Service Layers, Application development process, SOA methodology for Enterprise.				
Module 3	**Web Services**	**Quiz**	**Data patterns**	**08 Sessions**
Topics: Service Descriptions – WSDL – Messaging with SOAP – Service Discovery – UDDI – Message Exchange Patterns – Orchestration – Choreography – WS Transactions.				
Module 4	**Building SOA based Applications**	**Quiz**	**Security aspects**	**11 Sessions**
Topics: Business Process Design, Business case for SOA, Stake holder objectives, Service Oriented Analysis and Design – Service Modeling – Design standards and guidelines – Composition – WS-BPEL – WS-Coordination – WS-Policy – WS-Security , Tools available for implementing SOA, SOA Security, approach for enterprise wide SOA implementation, Trends in SOA, Technologies in Relation to SOA, Advances in SOA, SOA Support in J2EE.				

Targeted Application & Tools that can be used:

Basic HTML and XML

Textbook(s):

1. Thomas Erl, "*Service Oriented Architecture: Concepts, Technology, and Design*", Pearson Education, 2016.
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6532

2. Ron Schmelzer et al. "*XML and Web Services*", Pearson Education, 2013
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6645

References

1. Frank P.Coyle, "*XML, Web Services and the Data Revolution*", Pearson Education, 2002
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6647

2. Eric Newcomer, Greg Lomow, "*Understanding SOA with Web Services*", Pearson Education, 2005
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6619

3. Sandeep Chatterjee and James Webber, "*Developing Enterprise Web Services: An Architect's Guide*", Prentice Hall, 2004.
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5906

4. James McGovern, Sameer Tyagi, Michael E.Stevens, Sunil Mathew, "*Java Web Services Architecture*", Morgan Kaufmann Publishers, 2003.
https://www.elsevier.com/books/java-web-services-architecture/mcgovern/978-1-55860-900-6

Web Resources:

1. https;//presiuniv.knimbus.com/user#/home
2. https://www.coursera.org/learn/service-oriented-architecture
3. https://nptel.ac.in/courses/soa

Topics relevant to "SKILL DEVELOPMENT": Based on an understanding of architectural styles, understanding web applications based on XML, review architectures for web applications, Service-Oriented Architecture (SOA) in two approaches: Web Services (WS*) and Representational State Transfer (REST) architecture for Skill Development through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.

Course Code: CSE3016	**Course Title:CSE3016 Neural Networks and Fuzzy Logic** **Type of Course: Discipline Elective in AI & ML Basket Theory Course**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory.		

Course Objective	The objective of the course is to familiarize the learners with the concepts of **Neural Networks and Fuzzy Logic** and attain **Skill Development** through **Participative Learning** techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Define the concept of Neural Networks. [Knowledge] 2. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge] 3. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 4. Demonstrate the Fuzzy logic concepts and its applications.[Application]			
Course Content:				
Module 1	**Introduction to Neural Network**	Quiz	Single Layer Perceptron	**9Classes**
Topics: Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks. Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.				
Module 2	**Multilayer Perceptron**	Quiz	Multilayer Perceptron	**10 Classes**
Topics: Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples. Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies. Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.				
Module 3	**Fuzzy Sets, Operations and Relations**	Quiz	Fuzzy Operations	**10Classes**
Topics: Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets. Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations. Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.				
Module 4	**Fuzzy Logic and Fuzzy Logic Controller**	Assignment	Developing Fuzzy Logic Controller	**10Classes**
Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions. Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.				
Targeted Application & Tools that can be used: 1. Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.) 2. Matlab (Neural Network Toolbox, Fuzzy Logic Toolbox)				
Project work/Assignment:				

Students will have to do group assignments for Modules 2 & 4. As a part of their assignments, they will have to implement the solution to particular problems.

Textbook(s):

1. Haykin, Simon. "*Neural networks and learning machines*", 3/E. Pearson Education India, 2011. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553
2. George J. Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic- Theory and Applications*", Prentice Hall of India, 2015.
   https://www.worldcat.org/title/fuzzy-sets-and-fuzzy-logic-theory-and-applications/oclc/505215200

References:

1. Shivanandam, Deepa S, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html
2. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374
3. Kumar S., "*Neural Networks - A Classroom Approach*", Tata McGraw Hill, 2nd Edition 2017.https://www.worldcat.org/title/neural-networks-a-classroom-approach/oclc/56955342
4. Fakhreddine O. Karray, and Clarence W. De Silva. "*Soft computing and intelligent systems design: theory, tools, and applications*". Pearson Education, 2009.

Weblinks

https://www.pearson.com/en-gb/search.html?q=Karray%20Soft-Computing-and-Intelligent-Systems-Design-Theory-Tools-and-Applications

Topics relevant to "Skill Development ": Assignment implementations in software, batch wise presentations are used for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. S. Thiruselvan		
Recommended by the Board of Studies on	BOS NO: 12th BOS, held on 04/08/2021		
Course Code: CSE3098	**Course Title: Vulnerability Assessment and Penetration Testing** **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	CSE3078		
Anti-requisites	**NIL**		
Course Description	This course explores the tools that can be used to perform information gathering. This course also covers how vulnerability can be carried out by means of tools or manual investigation, and analysis of common attacks in data, mobile applications and wireless networks		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Vulnerability Assessment and Penetration Testing** and attain **Employability** through **Problem Solving** Methodologies.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the basic principles for information gathering and detecting vulnerabilities in the system.		

	• Determine the security threats and vulnerabilities in SDN networks and web applications. • Able to use the exploits in mobile applications and wireless networks • Understand the metasploit and metrepreter are used to automate the attacks and penetration testing techniques.			
Course Content:				
Module 1	**Information Gathering, Host Discovery and Evading Techniques**	Assignment	Theory	**9 Sessions**
Topics: Introduction - Terminologies - Categories of Penetration Testing - Phases of Penetration Test -Penetration Testing Reports - Information Gathering Techniques - Active, Passive and Sources of Information Gathering – Approaches, Host discovery - Scanning for open ports and services- Types of Port, Vulnerability Scanner Function, pros and cons - Vulnerability Assessment with NMAP - Testing, SCADA environment with NMAP				
Module 2	**Vulnerability Scanner in SDN Networks and Web application**	Quiz	Theory	**10 Sessions**
Topics: Nessus Vulnerability Scanner - Safe check – Silent dependencies - Port Range Vulnerability Data Resources, SDN Data plane, Control Plane, Application Plane. SDN security attack vectors and SDN Harderning, Authentication Bypass with Insecure Cookie Handling - XSS Vulnerability - File inclusion vulnerability - Remote file Inclusion -Patching file Inclusions - Testing a website for SSI Injection.				
Module 3	**Mobile Application Security and wireless network Vulnerability analysis**	Quiz	Theory	**11 Sessions**
Topics: Types of Mobile Application Key challenges in Mobile Application and Mobile application penetration testing methodology, Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention -Handheld Exploitation, WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless – WLAN Penetration Test Methodology.				
Module 4	**Exploits**	Quiz	Theory	**8 Sessions**
Topics: Architecture and Environment- Leveraging Metasploit on Penetration Tests, Understanding - Metasploit Channels, Metasploit Framework and Advanced Environment configurations – Understanding the Soft Architecture, Configuration and Locking, Advanced payloads and add on modules Global datastore, module datastore, saved environment Meterpreter.				
Targeted Application & Tools that can be used: This course helps the students to understand the threats and vulnerabilities using NMAP.				
Project work/Assignment:				
Project Assignment:				
Text Book				

1. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2015. ISBN : 78-1-4822-3161-8.
2. Dr. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing made easy , Syngress publications, Elsevier, 2013. ISBN :978-0-12-411644-3.
3. Mayor, K.K.Mookey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0

References

1. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 PacktPublishing.
2. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress Publication

Web resources: https://onlinecourses.nptel.ac.in/noc19_cs68/preview - **IIT Kharagpur,** Prof. Indranil Sen Gupta

Topics relevant to development of "EMPLOYABILITY SKILLS": Exploitation, Penetration testing techniques, for development of Employability skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in course handout.

Course Code: CSE3098	**Course Title: Vulnerability Assessment and Penetration Testing** **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	CSE3078		
Anti-requisites	**NIL**		
Course Description	This course explores the tools that can be used to perform information gathering. This course also covers how vulnerability can be carried out by means of tools or manual investigation, and analysis of common attacks in data, mobile applications and wireless networks		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Vulnerability Assessment and Penetration Testing** and attain **Employability** through **Problem Solving** Methodologies.		

<table>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
• Understand the basic principles for information gathering and detecting vulnerabilities in the system.
• Determine the security threats and vulnerabilities in SDN networks and web applications.
• Able to use the exploits in mobile applications and wireless networks
• Understand the metasploit and metrepreter are used to automate the attacks and penetration testing techniques.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Information Gathering, Host Discovery and Evading Techniques</td><td>Assignment</td><td>Theory</td><td>9 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction - Terminologies - Categories of Penetration Testing - Phases of Penetration Test -Penetration Testing Reports - Information Gathering Techniques - Active, Passive and Sources of Information Gathering – Approaches, Host discovery - Scanning for open ports and services- Types of Port, Vulnerability Scanner Function, pros and cons - Vulnerability Assessment with NMAP - Testing, SCADA environment with NMAP</td></tr>
<tr><td>Module 2</td><td>Vulnerability Scanner in SDN Networks and Web application</td><td>Quiz</td><td>Theory</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Nessus Vulnerability Scanner - Safe check – Silent dependencies - Port Range Vulnerability Data Resources, SDN Data plane, Control Plane, Application Plane. SDN security attack vectors and SDN Harderning, Authentication Bypass with Insecure Cookie Handling - XSS Vulnerability - File inclusion vulnerability - Remote file Inclusion -Patching file Inclusions - Testing a website for SSI Injection.</td></tr>
<tr><td>Module 3</td><td>Mobile Application Security and wireless network Vulnerability analysis</td><td>Quiz</td><td>Theory</td><td>11 Sessions</td></tr>
<tr><td colspan="5">Topics:
Types of Mobile Application Key challenges in Mobile Application and Mobile application penetration testing methodology, Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention -Handheld Exploitation, WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless – WLAN Penetration Test Methodology.</td></tr>
<tr><td>Module 4</td><td>Exploits</td><td>Quiz</td><td>Theory</td><td>8 Sessions</td></tr>
<tr><td colspan="5">Topics:
Architecture and Environment- Leveraging Metasploit on Penetration Tests, Understanding - Metasploit Channels, Metasploit Framework and Advanced Environment configurations – Understanding the Soft Architecture, Configuration and Locking, Advanced payloads and add on modules Global datastore, module datastore, saved environment Meterpreter.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
This course helps the students to understand the threats and vulnerabilities using NMAP.</td></tr>
<tr><td colspan="5">Project work/Assignment:</td></tr>
</table>

Project Assignment:
Text Book 2. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2015. ISBN : 78-1-4822-3161-8. 3. Dr. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing made easy , Syngress publications, Elsevier, 2013. ISBN :978-0-12-411644-3. 4. Mayor, K.K.Mookey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
References 2. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 PacktPublishing. 3. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress Publication **Web resources:** https://onlinecourses.nptel.ac.in/noc19_cs68/preview - **IIT Kharagpur,** Prof. Indranil Sen Gupta
Topics relevant to development of "EMPLOYABILITY SKILLS": Exploitation, Penetration testing techniques, for development of Employability skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in course handout.

Course Code: **CSE3190**	**Course Title: Fundamentals of Data Analytics** **Type of Course: Theory-embedded Lab**	**L-T- P- C**	2	0	2	3
Version No.	3.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Fundamentals of Data Analytics is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an					

	intuitive way to analysis the data. This course will help the students to apply the knowledge on data analysis to a wide range of applications.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Fundamentals of Data Analytics** and attain **SKILL DEVELOPMENT** through **PROBLEM SOLVING** Methodologies.
Course Out Comes	On successful completion of the course the students shall be able to: 5) **Explain different types of data and variables.** 6) **Interpret data using appropriate statistical methods.** 7) **Demonstrate the collection, processing and analysis of data for any given application and Illustrate various charts using visualization methods.** 8) **Apply the Data Analysis techniques by R Programming**
Course Content:	

Module 1	Introduction to Data Analysis	Assignment	Data Collection, data analysis, Programming	**8 Sessions**
Topics: Introducing Data, overview of data analysis: Data in the Real World, Data vs. Information, The Many "Vs" of Data, Structured Data and Unstructured Data, Types of Data, Data Analysis Defined, Types of Variables, Central Tendency of Data, Scales of Data, Sources of Data. Data preparation. **R Studio:** Base R-R Studio IDE-Introduction to R Projects and R Markdown. Basic R: R as a calculator-Scripts and Comments-R Variables. Data I/O: Working Directories-Importing Data Exporting Data-More ways to save-Data I/O in Base R.				
Module 2	Data Analysis and Visualization	Case studies	Programming	**8 Sessions**
Topics: Data Summarization**:** One Quantitative and Categorical Variable. Data Classes: One Dimensional Data Classes-Data Frames and Matrices-Lists. Data Cleaning: Dealing with Missing Data-Strings and Recoding Variables. Manipulating Data in R: Reshaping Data-Merging Datasets. Data Visualizations: Plotting with ggplot2- Plotting with Base R				
Module 3	Statistical Analysis	Case studies	R programming	**7 Sessions**
Topics: Proportion tests-Chi squared test-Fisher exact test-Correlation-T test-Wilcoxon Rank sum tests-Wilcoxon signed rank test- one-way ANOVA test- Kruskal Wallis test				
Module 4	Predictive Analysis	Case studies	Programming	**8 Sessions**
Topics: Linear least-squares – implementation – the goodness of fit – testing a linear model – weighted resampling. Regression using Stats models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – accuracy. Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis				

List of Laboratory Tasks:

Experiment No. 1: Introduction to R and RStudio

Level 1: Getting Started with R and RStudio

- Installing R and RStudio.
- Basic R syntax and commands.

Level 2: Working with RStudio

- Understanding the RStudio interface.
- Creating and managing R scripts.

Experiment No. 2: Basic Data Handling in R

Level 1: Data Types and Structures in R

- Vectors, matrices, and data frames.
- Lists and factors.

Level 2: Data Import and Export

- Reading data from CSV, Excel, and text files.
- Exporting data to different formats.

Level 3: Exploring Datasets

- Using functions like head(), summary(), and str().

Experiment No. 3: Basic Data structure in R

Level 1: a. Demonstrate a program to join columns and rows in a data frame using cbind() and rbind() in R.

b.Implement different data structures in R (Vectors, Lists, Data Frames)

Level 2: R AS CALCULATOR APPLICATION a. Using with and without R objects on console

c. Using mathematical functions on console
d. Write an R script, to create R objects for the calculator application

Experiment No. 4: Data Cleaning and Preprocessing

Level 1: Handling Missing Data in R

- Identifying missing values.
- Imputing missing values using mean, median, or other methods.

Level 2: Data Transformation in R

- Standardizing and normalizing data.
- Log-transformations and scaling.

Experiment No. 5: Exploratory Data Analysis (EDA) with R

Level 1: Descriptive Statistics

- Calculating mean, median, and standard deviation.
- Visualizing data using histograms, box plots, and scatter plots.

Experiment No. 6: Data Visualization with ggplot2

Level 1: Demonstrate various graphs that can be made and altered using the ggplot2 package.

Level 2: Create 500 random temperature readings for six cities over a season and then plot the generated data using ggplot2 packages in R

Experiment No. 7: Perform Tests of Hypotheses hypothesis test (parametric)

Level 1: How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value.

Level 2: A teacher claims that people who work for only five hours per week will score significantly lower than people who work for ten hours per week on a quantitative abilities test. He brings twenty people and randomly assigned them to one or two groups. In one group he has participants who work for ten hours and in another group, he has participants who work for five hours. He conducts the test for all participants. Scores on the test range from one to ten with higher scores representing better performance. Test if there is any significant difference between those who work for five hours per week versus those who work for ten hours per week based on the test performance.

Experiment No 8: Hypothesis – Non-Parametric Test

Level 1: A car manufacturing company like to find the sales of three types of cars produced by them in three regions and is given. Test if there is an association between the regions and types of cars purchased.

Experiment No 9: Correlation and Covariance

Level 1: Using the iris data set in R

d. Find the correlation matrix.
e. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
f. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

Level 2 : Ramesh is doing a statistics paper in his post-graduation course. He met his friend Amal who is a textile engineer. Ramesh, who is doing his internship at ABC Researchers, is interested in a question. He poses this question to Amal and tries to find if he can answer. The question is as follows: The data regarding sales of soft- drinks and sales of cotton clothes in a place during the last 12 months are given. Find if there is any association between sales of soft drinks and sales of cotton clothes. Also explain the reason if there is any relationship.

Experiment No 11: Regression Model

Level 1: Import data from web storage (http://www.ats.ucla.edu/stat/data/binary.csv). Name the dataset and now do Logistic Regression to find out the relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained, and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS).

Level 2: Demonstrate multiple regressions, if data have a continuous Independent variable. Apply on the above dataset

Experiment No. 12: Time Series Analysis in R

Level 1: Demonstrate Timeseries analysis using Time Series Data Library at http://robjhyndman.com/TSDL/.

Targeted Application & Tools that can be used:

Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc.

Text Books

6. Glenn J. Myatt and Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback", Import, 22 July 2014.
7. Introduction to statistics and Data analytics, Christian H, Michael S, Springer,2016
8. Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020 (E-resource)
9. Introduction to Time Series and Forecasting (Springer Texts in Statistics), Peter Brockwell, Richard A. Davis, Springer, 2016.

References

3. Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback, Glenn J. Myatt and Wayne P. Johnson, Import, 22 July 2014.
4. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet, Springer 2013.

Online resources:

http://www.modernstatisticswithr.com/solutions.html#solutionsch3

https://johnmuschelli.com/intro_to_r/ https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/
Topics relevant to development of "FOUNDATION SKILLS": 2. Statistical Concepts for data, visualization techniques. 3. Data collection for project based assignments. 4. Inferential Statistics (T test, Z test) 5. Probability Calculation **for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**

Course Code: **CSE3095**	**Course Title: Cloud Security** **Type of Course: Discipline Elective in Cloud Computing Basket** **Theory**	**L-T- P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	**[1] Cloud Computing and Services (CSE322)**		
Anti-requisites	**NIL**		
Course Description	This course provides ground-up coverage on the high-level concepts of cloud landscape, architectural principles, and techniques. It describes the Cloud security architecture and explores the guiding security for Infrastructure and Softwares.		
Course Objective	**This course is designed to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques.**		
Course Outcomes	On successful completion of this course the students shall be able to: 1. **Describe** fundamentals of cloud computing [**Knowledge].** 2. **Explain** cloud computing security architecture and associated challenges **[Comprehension].** 3. **Discuss** cloud computing software security essentials **[Comprehension].**		

	4. **Apply** infrastructure security and data security in cloud computing enviroment. **[Application].**			
Course Content:				
Module 1:	**Fundamentals of Cloud Computing**	**Quiz**	Knowledge based Quiz	**10 Sessions**
Topics: Cloud Computing at a Glance, Building Cloud Computing Environments, Computing Platforms and Technologies, Cloud Computing Architecture: Cloud Delivery Models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud Deployment Models, Expected Benefits.				
Module 2:	**Cloud Security Challenges and Cloud Security Architecture**	**Quiz**	Comprehension based Quiz	**10 Sessions**
Topics: Security Policy Implementation, Computer Security Incident Response Team, Virtualization Security Management. Architectural Considerations, Identity Management and Access Control, Autonomic Security**.**				
Module 3	**Cloud Computing Software Security Essentials**	**Assignment**	Batch-wise Assignments	**9 Sessions**
Topics: Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Secure Cloud Software Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery.				
Module 4:	**Infrastructure Security and Data Security**	Assignment and Presentation	Batch-wise Assignment and Presentations	**9 Sessions**
Topics: Infrastructure Security: The Network Level, The Host Level, The Application Level. **Data Security :** Aspects of Data Security, Data Security Mitigation, Provider Data and its Security.				
Targeted Application & Tools that can be used: Use of CloudSim simulator.				
Project work/Assignment: **Survey on Cloud Service Providers**				
Text Book 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill Education, July 2021. 2. Roland L Krutz and Russell Dean Vines, "*Cloud Security - A Comprehensive Guide to Secure Cloud Computing*", Wiley Publishing, Inc. 2019.				
References 1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, "*Secure Cloud Computing*", Springer, ISBN 978-1-4614-9278-8 (eBook). 2. John Rittinghouse and James Ransome, "*Cloud Computing, Implementation, Management and Security*", CRC Press, 2010. 3. Tim Mather, Subra Kumaraswamy and Shahed Latif", "Cloud Security and Privacy – An Enterprise Perspective on Risks and Compliance", Oreily Publication, 2009.				
Topics related to development of "FOUNDATION": Cloud computing architecture, Security policy implementation. Topics related to development of "EMPLOYABILITY": Infrastructure security and Data security.				

Course Code: CSE3150	Course Title: Front-end Full Stack Development	L- T-P- C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	Nil		
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.		
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		
Course Outcomes	On successful completion of the course the students shall be able to: 1] Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension] 2] Illustrate development of a responsive web. [Application] 3] Apply concepts of Angular.js to develop a web front-end. [Application] 4] Apply concepts of Angular.js to develop a web front-end. [Application]		
Course Content:			

Module 1	Fundamentals of DevOps and Web Development	Project	Programming	04 Sessions
Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control. HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform **Assignment:** Develop a website for managing HR policies of a department.				
Module 2	Responsive web design	Project	Programming	03 Sessions
Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction **Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society.				
Module 3	Fundamentals of Angular.js	Project	Programming	08 Sessions
Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using				

Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma).
Assignment: Develop a software tool to do inventory management in a warehouse.

Module 4	Fundamentals of React.js	Project	Programming	**15 Sessions**

Topics:
Overview of React.js.; Reactive Programming; React Components; Render Method; Virtual DOM and Bandwidth Salvation; Two Distinct Ways of Initializing a React Class; States & Life Cycles; Component Mounting; Node.js & NPM; JSX Walkthrough; React Testing.
Assignment: Develop a web-based application to book movies/events (like bookmyshow).

Targeted Application & Tools that can be used:

Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.

Professionally Used Software: GCC compiler.

Project work/Assignment:

1. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using Java.**

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015
T2. Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer",* APress, 2018

References:

R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020.
R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials",* Packt Publishing, 2016
R3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development.";* Wiley; 2014.
R4. Greg Sidelnikov, *"React.js Book_ Learning React JavaScript Library"*, 1 edition, Scratch-River Tigris LLC 2016
R5. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

Course Code: **CSE3151**	**Course Title:** **Java Full Stack Development**	**L- T-P- C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**Nil**		
Anti-requisites	**CSE3152 .NET Full Stack Development**		

Course Description	This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.			
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.			
Course Outcomes	**On successful completion of the course the students shall be able to:** **1] Practice the use of Java for full stack development [Application]** **2] Show web applications using Java EE. [Application]** **3] Solve simple applications using Java Persistence and Hibernate [Application]** **4] Apply concepts of Spring to develop a Full Stack application. [Application]** **5] Employ automation tools like Maven, Selenium for Full Stack development. [Application]**			
Course Content:				
Module 1	Introduction	Project	Programming	**03 Sessions**
Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.				
Module 2	Java EE Web Applications	Project	Programming	**05 Sessions**
Topics: Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App **Assignment:** Develop an application for managing HR policies of a department.				
Module 3	Java Persistence using JPA and Hibernate	Project	Programming	**06 Sessions**
Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) **Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society..				
Module 4	Spring Core	Project	Programming	**10 Sessions**
Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented				

Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development **Assignment:** Develop a software tool to do inventory management in a warehouse.				
Module 5	Automation tools	Project	Programming	**06 Sessions**
Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands **Assignment:** Illustrate the use of automation tools in the development of a small software project.				
Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.** **Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.**				
Project work/Assignment:				
1. **Problem Solving: Design of Algorithms and implementation of programs.** 2. **Programming: Implementation of given scenario using Java.**				
Text Book: T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015				
References R1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017. R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."*, Apress, 2015				

Course Code: **CSE3152**	**Course Title: .NET Full Stack Development**	**L-T- P- C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**Nil**		
Anti-requisites	**CSE3151 Java Full Stack Development**		
Course Description	This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.		

Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.			
Course Outcomes	**On successful completion of the course the students shall be able to:** **1] Practice the use of C# for developing a small application [Application]** **2] Show web applications using Entity Framework. [Application]** **3]Solve simple web applications that use SQL and ASP.NET [Application]** **4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]**			
Course Content:				
Module 1	C# Programming for Full Stack Development	Project	Programming	**10 Sessions**
Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework **Assignment:** Develop a small application for managing library using C#.				
Module 2	Entity Framework Core 2.0	Project	Programming	**06 Sessions**
Topics: Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET **Assignment:** Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project	Programming	**06 Sessions**
Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; **Assignment:** Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project	Programming	**08 Sessions**
Topics: Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application **Assignment:** Develop a software tool to do inventory management in a warehouse.				
Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**				

Professionally Used Software: Visual Studio
Project work/Assignment:
1. **Problem Solving: Design of Algorithms and implementation of programs.** 2. **Programming: Implementation of given scenario using .NET.**
Text Book: T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015 T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.
References R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021. R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017. R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018. R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017.

Course Code: **CSE3016**	**Course Title:CSE3016 Neural Networks and Fuzzy Logic** **Type of Course: Discipline Elective in AI & ML Basket** **Theory Course**	**L-T-P- C**	3-0	0	3
Version No.	1.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Neural Networks and Fuzzy Logic** and attain **Skill Development** through **Participative Learning** techniques.				

Course Outcomes	**On successful completion of this course the students shall be able to:** 2. Define the concept of Neural Networks. [Knowledge] 3. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge] 4. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 5. Demonstrate the Fuzzy logic concepts and its applications.[Application]			
Course Content:				
Module 1	**Introduction to Neural Network**	Quiz	Single Layer Perceptron	**9Classes**
Topics: Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks. Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.				
Module 2	**Multilayer Perceptron**	Quiz	Multilayer Perceptron	**10 Classes**
Topics: Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples. Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies. Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.				
Module 3	**Fuzzy Sets, Operations and Relations**	Quiz	Fuzzy Operations	**10Classes**
Topics: Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets. Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations. Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.				
Module 4	**Fuzzy Logic and Fuzzy Logic Controller**	Assignment	Developing Fuzzy Logic Controller	**10Classes**
Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions. Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.				
Targeted Application & Tools that can be used: 2. Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.) 3. Matlab (Neural Network Toolbox, Fuzzy Logic Toolbox)				
Project work/Assignment:				
Students will have to do group assignments for Modules 2 & 4. As a part of their assignments, they will have to implement the solution to particular problems.				

Textbook(s):

2. Haykin, Simon. "*Neural networks and learning machines"*, 3/E. Pearson Education India, 2011. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553
3. George J. Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic- Theory and Applications*", Prentice Hall of India, 2015.

https://www.worldcat.org/title/fuzzy-sets-and-fuzzy-logic-theory-and-applications/oclc/505215200

References:

2. Shivanandam, Deepa S, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html
3. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011.

https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374

4. Kumar S., "*Neural Networks - A Classroom Approach*", Tata McGraw Hill, 2nd Edition 2017.https://www.worldcat.org/title/neural-networks-a-classroom-approach/oclc/56955342
5. Fakhreddine O. Karray, and Clarence W. De Silva. "*Soft computing and intelligent systems design: theory, tools, and applications*". Pearson Education, 2009.

Weblinks

https://www.pearson.com/en-gb/search.html?q=Karray%20Soft-Computing-and-Intelligent-Systems-Design-Theory-Tools-and-Applications

Topics relevant to "Skill Development ": Assignment implementations in software, batch wise presentations are used for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: **CSE3087**	**Course Title: Applied Machine Learning** **Type of Course: 1] Program Core** **2] Laboratory integrated**	**L-T-P- C**	2 - 0	2	3
Version No.	1.0				
Course Pre-requisites	**CSE3001 Artificial Intelligence and Machine Learning**				
Anti-requisites	**NIL**				
Course Description	Machine Learning algorithms are the key to develop intelligent systems such as Apple's Siri, Google's self-driving cars etc. This course introduces the concepts of the core machine learning techniques such as Regression learning, Bayesian learning, Ensemble learning, Perceptron learning, Unsupervised learning, Competitive learning, learning from Gaussian mixture models and learning to detect outliers. Course lectures covers both the theoretical foundations as well as the essential algorithms for the various learning methods. Lab sessions complement the lectures and enable the students in developing intelligent systems for real life problems.				
Course Objectives	This course is designed to improve the learners 'EMPLOYABILITY SKILLS' by using EXPERIENTIAL LEARNING techniques. The supervised hands-on laboratory exercises, assessments and the group projects facilitate this learning process.				

Course Out Comes	On successful completion of the course the students shall be able to: 1] Apply advanced supervised machine learning methods for predictive modeling. [Application] 2] Produce machine learning models with better predictive performance using meta learning algorithms [Application] 3] Create predictive models using Perceptron learning algorithms[Application] 4] Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection[Application] 5] Implement machine learning based intelligent models using Python libraries. [Application]			
Course Content:				
Module 1	Supervised Learning	Assignment	Programming using Keras/Sklearn	**No. of Classes L – 7 P – 12**
Topics: An overview of Machine Learning(ML); ML workflow; types of ML; Types of features, Feature Engineering -Data Imputation Methods; Regression – introduction; simple linear regression, loss functions; Polynomial Regression; Logistic Regression; Softmax Regression with cross entropy as cost function**; Bayesian Learning** – Bayes Theorem, estimating conditional probabilities for categorical and continuous features, Naïve Bayes for supervised learning; Bayesian Belief networks; Support Vector Machines – soft margin and kernel tricks.				
Module 2	Ensemble Learning	Assignment	Programming using Keras/Sklearn	**No. of Classes L-3 P-4**
Topics: **Ensemble Learning** – using subset of instances – Bagging, Pasting, using subset of features –random patches and random subspaces method; Voting Classifier, Random Forest; Boosting – AdaBoost, Gradient Boosting, Extremely Randomized Trees, Stacking.				
Module 3	Perceptron Learning	Assignment /Quiz	Programming using Keras/Sklearn	**No. of Classes L-7 P -2**
Topics: **Perceptron Learning** – from biological to artificial neurons, Perceptrons, Linear Threshold Units, logical computations with Perceptrons, common activation functions – sigmoid, tanh, relu and softmax, common loss functions, multi-layer Perceptrons and the Backpropagation algorithm using Gradient Descent.				
Module 4	Unsupervised Learning	Assignment	Programming using Keras/Sklearn	**No. of Classes L-6 P -6**
Topics: **Unsupervised Learning** – simple k Means clustering- simple and mini-batch**;** updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhoutte coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) **Competitive Learning** - Clustering using Kohenen's Self Organising Maps (SOM), **Density Based Spatial Clustering – DBSCAN**; clustering using Gaussian Mixture Models (GMM) with EM algorithm ; Outlier Detection methods – **Isolation Forest, Local Outlier Factor(LOF)**				

List of Laboratory Tasks:

Experiment N0 1: Methods for handling missing values
Level 1: Given a data set from UCI repository, implement the different ways of handling missing values in it using Scikit-learn library of Python
Level 2: Implement one of these methods using a custom defined function in Python.

Experiment No. 2: Data Visualization
Level 1 Perform Exploratory Data Analysis for a given data set by creating Scatter Plot, Pair Plot, Count Plot using Matplotlib and Seaborn
Level 2 Create Heat Maps, WordCloud

Experiment No. 3: Regression learning
Level 1 Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the models parameters and the performance metrics. Plot the learning curves.
Level 2 Implement the polynomial regression algorithm. Compare the learning curves of Polynomial and Linear Regression.

Experiment No.4: Logistic regression
Level 1 Write custom code for generating the logistic/sigmoid plot for a given input
Level 2 Given a data set from UCI repository, implement the Logistic regression algorithm. Estimate the class probabilities for a given test data set. Plot and analyze the decision boundaries.

Experiment No.5: Bayesian Learning
Level 1 Given a data set from UCI repository, implement a classification model using the Bayesian algorithm

Experiment No.6: Support Vector Machine(SVM)
Level 1 Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.

Experiment No. 7: Ensemble Learning
Level 1 : Implement Ensemble Learning algorithms such as Bagging, Pasting and Out-of Bag Evaluation
Level 2 : Random Patches and Random Subspace Method

Experiment No. 8: Ensemble Learning
Level 1 : AdaBoost and Gradient Boosting, Stacking

Experiment No. 9: Perceptron Learning
Level 1 : Implement the Perceptron Classifier
Level 2 : – An Image Classifier Using the Sequential API of Keras

Experiment No. 10: Unsupervised Learning
Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhoutte Coefficient . Compare the inertia of both as k increases. Tuning the hyperparameter 'k' using GridSearchCV.
Level 2 : – Using clustering for Image segmentation and Preprocessing. Kmeans++
Experiment No. 11: Density Based Clustering
Level 1 Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.
Experiment No. 12: Outlier Detection
Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor

Targeted Application & Tools that can be used :

1. Execution of the ML algorithms will be done using the Google's cloud service namely "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
2. The data sets will be from the bench marking repositories such as UCI machine learning repository available at : https://archive.ics.uci.edu/ml/index.php
3. Laboratory tasks will be implemented using the libraries available in Python such as Scikit learn, matplotlib, seaborn, perceptron and the deep learning framework namely Keras.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Students can be assigned a mini project to develop a machine learning application for real-life problems in various domains such as health care, business intelligence, environmental modeling, etc.

Text Book

There are a number of useful textbooks for the course, but each cover only a part of the course syllabus. Following is an indicative list of textbooks.

1. Aurélien Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Oreilly, Second Edition, 2019.
2. Andreas C Muller, Sarah Guido, "Introduction to Machine Learning with Python :A Guide for Data Scientists", Oreilly, First Edition, 2018
3. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.

References In references apart from the books and web links, mention a few standards &Hand books relevant to the Laboratory tasks used by the professionals.

1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining"*,** Pearson Education, 2016.
2. **https://towardsdatascience.com/machine-learning/home**
3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/
4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Course Code: CSE 3014	**Course Title: FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING** **Type of Course: Theory Only Course**	**L-T- P- C**	3-0	0	3
Version No.	1.0				
Course Pre-requisites	[1] CSE 3001 – Artificial Intelligence and Machine Learning				
Anti-requisites	NIL				
Course Description	The purpose of this course is to introduce students to the science of natural language processing (NLP). NLP is the science of extracting information from unstructured text. It is basically how we can teach machines to understand human languages and extract meaning from text. In addition to regular theory, the course also involves: 1. Programming Assignments 2. Regular Quiz Tests (once a week and once after every module)				

Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Natural language Processing and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • **Understand** the fundamental concepts of Natural Language Processing. [Knowledge] • **Read** corpora and **train** models for different NLP tasks. [Application] • **Use** word embeddings for solving an NLP Application. [Application] • **Understand** sequence to sequence modeling as used in machine translation. [Application]			
Course Content:				
Module 1	**Introduction**	Quizzes		**7 Sessions**
Topics: Introduction. History. Text Analytics. Various tasks in NLP. Sentence boundary Detection. Edit distance. Introduction to word embeddings, PoS tagging, chunking, parsing, machine translation.				
Module 2	**Word and Text Representations**	Quizzes	Assignments	**8 Sessions**
Topics: Logistic Regression and Naïve Bayes classification. Vector semantics and embeddings. Neural Networks and Neural Language Models. Text representations and classification. Deep learning architectures for sequence processing (CNN and LSTM).				
Module 3	**PoS Tagging, NER Tagging and Parsing**	Quizzes	Assignments	**12 Sessions**
Topics: Part-of-Speech Tagging – using NLTK and spacy. Building a PoS Tagger using existing data and Hidden Markov Model. Named Entity Recognition. Relationship between NER tagging and PoS tagging. Constituency Parsing.				
Module 4	**NLP Applications**	Quizzes		**9 Sessions**
Topics: Lexical Resource Creation. Sentiment Analysis. Machine Translation. Word Sense Disambiguation and WordNet. Question Answering.				
Targeted Application & Tools that can be used: 1. **Python Libraries (Eg. NLTK, Spacy, etc.)** 2. **Java (Stanford CoreNLP)** 3. **Google Colab**				
Project work/Assignment:				
Assignment: Students will have to do group assignments for Modules 2 & 3. As a part of their assignments, they will have to implement the solution to particular problems.				
Text Book **T1**Daniel Jurafsky, and James Martin."*Speech and Language Processing*" (3rd edition draft, 2022)				
References				

R1Chris Manning and HinrichSchutze, "*Foundations of Statistical Natural Language Processing*", 1st Edition, MIT Press. 1999. **R2**PawanGoyal, "*Natural Language Processing*". NPTEL. **E-Book Link for R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBqAvLd1WscI0RqC/view** **Web resources:https://web.stanford.edu/~jurafsky/slp3/** **NPTEL Course: https://onlinecourses.nptel.ac.in/noc22_cs98/course**
Topics relevant to "SKILL DEVELOPMENT": Assignment implementations in software, batch wise presentations for developing Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3010	**Course Title: Deep Learning Techniques** **Type of Course: Program Core Theory**	**L-T- P-C**	3-0	0	3
Version No.	2.0				
Course Pre-requisites	Data Mining and Machine Learning fundamentals Basic working knowledge of Statistics and Probability Familiarity with programming languages and hands on coding				
Anti-requisites	NIL				
Course Description	The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Deep Learning Techniques and attain Skill Development through Participative Learning techniques.				
Course Out Comes	On successful completion of the course the students shall be able to: Apply basic concepts of Deep Learning to develop feed forward models(Knowledge)				

	Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks(Comprehension) Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. (Comprehension) Analyze performance of implemented Deep Neural models(Application)			
Course Content:				
Module 1	Introduction to Deep Learning	Assignment	Programming	**10 Sessions**
Topics: Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, , Perceptron, MLP Structures, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks, Building your Deep Neural Network: Step by Step.				
Module 2	Improving Deep Neural Networks	Assignment	Programming	**8 Sessions**
Topics: Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization, Artificial Neural network.				
Module 3	Deep Supervised Learning Models	Assignment	Programming	**10 Sessions**
Topics: Convolutional neural network, Deep learning in Sequential Data, RNN & LSTM, GRU, Deep Models in Pattern Recognition.				
Module 4	Deep Unsupervised Learning	Assignment	Programming	**10 Sessions**
Topics: Basics of Deep unsupervised learning, Auto encoders, Boltzman Machine, Restricted Boltzmann Machine, Kohonen Networks, Deep Belief Network, Hopfield Network,Generative Adversarial Networks, Probabilistic Neural Network.				
Targeted Application & Tools that can be used: **Google collab** **Professionally used software** : Anaconda, Spider.				
Text Book **T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017**				
References **R 1.** Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013 R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015 R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013 R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008. Weblinks: W1: pu.informatics.global, **https://sm-nitk.vlabs.ac.in/**				
Topics relevant to "SKILL DEVELOPMENT": Real time Data Analysis using Deep learning. Naming and coding convention for Data Science Project Development using ML/DL for Skill				

Development through Participative Learning techniques. This is attained through the **Presentation** as mentioned in the assessment component.

Course Code: **CSE465**	**Course Title: Reinforcement Learning** **Type of Course: Theory Only**	**L-T- P-C**	3-0	0	3
Version No.	1.0				
Course Pre-requisites	• Knowledge of programming in Python is required. • Knowledge of probabilities/statistics, calculus and linear algebra is required. • Machine learning background, as provided for example by COMP-551 or COMP-652 is required.				
Anti-requisites	NIL				
Course Description	The goal of this class is to provide an introduction to reinforcement learning, a very active research sub-field of machine learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as power plant optimization or dynamical system control, to game playing, inventory control, and many other fields. Notably, reinforcement learning has also produced very compelling models of animal and human learning. During this course, we will study theoretical properties and practical applications of reinforcement learning. We will follow the second edition of the classic textbook by Sutton & Barto (available online for free, or from MIT Press), and supplement it as needed with papers and other materials.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Reinforcement Learning** and attain **Skill Development** through **Problem Solving** Methodologies.				
Course Out Comes	On successful completion of the course the students shall be able to: Knowledge of basic and advanced reinforcement learning techniques. Identification of suitable learning tasks to which these learning techniques can be applied. Appreciation of some of the current limitations of reinforcement learning techniques.				

	Formulation of decision problems, set up and run computational experiments, evaluation of results from experiments.			
Course Content:				
Module 1	Introduction	Assignment	Programming	**No. of Classes:10**
Topics: Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. **Probability Primer** Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.				
Module 2	Markov Decision Process	Assignment	Programming	**No. of Classes:10**
Topics: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.				
Module 3	Prediction and Control by Dynamic Programing	Assignment	Programming	**No. of Classes:10**
Topics: Overview of dynamic programing for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions **Monte Carlo Methods for Model Free Prediction and Control** Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.				
Module 4	TD Methods and Policy Gradients	Assignment	Programming	**No. of Classes:10**
Topics: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants. Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.				
Targeted Application & Tools that can be used: While Convolution Neural Network (CNN) and Recurrent Neural Network (RNN) are becoming more important for businesses due to their applications in Computer Vision (CV) and Natural Language Processing (NLP), Reinforcement Learning (RL) as a framework for computational neuroscience to model decision making process seems to be undervalued. Besides, there seems to be very little resources detailing how RL is applied in different industries. Despite the criticisms about RL's weaknesses, RL should never be neglected in the space of corporate research given its huge potentials in assisting decision making. **Tools**: Torch, Google Colaboratory, Spider, Jupiter Notebook				
Project work/Assignment:				
This part is written for general readers. At the same time, it will be of greater value for readers with some knowledge about RL. • **Resources management in computer clusters**				

Designing algorithms to allocate limited resources to different tasks is challenging and requires human-generated heuristics. The paper "Resource Management with Deep Reinforcement Learning" [2] showed how to use RL to automatically learn to allocate and schedule computer resources to waiting jobs, with the objective to minimize the average job slowdown.
State space was formulated as the current resources allocation and the resources profile of jobs. For action space, they used a trick to allow the agent to choose more than one action at each time step. Reward was the sum of (-1/duration of the job) over all the jobs in the system. Then they combined REINFORCE algorithm and baseline value to calculate the policy gradients and find the best policy parameters that give the probability distribution of actions to minimize the objective.

- **Traffic Light Control**

Researchers tried to design a traffic light controller to solve the congestion problem. Tested only on simulated environment though, their methods showed superior results than traditional methods and shed a light on the potential uses of multi-agent RL in designing traffic system.
Five agents were put in the five-intersection traffic network, with a RL agent at the central intersection to control traffic signalling. The state was defined as eight-dimensional vector with each element representing the relative traffic flow of each lane. Eight choices were available to the agent, each representing a phase combination, and the reward function was defined as reduction in delay compared with previous time step. The authors used DQN to learn the Q value of the {state, action} pairs.

- **Robotics**

There are tremendous works on applying RL in Robotics. Readers are referred to for a survey of RL in Robotics. In particular, trained a robot to learn policies to map raw video images to robot's actions. The RGB images were fed to a CNN and outputs were the motor torques. The RL component was the guided policy search to generate training data that came from its own state distribution.

- **Web System Configuration**

There are more than 100 configurable parameters in a web system and the process of tuning the parameters requires a skilled operator and numerous trail-and-error tests. The paper "A Reinforcement Learning Approach to Online Web System Auto-configuration" showed the first attempt in the domain on how to do autonomic reconfiguration of parameters in multi-tier web systems in VM-based dynamic environments.
The reconfiguration process can be formulated as a finite MDP. The state space was the system configuration, action space was {increase, decrease, keep} for each parameter, and reward was defined as the difference between the given targeted response time and measured response time. The authors used the model-free Q-learning algorithm to do the task.

Text Book

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition
2. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia
3. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy

References

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019.
2. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012):

E-Resources

NPTEL course – https://onlinecourses.nptel.ac.in/noc19_cs55/preview
https://archive.nptel.ac.in/courses/106/106/106106143/
https://www.digimat.in/nptel/courses/video/106106143/L35.html

Topics relevant to "SKILL DEVELOPMENT": Real time Data Analysis using Reinforcement learning **for Skill Development through Problem Solving techniques. This is attained through assessment component mentioned in course handout.**

Course Code: **CSE3208**	**Course Title: Artificial Intelligence in Practice** **Type of Course: 1] Discipline Elective** **2] Laboratory integrated**	**L- T- P- C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	**CSE3001 Artificial Intelligence and Machine Learning**					
Anti-requisites	**NIL**					

<table>
<tr><td>Course Description</td><td colspan="4">This course covers some of the applications in artificial intelligence, such as logic, searching, adversarial search, constraint satisfaction, Bayesian networks, etc.

Topic include: AI methodology, Logic in AI, Resolution Principle, Graphical Search techniques, Adversarial Search techniques, Game playing, Uncertainty and Probability, Reasoning in AI, and Sequence Labeling.</td></tr>
<tr><td>Course Objectives</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence in Practice and attain SKILL DEVELOPMENT through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:

1] Explain different methods of searching, proving, and analysis in AI. [Comprehension]

2] Prove, by resolution, different situations in First Order Logic. [Application]

3] Implement various graphical and adversarial search algorithms [Application]

4] Solve sequence labeling problems using HMM. [Application]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Search Methods for Problem Solving</td><td>Assignment</td><td>Python Programming</td><td>No. of Classes L – 12 P – 16</td></tr>
<tr><td colspan="5">Topics: Introduction to Problem space and state space. State space search techniques. Solving Problems by Searching – Uninformed Search, Informed Search and Adversarial Search. Uninformed Search Techniques – Breadth-First Search, Depth-First Search, and Uniform Cost Search. Dijkstra’s Single-Source Shortest Path. Applications of uninformed search. Informed Search Techniques – Greedy Best-First Search. A* Search. Adversarial Search – Game Playing, Minimax Search, Alpha-Beta Pruning, Ideal Ordering. Extensions of adversarial search – Expectiminimax, and MaxN. Constraint Satisfaction Problems – Constraints. Definition of a CSP. Examples of Constraint Satisfaction Problems. Arc consistency. Problem structure and problem decomposition. Backtracking. Backtracking heuristics. Local search. Timetable scheduling as a real-world example.</td></tr>
<tr><td>Module 2</td><td>Knowledge-Based Logic Representation</td><td>Assignment</td><td>Python Programming</td><td>No. of Classes L-8 P-4</td></tr>
<tr><td colspan="5">Topics: Representation, Reasoning, and Logic. Prepositional Logic. First-Order Logic. Syntax and Semantics. Inference Rules. Propositional and First-Order Resolution. Applications for solving story problems using Resolution.</td></tr>
<tr><td>Module 3</td><td>Uncertainty in AI</td><td>Assignment /Quiz</td><td>Programming using Keras/Sklearn</td><td>No. of Classes L-10 P -10</td></tr>
</table>

Topics: Uncertainty in AI. Revision of Probability Basics and Bayes Theorem. Bayesian Networks. Hidden Markov Models. Sub-problems in HMM and their solutions – Forward probability and Viterbi Algorithm. Case study of sequence labeling using HMM for part-of-speech tagging and named entity recognition.

List of Laboratory Tasks:

Experiment No. 1: Python File Handling
Level 1: Read a text file in Python
Level 2: Parse a text file in Python

Experiment No. 2: Implementation of Graph Algorithms
Level 1 Implement graph algorithms by taking input from the console
Level 2 Implement graph algorithms by reading files.

Experiment No. 3: Implementation of Uninformed Search Algorithms
Level 1 Implement BFS and DFS on unweighted graphs
Level 2 Implement BFS and DFS on weighted graphs

Experiment No. 4: Implementation of Heuristic Search Algorithms
Level 1 Implement Greedy Best-First Search
Level 2 Implement A* Search

Experiment No. 5: Implementation of Adversarial Search
Level 1 Implement a Game Tree
Level 2 Implement a Alpha-Beta Pruning

Experiment No. 6: Implementation of a CSP Solver
Level 1 Implement a CSP solver for solving a cryptarithmetic problem.
Level 2 Implement a CSP solver for solving map colouring problem.

Experiment No. 7: Using Python Packages for CSPs
Level 1 Implement a CSP solver using Python Constraints package.
Level 2 Implement a Sudoku solver using Python Constraints package.

Experiment No. 8: Implement a Decision Maker
Level 1 Implement a Minesweeper Solver
Level 2 Implement a Battleship Solver

Experiment No. 9: Implement a Hidden Markov Model
Level 1 Implement a generic HMM
Level 2 Calculate the forward probability of a sequence

Experiment No. 10: Implement a Hidden Markov Model for Part-of-Speech Tagging
Level 1 Implement a HMM for solving part-of-speech tagging
Level 2 Use a part-of-speech tagger from Python's NLTK

Targeted Application & Tools that can be used :

1. Google Colab or any other Python IDE.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Students will have to do NPTEL assignments for any one of the AI-related courses as given by the Instructor-in-Charge for the semester. Some of the relevant courses are given below.

Text Books

1. Stuart Russel and Peter Norvig. *Artificial Intelligence: A Modern Approach*. 4th Edition. Pearson Education. 2022.
2. Lavika Goel. *Artificial Intelligence: Concepts and Applications*. 1st Edition. Wiley. 2021.
3. Prateek Joshi and Alberto Artasanchez. *Artificial Intelligence with Python*. 2nd Edition. Packt. 2020.
4. Arnaldo Perez Castano. *Practical Artificial Intelligence*. 1st Edition. Apress. 2018.
5. Elaine Rich, Kevin Knight and Shivashankar B Nair. *Artificial Intelligence*. 4th Edition. MedTech Science Press. 2024.
6. Mark Watson. *Practical Artificial Intelligence Programming with Java*. 6th Edition. Lean-pub. 2023.

References

1. Deepak Khemani. *A First Course in Artificial Intelligence*. 1st Edition. 6th Reprint, 2018.

2. Munesh Chandra Trivedi. *A Classical Approach to Artificial Intelligence*. 2nd Edition. Khanna Publishers. 2018.

3. George Luger. *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*. 6th Edition. Pearson Education. 2021.

Other E-Resources (NPTEL and other video links):

1. Mausam (IIT Delhi), "An Introduction to Artificial Intelligence".
   Link: https://nptel.ac.in/courses/106102220.
2. Shyamanta M. Hazarika (IIT Guwahati), "Fundamentals of Artificial Intelligence".
   Link: https://nptel.ac.in/courses/112103280.
3. Deepak Khemani (IIT Madras), "Artificial Intelligence: Search Methods for Problem-Solving".
   Link: https://nptel.ac.in/courses/106106226.
4. Deepak Khemani (IIT Madras), "Artificial Intelligence: Knowledge Representation and Reasoning".
   Link: https://nptel.ac.in/courses/106106140.
5. Deepak Khemani (IIT Madras), "AI: Constraint Satisfaction".
   Link: https://nptel.ac.in/courses/106106158.
6. IJCAI 2020 Talk by Eugene Freuder.
   Link: https://ijcai20.org/excellence-research-award-session/.

Course Code: CSE 3012	**Course Title: Time Series Analysis** **Type of Course: Laboratory Integrated**	**L-T- P-C**	2 - 0	2	3
Version No.	1				

Course Pre-requisites	CSE 3001 Artificial Intelligence and Machine Learning
Anti-requisites	--
Course Description	The course will provide a basic introduction to modern time series analysis. This course teaches time-series analysis and the methods used to predict, process, and recognize sequential data. The objective of the course is to give students a better understanding of the concepts and the tools in time series analysis. The course develops a comprehensive set of tools and techniques for analyzing various forms of time series and for understanding the current literature in applied time series econometrics. This course covers time series regression and exploratory data analysis, ARMA/ARIMA models, model identification/estimation/linear operators, Fourier analysis, spectral estimation, and state space models.
Course Objective	This course is designed to improve the learners "EMPLOYIBILITY SKILLS" by using EXPERIENTIAL LEARNING techniques. Lecturers on the Time Series Analysis facilitates the Peer Learning and group projects on real time applications.
Course Out Comes	**On successful completion of the course the students shall be able to:** Understand basic concepts in time series analysis and forecasting. [Understand] Understand the use of time series models for forecasting and the limitations of the methods. [Understand] Develop time series regression models. [Application] Compare with multivariate times series and other applications. [Comprehension]
Course Content:	

Module 1	INTRODUCTION OF TIMESERIES ANALYSIS	Assignment	Data Collection/Interpretation	**L[6] +P[2] Sessions**

Topics:
Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting.

Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

Module 2	TIME SERIES REGRESSION MODEL	Assignment/Quiz	Case studies	**L[6] +P[3] Sessions**

Topics:
Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.

Module 3	AUTOREGRESSIVE INTEGRATED MOVING	Quiz	Case studies	**L[10] +P[2] Sessions**

	AVERAGE (ARIMA) MODELS			

Topics:
Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the "BEST" Model - Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models .

Module 4	MULTIVARIATE TIME SERIES MODELS AND FORECASTING	Assignment	Case studies	**L[8] +P[1] Sessions**

Topics:
Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting.

List of Laboratory Tasks:

1. Loading, Preprocessing and Handling Time series data.
2. Fitting and plotting by Modified Exponential Curve.
3. Estimating and eliminating trend using Aggregation, Smoothing and Polynomial Fitting.
4. Eliminating Trend and Seasonality via Differencing and Decomposition.
5. Fitting of Trend using Moving Average Method.
6. Forecasting by Exponential Smoothing, ARIMA.
7. Forecasting by Seasonal autoregressive integrated moving average model (SARIMA).
8. Develop Time series model using Multivariate Analysis models via Canonical Correlation
9. Develop Time series model using Multivariate Analysis models via Structural Equation Modeling.
10. Develop Time series model using Inter Dependence Techniques via Factor Analysis.
11. Develop Time series model using Inter Dependence Techniques via Cluster Analysis.

Targeted Application & Tools that can be used

Target Applications:

- HealthCare Industries.
- Manufacturing Industries.
- Cyber Security.
- Smart Intelligent systems.

Tools:

- Python
- R
- MATLAB
- XLSTAT
- Tableau
- Qlik Sense

Project work/Assignment:

Assignment:

- Predicting changes in the thickness of Ozone layer based on its time-series data from 1926 – 2016.
- Examine the South African GDP on a period from 1960 to 2016. Our data contains 226 observations and has been obtained from OECD Statistics.
- Developing an ARIMA model to forecast the monthly Australian gas production level for the next 12 months.

Text Book

T1 Douglas C. Montgomery, Cheryl L. Jen , Introduction To Time Series Analysis And Forecasting,
4th Edition, Wiley Series In Probability And Statistics, 2019.
https://b-ok.cc/book/2542456/2fa941

T2 Dr. Avishek Pal , Dr. Pks Prakash , Master Time Series Data Processing, Visualization, And
Modeling Using Python, 2019.
https://b-ok.cc/book/3413340/2eb247

T3 John Wiley & Sons , Time Series Analysis And Forecasting By Example ,Technical University Of
Denmark, 2021.
https://b-ok.cc/book/1183901/9be7ed

References

R1 Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).

R2 Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical
Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons
Ltd.

R3 Time Series Analysis by James D Hamilton Copyright © 2020 by prince town university press.

E book link R1: https://b-ok.cc/book/2802612/149485

E book link R2: https://b-ok.cc/book/3704316/872fbf

E book link R3: https://b-ok.cc/book/3685042/275c71

Web resources:

1. https://www.coursera.org/learn/practical-time-series-analysis
2. https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/
3. https://swayam.gov.in/nd1_noc19_mg46/preview

Topics relevant to development of "Skill Development":

Systematic variation in time series data
Autoregressive Models
Exponential smoothing models or esms
Generating forecasts on time series

Topics relevant to development of "Employability Skills"

Time series analysis to Monitor and access water resources.
Remote Sensing time series analysis for Crop Monitoring.
Satellite Image Time series Analysis.
Waste Monitoring and Analysis.

Course Code: CSE 3015	Course Title: ADVANCED NATURAL LANGUAGE PROCESSING Type of Course: Integrated	L- T-P-C	2 -0	2	3
Version No.	1.0				
Course Pre-requisites	CSE 3014 – Fundamentals of Natural Language Processing				
Anti-requisites					
Course Description	This course is an advanced course for Natural Language Processing. As a part of the course, students will be introduced to solving multiple problems in natural language processing, such as sentiment analysis, machine translation, cognitive natural language processing, etc. Topics include: Machine translation, Text summarization, Sentiment analysis, Cognitive NLP, Gaze behaviour, Evaluation Metrics, etc.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced Natural Language Processingand attain Employability through Experiential Learning techniques.				
Course Out Comes	On successful completion of the course the students shall be able to: Understand how to solve different problems in natural language processing. [Comprehension] Solve natural language generation problems such as machine translation and text summarization. [Application] Perform sentiment analysis on reviews to discern the stance of the writer. [Application] Use public gaze behaviour data to improve the performance of different NLP systems. [Application]				
Course Content:					
Module 1	Pre-trained Language Models			4 Sessions	
Topics: Introduction to Pre-Trained Language Models. BERT. Multi-lingual variants of BERT. Introduction to NLTK and Huggingface Transformers.					
Module 2	Machine Translation and Text Summarization			7 Sessions	
Topics: Introduction to machine translation – source and target languages. Pivot-based machine translation. Using Transformers for machine translation. Monolingual machine translation examples. Machine translation evaluation metrics – BLEU. Implementation of BLEU score calculation using NLTK in Python. Other MT metrics – METEOR, TER, etc. Text summarization –					

definition. Types of summarizations – Extractive and Abstractive Summarization. Summarization evaluation metrics – ROUGE score.				
Module 3	Sentiment Analysis			6 Sessions
Topics: Introduction to Sentiment Analysis. Solving sentiment analysis using text classification. Classification of sentiment analysis based on different levels – polarity-based and intensity-based. Challenges in sentiment analysis – sarcasm, thwarting, negations. Case studies in sentiment analysis – Reviewer rating prediction, short-text classifications, etc.				
Module 4	Cognitive NLP Using Gaze Behaviour			7 Sessions
Topics: Eye-Mind Hypothesis and gaze behaviour terminology. Using gaze behaviour for prediction of translation complexity, sentiment analysis complexity, sarcasm understandability, text complexity, text quality prediction, etc. Challenges with recording gaze behaviour at run time. Comparison of gaze behaviour across different people – normalization and binning. Gaze behaviour datasets. Mitigation of recording gaze behaviour at run time using type aggregation.				
List of Laboratory Tasks: Familiarization with Python. Using Python to read text files, basic tokenization and other preprocessing. Introduction to NLTK and Huggingface Transformers in Python. Using Huggingface Transformers to create a simple MT application. Implementation of pivot-based machine translation using Huggingface Transformers. Calculation of BLEU using NLTK – difference between sentence_bleu and corpus_bleu methods. Implementation of extractive summarization. Polarity classification of text using VADER. Intensity prediction of text using Weighted Normalized Polarity Intensity. Estimating gaze behaviour for a user using normalization and binning Calculating gaze behaviour for a text based on type aggregation in multiple languages. Complex word identification using gaze behaviour.				
Targeted Application & Tools that can be used: Google Colab Python IDE (Eg. PyCharm) Huggingface Transformers NLTK				

Project work/Assignment:
Assignment: Students will have to do a course group assignment over the course of the semester. The assignment topics can be taken from Modules 2 or 3 as per the instructor-in-charge.
Text Books T1 Daniel Jurafsky, and James Martin. “Speech and Language Processing” (3rd edition draft, 2022). T2 Abhijit Mishra, and Pushpak Bhattacharyya. “Cognitively Inspired Natural Language Processing: An Investigation Based on Eye Tracking”. Springer, Singapore. 2018.
References R1 Steven Bird, Ewan Klein, and Edward Loper. “Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit”. O’Reilly Publishers. 2009. R2 Chris Manning, and Heinrich Schutze. “Foundations of Statistical Natural Language Processing”. MIT Press. 1999. E book link R1: https://www.nltk.org/book/ E book link R2: https://nlp.stanford.edu/fsnlp/ R3 Web resources: http://pu.informatics.global
Topics relevant to “EMPLOYABILITY SKILLS”: Calculation of BLEU and ROUGE scores using NLTK , Estimating gaze behaviour through type aggregation, Using Hugging face Transformers for machine translation for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3108	**Course Title: Expert Systems** **Course type : Theory Only**	**L-T-P- C**	**3** -0	**0**	**3**
Version No.	1.0				
Course Pre-requisites	**“CSE 3108 – Expert systems” course**				
Anti-requisites	**NIL**				

Course Description	The purpose of this course is to present the concepts of intelligent agents, searching, knowledge and reasoning, planning, learning and expert systems, to study the idea of intelligent agents and search methods, to study about representing knowledge, to study the reasoning and decision making in uncertain world, to construct plans and methods for generating knowledge, to study the concepts of expert systems.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Expert Systems and attain **Employability** through **Participative Learning** techniques .			
Course Out Comes	On successful completion of this course the students shall be able to: 1. CO1: Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions. 2. CO2: Demonstrate awareness of informed search and exploration methods. 3. CO3: Explain about AI techniques for knowledge representation, planning and uncertainty Management. 4. CO4: Develop knowledge of decision making and learning methods.			
Course Content:				
Module 1	Introduction	Assignment	Theory	**9 Hours**
Topics: **Introduction to AI:** Intelligent agents – Perception – **Natural language processing** – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.				
Module 2	Knowledge and Reasoning	Assignment	Theory	**9 Hours**
Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – **Logical agents:** Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.				
Module 3	Uncertain knowledge and Reasoning	Assignment	Theory	**8 Hours**
Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – **Probabilistic reasoning** – Making simple decisions.				
Module 4	Planning and Learning	Assignment	Theory	**9 Hours**
Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – **Learning:** Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.				

Module 5 Expert Systems	Assignment 10hrs	Theory	
Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.			
Targeted Application & Tools that can be used:			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
Text Book 1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education, 2003 / PHI. 2. 2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.			
References 1. 1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002. 2. 2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995. 3. 3. Janakiraman, K.Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science. 4. 4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.			
Links : **pu.informatics.global, https://sm-nitk.vlabs.ac.in/**			
Topics relevant to "EMPLOYABILITY SKILLS": Optimal and imperfect decisions, Logical agents, for developing Employability Skills through Participative Learning Techniques. This is attained through Review of digital/e resource as mentioned in course handout.			

Course Code: CSE3017	**Course Title: Autonomous Navigation and Vehicles** **Type of Course : Theory**	**L-T- P-C**	3 - 0	0	3
Version No.	1.1				
Course Pre-requisites	• Real-time embedded programming • Optimal estimation and control • Linear algebra				
Anti-requisites	NIL				
Course Description	Overview of technologies vehicles including sensors, sensing algorithms, machine learning, localization, mapping, object detection, tracking, communication and security. Hands-on implementation of robotic sensing and navigation algorithms on both simulated and physical mobile platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for vision-based navigation of autonomous vehicles (e.g., mobile robots, self-driving cars, drones). It culminates in a critical review of recent advances in the field and a team project aimed at advancing the state-of-the-art.				

	Topics include: Autonomous driving technologies overview, Object Recognition and Tracking, Localization with GNSS, Visual Odometry, Perceptions In Autonomous driving, Deep learning in Autonomous Driving Perception, Prediction and Routing, Decision planning and control
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Understand the Autonomous system's and its requirements. Explain algorithm, sensing, object recognition and tracking of an Autonomous system. [Understand] 2. Do the error analysis of Localization systems and use the tools and techniques,[Analyze] 3. Explain, plan and control the traffic behavior, and shall be able to do lane level routing and create simple algorithms. [Application] 4. Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform.[Application]
Course Content:	

Module 1	**12 Sessions**
Introduction to autonomous driving: Autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception. Object Recognition and Tracking: Autonomous driving client system, driving cloud platform, Robot Operating System, HD Map Production, Deep learning Model Training, Localization with GNSS: GNSS overview, GNSS error analysis, satellite based augmentation systems, real time kinematic and differential GPS, precise point positioning, Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry.	
Module 2	**8 Sessions**
Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Sterio, Optical flow and Scene flow. **Deep learning in Autonomous Driving Perception:** Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow.	
Module 3	**10 Sessions**
Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost.	
Module 4	**08 Sessions**
Decision planning and control: Behavioral decisions, Motion planning, Feedback control Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating systems and computing platform Cloud platform for Autonomous driving: Introduction, infrastructure, simulation.	
Targeted Application & Tools that can be used: **Applications:** Obstacle Avoidance, Path Planning, Autonomous Vehicles. **Tools: MIDGUARD** A Simulation platform for Autonomous Vehicle navigation.	
Project Work/Assignment: 1. Develop a system that avoids obstacles in the path. 2. To develop a cloud based autonomous navigation, what are the parameters should be considered, draw a framework for the navigation system.	
Text Book	

T1: Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 2nd Edition, 2019 **T2:** Ronald K. Jurgen Autonomous Vehicles for Safer Driving SAE International Edition , 2019
References R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 1st Edition, 2016 R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 1st Edition, 2016 R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 1st Edition, 2018 **Web Resources:** http://pu.informatics.global
Topics relevant to development of "Employability": Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

Course Code: UG COURSE: **CSE3018**	Course Title: Digital Health and Imaging Type of Course: Discipline elective Theory	L-T-P-C	3 -0	0	3
Version No.	1.0				
Course Pre-requisites	MAT1003 Applied Statistics CSE3081 Digital image processing				
Anti-requisites	NIL				
Course Description	Digital health and Imaging course it focuses on the intersection of healthcare, technology, and medical imaging. This course provides an in-depth understanding of how digital technologies are transforming the field of healthcare, particularly in the areas of medical imaging, diagnostics, and patient care.				
Course Out Comes	Upon successful completion of the Machine Vision course, students can expect to achieve the following outcomes: 1. Understand the Role of Digital Health: Explain the concept and significance of digital health in modern healthcare. Understand how digital technologies are transforming healthcare delivery, patient care, and healthcare management. **[Knowledge]** 2. Describe Medical Imaging Modalities: Identify and describe various medical imaging modalities, such as X-ray, CT scan, MRI, ultrasound, and nuclear medicine. Understand the principles, advantages, limitations, and clinical applications of each imaging modality. **[Comprehension]** **3.** Apply Digital Imaging processing Techniques on Medical images **[Application]**				

	4. Application of Image processing in diagnosis of diseases using medical images from various medical imaging modalities. **[Application]**			
Course Content:				
Module 1	Introduction to Digital Health	Assignment	Practical	No. of Classes:8
Overview of digital health and its impact on healthcare, Introduction to telemedicine, wearables, and health monitoring devices, Ethical and legal considerations in digital health.				
Module 2	Medical Imaging Modalities	Assignment	Practical	No. of Classes:10
Principles and applications of various medical imaging modalities, X-ray imaging, computed tomography (CT), and magnetic resonance imaging (MRI),Ultrasound imaging and nuclear medicine imaging, Imaging modalities for specific healthcare domains (e.g., radiology, cardiology).				
Module 3	Digital Image Processing Fundamentals	Assignment	Practical	No. of Classes:14
Digital image representation and properties, Image enhancement techniques, Image filtering and restoration, Image segmentation and feature extraction.				
Module 4	Image Analysis in Healthcare	Assignment	Practical	No. of Classes:10
Image registration and fusion techniques, Quantitative image analysis for disease diagnosis and treatment planning, Computer-aided detection and diagnosis in medical imaging, Machine learning in medical image analysis				
Group Project: 1. OCT image dataset of retina, Retinal layer segmentation using CNN models. 2. MRI image dataset of Brain, Tumor detection and classification. 3. Fundus image dataset of eye, Blood vessel segmentation. 4. EEG Data analysis. 5. ECG Data analysis. 6. CT Data set of Chest to detect COPD (Chronic pulmonary obstructive disease).				
Tools/Software Required : 1. OpenCV 4				

2. Python 3.7
3. MATLAB

Text Books

1. "Biomedical Signal and Image Processing with Artificial Intelligence" by Chirag Paunwala, Mita Paunwala, Rahul Kher (2023)
2. "Biomedical Signal and Image Processing" by Kayvan Najarian and Robert Splinter 2nd edition(2012)

References

1. "Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods 4th edition (2018).
3. "Digital Health: Scaling Healthcare to the World" by Paul Sonnier 2nd edition (2018)

Course Code: CSE3019	Course Title: Stochastic Decision making Type of Course: Theory	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	A course in Statistics: STAT-UB 1 or STAT-UB 3 or STAT-UB 103. Basic familiarity with Microsoft Excel: developing and copying formulas with relative and absolute cell addresses, and using the function and chart wizards.					
Anti-requisites						
Course Description	This course introduces the basic concepts, principles, and techniques of decision making under uncertainty. Students will learn how to model complex business problems that involve risk and uncertainty with the help of spreadsheet models. The course covers analytical models such as Decision Tree, Stochastic Optimization, Simulation & Optimization, and Dynamic Optimization. The course is hands-on. The emphasis will be on model formulation and interpretation of results, not on mathematical theory. This course emphasizes optimization models with uncertain parameter values. In contrast, the DMA course focuses on various deterministic optimization models and Monte Carlo simulation.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Stochastic Decision making and attain Employability through Participative Learning techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: Gain basic knowledge about stochastic processes in the time domain. The student has acquired more detailed knowledge about Markov processes with a discrete state space, including Markov chains, Poisson processes and birth and death processes. Know about queueing systems and Brownian motion, in addition to mastering the fundamental principles of simulation of stochastic processes and the construction of Markov chain Monte Carlo (MCMC) algorithms. formulate simple stochastic process models in the time domain and provide qualitative and quantitative analyses of such models.			
Course Content:	Use data to model currency exchange rates, stock prices, commodity prices, air travelDemand; Brief introduction to Monte Carlo simulation; Optimal financial hedging strategies; Supply contract selection; Airline booking control. Introduction to decision tree; Value of information; Bayesian updateValue an R&D project: managing technology risk; Value a license agreement; Options to postpone, expand, and contract.			
Module 1	Simple static stochastic optimization models	Assignment	Simulation/Data Analysis	14 Sessions
Use data to model currency exchange rates, stock prices, commodity prices, air travelDemand; Brief introduction to Monte Carlo simulation; Optimal financial hedging strategies; Supply contract selection; Airline booking control. Introduction to decision tree; Value of information; Bayesian updateValue an R&D project: managing technology risk; Value a license agreement; Options to postpone, expand, and contract.				
Module 2	sequential decision making: decision tree	Assignment	Simulation/Data Analysis	14 Sessions

Introduction to dynamic programming; Binomial tree; American option pricing; Targeted marketingInventory management at a retail pharmacy; Optimal timing for market entry; Cash management at a retail bank.Moving average; Trends; Seasonality .Introduction to linear programming; Production planning with forecasted demand; Airline revenue management				
Module 3	Real options and decision tree	Term paper/Assignment	Simulation/Data Analysis	14 Sessions
Capital budgeting: when projects have uncertain NPVs and uncertain capital usage; Production strategy: managing quality risk of raw materials; Value-at-risk Plant location for a multinational firm: hedging currency exchange risk; Process flexibility: hedging demand risk.Inventory transshipment: managing demand risk; Capacity planning for an electric utility.				
List of Laboratory Tasks				
Targeted Application & Tools that can be used: The course is theory based and students will get hands on experience in statistical tools.				
Assignment:				
Text Book J Medhi, "Stochastic Processes"				
References A K Basu, "Introduction to Stochastic process" Ming Liao, "Applied Stochastic Process" Time A Wheeler, Kyle H.Wray, "Algorithms for Decision making" E-Resources https://presiuniv.knimbus.com/user#/home				
Topics relevant to the "EMPLOYABILITY SKILLS": Combing simulation with linear optimazation, for development of Employability skills through Participative Learning Techniques. This is attained through the assessment components mentioned in the course handout.				

Course Code: CSE3103	Course Title: Cognitive Science & Analytics Type of Course : Theory	L- T- P- C	3 -0	0	3
Version No.	1.1				
Course Pre-requisites	CSE3008: Machine Learning Techniques				
Anti-requisites	NIL				
Course Description	Overview of biological structure and artificial network, sensing algorithms, machine learning, localization. Hands-on implementation of cognitive recognition algorithms on both simulated and physical platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for cognitive analysis. It culminates in a critical review of recent advances in the field and a team project aimed at advancing the Reasoning.				
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.				
Course Out Comes	On successful completion of the course the students shall be able to: Understand the different neural network models. [Understand] Understand cognition systems and its requirements. [Understand] Apply dynamic System concepts in Cognitive Science and Neuroeconomics. [Application] Apply Cognitive Science in Learning and Reasoning. [Application]				
Course Content:					
Module 1					8 Sessions
Introduction to Biological Neuron: Structure of Neuron, Action Potential, Process of Action Potential, Process of Synaptic Transmission, Stimulate the synaptic vesicle, Depolarization of the neuron, Memory (Biological Basis): Theories of Memory Formation, System Consolidation Theory, Multiple-Trace Theory, Reconsolidation Theory,					

Artificial Neural Network: Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron. Bayesian Network, Degree of Belief, Conditional Probability, Bayes's Rule	
Module 2	12 Sessions
Cognitive Architecture: Fundamental Concepts, Cognitive View, Computers in Cognitive Science, Applied Cognitive Science, Interdisciplinary Nature of Cognitive Science, Nature of Cognitive Psychology, Notion of Cognitive Architecture, Global View of the Cognitive Architecture, Cognitive Processes, Working Memory, and Attention. Neuroscience: Brain and Cognition, Introduction to the Study of the Nervous System, Organization of the Central Nervous System, Neural Representation, Neuropsychology, Computational Neuroscience,	
Module 3	10 Sessions
MO D E L S AN D TOO LS : The Physical Symbol System Hypothesis :Intelligent Action and the Physical Symbol System, Neural based Models of Information Processing. Cognitive Science and Dynamical Systems, Applying Dynamical Systems. Neuroeconomics: Perception as a Bayesian Problem, Neuroeconomics: Bayes in the Brain Strategies for Brain Mapping, Studying Cognitive Functioning: Techniques from Neuroscience	
Module 4	08 Sessions
Application: Models of Language Learning- Language Learning in Neural Networks, Bayesian Language Learning, Language Acquisition, Natural Language Processing, Semantics. Neural Network Models of Children's Physical Reasoning, Cognitive Science and the Law, Autonomous Vehicles: Combining Deep Learning and Intuitive Knowledge,	
Targeted Application & Tools that can be used: Applications: Behavior-Based Robotics Tools: SHAKEY's Software, Logic Programming in STRIPS and PLANEX	
Project Work/Assignment: 1. Develop a Model for Cognition and Knowledge Representation 2.Develop a Model for Biorobotics- Insects and Morphological Computation	
Text Book T2: José Luis Bermúdez, COGNITIVE SCIENCE l Publishers 3rd Edition, Cambridge University Press,2020	

T2: Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, COGNITIVE SCIENCE Publishers 3rd Edition, Cambridge University Press,2020
References R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 2nd Edition, 2019 R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 12n Edition, 2020 R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 2nd Edition, 2019 Web Resources: https://www.cambridge.org/highereducation/books/cognitive-science/
Topics relevant to development of "Employability": Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

Course Code: CAI3411	**Course Title: Generative AI** **Type of Course: Integrated**	**L-T-P-C**	**2**	**0**	**2**	**3**
Version No.	1.0					
Course Pre-requisites	**CSE3001 – Artificial Intelligence and Machine Learning**					
Anti-requisites	NIL					
Course Description	This course builds the foundational insight of understanding generative AI models and to explore various architectures, algorithms and practices of Gen AI skills to accelerate strategic decision making with data and deliver cutting-edge products faster with GenAI-augmented software development and leverage Gen AI tools to optimize workflows.					
Course Objective	The objective of the course is to familiarize the learners to explore the competence in benchmarking and comprehend the potential generative AI models and techniques to revolutionize industries and create prominent Gen AI tools to attain **Employability Skills** through **Experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** CO 1: Infer the concepts of generative AI models and prompt engineering in tailoring customized outputs [Understand].					

		CO 2: Demonstrate attention mechanism and transformers architecture with practical Applications. [Apply]. CO 3: Practice advanced generative AI techniques using Langchain Python framework [Apply]. CO 4: Solve real-time applications using multi-modal generative AI models [Apply].			
Course Content:					
Module 1	Introduction to Generative AI	Participative Learning		Brainstorming session/Quiz	**No. of classes** **L-6 P-8**
	Topics: Introduction to Generative models: Historical perspective and evolution, Applications, Types of Generative models for different data modalities, Large Language Models (LLMs) – Introduction, evolution, Generative pre-trained transformers (GPT) and its variants, Google DeepMind's, PaLM2, LLaMa and its series of models by Meta AI, Claud and its variants by Anthropic, Prompt Engineering-basic prompting.				
Module 2	Text-based Generative models	Participative Learning		Fish bowl, Think-pair & share	**No. of classes** **L-8 P-6**
	Topics: Text-based Generative models: State-of-the Art models, RNN, LSTM, Transformer Architecture, Transformer based Generative models: BERT, GPT, Training and Fine tuning LLMs for Generative task, Open AI's Pre-trained transformers for Text Generation: ChatGPTs, Limitations of LLMs: Lack of context and Hallucination risks, Techniques to mitigate these limitations: chaining and retrieval augmentation, Workflow of an LLM application.				
Module 3	Introduction to Lang Chain	Experiential Learning		Implementation of Gen AI models using Langchain Framework	**No. of classes** **L-8 P-8**
	Topics: Introduction to Lang chain: Types, Components, Information retrieval using agents and tools in Lang chain, Retrieval Augmented Language Models (RaLM): Understanding Retrieval and vectors: Embeddings, Vector storage, Vector indexing, Vector Libraries, Vector Databases, Chatbot using memory and conversation buffer.				
Module 4	Generative models for other Data modalities	Project-based Learning		Multi-Modal Gen AI models for Realtime Applications	**No. of classes** **L-8 P-8**
	Topics: Generative Adversarial Networks (GAN): GAN Architecture, GAN variants, Neural Style transfer with GAN, Training GANs and common challenges, GAN applications in image and text generation, Variational Auto Encoders (VAEs) and its variants, Image generation models: Dall-E, MidJourney and stable diffusion: Architecture and components of stable				

	diffusion, Text-to-image Generation, Parameter tuning, Image-to-image generation, Training custom models, In-Painting: Exchanging classes, Multi-modal generative models using Whisper for Audio: Speech-to-Text generation.
	List of Laboratory Tasks:
	Experiment No.1: Setting up Python IDE(Spyder) and OpenAI API key. Introduction to OpenAI playground and prompting **Level 1**: **Document** the installation and the process for generating models in OpenAI **Level 2: Solve** various GenAI models of OpenAI from Playground using prompts
	Experiment No.2: Text classification, summarization, sentiment analysis, chatbot application, code explanation with generating single and multiple response(S). **Level 1**: **Practice** the text generation model of OpenAI and Spyder IDE to implement various applications.
	Experiment No.3: Embeddings – for words, similarity between words, text embeddings, plagiarism check of documents **Level 1: Use** generating embeddings for words, text and documents **Level 2: Apply** the embeddings API to develop applications for plagiarism check
	Experiment No.3: Image generation using Dall E. Using GPT-Vision model for text to image generation and image-to-text. **Level 1: Apply** GPT-vision model for text-to-image generation and image-to-image
	Experiment No.5: Transformer based text and email classification **Level 1: Develop** transformer-based AI models for classifying text/email
	Experiment No.6: BERT for masked token generation **Level 1: Develop** BERT based model for generating masked tokens
	Experiment No.7: Creating applications using different types of LangChains – Simple Sequential, Sequential and map reduce **Level 1: List** the various types of chains in Langchain **Level 2: Practice** different types of chains using Spyder IDE and OpenAI
	Experiment No.8: Information retrieval using agents and tools in Langchain. **Level 1: Use** agents and tools with Langchain for information retrieval
	Experiment No.9: Custom Document loading and retrieval in LangChain using ChromaDB **Level 1: Understand** ChromeDb **Level 2: Apply** chromed with Langchain to generate information retrieval model from custom document

	Experiment No.10: Create a GPT like Chatbot using the memory component and RALM in LangChain **Level 1: Show** GPT like chatbot using memory component and retrieval augmented language model
	Experiment No.11: Using action agents, human as a tool and plan and execute agents for information retrieval. **Level 1: Understand** action agents and plan and execute agents **Level 2: Use** agents and tools for information retrieval
	Experiment No.12: Implement GAN for neural style transfer **Level 1: Demonstrate** a style transfer algorithm using generative models and experiment with the transformation of images by applying different artistic styles, assessing both the technical aspects and the aesthetic outcomes
	Experiment No.13: Text to Image generation using Dall-e/stable diffusion using prompts **Level 1: List** various image generation models **Level 2: Use** an image generation model to generate image from prompts
	Experiment No.14: Image to Image generation using stable diffusion **Level 1: Apply** stable diffusion to generate image from an image using prompts
	Experiment No.15: Speech to text and multi-modal generative models using Whisper for Audio **Level 1: Identify** the generative model for text, image and audio data **Level 2: Use** Langchain to create models for generating different data modalities. Ex: Audio-to-text
	Targeted Application & Tools that can be used Open AI Generative AI models: GPT 3.5 Turbo, GPT 4.0 vision model, Dall-E 3.0, Lang Chain Framework in Python, Python IDE, Stable Diffusion, Gemini, Hugging Face,
	Mini-Project work
	<u>Mini-Project Titles:</u> 1. Conversational Chatbot that interacts with documents: create a conversational chatbot to enage users in meaningful dialogues, answer queries, offer recommendations, and aid tasks using provided documents as inputs. 2. Sentiment Analysis/Intent Analysis/Toxicity Analysis 3. Natural Language Translation – Instruction Tuning using FLAN (Finetuned language Net) model 4. Questions and Answering systems – Extractive & Generative

	5. Text Summarization – Medicine – Med-PaLM 6. Given the Academic guidelines of the University, generate the student Handbook with FAQs and solutions. 7. Generating Cartoon based story telling 8. Simulate various driving conditions to improve safety and performance in Autonomous vehicles 9. In Financial management, generate synthetic financial data for stress testing and scenario analysis 10. Personalized recommendations/Product suggestions/tailored content based personalized design studio 11. Simulate characters for Games 12. Create conversational agents 13. Tutor in a range of preferred subjects 14. Generate codes 15. Draft documents 16. Answer questions about any knowledge base 17. Create an application which uses LangChain to connect OpenAI API to DALL-E. This image generation application turns written descriptions into lifelike pictures and artwork. 18. Embark on building a personalized language model with Falcon-7b. Utilize personalized LLM technique to explore text generation capabilities by providing task examples as inputs. 19. Use OpenAI's DALL-E and Gradio UI to develop an innovative logo builder. Th app creates unique and stunning logos from text prompts, revolutionizing the logo design process. 20. Crafting an AI powered HR Assistant: Develop a virtual assistant designed to answer queries related to Audi HR policy. Leverage Python libraries and OpenAI's GPT model for accurate and efficient query responses.
	TEXT BOOKS: **T1:** Generative AI with LangChain, Ist Edition by Ben Auffarth, Packt. Inc. ISBN: 978-1-83508-346-8, Decemeber 2023. **T2**: Generative Deep Learning, 2nd Edition by David Foster, O'Reilly Media, Inc. ISBN: 9781098134181, May 2023. **T3:** Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, O'Reilly Media,

Inc., ISBN:9781098153373, July 2024.

REFERENCES:

R1. Bandi, A., Adapa, P. V. S. R., & Kuchi, Y. E. V. P. K. (2023). The power of Generative AI: a review of requirements, models, Input–Output formats, evaluation metrics, and challenges. Future Internet, 15(8), 260. https://doi.org/10.3390/fi15080260

R2. Barachini, F., & Stary, C. (2022). From digital twins to digital selves and beyond. In Springer eBooks. https://doi.org/10.1007/978-3-030-96412-2

R3. Hadi, M. U., Tashi, Q. A., Qureshi, R., Shah, A., Muneer, A., Irfan, M., Zafar, A., Shaikh, M. B., Akhtar, N., Wu, J., & Mirjalili, R4. S. (2023). Large Language Models: A Comprehensive Survey of its Applications, Challenges, Limitations, and Future Prospects. https://doi.org/10.36227/techrxiv.23589741.v4

R4. Hai-Jew, S. (n.d.). Generative AI in Teaching and Learning. IGI Global.

R5. Salvaris, M., Dean, D., & Tok, W. H. (2018). Generative adversarial networks. In Apress eBooks (pp. 187–208). https://doi.org/10.1007/978-1-4842-3679-6_8

MOOC's/Swayam Courses/Online Courses:

h https://onlinecourses.swayam2.ac.in/imb24_mg116/preview

Certification Course by Google :

1. **https://www.cloudskillsboost.google**
   a. **Introduction to Generative AI (Beginner)**
   b. **Gemini for Google Cloud (Intermediate)**
   c. **Generative AI for Developers (Advanced)**
2. **https://www.credly.com/badges/90e3eae0-87f3-44e3-af82-658e837aad3d/public_url**
3. **https://www.coursera.org/learn/generative-ai-with-llms**
4. **https://www.coursera.org/specializations/prompt-engineering**

ONLINE RESOURCES:

W1. https://openai.com

W2: https://python.langchain.com/v0.2/docs/introduction/

	W3: https://www.udemy.com/course/master-ai-image-generation-using-stable- diffusion/?kw=Image+generation+using&src=sac&couponCode=LETSLEARNNOWPP W4: https://huggingface.co/google-t5/t5-base W5: https://dominguezdaniel.medium.com/exploring-image-generative-ai-models-9359705b15d3 W6: https://cloud.google.com/use-cases/retrieval-augmented-generation?hl=en# W7: https://ig.ft.com/generative-ai/ W8: https://medium.com/@samia.khalid/bert-explained-a-complete-guide-with-theory-and-tutorial-3ac9ebc8fa7c
	Topics relevant to "EMPLOYABILITY SKILLS": Topics of all four modules will help in developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

fCourse Code: CSE3088	**Course Title:** Business Intelligence and Analytics **Type of Course: Theory**	**L-T- P-C**	3 -0	0	3
Version No.	1.1				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	Business Intelligence (BI) refers to technologies, applications, and practices for the collection, integration, analysis, and presentation of business information. The purpose of business intelligence is to support better business decision making. This course provides an overview of the technology of BI and the application of BI to an organization's strategies and goals.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Business Intelligence and Analytics and attain Employability through Problem Solving Methodologies.				
Course Out Comes	On successful completion of the course the students shall be able to: 1. Introduce the concepts and components of Business Intelligence (BI) [Knowledge] 2. Evaluate the technologies that make up BI (data warehousing, OLAP) [COMPREHENSION] 3. Define how BI will help an organization and whether it will helpful [COMPREHENSION] 4. Identify the technological architecture that makes up BI systems [COMPREHENSION]				
Course Content:					
Module 1	**Basics of Insights**	Assignment	Programming Task		**10 Sessions**

Topics:
The importance of data in the information age – the data value chain – tools for generating insights – job roles available in the data insights market

Module 2	Basics Statistics: Foundation of Quantitative Insights	Assignment		**12 Sessions**

Topics:
Basic statistics – Variables - Measures of central tendency - Measures of dispersion - Normal distribution and histograms - The empirical rule - Covariance and correlation

Module 3	Data Visualization	Assignment		**10 Sessions**

Topics:
Data visualisation and Anscombe's Quartet - Data cleaning using SAS Data Studio - Bar and Pie Charts

Module 4	Advanced charts and dashboards			**13 Sessions**

Topics:
Multi variation correlation matrix and bar and line chart - SAS Visual Analytics filtering and controls - KPIs and targeted bar charts - Dashboard theory – Demand forecasting - Linear regression analysis – Forecasting - Forecasting and smoothing methods

Targeted Application & Tools that can be used:
Professionally used software

Project work/Assignment:

Text Book

1. Business Intelligence Guidebook: From Data Integration to Analytics 1st Edition, Kindle Edition.
2. Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications (Addison-Wesley Information Technology Series) 1st Edition, Kindle Edition

References

1. Successful Business Intelligence, Second Edition: Unlock the Value of BI & Big Data 2nd Edition, Kindle Edition

Weblinks:

W1: https://www.coursera.org/learn/business-intelligence-data-analytics#
W2: https://onlinecourses.nptel.ac.in/noc20_mg11/preview

Topics relevant to "EMPLOYABILITY SKILLS": information age , data value chain **for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**

Course Code: CAI3402	**Course Title:** Optimization Techniques for Machine Learning **Type of Course:** Integrated	**L- T- P- C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE3001					
Anti-requisites	**NIL**					
Course Description	This course introduces a range of machine learning models and optimization tools that are used to apply these models in practice. Course will introduce what lies behind the optimization tools often used as a black box as well as an understanding of the trade-offs of numerical accuracy and theoretical and empirical complexity. For the students with some optimization background this course will introduce a variety of applications arising in machine learning and statistics as well as novel optimization methods targeting these applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Optimization Techniques for Machine Learning** and attain **Skill Development** through **Participative Learning** techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: **Describe** fundamentals of Optimization Techniques [**Remember**]. **Explain** Optimization Techniques for Machine learning. [**Understand**]. **Discuss** Convex optimization models [**Understand**]. **Apply** Methods for convex optimization [**Apply**].					
Course Content:						
Module 1:	**Optimization Basics**	**Quiz**	Knowledge based Quiz	**16[8L+8P]Sessions**		
Topics: Introduction, The Basics of Optimization: Bivariate and Multivariate, Convex Objective Functions, Properties of Optimization in Machine Learning: Least-Square Classification, Support Vector Machines, Logistic Regression, Optimization Models for Binary Targets, Optimization Models for the Multiclass Setting, Coordinate Descent.						
Module 2:	**Optimization Solutions**	**Quiz**	Comprehension based Quiz	**15[8L+7P]Sessions**		
Topics: Introduction, Challenges in Gradient-Based Optimization: Momentum-Based Learning, RMSProp, Newton Method, Newton Methods in Machine Learning: Computationally Efficient Variations of Newton Method, The Subgradient Method, Proximal Gradient Method, Non-differentiable Optimization Functions: Designing Surrogate Lose Functions.						
Module 3	**Constrained Optimization**	**Assignment**	Batch-wise Assignments	**14[7L+7P]Sessions**		

Topics: Introduction, Primal Gradient Descent Methods: Primal Gradient Descent, Lagrangian Relaxation and Duality: Fundamentals of SVM Dual, Optimization Algorithms for the SVM Dual				
Module 4:	**Optimization in Computational Graphs**	Assignment and Presentation	Batch-wise Assignment and Presentations	**15[7L+8P]Sessions**
Topics: Introduction, basics, Optimization in Directed Acyclic Graphs: Optimizations in Directed Acyclic Graphs, Broad Framework, Application: Node-to-Node derivations using Brute Force				
Targeted Application & Tools that can be used: **Use of Matlab tool**				
Project work/Assignment: **Survey on Methods for convex optimization** **Survey on Machine learning models related to optimization**				
Introduction to Optimization Problems using Python/Matlab. Implement Bivariate and Multivariate Optimization. Solve Least-Square Classification Problem. Implement Support Vector Machine (SVM) Optimization. Logistic Regression Model Optimization. Coordinate Descent Algorithm Implementation. Gradient Descent and Stochastic Gradient Descent Techniques. Implement Momentum-based Gradient Descent. RMSProp Optimization Method Application. Newton Method Implementation for Machine Learning. Subgradient Method for Non-differentiable Functions. Proximal Gradient Method Implementation. Solve Constrained Optimization Problems with Lagrangian Methods. Optimization in Directed Acyclic Graphs. Survey and Comparative Analysis of Optimization Algorithms.				
Text Book T1. Charu C. Aggarwal, " *Linear Algebra and Optimization for Machine Learning*", Springer, 2020. T2. Sra Suvrit, Nowozin Sebastian, and Wright Stephen J, "*Optimization for Machine Learning*", The MIT Press,2012.				
References R1.Guanghui Lan, "*First-order and Stochastic Optimization Methods for Machine Learning*", Springer Cham, 2020. **Web References** W1. https://sm-nitk.vlabs.ac.in/ W2. https://nptel.ac.in/courses/				
Topics relevant to SKILL DEVELOPMENT: Concepts of Convex optimization models and Methods for convex optimization f**or Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**				

Course Code: CAI3405	**Course Title: Explainable AI** **Type of Course: Integrated**	**L- T-P- C**	**2**	**0**	**2**	**3**

Version No.	1.0			
Course Pre-requisites	CSE3001			
Anti-requisites	NIL			
Course Description	This course introduces the concepts, techniques, and challenges of **Explainable Artificial Intelligence (XAI)**. Students will learn to build interpretable models and apply explainability tools to demystify complex AI decisions, making AI systems **transparent, trustworthy, and accountable**. Emphasis will be on practical implementation and evaluation using real-world datasets.			
Course Objective	1 Understand the need for and principles of explainable AI 2 Explore techniques for explaining model predictions 3 Gain hands-on experience with state-of-the-art XAI tools and libraries 4 Build models that are interpretable and meet regulatory or ethical standards			
Course Outcomes	On successful completion of this course the students shall be able to: Explain the importance and scope of explainability in AI Compare interpretable models with black-box models Apply XAI techniques (e.g., LIME, SHAP) to real-world datasets Develop systems with enhanced transparency and traceability Evaluate explainability metrics and their impact on model trustworthiness			
Course Content:				
Module 1	**Introduction to Explainable AI**	Understand		**13[7L+4P] Sessions**
Topics: What is Explainability? Why it matters, Challenges in interpreting ML/DL models AI Ethics and Responsible AI				
Module 2	**Interpretable Models vs. Black-box Models**	Apply		**14[7L+7P] Sessions**
Topics: Decision Trees, Linear Models, Rule-based Models, Black-box models: Neural Networks, Ensemble methods, Trade-offs between accuracy and explainability				
Module 3	**Post-Hoc Explanation Techniques**	Assignment		**14[6L+8P] Sessions**

Topics:

Local vs. Global explanations,

LIME (Local Interpretable Model-Agnostic Explanations),

SHAP (SHapley Additive exPlanations),

Partial Dependence Plots, Feature Importance

Module 4	**Visual and Textual Explanations**	Assignment	**14[6L+8P] Sessions**

Saliency maps for CNNs,

Attention mechanisms in NLP,

Counterfactual and contrastive explanations

Project work/Assignment:

Assignment 1 on (Module 1 and Module 2)
Assignment 2 on (Module 3)

List of Lab Tasks:

Lab 1 – Compare interpretable vs. black-box models

Lab 2 – Implement LIME for image/text classification

Lab 3 – Apply SHAP to a random forest classifier

Lab 4 – Visualize CNN saliency maps for image predictions

Lab 5 – Use What-If Tool (TensorBoard) for exploring model fairness

Lab 6 – Build a decision support tool using explainable outputs

Lab 7 – Case Study: Explainability in credit scoring models

Lab 8 – Final Project: Explainable AI dashboard for real-world data

REFERENCE MATERIALS:

TEXTBOOKS

- **Christoph Molnar – *Interpretable Machine Learning*, 2022 Edition (Free online)**
- **Sameer Singh et al. – *Explainable AI: A Guide for Practitioners***
- **Gunning & Aha – *DARPA's XAI Program Publications***

REFERENCES

IEEE XAI publications
Research papers from NeurIPS, ICML, and ACL on XAI

XAI Fairness & Bias Toolkits by Google, IBM, and Microsoft

JOURNALS/MAGAZINES

IEEE Transactions on Artificial Intelligence
Journal of Artificial Intelligence Research (JAIR)
ACM Transactions on Intelligent Systems and Technology (TIST)
Artificial Intelligence Journal (Elsevier)

SWAYAM/NPTEL/MOOCs:

NPTEL: *Responsible AI* by IIT Madras
Coursera: *Explainable AI with Google Cloud*
FastAI: Modules on Model Interpretation
IBM AI Explainability 360 Toolkit

Course Code: CAI3406	**Course Title: Responsible AI** **Type of Course: Integrated**	**L- T-P- C**	2	**0**	2	**3**
Version No.	1.0					
Course Pre-requisites	CSE3001					
Anti-requisites	**NIL**					
Course Description	Responsible AI emphasizes transparency and explainability, ensuring that AI-driven decisions are understandable and justifiable. It also prioritizes security, reliability, and sustainability, aiming to create AI systems that are safe, efficient, and environmentally conscious. Ultimately, Responsible AI seeks to align technology with human values, promoting trust and ensuring that AI enhances rather than harms society.					
Course Objective	The objective of Responsible AI is to develop and deploy artificial intelligence in a way that is ethical, fair, transparent, and aligned with human values.					
Course Out Comes	**On successful completion of this course the students shall be able to:** To state aspects of responsible AI such as fairness, accountability, bias, privacy etc.[Remember] To assess the fairness and ethics of AI models.[Understand] To enforce fairness in models and remove bias in data.[Understand] To preserve the privacy of individuals while learning from them and apply it to various domains.[Apply]					
Course Content:						
Module 1	Introduction to Responsive AI (Remember)	Assignment				**11 Sessions**
	Topics:					

	Artificial Intelligence Fundamentals, definition of responsible AI, Importance of responsible AI, core principles of responsible AI, Regulations and Policies, challenges, Responsible AI in practice.					
Module 2		Fairness and Bias (Understand)	Assignment			**11 Sessions**
	Topics: Sources of Biases, Exploratory data analysis, limitation of a dataset, Preprocessing, in processing and postprocessing to remove bias, Group fairness and Individual fairness, Counterfactual fairness					
Module 3		Interpretability and explainability, Ethics and Accountability (Understand)	Assignment			**12 sessions**
	Topics: Interpretability through simplification and visualization, Intrinsic interpretable methods Post Hoc interpretability, Explainability through causality, Model agnostic Interpretation, Auditing AI models, fairness assessment, Principles for ethical practices					
Module 4		Privacy preservation (Apply)	Assignment			**11 sessions**
	Topics: Attack models, Privacy-preserving Learning, Differential privacy, Federated learning, Case Study- Recommendation systems, Medical diagnosis, Hiring/ Education, Computer Vision, Natural Language Processing					
	Lab Experiments: **Lab 1** – Real-time sentiment analysis from live social media feed **Lab 2** – Build an AI-powered chatbot using Dialogflow or Rasa **Lab 3** – Create a user-adaptive recommendation engine **Lab 4** – Implement online learning for a dynamic classification problem **Lab 5** – Emotion recognition from facial expressions using webcam input **Lab 6** – Deploy a low-latency AI model using TensorFlow Lite **Lab 7** – Build a real-time fraud detection prototype using streaming data **Lab 8** – Mini Project: End-to-end responsive AI application					
	Targeted Application & Tools that can be used: ChatGPT, DeepSeek					
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
	Case Study in different domains					
	Text Book Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 04-Nov-2019;ISBN-10 : 3030303705, ISBN-13 : 978-3030303709 Christoph Molnar "Interpretable Machine Learning".Lulu, 1st edition, March 24, 2019; eBook. ISBN-10 : 0244768528, ISBN-13 : 978-0244768522 [available online]					

	References **R1**. Voeneky S, Kellmeyer P, Mueller O, Burgard W, eds. The Cambridge Handbook of Responsible Artificial Intelligence. In: The Cambridge Handbook of Responsible Artificial Intelligence: Interdisciplinary Perspectives. Cambridge Law Handbooks. Cambridge University Press; 2022:i-ii. **Web links** W1. Responsible AI for generative models: Designing for responsibility W2. Responsible AI W3. Microsoft Responsible AI - Fairness
	Topics relevant to development of "Employability": Responsible AI ethics, Fairness and Bias, ethics and accountability

Course Code: CAI3407	Course Title: Agentic AI Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course provides a comprehensive introduction to *Agentic AI*, focusing on building autonomous, tool-using systems powered by Large Language Models (LLMs). Students will explore the foundations of multi-step LLM workflows, prompt engineering, and asynchronous execution while gaining hands-on experience with leading frameworks like OpenAI API, CrewAI, LangGraph, and AutoGen. Through modules on multi-agent collaboration, graph-based agent design, and model context protocols, the course emphasizes practical skills in designing, orchestrating, and deploying intelligent agents capable of communication, memory management, and decision-making. Real-world case studies across domains such as robotics, finance, and smart cities will illustrate the transformative potential of agentic systems.					
Course Objective	Introduce the concept of Agentic AI and equip students with the foundational knowledge of LLM-based agent workflows. Develop practical skills in designing and deploying single-agent and multi-agent systems using modern frameworks such as OpenAI API, CrewAI, LangGraph, and AutoGen. Explore orchestration techniques, communication models, and collaboration strategies among intelligent agents.					

<table>
<tr><td></td><td colspan="4">Enable students to build graph-based workflows and memory-augmented agents for solving real-world problems.
Familiarize students with context-aware protocol design using Model Context Protocol (MCP) for structured and scalable agent communication.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:

CO1: Explain the core concepts of Agentic AI, including agent workflows, prompt engineering, and LLM function execution.

CO2: Use OpenAI APIs and asynchronous Python to build simple autonomous agentic systems after configuring the development environment.

CO3: Design multi-agent workflows using CrewAI with task coordination, memory, and collaboration strategies.

CO4: Construct graph-based agent workflows using LangGraph, leveraging state machines, reducers, and checkpointing.

CO5: Manage agent messaging protocols using AutoGen and Model Context Protocol (MCP).

CO6: Apply agentic AI systems to real-world domains such as robotics, finance, and smart infrastructure through case studies.</td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to Agentic AI and Foundations of LLM Workflows</td><td>Assignment</td><td></td><td>16[8L+8P]

Sessions</td></tr>
<tr><td colspan="5">Concept of Agentic AI & Multi-step LLM workflows, Building your first agentic system using OpenAI API, Setting up environments (Windows/Mac, Git, Cursor IDE, APIs), Prompt engineering for tool-based autonomy, Agent vs workflow patterns, Async Python and LLM function calling, Tool use and function execution in LLMs, Sequential and parallel processing in agentic workflows</td></tr>
<tr><td>Module 2</td><td>Multi-Agent Workflows and LLM Orchestration</td><td>Assignment</td><td></td><td>16[8L+8P]

Sessions</td></tr>
<tr><td colspan="5">Designing with CrewAI: Agents, tasks, tools, processes, crews, memory, building a web search tool; Multi-agent: Architectures, Designing a Multi Agent Structure with Message Passing, Modes of Collaboration Among AI Agents, communication and collaboration, Case Studies: Robotics, Finance, Smart Cities and Energy Grids, Pydantic AI: Introduction, Creating Simple Agent, Building agent with personas, goals, and dynamic memory.</td></tr>
</table>

Module 3	Graph-Based Agent Design with LangGraph	Assignment		16[8L+8P] Sessions
LangGraph architecture and components, State machines: Nodes, edges, reducers, Workflow graphs and supersteps, Checkpointing and persistent memory, Web automation with Playwright + LangGraph, Structured outputs and feedback loops, LangChain tool integration				
Module 4	AutoGen and Model Context Protocol (MCP)	Assignment		12[6L+6P] Sessions
AutoGen : agents, messaging, single agent, multiple agent. MCP: Introduction, Architecture, context fragmentation, clients, servers and protocol.				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3)				
List of Lab Tasks: Lab 1: Setting Up the Agentic AI Development Environment Objective: Install and configure required tools for agentic system development. Task: Set up Python, Git, OpenAI API key, Cursor IDE, and environment variables. Activity: Perform a guided installation and validate API access with a basic GPT query. Lab 2: First Agentic System using OpenAI API Objective: Understand LLM workflows through simple agent design. Task: Build a basic Python agent that takes user input and responds using GPT-4. Activity: Implement asynchronous function calling and test multiple prompts. Lab 3: Prompt Engineering for Tool Use Objective: Design effective prompts for LLMs to interact with tools. Task: Create prompt templates for a calculator, summarizer, and code explainer tools. Activity: Compare output quality with different prompting strategies.				

Lab 4: Agent vs Workflow Pattern

Objective: Distinguish between agent-based and workflow-based models.

Task: Implement both an agent and a predefined workflow for a document summarizer.

Activity: Analyze performance and flexibility trade-offs.

Lab 5: Building a Multi-Agent CrewAI System

Objective: Learn to coordinate multiple agents in a single task.

Task: Design a system with researcher, summarizer, and presenter agents.

Activity: Use CrewAI to assign roles, tools, and memory, then simulate a research task.

Lab 6: Case Study – Multi-Agent System for Web Search

Objective: Apply multi-agent collaboration to a real-world problem.

Task: Implement a system that searches the web and compiles a report.

Activity: Assign different sub-tasks to agents and use memory for tracking.

Lab 7: Building an Agent with Persona and Goals using Pydantic AI

Objective: Customize agent behavior using metadata.

Task: Create an agent with a defined personality, goals, and memory.

Activity: Use Pydantic schemas to enforce structure and simulate goal-seeking behavior.

Lab 8: LangGraph Basics – Nodes and Edges

Objective: Design workflows as state machines.

Task: Build a LangGraph with nodes for input, processing, and output.

Activity: Visualize the graph and simulate input-output flows.

Lab 9: Checkpointing and Feedback Loops in LangGraph

Objective: Implement persistent memory and iterative feedback.

Task: Add checkpoint nodes and feedback validation in LangGraph.

Activity: Re-run tasks based on user feedback or system failure.

Lab 10: Web Automation using LangGraph + Playwright

Objective: Enable agents to perform automated web tasks.

Task: Build an agent that logs into a site and extracts content.

Activity: Integrate Playwright actions into LangGraph nodes.

Lab 11: Building AutoGen Agents with Messaging

Objective: Explore agent communication and message passing.

Task: Create single-agent and multi-agent setups using AutoGen.

Activity: Simulate collaborative planning via structured messaging.

Lab 12: Model Context Protocol (MCP) – Context Fragmentation

Objective: Handle large context and multi-client coordination.

Task: Build an agent system using MCP to divide and manage context fragments.

Activity: Simulate a client-server model and trace message flows.

REFERENCE MATERIALS:

TEXTBOOKS

Building Agentic AI Systems, Anjanava Biswas Wrick Talukdar, 2025 Packt Publishing

REFERENCES

Michael Wooldridge, An Introduction to MultiAgent Systems, 2nd Ed

AI research papers from IJCAI, AAAI, AAMAS

OpenAI research on agentic models and autonomous systems

Case studies on autonomous robotics and virtual agent behavior

JOURNALS/MAGAZINES

Autonomous Agents and Multi-Agent Systems (Springer)

Journal of Artificial Intelligence Research (JAIR)

Artificial Intelligence Journal (Elsevier)

IEEE Transactions on Cognitive and Developmental Systems

SWAYAM/NPTEL/MOOCs:

NPTEL: Artificial Intelligence – Search Methods for Problem Solving

Coursera: Autonomous Agents – University of Alberta

edX: Multi-Agent Systems and Distributed AI

OpenAI Blog: Research articles on emerging agentic models (e.g., AutoGPT)

Course Code: CSE3001	Course Title: Artificial Intelligence and Machine Learning Type of Course: Integrated	L-T- P-C	2-0	2	3
Version No.	2.0				
Course Pre-requisites	MAT1001				
Anti-requisites	NIL				
Course Description	This course introduces the basic concepts of artificial intelligence. It introduces students to the basic concepts and techniques of Machine Learning (ML), a subset of Artificial Intelligence (AI), is an important set of techniques and algorithms used for solving several business and social problems. The objective of this course is to discuss machine learning model development using Python. Topics include: Working with Collections and Data Frames; Regression algorithms; Classification algorithms; Optimization techniques – Gradient Descent algorithm, Gradient Descent for simple Linear Regression; Ensemble Learning – Random Forest, Boosting techniques – AdaBoost and Gradient Boosting; Grid Search for optimal parameters; Clustering algorithms; Forecasting with Time-Series data : Auto-Regressive Integrated Moving Average Models, Recommender Systems : Association Rule Mining, Collaborative Filtering, Text Analytics – Sentiment Classification using Naïve Bayesian model.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Machine Learning and attain Skill Development through experiential Learning techniques.				
Course Out Comes	On successful completion of the course the students shall be able to: CO1: To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents. [Comprehension] CO2: Produce machine learning models for predictive analytics. [Application] CO3: Apply ensemble learning, optimization and hyper parameter tuning techniques for machine learning algorithms. [Application] CO4: Demonstrate different types of clustering techniques. [Application]				

	CO5: Employ time series forecasting techniques/models for real world problems. [Application]			
Course Content:				
Module 1	Introduction to Artificial Intelligence and Knowledge based systems	Assignment	Theory	6 Sessions
Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agent, Structure of Intelligent agent and its functions, Agents and Environment; Introduction to Knowledge representation, approaches and issues in knowledge representation, Introduction to searching algorithm in AI,Conceptual graphs, Methods for Logic representation(POL, FOL).				
Module 2	Supervised Machine Learning Algorithms	Assignment	Programming activity	16 Sessions
Topics: Introduction to the Machine Learning (ML) Framework, types of ML, types of variables/features used in ML algorithms, Feature engineering-Normalization, One-hot encoding, Simple Linear Regression, Multiple Linear Regression,Validation and Accuracy measures for Regression models. Classification models – Decision Tree algorithms using Entropy and Gini Index as measures of node impurity, model evaluation metrics for classification algorithms,Logistic regression, Naïve Bayes Classifiers and Naive Bayes model for sentiment classification – an introduction..				
Module 3	Advanced Machine Learning Concepts	Assignment	Programming activity	14 Sessions
Topics: Nearest Neighbor techniques, Cost functions and Optimization Technique – introduction to Gradient Descent, its applications on Linear Regression. C.Ensemble Learning algorithms – Bagging (Random Forest), Boosting(AdaBoost), XGBoost.				

Module 4	Clustering and Forecasting with Time-Series Data	Assignment	Programming activity	10 Sessions

Topics:

Partitioned Clustering – K-means and Hierarchical Clustering techniques, cluster validity measures, Components of Time Series data, Basic Concepts of Forecasting , An introduction to Forecasting from Time Series Models, calculating forecast accuracy, Association Rule Mining, Collaborative Filtering – User based and item based similarity, closed and maximal frequent item sets.

List of Laboratory Tasks:

Lab sheet -1

Level 1: A review of Python programming - Introduction to Python Stack for Data Science, Core Python Libraries for data analysis, Anaconda platform and its installation, Executing programs on Jupyter IDE/ Colab.

Level2: Programming exercises to revise variables, control statements and collections – lists, list comprehension

Lab sheet -2

Level 1 - Programming exercises on Tuples

Level 2- Nested data structures

Lab sheet -3

Level 1: Introduction to Numpy, Pandas,

Level 2: Scikit-learn and Visualization techniques.

Lab sheet -4

Level 1 - Dictionaries, dictionary comprehension.

Level 2 - Introduction to Data Frames using Pandas and working with frames

Lab sheet -5

Level 1- Regression Models Simple linear regression, outlier detection.

Level 2 - multiple linear regressions – model evaluation, multi-co linearity and handling multi-co linearity, outlier detection.

Lab sheet -6

Level 1- Decision Tree Classifiers - Decision Tree classifier using Gini Index- measuring test accuracy, displaying the tree, confusion matrix and ROC.

Level 2- Decision Tree Classifier using Entropy.

Lab sheet -7

Level 1 - Optimization Techniques Developing a Gradient Descent Algorithm for linear regression – using NumPy and using sklearn.

Level 2 - cohen_kappa_score.

Lab sheet -8

Level 1- Hyper parameter Tuning methods Hyper parameter tuning using Grid Search for Nearest Neighbor Classifiers and

Level 2- Hyper parameter tuning using Grid Search for Decision Tree Classifiers.

Lab sheet -9

Level 1 - Hyper parameter Tuning for Ensemble models Ensemble Learning – Random Forest – Building the model, Grid Search for optimal parameters,

Level 2 - Feature Importance. Ada Boost Classifiers and Gradient Boosting Classifiers

Lab sheet -10

Level 2 - Clustering – Kmeans – cluster centers and interpreting the clusters, finding the optimal number of clusters using Elbow Curve method.

Level 2 - Agglomerative Hierarchical Clustering – Compare the clusters formed by kmeans and Agglomerative Clustering

Lab sheet -1 1

Level 1 – Probability theory(Conditional Probability)

Level 2 - Naïve Bayes Model

Lab sheet -12

Level 1- Models forecasting Applications

Level 2 - Models for Forecasting Time Series data

Lab sheet -13

Level 1- Recommender Systems - Association Rule Mining using Apriori for frequent Itemset Generation.

Level 2 - Recommender Systems – user based similarity

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Google's Colab cloud service https://www.tutorialspoint.com/google_colab/index.html for executing and sharing of lab exercises.

Project work/Assignment:

Assignment: Programming: Implementation of given scenario using Python and Colab. Assignment: Learning courses for 4 Hours from the following link https://learn.datacamp.com/courses?topics=Machine%20Learning
Text Book T1. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2016 T2. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall.
References R1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining”, Pearson Education, 2016. R2. Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017. R3. Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning Using Python”, Wiley, First Edition 2019. E-References https://presiuniv.knimbus.com/user#/home
Topics relevant to development of “Skill Development”: Regression Models Decision Tree Classifiers Hyper parameter Tuning methods Agglomerative Hierarchical clustering Decision tree classifiers for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE701	**Course Title: Capstone Project** **Type of Course:**	**L- T-P-C**	0	0	0	4
Version No.	**1.0**					

Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**
Anti-requisites	**NIL**
Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.

Course Code: CSE732	**Course Title: Internship** **Type of Course:**	**L- T-P-C**	-	-	-	8
Version No.	**1.0**					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the					

	foundation necessary for the student to understand properly the nature of real-life problems.
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.
Course Outcomes	On successful completion of this course the students shall be able to: Identify the engineering problems related to local, regional, national or global needs. (Understand) Apply appropriate techniques or modern tools for solving the intended problem. (Apply) Design the experiments as per the standards and specifications. (Analyze) Interpret the events and results for meaningful conclusions. (Evaluate)

Course Code: CIV7601	Course Title: Universal Human Values and Ethics Type of Course: MAC course	L-T-P-C	-	-	-	0
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of the course is to develop a holistic perspective in students' life. The course adopts a self-reflective methodology of teaching and is designed to equip the students to explore their role in all aspects of living as a part of the society. It presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration. This self-exploration develops more confidence and commitment in students enabling them to critically evaluate their pre-conditioning and present beliefs. As an outcome of the holistic approach, the students will be able to practice the ethical conduct in the social and professional life. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information. This course is designed to cater to Human Values and Professional Ethics.					
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'SELF LEARNING' techniques					

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:

Recognize the importance of Value Education through the process of self-exploration
Explain the human being as the co-existence of the self and the body in harmony.
Describe the role of foundational values in building harmonious relationships.
Summarize the importance of a holistic perspective in developing ethical professional behavior.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Value Education</td><td>Online Assessment</td><td>MCQ Quiz</td><td>5 Sessions</td></tr>
<tr><td colspan="5">Topics:
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.</td></tr>
<tr><td>Module 2</td><td>Harmony in the Human Being</td><td>Online Assessment</td><td>MCQ Quiz</td><td>5 Sessions</td></tr>
<tr><td colspan="5">Topics:

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health</td></tr>
<tr><td>Module 3</td><td>Harmony in the Family and Society</td><td>Online Assessment</td><td>MCQ Quiz</td><td>5 Sessions</td></tr>
<tr><td colspan="5">Topics:

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.</td></tr>
<tr><td>Module 4</td><td>Implications of the Holistic Understanding – A Look at Professional Ethics</td><td>Online Assessment</td><td>MCQ Quiz</td><td>5 Sessions</td></tr>
<tr><td colspan="5">Topics:
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Strategies for Transition towards Value-based Life and Profession</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Application areas are Personal life, Education and Career, Workplace , Society and Environmental Responsibility
Tools: Online Tools – NPTEL and Swayam.</td></tr>
<tr><td colspan="5">Project work/Assignment:</td></tr>
</table>

Assessment Type

Online exams (MCQs) will be conducted by the Department of Civil Engineering through Linways.

Online Link*:

UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin

Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

Text Book

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019.

Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.

Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.

P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

A N Tripathy, 2003, Human Values, New Age International Publishers.

E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press

M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.

Resources:

https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
https://onlinecourses.nptel.ac.in/noc25_mg141/preview
https://onlinecourses.swayam2.ac.in/ini25_hs52/preview
https://onlinecourses.nptel.ac.in/noc25_hs219/preview
https://onlinecourses.swayam2.ac.in/cec25_mg14/preview
https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
https://onlinecourses.swayam2.ac.in/imb25_mg196/preview

Topics relevant to Skill Development:

An attitude of enquiry.

Write reports

The topics related to Human values and Professional ethics:

All topics in are relevant to Human values and Professional ethics.