

# **St. Peter's Institute of Higher Education and Research**

(Deemed to be University U/S of the UGC Act, 1956)

NAAC Accredited, AICTE Approved and ISO-9001: 2015 Certified

Avadi, Chennai – 600 054. Tamil Nadu.



## **CURRICULUM & SYLLABI FOR**

## **BACHELOR OF TECHNOLOGY PROGRAMME**

**(FOUR YEARS)**

## **INFORMATION TECHNOLOGY**

**B.Tech. (INFORMATION TECHNOLOGY)  
REGULATION 2025**

**EFFECTIVE FROM ACADEMIC YEAR 2025-2026**

**CHOICE BASED CREDIT SYSTEM**

## **Vision & Mission**

### **VISION OF THE DEPARTMENT**

- To Enhance and extend educational services effectively to the satisfaction of all concerned.

### **MISSION OF THE DEPARTMENT**

- To provide an environment to support and encourage excellence in teaching-learning.
- To equip the students with conceptual, technical knowledge and competence required for the practice of their profession with moral and ethical values.
- Moulding the students acceptable to the business / industry world on par with National and International Standards.

## **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

**PEO 1:**To impart exhaustive knowledge to the students in all the sub-domains of Information Technology and the fast evolving IT tools to:

- Take up key assignments in IT and associated industries.
- Undertake and excel in higher studies and Research & Development in IT related fields and Management.
- Become an Entrepreneur in IT related fields.

**PEO 2:**To impart solid foundation in Computational Intelligence, Science and Interdisciplinary courses.

**PEO 3:**To design and develop novel products and innovative solutions for real life problems in Information Technology field and related domains.

**PEO 4:**To inculcate a conviction in the students to believe in self, impart professional and ethical attitude, nurture to be an effective team member, infuse leadership qualities, build proficiency in soft-skills, and the ability tolerate Engineering with social issues.

**PEO 5:**To provide a conducive and disciplined academic environment, quality of teaching with innovative and modern methods of pedagogy establishing the relevance of technical education as per the needs of the industry and society at large.

## **PROGRAM OUTCOMES (POs)**

Engineering Graduates will 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 analyze 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.

**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.

### **PROGRAM SPECIFIC OUTCOMES (PSOs)**

**PSO1:**An ability to specify, analyze & design a usable computing system that efficiently utilizes system software and hardware to cover current user requirements in a socially and economically acceptable form.

**PSO2:**An ability to state, design and implement a secure and reliable information communication system by using concepts of Computer Networks, Cryptography and Network Security and Cyber Forensics.

**PSO3:**An ability to state, design and implement knowledge based discovery and machine based learning in computer system by using the various concepts of Soft Computing, Neural Networks, Artificial Intelligence and Machine Learning

**FACULTY OF ENGINEERING AND TECHNOLOGY**

**UNDER GRADUATE PROGRAMMES**

**REGULATIONS - 2025**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Effective from the Academic Year 2025-2026**



**St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH**

**(Deemed to be university U/S 3 of UGC Act 1956)**

**Accredited with Grade "A+" by NAAC | ISO 9001:2015 Certified| Approved by AICTE**

**AVADI, Chennai - 600054**

## TABLES OF CONTENTS

<b>Sl. No.</b>	<b>TITLE</b>	<b>PAGE No.</b>
1	VISION AND MISSION OF THE INSTITUTION	i
2	ADMISSION	i
3	PROGRAMMES OF STUDY	ii
4	STRUCTURE OF THE PROGRAMME	ii
5	REGISTRATION AND ENROLLMENT	viii
6	REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE	xi
7	STUDENT COUNSELLING	xiii
8	CLASS COMMITTEE	xiv
9	EXAMINATIONS AND ASSESSMENT	xiv
10	EXAMINATIONS	xix
11	REQUIREMENTS FOR APPEARING FOR UNIVERSITY EXAMINATIONS	xxi
12	PASSING REQUIREMENTS FOR COMPLETION OF A COURSE	xxi
13	WITHDRAWAL FROM EXAMINATIONS	xxii
14	AUTHORIZED BREAK OF STUDY	xxiii
15	PURSUING COURSES IN OTHER INDIAN INSTITUTIONS AND ABROAD	xxiv
16	AWARD OF LETTER GRADES	xxiv
17	ELIGIBILITY FOR THE AWARD OF DEGREE	xxvii
18	RANKING	xxviii
19	DISCIPLINE	xxviii
20	STUDENT APPRAISAL	xxviii
21	DECLARATION OF RESULTS	xxviii
22	ACADEMIC BANK OF CREDITS (ABC)	xxviii
23	REVISION OF REGULATIONS / POWER TO MODIFY	xxix

## I. PREAMBLE

As per the recommendations of UGC, St. Peter's Institute of Higher Education and Research (SPIHER) has introduced Choice Based Credit System (CBCS) from the academic year 2015-16. Along with Choice Based Credit System the institution also adopted Outcome based Education (OBE) from 2015-16 academic year, with more emphasis on modified academic curriculum to meet corporate needs. Open electives, credits for internship, and semester abroad program are the measures taken to induce prolific quality component into the system. Continuous evaluation system is further strengthened with 40-60 percentage weightage that is in place for internal and external examinations respectively.

SPIHER has always strived to be a pioneer in delivering quality education. SPIHER has taken incremental steps in the right direction to provide holistic development to students through its academic curriculum. The four verticals namely knowledge, skill, self-development and learning to learn are considered while designing the curriculum. The curriculum is designed to facilitate multi-disciplinary learning, experiential learning through Project Based Learning as part of the learning process.

## II. DEFINITIONS AND NOMENCLATURE

### PRELIMINARY DEFINITIONS & NOMENCLATURE

- i. **Degree:** Refers to the academic award conferred upon a student after the successful completion of the program within the stipulated period, fulfilling the required credits and prescribed procedures. The degree is an undergraduate program **Bachelor of Technology**, commonly referred to as **B.Tech.**
- ii. **Programme:** Refers to the undergraduate degree program in engineering or technology.
- iii. **Branch:** Denotes the specialization or discipline within the undergraduate degree program, such as Civil Engineering, Mechanical Engineering, etc.
- iv. **Course:** Represents a unit of study within a semester, including theory, practical, laboratory-integrated theory, seminar, internship, or project work. Examples include subjects like English,

Mathematics, Environmental Science, Engineering Graphics, and Electronic Devices.

v. **Institution: Refers to St. Peter's Institute of Higher Education and Research, Avadi, Chennai.**

vi. **Academic Council:** The apex body responsible for all academic matters within the institution.

vii. **Director (Academic Affairs):** The official responsible for implementing relevant academic rules and regulations across all academic activities.

viii. **Controller of Examinations (CoE):** The official responsible for conducting examinations and declaring results.

ix. **Head of the Department (HoD):** The head of the respective academic department.

x. **Minor:** A discipline outside the student's major field of study, chosen for secondary specialization.

xi. **UGC:** University Grants Commission.

xii. **AICTE:** All India Council for Technical Education.

xiii. **SWAYAM:** Study Webs of Active-Learning for Young Aspiring Minds—an Indian **Massive Open Online Course (MOOC)** platform.

# ACADEMIC REGULATIONS 2025

Under Choice Based Credit System (CBCS)

## 1.0 VISION AND MISSION OF THE INSTITUTION

### 1.1 Vision:

To be a globally renowned institution in academic excellence, research and innovation by providing inspirational learning to produce socially conscious leaders capable of addressing future challenges with ethical values.

### 1.2 Mission:

- To provide a vibrant learning environment, fostering innovation and creativity inspired by cutting edge research.
- To instill ethical values, imbibe a sense of social responsibility and strive for societal wellbeing.
- To promote National and International alliances and collaborative initiatives to achieve global excellence.

## 2.0 ADMISSION

**2.1** Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

**2.2** Candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

**2.3** Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of

Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or

Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector

or any other examination of any other authority accepted by the Institution as equivalent thereto.

- 2.4** Multiple Entry options (Credit transfer through ABC), credit exemptions as per the direction of duly appointed expert committee in the respective department
- 2.5** The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.
- 2.6** The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.
- 2.7** The duration of the programme for the Degree of Bachelor of Technology will be four academic years, with two semesters in each year. The duration of each semester will normally be 90 working days. However, a student may complete the programme at a slower pace by taking more time, but not more than seven years.

### **3.0 PROGRAMMES OF STUDY**

Regulations are applicable to the following B.Tech. programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

S. No.	Programme	Discipline
1.	B.Tech.	Artificial Intelligence and Data Science
2.	B.Tech.	Biomedical Engineering
3.	B.Tech.	Civil Engineering
4.	B.Tech.	Computer Science and Engineering
5.	B.Tech.	Cyber Security
6.	B.Tech.	Electrical and Electronics Engineering
7.	B.Tech.	Electronics and Communication Engineering
8.	B.Tech.	Information Technology
9.	B.Tech.	Mechanical Engineering

### **4.0 STRUCTURE OF THE PROGRAMME**

The detailed courses of study for a programme will be decided by the respective department's Board of Studies. As per NEP 2020, the structure and lengths of degree programmes are adjustable. The undergraduate degree will be of 4-year duration, with multiple entries/exit options as per AICTE/UGC guidelines.

The students are allowed to exit the programme after I or II or III or IV year with Undergraduate Certificate, Undergraduate Diploma, Undergraduate Degree (B.Sc) and Undergraduate B.Tech. respectively as per the regulations of NEP 2020, Government of India. Similarly, the students from other institutions can join SPIHER institution in the 3<sup>rd</sup> or 5<sup>th</sup> or 7<sup>th</sup> semester with an appropriate Undergraduate Certificate or Undergraduate Diploma or Undergraduate Degree Certificates respectively.

The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition with the focus on the chosen major and minors as per the choices of the student. Every programme will have a curriculum with a syllabus consisting of theory, practical, Theory based practical, Project based theory, internship, project work, etc. for 161 credits.

#### **4.1 Categorization of Courses**

- i. Humanities, Social Sciences and Management Courses (HSC)** include English for communication, Employability Skills, Engineering Ethics and Human Values and Management courses.
- ii. Basic Science Courses (BSC)** include Mathematics, Physics, Chemistry, Biology, Environmental Science and Sustainability, etc.
- iii. Basic Engineering Courses (BEC)** include Engineering Practices, Engineering Drawing, Basics of Civil / Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.
- iv. Professional Core Courses (PCC)** include the core courses relevant to the chosen specialization/branch.
- v. Professional Elective Courses (PEC)** include the verticals with elective courses and elective courses relevant to the chosen specialization/ branch.
- vi. Open Elective Courses (OEC)** are Multidisciplinary courses that include the courses from Humanities and other disciplines of Engineering and Technology. Students can choose these courses from the list of Open Elective courses specified in the respective curriculum. Students may also choose courses from other disciplines from Swayam/NPTEL platform, including non-engineering courses.
- vii. Project Courses (PC)** Includes Project Work and/or Internship, Career Development Skills, Creative and Innovative Project, Seminar, Professional Practices, Case Study and Industrial/Practical Training
- viii. Mandatory Audit Courses (MAC)** Mandatory Audit Courses like

In d i a n Constitution and Humanity Rights, NCC/YRC/NSS/Rotary Club, Yoga Behavioral Science and entrepreneurship and Startups are offered to all engineering programs of the Institution.

- The activities will include Practical / Field activities / Extension lectures. The activities shall be beyond class hours. The student participation shall be for a minimum period of 2 hours per week during the respective semester and the activities will be monitored by the respective faculty in charge.
- Grades will be awarded on the basis of participation, attendance, performance and behavior. Grades shall be entered in the Grade statement as given below:  
Very Good, Good, Satisfactory and Unsatisfactory
- The Grades awarded by the faculty in-charge shall be entered in the respective semester Grade Sheet. If a student gets an unsatisfactory Grade, he/she has to repeat the above activity in the subsequent years.

#### **4.1.2 Online Courses for Credit Transfer**

The department shall approve the list of online courses offered by approved external agencies such as SWAYAM / NPTEL / MOOC. While listing the courses, the department shall consider the following points:

- a. The course evaluation is carried out by the same external agency
- b. Equivalent grading mechanism to be arrived at by the department

A student can register up to a maximum of 32 credits (total) as online courses during the entire programme of study. These shall be treated as Elective courses (programme elective or open elective). Students may be allowed to register for one course per semester. The student shall produce a Pass Certificate from the respective agencies. The credits(s) earned by the students will be transferred to the concerned course in the Grade Sheet.

#### **4.1.3 Value Added Courses**

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses. The details of the value-added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Director (Academic) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course. These value-added

courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study

#### **4.1.4 Industry Internship**

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field of study. The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training. In any case, the student shall obtain necessary approval from the Head of the Department / Dean Academic and the training has to be taken up at a stretch.

#### **4.1.5 Industrial Visit**

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Dean Academic shall ensure the same.

#### **4.2 CREDIT ASSIGNMENT FOR SEMESTER PROGRAM OF 15 WEEKS**

Each course is normally assigned certain number of credits:

Lecture Hours (Theory)	1 Credit / 1 Lecture hour / week
Practical Hours	1 Credit / 2 Practical hours / week, 2 Credits / 4 Practical hours / week
Tutorial	1 Credit / 1 hour / week.
Courses with Project Based Learning Approach (PBLA)	1 Credit / 1 Lecture Hour / week
Project Work Phase I	6 Credits / 6 hours of project work (Phase-I) / week
Project Work Phase II	12 Credits / 18 hours of project work (Phase - II) / week
Internship/Entrepreneurship/ Consultancy/In plant training/	1 Credit / minimum 2 weeks during vacation

- 4.3** Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, Project integrated theory courses, skill based courses etc.

**4.3.1 Course Coordinator for Common Course**

Each common theory course offered to more than one class or branch or group of branches, shall have a “course coordinator”. The course coordinator will be nominated by the Dean in consultation with respective Head of the Department. The Course Coordinator will be normally a senior faculty member who is one among the teachers teaching the course.

The “Course Coordinator” shall meet the teachers handling the course, as often as possible and ensure

- A common teaching methodology is followed for the course.
- The study materials are prepared by the staff members and communicated to the students periodically.
- The involvement of students in course-based projects and assignments.
- To prepare common question paper for continuous internal assessment tests.
- For uniform evaluation of continuous internal assessments answer sheets by arriving at a common scheme of evaluation.

The course coordinator is responsible for evaluating the performance of the students in the continuous internal assessments and end semester examinations and analyse them to find suitable methodologies for improvement in the performance. The analysis should be submitted to the HoD and Dean for suitable action.

- 4.4** The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

- 4.5 ENROLLMENT FOR B.Tech. (Honours) and B.Tech. minor with specialization in another discipline. (OPTIONAL)**

#### **4.5.1 B.Tech. (Hons.)**

- a) The students should have taken additional courses from a specified group of Professional Electives (vertical) or from any of the verticals of the same programme and earned a minimum of 18 credits.
- b) Should have passed all the courses prescribed in the curriculum and additional courses in the first attempt.
- c) Should have earned a minimum of 7.50 CGPA taking into account of all the courses prescribed in the curriculum and additional courses.
- d) Lateral Entry students shall be permitted to register for the courses from Semester V onwards provided the students have earned a minimum CGPA of 7.50 until Semester III and have cleared all the courses in the first attempt.
- e) If a student decides not to opt for Honor's, after completing certain number of additional courses, such additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum.

If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for calculation of CGPA and the same shall be indicated in a foot note appropriately.

If the student has failed in the additional courses or faced shortage of attendance, they will not be printed in the grade sheet and will not be considered for CPGA calculation and classification of degree.

#### **4.5.2 B.Tech. Minor with specialisation in another discipline:**

The student should have earned additionally a minimum of 18 credits in any one of the verticals offered from other Engineering Disciplines / Science and Humanities / Management.

- a) For these 18 credits students can optionally enroll and study a maximum of 6 credits in online mode from SWAYAM-NPTEL platform (in addition to the three online courses permitted for courses of curriculum), as approved by Head of the Department / Director Academic.

- b) B.Tech. (Hons.) and B.Tech. minor with specialization in another discipline will be optional for students and the students shall be permitted to select any one of them only.
- c) For the category 4.5.2, the students, including Lateral Entry, will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.
- d) B.Tech. (Hons.) or B.Tech. Minor shall be offered by the Department irrespective of the number of students enrolled.
- e) If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum.

If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for calculation of CGPA and the same shall be indicated in a foot note appropriately.

If the student has failed in the additional courses or faced shortage of attendance, they will not be printed in the grade sheet and will not be considered for CGPA calculation and classification of degree.

The student has to enroll for these additional courses separately and pay a tuition fee for studying these six additional courses and pay additional exam fee.

## **5.0 REGISTRATION AND ENROLLMENT**

- 5.1** Each student, on admission, shall be assigned to a Mentor, who shall advise and counsel the student about the details of the academic programme and the choice of courses, considering the student's academic background and career objectives.
- 5.2** After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn continuous assessment marks and appear for the end semester examinations.

**5.3** Each student on admission shall register for all the courses prescribed in the curriculum in the student's first Semester of study.

The enrollment for all the courses of curriculum from the Semesters II to VIII and additional courses for Honours and Minor from the semesters V and VIII will commence 5 working days prior to the commencement of the succeeding semester. The courses for Honours and Minor shall be registered separately under additional courses. The student shall enroll for the courses with the guidance of the student's Mentor. If the student wishes, the student may drop or add courses within 10 working days after the commencement of the concerned semester and complete the registration process duly authorized by the faculty in - charge within 30 days from the commencement of concerned semester. The list of students approved by the respective faculty-in-charge shall be final and would be considered for attendance, grades and calculation of CGPA and no changes shall be made thereafter.

**5.4** For enrollment, a student MUST have

- I. Cleared all the Institute and Hostel dues of the previous semesters and the current semester fees.
- II. Not been debarred from registering for a specified period on disciplinary or any other ground.

**5.5 Flexibility to Add or Drop courses:**

**5.5.1** A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. From the II to VII semesters, the student has the option of registering for additional courses or dropping existing courses in a semester. The total number of credits that a student can add or drop in a semester is limited to 8, subject to a maximum of 2 courses. Maximum number of credits enrolled in a semester (including Shortage of Attendance (SA), Honours and Minor) shall not exceed 30. The online courses registered shall be over and above this 30 credits.

**5.5.2** If the student wishes to earn more than the total number of credits prescribed in the curriculum of the student's programme within the minimum duration of the programme, then he/she can enroll for such additional courses in any programme with the permission of Head of the Department to which student belongs and Head of the Department in which the course is offered by paying the examination fee. The credits earned will be

neither considered for the computation of CGPA nor for the classification of the degree. The courses successfully completed will be printed in the grade sheet, however if there is shortage of attendance or failure, it shall neither be reflected in the grade sheet nor be considered for classification.

### **5.6 Choice of Professional Elective Courses**

The professional Elective Courses are listed in the Curriculum in Table format as verticals (Specialisation groups). A student can choose all the Professional Elective Courses either from one of the verticals or a combination of courses from all verticals in a semester. However, students irrespective of enrolling for additional courses for B.Tech. (Hons.) are not permitted to choose more than one course from a row. Students are permitted to enroll more than one elective course from the same vertical in a semester. In the subsequent semesters students are permitted to enroll one more course in a row, provided if he/she has cleared the earlier course of the same row. For a professional elective course and open elective course, minimum number of students enrolment permitted shall be 10. However, the minimum number is not applicable for students enrolling B.Tech. (Hons) and B.Tech. Minor. For each professional elective course at least two choices shall be offered.

### **5.7 Redoing a Course**

**Redoing a Course** refers to the process of re-registering for a course, attending all classes, meeting the attendance requirements as per Clause 6, obtaining fresh Continuous Assessment marks, and appearing for the End Semester Examinations. A student is required to redo a course under the following conditions.

- 5.7.1** If a student is prevented from writing end semester examination of any core course due to lack of attendance, the student has to register for that course again when offered next and redo the course.
- 5.7.2** If a student is prevented from writing the end semester examination of any professional/open elective course due to lack of attendance, the student can opt to register for the same course again when offered next and redo the course, or he/she can opt to register for a different professional/open elective course when it is offered, attend the classes, fulfill the attendance requirements as per clause 6, secure Continuous Assessment marks and appear for the End Semester Examinations.
- 5.7.3** If the course in which a student fails to secure a pass is a professional/open elective course, then the student can opt for a different professional/ open elective course, register for the same when it is offered, attend classes, fulfill the attendance requirements as per clause 6, secure Continuous Assessment marks and appear for End Semester Examinations.
- 5.7.4** A student who fails in Project work shall register for the course again, when offered next, and redo the course. In this case, the student shall attend the reviews and fulfill the attendance requirements as per clause 6.
- 5.7.5** A student who fails in Seminar / Case Study and Creative and Innovative project, where such other courses are evaluated through 100% continuous assessment, shall register for the same in the subsequent semester and redo the course. In this case, the student shall attend the classes and fulfill the attendance requirements as per clause 7 and earn continuous assessment marks.
- The student who fails in summer industrial training / internship shall attend the training / internship again and redo the course with the same organization or different organization with the approval of the HOD.

## **6.0 REQUIREMENTS FOR APPEARING THE END SEMESTER EXAMINATION OF A COURSE**

A student who has fulfilled the following conditions (vide clause 6.1 and 6.2) shall be deemed to have satisfied the attendance requirements for appearing for the end semester examination of a particular course.

- 6.1** Ideally every student is expected to attend all periods and earn 100% attendance. However, the student shall secure not less than 75% attendance, course wise, taking into account the number of periods required for that course, as specified in the curriculum.
- 6.2** If a student secures attendance between 65% and less than 75% in any course in the current semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events, with prior permission from the Chairman of Sports Board and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement (75%) and the student shall be permitted to appear for the end semester examination of that course. A maximum of 10% shall be allowed under On Duty (OD) / Medical leave category. In all such cases, the students should submit the required documents on joining after the absence to the Head of the Department through the Faculty Coordinator. The HOD shall inform the course instructor to provide necessary attendance at the end of semester before finalizing attendance. Producing such documents while finalizing attendance at the end of semester shall not be accepted.
- 6.3** A student shall normally be permitted to appear for the end semester examination of the course if the student has satisfied the attendance requirements (vide Clause 6.1 – 6.2) and has registered for the examination in those courses of that semester by paying the prescribed fee.
- 6.4** Students who do not satisfy clause 6.1 and 6.2 and who secure **less than 65%** attendance in a course will not be permitted to write the end semester examination of that course. The student has to register and redo the course when it is offered next as per Clause 5.4. If the course in which the student has been prevented is a professional/ open elective, the student can opt to redo the same course or opt for different professional/ open elective course as per Clause 5.7.2.
- 6.5** If a student has shortage of attendance in all the registered courses of the current semester as per curriculum, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

- 6.6** In the case of reappearance (Arrear) registration for a course (the courses for which redo is not required), the attendance requirement as mentioned in Clauses 6.1 - 6.3 is not applicable. However, the student has to register for the examination in that course by paying the prescribed fee.
- 6.7** A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear for the same course for improvement of letter grades / marks.

## **7.0 STUDENT COUNSELLING**

To help students in planning their courses of study and for general advice on the academic programme and personal counselling, Faculty members are assigned.

### **7.1 MENTOR**

To help the students in planning their courses of study and to render general advice regarding either the academic programme or any other activity, the Head of the Department concerned, will assign every year, a certain number of students from the first semester to a faculty member who will be called as Mentor. The set of students thus assigned will continue to be under the guidance of the Mentor till they complete the programme. Mentors will help the students on multiple exits, and also assess the proficiency of the student. Each student should have one-one interaction with the mentor at least once in a month.

### **7.2 FACULTY COORDINATOR**

There is a Faculty Coordinator who will be the in-charge for a particular batch. He will coordinate with the mentors for assessing the proficiency of the batch and report to the Head of the Department. He will also collect the course registration forms from the students. He also ensures whether the student submitted feedback at the end of the semester for the courses he/she has taken.

## **8.0 CLASS COMMITTEE**

a) Constitution of the Class Committee

For every class, a class committee shall be constituted by the Head of Department, as given below:

<b>Chairman</b>	A faculty member not teaching that particular class
<b>Members</b>	<ul style="list-style-type: none"><li>• Faculty of all the courses of study</li><li>• Four student members from the class to be nominated by the Head of the Department.</li></ul>

b) Functions of the Class Committee

- (i) The class committee shall meet thrice during the semester. The first meeting will be held within two weeks from the date of commencement of the semester in which the nature of the broad assessment procedure for the different courses will be discussed. The second and third meetings will be held six weeks and ten weeks respectively from the commencement of a semester to meaningfully interact and express opinions and suggestions to improve the effectiveness of teaching - learning process and analyze the performance of the students in the assessments. The chairperson of the class committee should send the minutes of the class committee meetings to the Dean through the Head of the Department, immediately after the meetings is over.
- (ii) During the first meeting of the class committee, all the faculty members shall give their course plan to the class committee chairperson/chairman for approval and uploading into the ERP.
- (iii) Any innovation in any course plan not agreed by the class committee or the HoD will be referred to the Dean for approval.

## 9.0 EXAMINATIONS AND ASSESSMENT

### 9.1 ASSESSMENTS

#### Continuous Internal Assessment

Continuous evaluation system is strengthened with 40-60 percentage weightage system in place for internal and external examinations. Three Continuous internal assessment will be conducted as per the academic calendar posted in our institution website. Internal mark for every course is awarded based on the performance in Continuous Internal Assessment and the assignments submitted.

#### 9.1.1 Theory Courses

- There will be a minimum of 2 Continuous Internal Assessments and 1 Model Test for

each theory course.

<b>DISTRIBUTION OF CONTINUOUS INTERNAL ASSESSMENT (CIA) MARKS FOR A THEORY COURSE</b>			
<b>Evaluation Component</b>	<b>Syllabus coverage</b>	<b>Duration of the Test</b>	<b>Max. Weightage (40 Marks)</b>
<b>CIA-1</b>	First 1.5 Units of the syllabus	2.0 Hours	7.5 Marks
<b>CIA-2</b>	Second 1.5 Units of the syllabus	2.0 Hours	7.5 Marks
<b>Model Test</b>	Full syllabus	3 Hours	15 Marks
<b>Assignment/ Mini Project (or) Group Presentation</b>	Two written assignments for each course / Written quiz (or) Presentation of a written Report (or) Case study / Multiple choice Objective Type Test or Technical Project involving not more than 3 students (or) any other Group Presentation related to the course.		5 Marks
<b>Attendance</b>			5 Marks

- The continuous assessment marks obtained by the candidate in the first appearance shall be retained, considered and valid for all subsequent attempts, till the candidate secures a pass.

### 9.1.2 Practical Courses

<b>S. No.</b>	<b>Category</b>	<b>Maximum Marks</b>
1.	Record	15
2.	Observation work	10
3.	Model Examination	15
Total		40

- For practical courses, the student will be evaluated on a continuous basis for 25 Marks (which will include performing all experiments, submitting observation and record note book in scheduled format and time), 15 marks for model exam at the end of the semester.

- For practical courses, if a student has been absent for some practical classes or has performed poorly, then the student will have to get permission from the lab in-charge and year coordinator to do the experiments, so that he/she meets all the requirements for the course and thereby allowed to appear for model and end semester practical exams
- If a student has not done all the experiments assigned for that lab, before the scheduled date will not be allowed to appear for the model and end semester practical exam. Such students will have to register the course again by doing all the experiments in the next semester when the course is offered.

### 9.1.3 End Semester Examinations (ESE)

- The end semester examinations shall be conducted at the end of the odd and even semester of the Academic year.
- End semester examinations will be conducted for a maximum of 100 marks. The marks secured in end semester exams will be converted to 60 marks.
- The evaluation of training will be made by a three member committee constituted by Head of the Department in consultation with Faculty Advisor and respective Training Coordinator. A presentation should be made by the student before the Committee, based on the Industrial Training or Professional Enrichment undergone.

#### Pattern of Question Paper (Theory) for Model and ESE

Particulars	Remarks
Maximum Marks	60 Marks
Duration	3 Hours
Part – A (Q.No. 1 to 10)	MCQ (10x1=10)
Part – B (Q.No. 11 to 15)	Short Answers (Either or Type) (5x10=50)

### 9.1.4 Project Work/ Semester long Internship

The student shall register for Project Work-I in pre-final semester and Project Work-II in final semester. Project work may be allotted to a single student or to a group of students not exceeding 4 per group. Project Work-II may/may not be a continuation of Project Work-I. If Project Work II is not a continuation of Project Work I, then the topic and constitution of the project team members need not be the same.

The project review would be conducted by a review committee where the student/ team shall make a presentation on the progress made, before the

committee. The Head of the department shall constitute the review committee for each branch in consultation with Director Academic, approved by CoE. The members of the review committee will evaluate the progress of the project and award marks.

- The guides would evaluate the students based on their performance and follow up.
- For Project work out of 100 marks, the maximum marks for Continuous Internal Assessment are fixed as 40 and the End Semester Examination (project report evaluation and viva-voce examination) carries 60 marks.

There shall be **Three Continuous Internal Assessments** (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee. The committee shall consist of the supervisor, expert member from the department and a project co-ordinator from another department. The total marks obtained in the three Reviews shall be reduced to 40 marks.

Continuous Internal Assessment (40 Marks)				End Semester Examinations (60 Marks)			
Review 0	Review I	Review II	Review III	Project Report & Presentation		Viva-Voce Examination	
10	10	10	10	Supervisor	External	Internal	External
				20	20	10	10

- A student is expected to attend all the project reviews conducted by the institution on the scheduled dates. It is mandatory for every student to attend the reviews, even if they are working on a project in an industry, which is outside Chennai city. If a student does not attend any of the project reviews, he / she shall not be allowed for the successive reviews and thereby not allowed to appear for the final viva voce.
- The candidate is expected to submit the project report as per the guidelines of the institution on or before the last day of submission. If a candidate fails to submit the project report on or before the specified deadline, he/she can be granted an extension of time up to a maximum limit of 5 days for the submission of project work, by the Head of the Department.
- If he/she fails to submit the project report, even beyond the extended time, then

he/she is deemed to have failed in the project work and shall register for the same in the subsequent semester and re-do the project after obtaining permission from the HoD and the respective Deans.

#### **9.1.5 Assessment for Summer internship:**

The summer Industrial / Practical Training/ summer internship/ summer project shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of the summer Industrial / Practical Training/ summer internship/ summer project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted by a three-member Departmental Committee constituted by the Head of the Department consisting of one co-ordinator and two faculty members. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department. The evaluation shall be carried out as per the procedure shown below.

<b>Internship / Industrial Training</b>		
<b>Evaluation Marks (60)</b>		
Report	Presentation	Viva Voce
40	10	10

#### **9.0.1 Assessment for Online Courses**

Students may be permitted to credit two online courses (which are provided with certificate), subject to a maximum of six credits. The online course of 3 credits can be considered instead of one elective course. These online courses shall be chosen from the SWAYAM platform, provided the offering organization conducts regular examination and provides marks. The credits earned shall be transferred and the marks earned shall be converted into grades and transferred, provided the student has passed in the examination as per the norms of the offering organization. The details regarding online courses taken up by the student and marks/credits earned and the approval for the course from Concerned Head of the Department shall be sent to the Controller of Examinations, in the subsequent semester(s) along with the details of the elective(s) to be dropped.

## **9.2 ASSESSMENT WEIGHTAGE:**

There will be Continuous Internal Assessment and End Semester Examination for all courses of all programmes.

### **(i) Theory courses**

Continuous Internal Assessment : 40 Marks

End Semester Examination : 60 Marks

### **(ii) Practical courses**

Continuous Internal Assessment : 40 Marks

End Semester Examination : 60 Marks

### **(iii) Theory + Practical courses:**

Continuous Internal Assessment : 40 Marks

(Average of Theory and Practical)

End Semester Examination 60 Marks

(Average of Theory and Practical) :

## **10.0 EXAMINATIONS**

### **10.1 RE-EXAMINATION**

Re-examination requests shall be considered only for the Continuous Internal Assessment and the Examinations in the last instructional week of the semester based on medical reasons.

### **10.2 REVALUATION**

A candidate can apply for revaluation of his/her End semester examination answer paper in a theory course, immediately after the declaration of results, on payment of a prescribed fee through the ERP. The Controller of Examinations will arrange for the revaluation and the result will be intimated to the candidate through website.

Revaluation is not permitted for practical courses and for project work.

### **10.3 SCRIBE FOR EXAMINATION**

Divyangjan students or students with temporary physical disability or injury due to accident or illness can apply for a scribe (writer) with proof of disability as a medical

certificate obtained from a Registered Medical Officer. The student shall be assigned a scribe by CoE to such student. The application for the scribe should be submitted in the CoE office well in advance or at least 2 days before the examination, to make necessary arrangements (Scriber, Separate Examination Hall etc.). The scribe assigned shall neither be a student nor a degree holder of any technical programme having similar competency.

Divyangjan students/ students with reading or writing disability, who can write at a slower speed as compared to a normal student would be allowed an extra time of 30 minutes to write the examination for each course. The proof of disability and application of extra time has to be submitted to the CoE office well in advance or 3 days before the start of the examination.

#### **10.4 ACADEMIC MALPRACTICE**

Academic malpractice would be strictly prohibited and any student who is found indulging in such activity would be penalized as per the recommendations of the Malpractice Committee constituted by the CoE with the approval of the Director Academic. The Committee would inquire and decide on the action based on the norms and policy listed in the Examination Manual.

#### **10.5 SUPPLEMENTARY EXAMINATION**

Supplementary examination will be conducted only for the final semester students within 10 days from the date of publication of revaluation results for students who have backlogs to complete the programme. Only such students shall apply with the prescribed fee to the Controller of Examinations within the stipulated time.

### **11.0 REQUIREMENTS FOR APPEARING FOR UNIVERSITY EXAMINATIONS**

A student shall normally be permitted to appear for the University Examinations for all the courses registered in the current semester if he/she has satisfied the semester completion requirements. Further, examination registration by a student is mandatory for all the courses in the current semester and all arrear(s) course(s) for the University examinations failing which, the student will not be permitted to move to the higher semester. A student who has already appeared for any course in a semester and passed the examination is not entitled to reappear in the same subject for

improvement of grades.

## **12.0 PASSING REQUIREMENTS FOR COMPLETION OF A COURSE**

- A candidate who secures not less than 50% of total marks prescribed for the courses (Continuous Assessment + End semester examination) with a minimum of 40% of the marks prescribed for the end-semester Examination in theory, theory with practical components (40% individually in theory and laboratory) and practical courses (including Project work), shall be declared to have passed in the Examination. However, if a student fails in any integrated theory and practical course, he/she should register and appear for the End semester examination in both theory and practical components of this course.
- If a student fails to secure a pass in a theory course / theory with laboratory/laboratory course (except electives), the student shall register and appear only for the end semester examination in the subsequent semester. In such case, the continuous assessment marks obtained by the candidate in the first appearance shall be retained and considered valid for all subsequent attempts till the candidate secure a pass. However, from the third attempt (current semester's end semester examination is considered as the first attempt) onwards if a candidate fails to obtain pass marks (IA + End Semester Examination), then the candidate shall be declared to have passed the examination if he/she secure a minimum of 50% marks prescribed for the university end semester examinations alone.
- If a student has submitted the project report but absent in the end semester examination of project work, the student is deemed to be failed. In this case and also if a student attends and fails in the End semester examination of Project work of B.Tech, he/she shall attend end semester examination again within 60 days from the date of declaration of the results. The subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case, the student fails in the subsequent viva-voce examination also, the student shall redo the course again, when offered next.
- If a student is absent during the viva - voce examination, it would be considered as fail. If a student fails to secure a pass in Project Work-I, the student shall register for the course again in the subsequent semester and can-do Project Work-I and II

together.

- The passing requirement for the courses which are assessed only through continuous assessment, shall be fixed as minimum 50%.

### **13.0 WITHDRAWAL FROM EXAMINATIONS**

- A candidate may, for valid reasons, (medically unfit / unexpected family situations) be granted permission to withdraw from appearing for the examination in any course or courses in any one of the semester examination during the entire duration of the degree programme.
- Withdrawal application shall be valid only if the candidate is otherwise normally eligible (if he/she satisfies Attendance requirements and should not be involved in Disciplinary issues or Malpractice in Exams) to write the examination and if it is made within FIVE days before the commencement of the examination in that course or courses and also recommended by the Director Academic through HoD.
- Notwithstanding the requirement of mandatory FIVE days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered based on the merit of the case.
- Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for the purpose of Classification of Degree.
- Withdrawal is NOT permitted for arrears examinations of the previous semesters.

### **14.0 AUTHORIZED BREAK OF STUDY**

- This shall be granted by the Institution, only once during the full duration of study, for valid reasons for a maximum of one year during the entire period of study of the degree programme.
- A candidate is normally not permitted to temporarily break the period of study. However, if a candidate would like to discontinue the programme temporarily in the middle of duration of study for valid reasons (such as accident or hospitalization due to prolonged ill health), he / she shall apply through the Director Academic in advance (Not later than the Reopening Day of that semester) through the Head of the Department stating the reasons. He /She should also mention clearly, the Joining date and Semester for Continuation of Studies after completion of break of Study. In such cases, he/she will attend classes along with the Junior Batches. A student who availed

break of study has to rejoin only in the same semester from where he/she left.

- The total period for completion of the programme shall not exceed more than 10 consecutive semesters from the time of commencement of the course irrespective of the period of break of study in order that he / she may be eligible for the award of the degree.
- If any student is not allowed to appear for End Semester Examinations for not satisfying Academic requirements and Disciplinary reasons, (Except due to Lack of Attendance), the period spent in that semester shall NOT be considered as permitted 'Break of Study' and is NOT applicable for Authorized Break of Study.
- In extraordinary situations, a candidate may apply for additional break of study not exceeding another one Semester by paying prescribed fee for break of study. Such extended break of study shall be counted for the purpose of classification of First Class Degree.
- If the candidate has not reported back to the department, even after the extended Break of Study, the name of the candidate shall be deleted permanently from the institution enrolment. Such candidates are not entitled to seek readmission under any circumstances.
- This shall be granted by the Institution, only once during the full duration of study, for valid reasons for a maximum of one year during the entire period of study of the degree programme.

#### **15.0 PURSUING COURSES IN OTHER INDIAN INSTITUTIONS AND ABROAD**

- A student can be selected, to get Professional Exposure in his/her area of Expertise in any Reputed Research Organization or Educational Institution of repute or any Universities in India and abroad.
- This is possible only with the List of Research Organizations, Educational Institutions in India and abroad approved by the Academic Council.
- The student can have the option of spending not more than three to Six months in the Final year or Pre - final year of his/her Degree. During this period, the student can do his/her Project work or register for courses which will be approved by the Class Committee and Director Academic, under the Guidance of a Project Supervisor who is employed in the Organization and Co-guided by a staff member from our

Institution.

- Credit Transfer can be done by the CoE on submission of certificate through the HoD and Director Academic within 15 days of completion.
- The students who undergo training outside the Institution (either in India or Abroad) is expected to abide by all Rules and Regulations to be followed as per Indian and the respective Country Laws, and also should take care of Financial, Travel and Accommodation expenses.

## 16.0 AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

### RANGE OF MARKS FOR GRADES

Range of Marks	Letter Grade	Grade Point
90 -100	O	10
80 – 89	A+	9
70 – 79	A	8
60 – 69	B+	7
50 – 59	B	6
00-49 (Reappear)	F	0

ABSENT	AAA	0
Withdrawal	W	0
Authorised Break of Study	ABS	0

## 16.0 CUMULATIVE GRADE POINT AVERAGE CALCULATION

The CGPA calculation on a 10 Point scale is used to describe the overall performance of a student in all courses from first semester to the last semester. RA, AAA and W grades will be excluded for calculating GPA and CGPA.

$$\text{GPA} = \frac{\sum_{i=1}^N C_i \text{GP}_i}{\sum_i C_i} \qquad \text{CGPA} = \frac{\sum_{i=1}^N C_i \text{GP}_i}{\sum_i C}$$

Where

$C_i$  – Credits for the course

$\text{GP}_i$  – Grade Point for the course

$i$  – Sum of all courses successfully cleared during all the semesters

$n$  - Number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA

### 16.1 GRADE SHEET

After revaluation results are declared in each semester, Grade Sheets will be issued to each student. At the end of programme a consolidated grade sheet also will be issued to each student. The grade sheet and consolidated grade sheet will contain the following details:

- The programme and degree in which the candidate has studied
- The list of courses enrolled during the semester and the grade secured
- The Grade Point Average (GPA) for the semester.

### 16.2 CLASSIFICATION OF DEGREE AWARDED

Final Degree is awarded based on the following

Range of CGPA	Classification of Degree
$\geq 7.50$	<b>First Class with Distinction</b>
$\geq 6.00 < 7.50$	<b>First Class</b>
$\geq 5.00 < 6.0$	<b>Second Class</b>

Minimum requirements for award of Degree: A student should have obtained a minimum of 5.0 CGPA.

- A candidate who qualifies for the award of the Degree having passed the examination in all the courses of all the 8 semesters in his/her first appearance within a maximum of 10 consecutive semesters securing a overall CGPA

om 1st semester) shall be declared to have passed the examination in **First Class with Distinction**. Authorized Break of Study vide Clause 14, will be considered as an Appearance for Examinations, for award of First Class with Distinction. Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction.

- A candidate who qualifies for the award of the Degree having passed the examination in all the courses of all the 8 semesters within a maximum period of 10 consecutive semesters after his/her commencement of study securing a overall CGPA of not less than 6.0 (Calculated from 1st semester), shall be declared to have passed the examination in **First Class**. Authorized break of study vides Clause 14 (if availed of) or prevention from writing End semester examination due to lack of attendance will not be considered as Appearance in Examinations. For award of First class, the extra number of semesters than can be provided (in addition to four years for Normal UG programme) will be equal to the Number of semesters availed for Authorized Break of Study or Lack of Attendance. Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class.
- All other candidates who qualify for the award of the Degree having passed the examination in all the courses of all the 8 semesters within a maximum period of 10 consecutive semesters after his/her commencement of study securing a overall CGPA of not less than 5.0, (Calculated from 1st semester) shall be declared to have passed the examination in **Second Class**.
- A candidate who is absent in semester examination in a course/project work after having registered for the same, shall be considered to have appeared in that examination for the purpose of classification.

## **17.0 ELIGIBILITY FOR THE AWARD OF DEGREE**

A student shall be declared to be eligible for the award of the Certificate / Diploma / UG Degree / UG Honours degree, provided the student has successfully completed all the requirements of the programme, and has passed all the prescribed examinations in all the I/II/III/IV year respectively within the maximum period specified in clause 2.7.

- i) Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- ii) Successfully completed the programme requirements and has passed all the courses prescribed in all the semesters within a maximum period of 5 years reckoned from the commencement of the first semester to which the candidate was admitted.
- iii) Successfully completed any additional courses prescribed by the Institution.
- iv) has earned a CGPA of not less than 5
- v) has no dues to the Institution, Library, Hostels, etc.,
- vi) has no disciplinary action pending against him / her.

## **18.0 RANKING**

- A candidate who qualifies for the UG degree programme passing all the examinations in the first attempt, within the minimum period prescribed for the programme of study from semester I through semester VIII to the programme shall be eligible for ranking. Such ranking will be confirmed to 10 percent of the total number of candidates qualified in that particular programme of study subject to a maximum of 10 ranks.

## **19.0 DISCIPLINE**

- Every student is required to observe disciplined and decorous behavior both inside and outside the Institution and not to indulge in any activity which will tend to bring down the prestige of the Institution. If a student indulges in malpractice in any of the end semester theory / practical examination, continuous assessment examinations he/she shall will be liable for disciplinary action as prescribed by the Institution from time to time.

## **20.0 STUDENT APPRAISAL**

- It is mandatory for every student to submit the feedback on each and every course, he/she has undergone, at the end of every semester.

## **21.0 DECLARATION OF RESULTS**

- The End Semester Examination results will be declared in institution website and the same is shared with the Head of the Department. In

general the results will be declared within 15 days from the date of last examination.

## **22.0 ACADEMIC BANK OF CREDITS (ABC)**

All the students who admitted in any one of the above programmes are mandatory to register in the Academic Bank of Credits (ABC) portal provided by the Ministry of Education (MoE), Government of India.

## **23.0 REVISION OF REGULATIONS / POWER TO MODIFY**

- St. Peter's Institute of Higher Education and Research (Deemed to be University) may revise, amend, or modify the regulations, examination schemes, and syllabi as deemed necessary from time to time.

Notwithstanding the provisions stated above, the Academic Council holds the authority to alter any or all of these regulations as required, subject to approval by the Executive Council.

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**DEPARTMENT OF INFORMATION TECHNOLOGY  
FACULTY OF ENGINEERING & TECHNOLOGY  
UG PROGRAM (CBCS) – B.TECH. INFORMATION TECHNOLOGY  
(2025–2026 Batch and onwards)**

**SEMESTER I**

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objective s and outcome s		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	POs		L	T	P		CIA	ESE	Total
I	25 MAU108	Engineering Mathematics- I	BSC	5.5			4,8	3	1	0	4	40	60	100
I	25PHU121	Engineering Physics + Laboratory	BSC	4.5			4,8	3	0	2	4	40	60	100
I	25EVS001	Environmental Science	BSC	4.5			4,8,9,11	2	0	0	2	40	60	100
I	25ENU121	Technical English + Laboratory	HSC	4.5			4,8	3	0	2	4	40	60	100
I	25EEU101	Basics of Engineering	BEC	4.5			4,8,9,11	3	0	0	3	40	60	100
I	25CSU121	Programming for Problem Solving + Laboratory	BEC	4.5	1,2	1-5	4,5,8,9	2	0	4	4	40	60	100
I	25MEU101	Engineering Graphics	BEC	4.5			4,8,9	2	1	0	3	40	60	100
I	25MAC111	NCC/YRC/NSS/Rotary Club	MAC	4.5			8,9,11	0	0	2	0			
Semester Total											24	280	420	700

## SEMESTER II

Semester	Course Code	Title of the Course	Course Category	NCRF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
II	25MAU208	Engineering Mathematics II	BSC	4.5			4,8	3	1	0	4	40	60	100
II	25CHU221	Engineering Chemistry + Laboratory	BSC	4.5			4,8	3	0	2	4	40	60	100
II	25ECU223	Digital System Design+ Lab	BEC	4.5			4,8,9	2	0	0	3	40	60	100
II	25ITU221	Object Oriented Application Development + Laboratory	PCC	4.5	1-5	1-3	4,5,8,9	3	0	2	4	40	60	100
II	25ITU222	Data Structures and Algorithms + Laboratory	PCC	4.5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
II	25IKS001	Introduction to Indian Knowledge System	IKS	4.5			4,8,9,11	2	0	0	2	40	60	100
II	25MEU211	Design Thinking and Innovations Laboratory	BEC	4.5			4,8,9	0	0	4	2	40	60	100
II	25MAC201	Indian Constitution and Human Rights	MAC	4.5			4,8,9,11	2	0	0	2	40	60	100
Semester Total											25	320	480	800

### SEMESTER III

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
II I	25MAU301	Discrete Mathematics	BSC	4.5				3	1	0	4	40	60	100
II I	25UHV001	Universal Human Values and Ethics	HSC	4.5				2	0	0	2	40	60	100
II I	25ITU321	Principles of Operating Systems + Laboratory	PCC	5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
II I	25ITU301	Information Storage and Management	PCC	5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
II I	25ITU322	Database Management Systems and Services + Laboratory	PCC	5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
II I	25ITU323	Design and Analysis of Algorithms + Laboratory	PCC	5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
II I	25ITU302	Embedded Systems and IoT	PCC	5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
II I	25MAC311	Yoga	MAC				3	0	0	1	0	0	0	0
Semester Total											24	280	420	700

## SEMESTER IV

Semester	Course Code	Title of the Course	Course Category	NCRF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
IV	25ITU421	Object Oriented Modeling & Design + Laboratory	PCC	5	1-5	1-3	4,5,8,9	3	0	2	4	40	60	100
IV	25ITU401	Web Application Development	PCC	5	1-5	1-3	4,5,8,9	3	0	0	3	40	60	100
IV	25ITU402	Introduction to Artificial Intelligence Engineering	PCC	5	1-5	1-3	4,5,8,9	3	0	0	3	40	60	100
IV	25ITU403	Computer Networking	PCC	5	1-5	1-3	4,5,8,9	3	0	0	3	40	60	100
IV	25ITU411	Computer Networking Laboratory	PCC	5	1-5	1-3	4,8,9	0	0	4	2	40	60	100
IV	25ITU412	Web Application Development Laboratory	PCC	5	1-5	1-3	4,8,9	0	0	4	2	40	60	100
IV	25ITU491	Mini Project	PRO	5.5	1-5	1-3	4,8,9	0	0	4	2	40	60	100
IV	25IKS002	Vedic Mathematics and Critical Thinking	IKS	4.5			4,8	2	0	0	2	40	60	100
Semester Total											21	320	480	800

## SEMESTER V

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
V	25ITU501	Fundamentals of Machine Learning	PCC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
V	25ITU502	Next Generation Wireless Networks	PCC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
V	25ITU521	Cloud Computing + Laboratory	PCC	5.5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
V		Professional Elective-1	PEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
V		Professional Elective-2	PEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
V		Open Elective-1	OEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
V	25ITU511	Artificial Intelligence and Machine Learning Laboratory	PCC	5.5	1-5	1-3	4,8,9	0	0	4	2	40	60	100
V	25ITU581	Internship-1	IAS	5.5	1-5	1-3	4,8,9	0	0	0	1	40	60	100
V	25MAC501	Entrepreneurship and Startup	MAC	4.5			4,9	3	0	0	3	40	60	100
Semester Total											25	360	540	900

## SEMESTER VI

Semester	Course Code	Title of the Course	Course Category	NCF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
VI	25ITU621	Full Stack Development Testing + Laboratory	PCC	5.5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
VI	25ITU622	Foundations of Data Science + Laboratory	PCC	5.5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
VI	25ITU623	Cryptography and Network Security + Laboratory	PCC	5.5	1-5	1-3	4,8,9	3	0	2	4	40	60	100
VI		Professional Elective-3	PEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VI		Professional Elective-4	PEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VI		Open Elective 2 (Online)	OEC	5.5	1-5	1-3	4,8,9	3	0	0	3	40	60	100
Semester Total											21	240	360	600

## SEMESTER VII

Semester	Course Code	Title of the Course	Course Category	NCRF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
VII	25ITU721	Agile Software development + Laboratory	PCC	6	1-5	1-3	4,8,9	3	0	2	4	40	60	100
VII		Professional Elective 5	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VII		Professional Elective 6	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VII		Open Elective 3	OEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VII	25ITU791	Project Work - Phase I	PRO	6	1-5	1-3	4,8,9	0	0	12	6	40	60	100
VII	25ITU781	Internship-2	IAS	6	1-5	1-3	4,8,9	0	0	0	1	40	60	100
Semester Total											20	240	360	600

## SEMESTER VIII

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
VIII		Open Elective 4 (Online)	OEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
VIII	25ITU891	Project Work - Phase II	PRO	6	1-5	1-3	4,8,9	0	0	24	12	40	60	100
Semester Total											15	80	120	200

## VERTICAL – 1 : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
	25ITU531A	Soft Computing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU532A	Deep Learning	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU631A	Natural Language Processing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU632A	Computer Vision and Image Recognition	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU731A	Responsible AI	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU732A	Large Language Models(LLM)	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100

### VERTICAL – II : CYBERSECURITY

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objective s and outcome s		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEO s	Pos		L	T	P		CIA	ESE	Total
	25ITU531 B	Ethical Hacking	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU532 B	Security Incident Response and Management	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU631 B	Blockchain and Cryptocurrency	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU632 B	Software Defined Networks	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU731 B	Legal, Ethical and Social issues in Information Security	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU732 B	Cybercrimes and Digital Forensics	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100

### VERTICAL III : DATA SCIENCE AND CLOUD COMPUTING

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objective s and outcome s		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEO s	Pos		L	T	P		CIA	ESE	Total
	25ITU531 C	Serverless Computing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU532 C	Cloud Security	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU631 C	Data Mining and Data Warehousing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU632 C	Containerization and Virtualization Technologies	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU731 C	Big Data Analytics	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU732 C	Edge and Fog Computing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100

### VERTICAL IV: DIGITAL MEDIA TECHNOLOGIES

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
	25ITU531D	Image Processing and Computer Vision	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU532D	Multimedia and Animation	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU631D	Game Design & Development	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU632D	Augmented and Virtual Reality	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU731D	UI and UX Design	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU732D	Data Visualization Techniques	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100

### VERTICAL – 5: NEXT GENERATION TECHNOLOGIES

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	Pos		L	T	P		CIA	ESE	Total
	25ITU531E	IOT and Smart Systems	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU532E	5G and Future Wireless Technologies	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU631E	Quantum Computing	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU632E	Extended Reality	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU731E	Amazon Web Services: Fundamentals and Applications	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100
	25ITU732E	Generative AI	PEC	6	1-5	1-3	4,8,9	3	0	0	3	40	60	100

## SEMESTER - 1

B.E. / B.Tech. (Common to all Branches)

2025-2026

25 MAU108

ENGINEERING MATHEMATICS - I

Semester – I  
4H – 4C

**Instruction Hours / week: L: 3 T: 1 P: 0    Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

### Course Objectives

- Develop the uses of matrix algebra techniques that is needed by engineers for practical applications.
- Differentiate continuity and differentiability under differential calculus.
- Identify functions of several variables. This is required in many branches of engineering.
- Solve the problems under integral calculus.
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

### Course Outcomes (COs)

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Use the matrix algebra methods for solving practical problems	Apply
CO2	Use differential calculus ideas on several variable functions	Apply
CO3	Apply the concept of several variable functions in calculus	Understand
CO4	Apply the concept of integral calculus	Apply
CO5	Apply multiple integral ideas in solving areas, volumes and other applications	Apply

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS 01	PS 02	PS 03
CO 1	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--	--
CO 2	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--	--
CO 3	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--	--
CO 4	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--	--
CO 5	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--	--

### CO-PO Mapping

1 - low, 2 - medium, 3 - high

### UNIT I – MATRICES

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

## **Unit II – DIFFERENTIAL CALCULUS**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

## **Unit III – FUNCTIONS OF SEVERAL VARIABLES**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

## **Unit IV – INTEGRAL CALCULUS**

Definite and Indefinite integrals — Substitution rule — Techniques of Integration — Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions — Improper integrals.

## **Unit V – MULTIPLE INTEGRALS**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Kreyszig, E. (2016). Advanced Engineering Mathematics. 10th Edition, John Wiley and Sons.
2. Grewal, B.S. (2018). Higher Engineering Mathematics. 44th Edition, Khanna Publishers.
3. Bali, N., Goyal, M., & Watkins, C. (2009). Advanced Engineering Mathematics. 7th Edition, Firewall Media.
4. Jain, R.K. & Iyengar, S.R.K. (2016). Advanced Engineering Mathematics. 5th Edition, Narosa Publications.
5. Narayanan, S. & Manicavachagom Pillai, T.K. (2009). Calculus, Volume I and II, S. Viswanathan Publishers.

**Instruction Hours / week: L: 3 T: 0 P: 2    Marks: Internal: 40    External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

**Course Objectives**

- Provide a foundational understanding of the electrical properties of materials
- Introduce the fundamental concepts and behaviour of semiconductor materials
- Develop a conceptual and mathematical understanding of elasticity
- Explain the thermal properties of engineering materials
- Examine experimental evidence such as electron diffraction.

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Discuss the basic electrical properties of materials and classify materials based on band theory.	Understand, Apply
CO2	Explain the properties of semiconductor materials and determine the band gap using appropriate experimental methods.	Understand, Apply
CO3	Calculate different moduli of elasticity and explain their applications in engineering and materials science.	Apply
CO4	Describe the thermal properties of materials and their applications, such as thermal expansion in joints and the functioning of heat exchangers.	Remember, Apply
CO5	Interpret the concept of wave-particle duality and describe experimental evidence, such as electron diffraction, that supports this duality.	Understand

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO 1	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 5	3	3	3	3	3	3	3	2	3	1	2	3	3	3	2

**1 - low, 2 - medium, 3 - high**

**UNIT-I ELECTRICAL PROPERTIES OF MATERIALS**

Classical free

electron theory-Expression for Electrical conductivity-thermal conductivity-expression- Wiedmann Franz law- success and failure-electrons in metals-Particle in three dimensional box- degenerate

state- Fermi Dirac Statistics-Density of Energy states-Electron in periodic potential-Bloch Theorem- Metals and Insulators-Energy bands in solids-Effective mass of electron- Concept of holes.

## **UNIT II SEMICONDUCTORS AND TRANSPORT PHYSICS**

Intrinsic semiconductors- Carrier concentration derivation– Fermi level – variation of Fermi level with temperature –electrical conductivity – band gap determination -extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – Variation of fermi level with temperature and impurity concentration.

## **UNIT III PROPERTIES OF MATTER**

Elasticity – Poisson's ratio and relationship between moduli (qualitative) – stress-strain diagram for ductile and brittle materials, uses – factors affecting elastic modulus and tensile strength – bending of beams – cantilever – bending moment – Young's modulus determination – theory and experiment – uniform and non-uniform bending – I shaped girders – twisting couple torsion pendulum – determination of rigidity modulus- moment of inertia of a body .

## **UNIT IV THERMAL PHYSICS**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints – bimetallic strips – thermal conduction, convection and radiation – heat conduction in solids – thermal conductivity – Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

## **UNIT V QUANTUM PHYSICS**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) – scanning tunnelling microscope.

**PERIODS: 45**

### **PRACTICAL EXERCISES**

1. Torsional Pendulum-Determination of Moment of Inertia and Rigidity Modulus with equal masses
2. (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber
3. Determination of Young's modulus by non-uniform bending method
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method
5. Ultrasonic Interferometer-Determination of Velocity of Ultrasonic waves and Compressibility of the given liquid
6. Determination of band gap of a semiconductor
7. LC circuit and LCR circuit

### **SUGGESTED READINGS:**

1. Charles Kittel – Introduction to Solid State Physics, 8th Edition (2018) Publisher: Wiley
2. Brij Lal and N.Subramaniam, Properties of Matter S. Chand & Co., New Delhi 1994)
3. G. Aruldas's Quantum Mechanics is the Second Edition, published by PHI Learning in 2008.
4. Donald A. Neamen's Semiconductor Physics and Devices: Basic Principles is the 4th Edition, published in 2012 by McGraw-Hill.

5. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
6. R. Shankar's Principles of Quantum Mechanics is the Second Edition, published in 1994 by Plenum Press
7. Dr. S. Stella Mary, 'Practical Engineering Physics' R. K. Publications, 2013
8. C.C. Ouseph, U.J. Rao, V. Vijayendran, 'Practical Physics and Electronics', S. Viswanathan Printers and Publishers Pvt. Ltd., 2011

25EVS001

ENVIRONMENTAL SCIENCE

Semester – I  
2H – 2C

Instruction Hours / week: L: 2 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Understand the scope and significance of the environment, raise public awareness about various environmental hazards and the structure and function of ecosystems
- Introduce the concept of biodiversity, its different types and the importance of its conservation at global, national, and local levels.
- Understand the causes, effects, and control measures of various environmental hazards, solid waste and disaster management, role of individuals in pollution prevention.
- Understand the need for new and renewable energy sources, focusing on energy management and conservation, and their applications.
- Understand the concepts of global and local environmental issues, various environmental protection laws

**Course Outcomes (COs)**

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Define the environment and its significance, different environmental hazards, and the roles of producers, consumers, and decomposers in ecosystems, energy flow and the structure of food chains, food webs, and ecological pyramids in various ecosystems.	Understand
CO2	Define biodiversity and its various levels, biodiversity hotspots, threats to biodiversity, and the importance of conserving endangered and endemic species in India using in-situ and ex-situ methods.	Understand
CO3	Identify the causes, effects control of different environmental hazards (air, water, marine, soil, noise, thermal, and nuclear pollution), importance of solid waste management and disaster management (floods, earthquakes, cyclones, and landslides), the role of individuals in preventing pollution and pollution case studies.	Remember
CO4	Explore the role and potential of new and renewable energy sources, different types of renewable energy and their applications, particularly hydrogen, ocean, tidal, and geothermal energy, the concepts and technology behind energy management and conservation.	Understand
CO5	Identify key environmental issues and the role of environmental protection laws in safeguarding ecosystems, wildlife, and forests.	Understand

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	1	3	1	2	2	2	1	1	1	1	1	3	2	2	2
CO 2	3	2	3	1	2	2	2	1	1	1	1	1	2	3	2	3
CO 3	2	2	3	1	2	1	2	1	1	1	1	1	3	2	3	2

CO 4	3	1	2	1	2	2	2	1	1	1	1	1	2	3	2	3
CO 5	3	2	3	1	1	1	2	1	1	1	1	1	3	2	3	3

**1 - low, 2 - medium, 3 - high**

#### **UNIT I – ENVIRONMENT AND ECOSYSTEM**

Environment – Definition, scope and significance - Public awareness: Risk and hazards - Chemical hazards, Physical hazards, Biological hazards in the environment. Ecosystem - concept -structure and function - producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem

#### **UNIT II – BIODIVERSITY AND ITS CONSERVATION**

Introduction to Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses of biodiversity - biodiversity at global, national (India) and local levels - Hotspots, threats to biodiversity - Endangered and endemic species of India - conservation of biodiversity - *In-situ* & *Ex-situ*.

#### **UNIT III – ENVIRONMENTAL POLLUTION AND MANAGEMENT**

Definition, Causes - Effects and control measures of Air, Water, Marine, soil, Noise, thermal and nuclear hazards, Solid waste Management : Causes, effects and control measures of urban and industrial wastes- Role of an individual in prevention of pollution- Pollution case studies- Disaster management : floods, earthquake, cyclone and landslides

#### **UNIT IV – RENEWABLE SOURCES OF ENERGY**

Role and potential of new and renewable source- Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy

#### **UNIT V – ENVIRONMENTAL PROTECTION**

Climate change- Global, Regional and local environmental issues. Environmental Impact Assessment. Environment protection act, wildlife protection act. and forest conservation act.

#### **SUGGESTED READINGS:**

1. Gilbert M.Masters "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education (2004).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi (2006).
3. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publication (2010).
4. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
5. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
6. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
7. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
8. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
9. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
10. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005

11. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013

25ENU121

TECHNICAL ENGLISH

Semester – I  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2    Marks: Internal: 40    External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Enhance the communicative competence of learners.
- Assist learners in using language effectively in academic/work contexts.
- Strengthen students' English language skills by engaging them in listening, speaking, and grammar learning activities that are relevant to authentic contexts.
- Develop analytical thinking skills for problem-solving in communicative contexts
- Equip them with writing skills needed for academic as well as workplace contexts.

**Course Outcomes (COs)****At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Listen and comprehend complex academic texts.	Remember
CO2	Read and infer the denotative and connotative meanings of technical texts.	Apply
CO3	Write definitions, descriptions narrations and essays on various topics.	Apply
CO4	Speak fluently and accurately and informal communicative contexts.	Apply
CO5	Express their opinions effectively in both oral and written medium of communication.	Create

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO 1	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO 5	3	3	3	3	3	3	3	2	3	1	2	3	3	3	2

1 - low, 2 - medium, 3 - high

**UNIT I INTRODUCTION TO COMMUNICATION SKILLS**

Listening—for general information-specific details-conversation: Introduction to classmates.  
Speaking - Self Introduction; Introducing a friend; Conversation - politeness strategies; Telephone conversation. Reading - Reading brochures (technical context). Writing-Writing emails/letters introducing oneself, Paragraph Writing, Reading Comprehension. Grammar – Parts of Speech,

Sentence kinds. Wh-Questions forms and Tags. Vocabulary-Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

## **UNIT II: REPORTING AND NARRATIONS**

Listening- Listening to podcast, anecdotes/stories/event narration; documentaries and interviews. Speaking- Narrating personal experiences/events; Interviewing a celebrity; Reporting and summarizing of documentaries/podcasts/interviews. Reading- Reading biographies, travelogues, news paper reports, Excerpts from literature, travel and technical blogs. Writing – Report Writing - Short Report on an event. Grammar- Sentence Structures, Tenses. Vocabulary– Antonyms, Word Formation (prefixes & suffixes).

## **UNIT III: ACADEMIC DEVELOPMENT AND COMMERCIAL REVIEWS**

Listening- Listen to a classroom lecture. Speaking–Picture description; Giving instruction to use the product; Presenting a product and summarizing a lecture. Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; Instructions. Grammar-Active & Passive Voice, The Impersonal Passive., Subject-Verb Agreement; Infinitive and Gerunds. Vocabulary - Compound Words, Homonyms; and Homophones.

## **UNIT IV: SCIENTIFIC REPORTS AND PRESENTATION TECHNIQUES**

Listening – Listening to TED Talks; Scientific lectures and educational videos. Speaking – Small Talk; Mini presentations and making recommendations. Reading–News paper articles; Journal reports–and Non Verbal Communication (tables, pie charts etc.). Writing–Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode), Checklists. Grammar– Error correction; If conditional sentences., Vocabulary- Discourse markers, Connectives, Articles.

## **UNIT V: POINT OF VIEW AND PLACEMENTS.**

Listening–Listening to debates/discussions; different view points on an issue; and panel discussions. Speaking–Group discussions, Debates, and Expressing opinions through Simulations & Role play. Reading – Reading Editorials and Opinion Blogs. Writing–Job/ application–Cover letter & Resume. Grammar–Numerical adjectives, Punctuation. Vocabulary- Cause & Effect Expressions

**PERIODS:60**

## **PRACTICAL EXERCISES**

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics/ Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Argumentative Skills/Role Play Presentation with Stress and Intonation

## **SUGGESTED READINGS:**

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.
3. Technical Communication–Principles And Practices by Meenakshi Raman & Sangeeta Sharma
4. Dr.S.Uma Maheswari. English Workbook for Engineers and Technologists
5. Lakshmi Narayanan, Course Book on Technical English

25EEU101

BASICS OF ENGINEERING

Semester – I  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives**

- To understand the basic calculations and measurements in DC circuits.
- To familiarize with working and characteristics of different DC and AC machines.
- To impart knowledge on the fundamentals of measuring electrical and electronic quantities, various sensors and transducers to measure non-electrical quantities.
- Demonstrate the fundamentals and scope of Mechanical Engineering, covering its core principles, key domains, and emerging technologies
- Identify basic and modern construction materials, explain their engineering properties,

**Course Outcomes (COs)**

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.	Understand
CO2	Choose appropriate motor for specific applications based on the motor characteristics	Analyze
CO3	Analyze the functional blocks of a measurement system and the principles of various electrical and electronic instruments,	Analyze
CO4	Describe the scope of Civil Engineering and identify basic and modern construction materials along with their properties	Understand
CO5	Distinguish between different Steams of Mechanical Engineering and to gain foundational knowledge of mechanical systems, tools, and applications.	Understand

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS 01	PS 02	PS 03
CO 1	3	2	–	2	2	–	–	–	–	–	–	2	3	3	1	3
CO 2	3	3	–	2	2	–	–	–	–	–	–	2	3	3	1	3
CO 3	3	3	–	3	3	–	–	–	–	–	–	2	3	3	2	3
CO 4	2	1	–	–	–	2	2	–	–	–	–	1	–	–	3	2
CO 5	2	1	–	–	–	–	2	–	–	–	–	1	–	–	3	2

1 - low, 2 - medium, 3 - high

**UNIT I: DC CIRCUITS AND MEASUREMENTS**

The concept of voltage and current-Electric circuit elements: R, L, C – Independent and dependent sources – Ohm's law- Kirchoff's law- series and parallel resistive circuits – Voltage and current

division – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement of voltage, current and power in DC circuits.

## **UNIT II: ELECTRICAL MACHINES**

Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and Single phase induction motors. Working principle of BLDC Motor and its applications in home appliances.

## **UNIT III: ELECTRICAL AND ELECTRONIC INSTRUMENTATION**

Functional blocks of a measurement system - types of measurements - Direct and indirect measurements – Classification of instruments – Induction type – dynamometer type wattmeter's- Types of indicating Instruments Principles of Electrical Instruments – Multimeters, Oscilloscopes - Static and Dynamic characteristics of an instrumentation system – Errors in Measurement – Calibration and Standards.. Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall Effect – electromagnetic flow transducers

## **UNIT IV: INTRODUCTION TO CIVIL ENGINEERING AND MATERIALS**

Introduction to Civil Engineering- Basic Construction Materials- Properties of Engineering Materials- Selection of Materials for Construction- Modern Materials in Construction

## **UNIT V :SCOPE AND CORE PRINCIPLES OF MECHANICAL ENGINEERING**

Design, Manufacturing, Materials, Energy and Power Systems, Kinematics and Robotics, Instrumentation and Control, Emerging Trends, and Smart Applications.

**PERIODS: 45**

## **SUGGESTED READINGS:**

- 1.D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
- 2.Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGraw Hill Education (India) Private Limited, 2010.
- 3.S.K.Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson India, 2011.
- 4.Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2015.
- 5.Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013.
- 6.Rajendra Prasad, "Fundamentals of Electrical engineering", Prentice Hall of India, 2006.
- 7.Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, 24th reprint 2016.
- 8.Sawhney, A. K., and Puneet Sawhney "A Course in Electrical and Electronic Measurements and Instrumentation" Dhanpat Rai & Company, 2016.

25CSU121

PROGRAMMING FOR PROBLEM SOLVING

Semester – I  
6H – 4C

Instruction Hours / week: L: 2 T: 0 P: 4    Marks: Internal: 40    External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Develop the foundational understanding of problem-solving techniques, algorithm design, and programming basics using C and Python.
- Apply conditional and iterative constructs effectively for developing logical, flow-controlled programs in both C and Python.
- Impart knowledge of function-based and modular programming approaches for creating structured, maintainable, and reusable code.
- Equip students with the ability to manipulate arrays, strings, and lists, and apply fundamental searching and sorting algorithms in C and Python..
- Introduce memory management concepts through pointers in C, and provide practical skills in file handling and understanding Python’s memory model.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Construct basic programs using variables, operators, and input/output functions in C and Python	Remember
CO2	Execute decision-making and looping structures to solve common computational problems	Apply
CO3	Assemble modular programs by defining reusable functions with appropriate parameter usage and scope control	Analyze.
CO4	Implement basic searching and sorting algorithms to process structured data arrays, strings, and lists	Create
CO5	Demonstrate the use of pointers and dynamic memory in C, and operate file handling and memory reference concepts in C and Python	Evaluate

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	1	1	2	3	2	2	1	2	2	1		3	2	3
CO 2	3	2	2	2	3	2	3	2	2	2	2	2	3	2	3
CO 3	3	2	2	2	3	2	3	2	1	1	2	1	3	2	3
CO 4	3	2	2	2	3	2	3	2	2	2	2	2	3	2	3
CO 5	3	1	1	2	3	2	2	2	2	1	1		3	2	3

1 - low, 2 - medium, 3 - high

## **UNIT I: INTRODUCTION TO PROGRAMMING**

Introduction to problem solving, algorithms, and flowcharts, Programming structure in C and Python, Data types, variables, constants, Operators and expressions (arithmetic, relational, logical, assignment, Input/output functions: scanf, printf (C); input(), print() (Python) Type conversion and casting

## **UNIT II: CONTROL FLOW AND ITERATIVE STATEMENTS**

Decision-making: if, if-else, nested if, switch-case (C); if-elif-else (Python), Looping constructs: while, for, do-while (C); while, for-in (Python), Loop control: break, continue, pass, Problem-solving using loops (e.g., sum of digits, reverse number, pattern printing)

## **UNIT III: FUNCTIONS AND MODULAR PROGRAMMING**

Defining and calling functions in C and Python, Function parameters, return types, recursion, Python-specific: default arguments, keyword arguments, lambda functions, Variable scope and storage classes, Modular programming: creating reusable code blocks

## **UNIT IV: ARRAYS, STRINGS, LISTS**

Arrays in C: 1D and 2D, basic operations, Strings in C: declaration, input/output, string.h functions, Python lists: indexing, slicing, built-in methods, list comprehensions, Python strings: methods, slicing, immutability, Searching and sorting algorithms (linear, binary search; bubble, selection sort)

## **UNIT V: POINTERS (C) AND FILE HANDLING IN C AND PYTHON**

Pointers in C-declaration and initialization- Pointers and arrays-Pointers and functions (call by reference)Pointers and structures, Dynamic memory allocation: malloc(), calloc(), realloc(), free(), File Handling in C-and python, Python memory model Mutable vs immutable objects, Function argument passing (by object reference) using id() to understand memory behavior

**PERIODS: 60**

## **PRACTICAL EXERCISES (C and Python):**

1. Write a Program to convert Celsius to Fahrenheit and vice versa. (Practice: I/O, arithmetic operators, conditionals)
2. Write a Program to simulate Simple Calculator that Perform addition, subtraction, multiplication, and division based on user input. (Practice: switch-case or if-elif-else.)
3. Write a program to check whether a given number is Odd or Even (Practice: conditionals, modulo operator).
4. Write a program to find Factorial of a Number using both iterative and recursive methods. (Practice: loops, recursion).
5. Write a program to Print Fibonacci series up to n terms. (Practice: loop/recursion logic.)
6. Write a program to find the GCD of two numbers. (Practice: functions, logic)
7. Write a program to check if a number is prime. (Practice: loops, conditionals, modularity.
8. Write a program to reverse a 1D array (C) or list (Python). (Practice: arrays/lists, loops)
9. Write a program to check if a given string is a palindrome. (Practice: string manipulation.)
10. Write a program to sort a list/array using bubble sort or selection sort. (Practice: sorting logic).
11. Write a program to define a structure for storing student data and display it. (Practice: structs, functions).
12. Write a program to implement stack using List (Python) Implement push and pop operations. (Practice: lists, stack logic).
13. Write a program to read from and write to a text file. Practice: file I/O basics.
14. Write a program to read a file and count the number of words. (Practice: string handling, file reading.)

## **SUGGESTED READINGS:**

1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education, 2022

2. John Zelle, "Python Programming: An Introduction to Computer Science", 3rd Edition, Franklin, Beedle & Associates, 2016. ISBN: 978-1590282755..
3. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media, 2013.
4. Eric Matthes, "Python Crash Course", 2nd Edition, No Starch Press, 2019.
5. Charles Severance, "Python for Everybody: Exploring Data in Python 3", 2nd Edition, Charles Severance, 2020.

25MEU101

ENGINEERING GRAPHICS

Semester – I  
3H – 3C

Instruction Hours / week: L: 2 T: 1 P: 0 Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Communicate the concepts, ideas and design of Engineering products through graphic skills.
- Acquaint the national standards related to technical drawings.
- Comprehend Orthographic, Isometric and perspective projection to represent the objects in two and three-dimensions.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Sketch and distinguish between conic curves, cycloids, and involutes, and construct appropriate scales for engineering applications.	Apply
CO2	Identify and apply projection techniques to represent points, lines, and plane surfaces in first angle orthographic views.	Remember
CO3	Assemble and design accurate projections of solid geometries and truncated forms using appropriate methods.	Analysis
CO4	Prepare developments and sections of solids with holes and cut-outs, and evaluate the true shape of these sections.	Evaluate
CO5	Create isometric and perspective projections of simple and compound solids, and utilize CAD tools for visualization.	Create

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	3	2	3	1	2	1	1	1	1	2	2	2	2	2	2	3
CO 2	3	2	2	1	2	1	1	1	1	2	2	2	2	2	2	3
CO 3	3	2	2	1	2	1	1	1	1	2	2	2	2	2	2	3
CO 4	3	2	2	1	2	1	1	1	1	2	2	2	2	2	2	3
CO 5	3	2	2	1	2	1	1	1	1	2	2	2	2	2	2	3

1 - low, 2 - medium, 3 – high

**UNIT I: PLANE CURVES AND FREE HAND SKETCHING**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.

## **UNIT II: PROJECTION OF POINTS, LINES AND PLANE SURFACES**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

## **UNIT III: PROJECTION OF SOLIDS**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

## **UNIT IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

## **UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Computer Aided Drafting (Demonstration Only) Introduction to drafting packages and demonstration of their use.

**PERIODS: 45**

### **SUGGESTED READINGS:**

1. Parthasarathy, N.S.and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition,2014.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore,(2017).
4. Venugopal K. and Prabhu Raja V., “Engineering graphics”, New Age International (P) Limited,(2008).
5. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, (2012).

**SEMESTER - II**

**B.E.,B.Tech. (Common to all Branches)**

**2025-2026**

**25 MAU208**

**ENGINEERING MATHEMATICS -II**

**Semester – II  
4H – 4C**

**Instruction Hours / week: L: 3 T: 1 P: 0.      Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**

**Course Objectives**

- Define and differentiate the Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.
- Identify Fourier and half range Fourier transform techniques used in wide variety of situations.
- Apply the effective mathematical tools for the solutions of partial differential equations that model several physical processes.
- Evaluate Fourier transform techniques for different functions.
- Identify Z-transforms and Elementary properties of several functions

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Solve the methods of solving Partial differential equations.	Apply
<b>CO2</b>	Apply the concepts in Fourier series.	Apply
<b>CO3</b>	Apply the Partial derivative one-two dimensional concept in solving the Heat flow equations.	Apply
<b>CO4</b>	Solve the problems under Fourier transforms.	Apply
<b>CO5</b>	Identify and apply Z-transform concepts in Problem solving.	Apply

**CO-PO Mapping**

<b>CO / PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO1 0</b>	<b>PO1 1</b>	<b>PO 12</b>	<b>PS 01</b>	<b>PS 02</b>	<b>PS 03</b>
<b>CO 1</b>	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--	3
<b>CO 2</b>	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--	3
<b>CO 3</b>	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--	3
<b>CO 4</b>	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--	3
<b>CO 5</b>	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--	3

**1 - low, 2 - medium, 3 - high**

**UNIT I: PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations. Solutions of standard types of first order partial differential equations – Lagrange’s linear equation. Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

**UNIT II: FOURIER SERIES**

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Root mean square value – Parseval’s identity – Harmonic analysis

### **UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**

Classification of PDE – Method of separation of variables – Fourier Series – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

### **UNIT IV: FOURIER TRANSFORMS**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

### **UNIT: V- Z TRANSFORMS**

Z-transforms – Elementary properties – Convergence of Z-transform – Initial and final value theorem – Inverse Z-transform using partial fraction and residues – Formation of difference equations.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Kreyszig, E., 'Advanced Engineering Mathematics', John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal, B.S., 'Higher Engineering Mathematics', Khanna Publishers, New Delhi, 44th Edition, 2018.
3. Bali, N., Goyal, M., and Watkins, C., 'Advanced Engineering Mathematics', Firewall Media, New Delhi, 7th Edition, 2009.
4. L.C. Andrews and B. Shivamoggi, 'Integral Transforms for Engineers', SPIE Press, 1999.
5. Narayanan, S., Manicavachagom Pillay, T.K., and Ramanaiah, G., 'Advanced Mathematics for Engineering Students', Vol. II & III, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998

25CHU221

ENGINEERING CHEMISTRY

Semester – II  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**Course Objectives**

- To inculcate a sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of the phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties, and combustion characteristics.
- To familiarize the students with the operating principles, working processes, and applications of energy conversion and storage devices.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Interpret water quality parameters and treatment methods for domestic and industrial use.	Understand
CO2	Differentiate nanomaterials based on their properties, types, and synthesis techniques.	Analyse
CO3	Analyze phase diagrams and composite material systems with respect to their components and applications.	Apply
CO4	Evaluate fuel types, combustion characteristics, and emission parameters for energy efficiency.	Evaluate
CO5	Compare various energy sources and storage systems based on their principles and applications.	Assess

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	1	-	-	-	-	-	-	1	-	2	3	3	2
CO 2	2	2	1	-	-	-	-	-	-	-	-	2	3	3	2
CO 3	2	2	1	-	-	-	-	-	-	3	-	2	2	3	2
CO 4	2	2	1	-	-	-	-	-	-	-	-	2	3	3	2
CO 5	2	2	1	-	-	-	-	-	-	-	-	2	3	3	2

1 - low, 2 - medium, 3 - high

**UNIT I: WATER AND ITS TREATMENT**

Water: Sources and impurities, Water quality parameters: Definition and significance of color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Domestic water treatment: Steps involved -primary treatment and disinfection (UV, Ozonation, breakpoint chlorination). Desalination of brackish water: Electro dialysis- Reverse Osmosis. Boiler troubles:

Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming and foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate, and Calgon conditioning) and External treatment – Ion exchange demineralization process and zeolite process.

## **UNIT II: NANOCHEMISTRY**

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube-Single walled and Multiwalled Nanotubes- Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics, and catalysis.

## **UNIT III: PHASE RULE AND COMPOSITES**

Phase rule: Introduction, definition of terms with examples. One component system – water system; Reduced phase rule; Construction of a simple eutectic phase diagram – Thermal analysis; Two component system: lead-silver system – Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix, and ceramic matrix) and Reinforcement (fiber, particulates, flakes, and whiskers). Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites (CMC), and Polymer matrix composites (PMC). Hybrid composites – definition and examples.

## **UNIT IV : FUELS AND COMBUSTION**

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Fractional distillation of Petroleum- Manufacture of synthetic petrol (Fischer–Tropsch and Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method. CO<sub>2</sub> emission and carbon footprint.

## **UNIT V: ENERGY SOURCES AND STORAGE DEVICES**

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working, and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – NICAD battery, lead acid battery, and lithium-ion battery; Electric vehicles – working principles; Fuel cells: H<sub>2</sub>-O<sub>2</sub> fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.

**PERIODS : 45**

## **PRACTICAL EXERCISES**

1. Determination of hardness of water by EDTA method.
2. Determination of chloride content of water sample by argento metric method.
3. Determination of alkali content of water sample.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Determination of strength of acids in a mixture using conductivity meter.
6. Conductometric titration of strong acid Vs strong base.
7. Estimation of copper by EDTA method.
8. Estimation of iron content by Potentiometry.
9. Determination of molecular weight of polymer using Ostwald viscometer.

## 10. Conductometric Precipitation titration

### **SUGGESTED READINGS:**

1. P. C. Jain and Monica Jain.(2018). Engineering Chemistry, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi.
2. Sivasankar B.(2008). Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
3. S.S. Dara.( 2018). A Textbook of Engineering Chemistry, S. Chand Publishing, 12th Edition.
4. Dr. Sayeeda Sultana (2016). Engineering Chemistry, R.K. Publishers, Coimbatore.
5. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday. (2018). Textbook of Nanoscience and Nanotechnology, Universities Press-IIM Series in Metallurgy and Materials Science, .
6. Dr. Sayeeda Sultana, (2016). Practical Engineering Chemistry laboratory manual, R.K. Publishers, Coimbatore, .

Instruction Hours / week: L: 2 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives**

- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
- To implement simple logical operations using combinational logic circuits
- To design combinational logic circuits, sequential logic circuits.
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Formulate canonical expressions for switching functions.	Understand
CO2	Apply various Boolean function minimization techniques including Karnaugh Map and Quine-McCluskey method to optimize logic circuits	Apply/ Analyze
CO3	Design and implement combinational circuits such as adders, subtractors, multiplexers, encoders, decoders, and code converters using HDL	Apply /create
CO4	Analyze, design, and simulate basic sequential circuits including flip-flops, counters, and shift registers using HDL	Analyze / Create
CO5	Explain the organization and operation of memory devices and apply programmable logic devices for implementing combinational logic.	Understand / Apply

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	1	-	1	-	-	-	-	-	-	-	1	2	1
CO 2	3	3	2	1	1	-	-	-	-	-	-	-	1	2	2
CO 3	3	3	3	2	3	-	-	-	-	1	1	-	1	2	3
CO 4	3	2	3	2	2	-	-	-	-	1	1	-	2	1	3
CO 5	3	2	2	1	1	-	-	-	-	-	-	-	2	1	3

**UNIT 1: Number System and Boolean Algebra**

Number Systems, Base Conversion Methods, Complements of Numbers, Codes- Binary Codes, Binary Coded Decimal Code and its Properties, Unit Distance Codes, Error Detecting and

Correcting Codes. Digital Logic Gates(AND,NAND,OR,NOR,EX-OR,EX-NOR), Properties of XOR Gates, Universal Gates, Basic Theorems and Properties, Switching Functions, Canonical and Standard Form.

**UNIT 2: Minimization Techniques:**

Introduction, The minimization with theorems, The Karnaugh Map Method, Three, Four and Five variable K- Maps, Prime and Essential Implications, Don't Care Map Entries, Using the Maps for Simplifying, Quine-McCluskey Method, Multilevel NAND/NOR realizations

**UNIT 3: Combinational Circuits:**

Design Procedure – Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Binary Adder, Parallel binary subtractor, Binary Multiplier, Multiplexers/De-Multiplexers, decoder, Encoder, Code Converters, Magnitude Comparator. Introduction to HDL — HDL Models of Combinational circuits.

**UNIT 4: Sequential Circuits:**

Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, Latches, Flip-Flops, SR,JK,D,T and Master slave, characteristic Tables and equations, Conversion from one type of Flip-Flop to another, Counters - Design of Single Mode Counter, Ripple Counter, Ring Counter, Shift Register, Ring counter using Shift Register - HDL Models of Sequential Circuits

**UNIT 5: Memory Devices:**

Classification of memories – ROM : ROM organization, PROM, EPROM,EEPROM, RAM: RAM organization, Write operation, Read operation, Static RAM , Programmable Logic Devices: Programmable Logic Array(PLA),Programmable Array Logic, Implementation of Combinational Logic circuits using ROM,PLA,PAL.

**PERIODS : 60**

**PRACTICAL EXERCISES:**

1. Experimental Verification of Logic Gates
2. Design and Experimental verification of Boolean function
3. Design of adders, subtractors& code converters
4. Design of Multiplexers & Demultiplexers.
5. Design of Encoders and Decoders
6. Design of Magnitude Comparators
7. Design and implementation of counters using flip-flops
8. Design and implementation of shift registers.
9. Coding combinational circuits using HDL
10. Coding sequential circuits using HDL

**SUGGESTED READINGS:**

1. Digital Design- Morris Mano, PHI, 3rd Edition.
  2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition.
  3. Switching and Finite Automata Theory- ZviKohavi & Niraj K. Jha, 3rd Edition, Cambridge.
  4. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.
  5. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson, 2013.
  6. Switching Theory and Logic Design – Bhanu Bhaskara –Tata McGraw Hill Publication, 2012
  7. Fundamentals of Logic Design- Charles H. Roth, Cengage Learning, 5th, Edition, 2004.
  8. Digital Logic Applications and Design- John M. Yarbrough, Thomson Publications, 2006.
  9. Digital Logic and State Machine Design – Comer, 3rd, Oxford, 2013
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25ITU221

OBJECT ORIENTED APPLICATION DEVELOPMENT

Semester-II  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2 Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

1. Understand and apply the fundamental concepts of object-oriented programming including classes, objects, encapsulation, inheritance, polymorphism, and abstraction.
2. Analyze and implement advanced object-oriented features such as function overloading, operator overloading, templates, and exception handling.
3. Design and develop programs using inheritance hierarchies, virtual functions, and abstract classes to solve complex programming problems.
4. Implement Java-based object-oriented solutions utilizing packages, interfaces, multithreading, and string handling mechanisms.
5. Develop interactive applications with graphical user interfaces using JavaFX controls, components, layouts, and event handling techniques.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Analyze programming problems and implement object-oriented solutions using classes, objects, and appropriate OOP constructs.	Apply
CO2	Apply inheritance, polymorphism, and exception handling techniques to develop robust applications	Apply
CO3	Implement appropriate Java programming constructs, including packages, interfaces, and multithreading	Understand
CO4	Demonstrate the concepts of exception handling and file management in both C++ and Java.	Apply
CO5	Evaluate and create interactive GUI applications using JavaFX components and event handling mechanisms.	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	1	1	1	2	2	1	1	3	3
CO2	3	3	3	2	3	1	1	2	2	2	2	2	3	3
CO3	3	3	3	3	3	1	1	2	2	2	2	2	3	3
CO4	3	3	3	3	3	1	1	2	2	2	2	2	3	3
CO5	3	3	3	3	3	1	1	2	2	2	2	2	3	3

1 - low, 2 - medium, 3 – high

**Unit I – FUNDAMENTAL CONCEPTS OF OOP**

Object-Oriented Paradigm - Elements of Object Oriented Programming – Structure of C++ program – Classes and Objects - Defining member functions - Passing and returning objects – Array of objects - Inline functions - Constructors - Parameterized Constructors - Constructor Overloading. Copy Constructor, Destructors, Default

arguments - new, delete operators - “this” pointer, Friend classes and Friend functions - Function Overloading – Operator Overloading - Generic programming with templates-Function templates - Class templates

### **Unit II – INHERITANCE, VIRTUAL FUNCTIONS AND EXCEPTION HANDLING**

Inheritance - Base class and derived class relationship - Forms of inheritance - Inheritance and member accessibility - constructors in derived class, abstract class, virtual functions, pure virtual function - Files and Streams - Opening and Closing a file- file modes- file pointers and their manipulation, sequential access to a file-random access to a file-Reading and Writing – Exception handling.

### **Unit III – INHERITANCE, PACKAGES AND INTERFACES IN JAVA**

Java Buzzwords – Overview of Java – Programming Structures in Java – Defining classes in Java - Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces -

### **Unit IV – EXCEPTION HANDLING, MULTITHREADING AND STRING HANDLING**

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java’s Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads – Multithreading. Wrappers – Auto boxing - Strings: Basic String class, methods and String Buffer Class.

### **Unit V – JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS**

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

## **PRACTICAL EXERCISES**

1. Design a C++ program to define a Student class and manage student records using an array of objects. Read details of n students, compute total and average marks, and display all records along with the topper.
2. Write a C++ program to create a Box class and demonstrate default constructor, parameterized constructor, constructor overloading, copy constructor, and destructor by creating objects in different ways.
3. Develop a C++ program to implement a BankAccount class where objects are passed as function arguments and returned from functions. Provide operations like deposit, withdrawal, balance display, and merging two accounts into a new account.
4. Write a C++ program to create a Complex class and overload operators to perform addition, subtraction, multiplication, equality checking, and formatted output of complex numbers.
5. Develop a C++ program to demonstrate friend function and friend class by allowing them to access and modify private data members of an Employee class.
6. Write a C++ program using templates to implement (i) a function template for sorting elements of any data type and (ii) a class template for a stack with push, pop, peek, and empty operations. Demonstrate with at least two data types.
7. Create a C++ program to define an abstract base class Shape with a pure virtual function area(). Derive Circle, Rectangle, and Triangle and use base class pointers to compute and display areas using runtime polymorphism.

8. Develop a C++ program using file streams to store and manage student records in a file. Support adding records, displaying all records, searching by roll number, and updating a record using random file access (seekg/seekp).
9. Write a Java program to define an Employee class and compute salary details. Demonstrate method overloading, objects as parameters, returning objects, and use of static members for common organization details.
10. Create a Java application using user-defined packages to organize classes such as Person, Student, and Faculty. Demonstrate method overriding, dynamic method dispatch, and implement an interface (e.g., Payable) in an appropriate class.
11. Develop a Java program that performs bank transactions and demonstrates exception handling using multiple catch blocks and nested try blocks. Create and use a user-defined exception (e.g., InsufficientBalanceException) for invalid withdrawals.
12. Write a Java program to demonstrate multithreading by creating multiple threads and implementing synchronization with inter-thread communication (wait()/notify()). Also include string processing operations and demonstrate wrapper classes with auto-boxing/unboxing.
13. Design a Java program to demonstrate file handling using FileInputStream/FileOutputStream and BufferedReader/BufferedWriter. The program should write employee/student records to a text file, read and display all records, and search a record by a key field (like ID/roll number). Also include exception handling for file-related errors (FileNotFoundException, IOException).
14. Develop a JavaFX application to demonstrate event handling and UI controls. The GUI should include TextField, RadioButton/CheckBox, ComboBox/ListView, and a Button. On button click (and at least one key/mouse event), the program should collect user selections, validate input, and display the result using a Label/Alert. Use at least one layout manager (GridPane/BorderPane/VBox) for arranging components.

## **SUGGESTED READINGS**

1. Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill, 2017.
2. E. Balagurusamy, "Object-oriented programming with C++", Tata McGraw Hill, 2017.
3. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
4. Herbert Schildt, "Java: The Complete Reference", 12th Edition (2021), McGraw-Hill Education.
5. Cay S. Horstmann, "Core Java Volume I – Fundamentals", 12th Edition (2022), Oracle Press.
6. Cay S. Horstmann, "Core Java Volume II – Advanced Features", 12th Edition (2022), Oracle Press.

**25ITU222 DATA STRUCTURES AND ALGORITHMS**

**Semester-II  
5H – 4C**

**Instruction Hours / week: L: 3 T: 0 P: 2**

**Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**

**Course Objectives**

- To understand the basic concepts of ADTs
- To design linear data structures–Stacks and Queues
- To understand linear data structure–Linked List
- To understand Tree and Graph structures
- To understand sorting, searching, and hashing algorithms

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Understand basic concepts of Data structure and algorithms.	Apply
CO2	Understand and implement linear data structures, such as stack and queues.	Apply
CO3	Understand and implement linear data structures-Linked Lists.	Understand
CO4	Understand and implement efficient tree structures and efficient graph algorithms.	Apply
CO5	Understand and implement different Sorting and Searching algorithms.	Apply

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PS 01	PS 02	PS 03
CO 1	3	1	2	2	3	2	2	2	3	2	3	1	1	2	2
CO 2	2	2	3	1	1	2	2	1	2	1	2	2	2	1	2
CO 3	1	3	2	2	1	2	2	1	2	2	2	1	1	2	1
CO 4	1	3	3	3	2	2	3	1	1	2	1	2	1	3	2
CO 5	3	1	2	1	1	3	3	2	3	2	3	2	2	2	1

**1 - low, 2 - medium, 3 - high**

**UNIT 1: INTRODUCTION**

Basic Terminologies: Elementary Data Organizations, Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off, Searching: Linear Search and Binary Search Techniques and their complexity analysis.

**UNIT 2: STACKS AND QUEUES**

ADT Stack and its operations, Applications of Stacks: Expression Conversion and evaluation– Corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

### **UNIT 3: LINKED LISTS**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and complexity analysis.

### **UNIT 4: TREES AND GRAPHS**

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, General Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and Complexity analysis.

### **UNIT 5: SORTING AND HASHING**

Objective and properties of different Sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing: Static Hashing Techniques, Collision resolution techniques, Dynamic Hashing techniques.

**PERIODS : 60**

### **PRACTICALEXERCISES: Implement all programs in C++**

1. Implement simple ADT programs.
2. Implementation of Stack and Queue ADTs
3. Implement List ADT using Arrays
4. Linked list implementations of List
5. Applications of List, Stack and Queue ADTs
6. Implementation of Tree representation and traversal algorithms
7. Implementation of Graph representation and traversal algorithms
8. Implementation of Sorting and Searching algorithms
9. Implementation of single source shortest path algorithm

### **SUGGESTED READINGS:**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2014.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Tata McGraw Hill, 2002.
4. Wisnu Anggoro, "C++ Data Structures and Algorithms", Packt Publishing, 2018.
5. Ellis Horowitz, Sartaj Sahni, Susan And person Freed, "Fundamentals of Data Structures In C", University Press, 2008

25IKS001

## INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM

Semester – II  
2H – 2C

Instruction Hours / week: L: 2 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

## Course Objectives

- To introduce students to the foundational concepts of the Indian Knowledge System (IKS)
- To explore the relevance and applications of IKS in contemporary times.
- To promote interdisciplinary learning through the integration of traditional Indian knowledge and modern education.

## Course Outcomes (COs)

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Describe the meaning, scope, and philosophical foundations of IKS	Remembering
CO2	Summarize the features of Indian education, language, and literary contributions	Understanding
CO3	Illustrate traditional Indian scientific and technological advancements	Applying
CO4	Examine the impact of Indian art, aesthetics, and socio-cultural practices	Analyzing
CO5	Evaluate the relevance and application of IKS in contemporary society	Evaluating

## CO-PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	2	2	1	1	2	0	0	0	0	0	2	1	1
CO 2	2	3	2	1	2	0	1	0	0	0	0	0	1	2	1
CO 3	2	2	3	2	2	1	2	1	0	0	0	0	2	1	2
CO 4	1	1	2	3	2	2	2	1	1	0	0	0	1	2	2
CO 5	1	1	1	2	3	3	2	2	1	0	0	0	1	3	3

1 - low, 2 - medium, 3 - high

## UNIT I: FOUNDATIONS OF INDIAN KNOWLEDGE SYSTEM

Meaning and Scope of IKS-Historical evolution and literary sources: Vedas, Upanishads, Puranas-Philosophical foundations: Darshanas (Nyaya, Vaisheshika, Samkhya, Yoga, Mimamsa, Vedanta)- Interdisciplinary nature of IKS.

## UNIT II: EDUCATION, LANGUAGE, AND LITERATURE

Traditional education systems: Gurukula, Pathashalas-Higher education: Nalanda, Takshashila- Role of Sanskrit and regional languages-Contributions of Panini, Bhartrihari-Epics and classical literature.

### **UNIT III: SCIENCE AND TECHNOLOGY IN IKS**

Mathematics: Sulbasutras, Aryabhata, Bhaskara-Astronomy: Surya Siddhanta-Ayurveda: Tridosha, healing systems-Metallurgy, Vastu Shastra, water management-

### **UNIT IV: INDIAN ART, CULTURE, AND SOCIETY**

Music, dance, painting, sculpture-Rasa theory, Natya Shastra-Festivals, rituals, socio-cultural life-Dharma, Purusharthas, social organization.

### **UNIT V: CONTEMPORARY RELEVANCE AND APPLICATIONS OF IKS**

IKS in modern education and research-Sustainable practices in agriculture, ecology, lifestyle-Yoga and meditation in wellness-Role of IKS in national identity and global relevance.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. **Kapil Kapoor (Ed.)** – *Encyclopedia of Hinduism*, Rupa Publications, Comprehensive overview of philosophical and literary foundations of IKS.
2. **Michel Danino** – *The Indian Mind: A Cultural and Philosophical Perspective*, DK Printworld- Offers insight into Indian civilization's unique philosophical frameworks and relevance today.
3. **V. Sivaramakrishnan (Ed.)** – *Cultural Heritage of India*, Ramakrishna Mission Institute of Culture-Multi-volume work covering various aspects of Indian science, arts, literature, and education.
4. **Subhash Kak, David Frawley & N.S. Rajaram** – *In Search of the Cradle of Civilization*, Motilal Banarsidass-Discusses early Indian contributions to science, mathematics, and cosmology.
5. **Bharatiya Vidya Bhavan Series** – *History and Culture of Indian People*-A classic multi-volume series offering a deep dive into ancient Indian education, society, arts, and sciences.
6. **Debroy, Bibek** – *The Bhagavad Gita, Upanishads, and the Vedas (Translations)*-For primary source reading and understanding scriptural references in IKS.
7. **R. Balasubramanian (Ed.)** – *The Bloomsbury Research Handbook of Indian Epistemology and Metaphysics*
8. **Yoga Sutras of Patanjali (Various commentaries)** – for insights into yoga, wellness, and consciousness studies.

25MEU211

DESIGN THINKING AND INNOVATIONS LAB

Semester – II

4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**Course Objectives**

- Demonstrate the significance of design thinking and contrast it with traditional problem-solving techniques.
- Manipulate each phase of the design thinking process to solve human-centered problems.
- Equip students with essential tools and techniques for user-centered design, creative idea generation, and rapid prototyping
- Understand innovation types, overcome barriers, analyze success stories, and effectively pitch ideas.
- Build innovative models through ideation and prototyping tools and strategies.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	<b>Distinguish between</b> traditional and design thinking approaches through hands-on comparisons.	Understand
CO2	<b>Apply</b> the five phases of design thinking to solve a user-focused problem.	Apply
CO3	<b>Create and use</b> empathy-based design tools to develop human-centric solutions.	Create
CO4	<b>Analyze innovation types, strategies, case studies, and confidently pitch ideas to stakeholders.</b>	Analyze
CO5	Develop sustainable, impactful solutions through design thinking and prototyping.	Create

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS 01	PS 02	PS 03
CO 1	3	2	1	1	2	2	3	3	3	3	2	2	3	2	3	2
CO 2	3	3	2	2	3	2	3	2	3	3	2	3	3	3	3	3
CO 3	3	3	3	2	3	2	2	2	3	2	1	3	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2
CO 5	3	2	2	2	2	3	3	3	3	3	2	3	3	3	3	2

1 - low, 2 - medium, 3 - high

**UNIT I: INTRODUCTION TO DESIGN THINKING**

Definition and importance of design thinking - Comparison with traditional problem-solving approaches - Key principles: Empathy, experimentation, and iteration. Problem Reframing Techniques.

## **UNIT II: PHASES OF DESIGN THINKING**

Empathize: Understanding users and their needs - Define: Framing the right problem to solve. Ideate: Generating a wide range of ideas - Prototype: Building representations of ideas - Test: Gathering feedback to refine solutions.

## **UNIT III: TOOLS AND TECHNIQUES**

Empathy maps, user personas, journey mapping - Brainstorming, SCAMPER, mind mapping - Rapid prototyping techniques: sketches, models, digital tools. Rapid idea generation tools for expanding creative thinking.

## **UNIT IV: INNOVATION STRATEGIES**

Types of innovation: product, process, business model - Barriers to innovation and how to overcome them - Case studies of successful innovations- Presenting and pitching ideas to stakeholders

## **UNIT V: SUSTAINABLE DESIGN AND PROTOTYPING**

Design thinking for sustainability and social impact. Tangible outcomes in terms of design and prototype development.

**PERIODS:45**

## **SUGGESTED READINGS:**

1. Jeanne Liedtka, Randy Salzman, Daisy Azer, Experiencing Design: The Innovator's Journey, Columbia Business School Publishing, 2021
2. Arne van Oosterom, Marcel Zwiers, This is Design Thinking. This is Service Design Doing, BIS Publishers, 2020
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Bloomsbury Academic, 2nd Edition, 2022
4. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Wiley, 2020
5. Robert Curedale, Design Thinking Process and Methods 5th Edition, Design Community College Inc., 2021.

25MAC201

INDIAN CONSTITUTION AND HUMAN RIGHTS

Semester – II  
2H – 2C

Instruction Hours / week: L: 2 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives.**

- To create the basic philosophical tenets of Indian Constitution and Human Rights.
- To underline the significance of our Constitution as Fundamental Law of the land and its features.
- To respect human rights, rule of law and democracy.
- To gain In-depth insight into the constitutional, statutory and institutional aspects of human rights protection in India.
- To identify the constitutional provisions dealing with human rights and special legislations dealing with protection of vulnerable and marginalized groups.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
C01	Demonstrate the provisions under the Constitution of India dealing with human rights	Remember
C02	Display the nature and scope of special legislations dealing with protection of human rights of marginalized and vulnerable sections.	Understand
C03	Apply practically human rights law to specific human rights problems in India	Apply
C04	Analyze complex human rights problems and apply relevant provisions of human rights law in India to a hypothetical situation/case study..	Analyze
C05	Acquainted with the theoretical knowledge of the underpinnings of the human rights framework in India, its operation and issues associated with its implementation.	Create

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	2	1	3	3	3	3	3	3	3	3	2	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3
CO 3	3	3	2	2	1	3	3	3	1	3	3	2	3	3	2	3
CO 4	3	2	3	3	3	2	3	2	2	3	3	3	1	3	2	3
CO 5	2	3	1	3	2	3	2	3	3	2	3	3	3	2	1	2

1 - low, 2 - medium, 3 – high

**UNIT I: THE CONSTITUTION**

Definition and Principles of the Constitution – Socio, Economic and Political Conditions in

India at the time of Independence – Contents and Amendments to the Constitution.

**UNIT II: FUNDAMENTAL RIGHTS**

Historical Perspectives on Rights in India – Fundamental Rights in India – Provisions in Articles 14 to 32 and its implications on Human Rights – Right against unlawful detention.

**UNIT III: DUTIES, DIRECTIVE PRINCIPLES AND AFFIRMATIVE ACTIONS**

Fundamental Duties of a citizen in India - Directive Principles - Policy and Practices in Reservation – Affirmative Actions: Special Provisions for SCs and STs.

**UNIT IV: PROTECTION OF WEAKER SECTIONS OF SOCIETY**

Constitutional Provisions for the Protection of women and children - Safeguard for the Labours – Minorities – Tribals.

**UNIT V: ENFORCEMENT MECHANISM AND EVALUATION**

Protection of Human Rights Act 1993 – National and State Human Rights Commissions – Role of Judiciary in Human Rights Protection – Critical Appraisal of the Current Status of Human Rights in India – AFSPA.

**PERIODS : 45**

**SUGGESTED READINGS:**

1. Desai, A.R. (ed.) (1986), Violations of Democratic Rights in India, Bombay: Popular Prakashan.
2. Meghraj Kapurderiya (2013) Indian Philosophical Foundation of Human Rights, New Delhi: R.P. Publications.
3. Mishra, P.K. (2012) Human Rights: Acts, Statutes and Constitutional Provisions, Jaipur: Ritu Publications.
4. Satish Chandra (1995) Minorities in National And International Laws, New Delhi: Deep and Deep Publications.

## SEMESTER – III

B.E. / B.Tech. (Common to all Branches)

2025-2026

Semester – III

25MAU301 DISCRETE MATHEMATICS WITH PROBABILITY AND STATISTICS

4H – 4C

Instruction Hours / week: L: 3 T: 1 P: 0 Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

### Course Objectives

- Define and identify the properties under set theory.
- Analyze the concepts of algebraic structure
- Demonstrate the probability the or to solve the problems.
- Apply and identify the concepts of testing the hypothesis
- Apply and classify the design of experiments and its applications to solve the problems.

### Course Outcomes (COs)

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Apply the knowledge of sets and Logic and do simple problems	Remember
CO2	Get thorough knowledge Algebraic Structure	Understand
CO3	Apply the concept of Probability in real life problems and derive at the solution	Apply
CO4	Identify large sample and small sample test to various test for single mean, double mean and variance..	Analyze
CO5	Classify One-way or Two-way ANNOVA and construct the table, finally solve the problem.	Create

### CO-PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	2	1	3	3	3	3	3	3	3	3	2	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3
CO 3	3	3	2	2	1	3	3	3	1	3	3	2	3	3	2	3
CO 4	3	2	3	3	3	2	3	2	2	3	3	3	1	3	2	3
CO 5	2	3	1	3	2	3	2	3	3	2	3	3	3	2	1	2

1 - low, 2 - medium, 3 - high

### UNIT I: SETS AND LOGIC

Basic Notations – Sets - Set and Properties - Set laws - The Boolean algebra of sets -The Boolean identities for sets – Propositional Logic – Propositional equivalences – Predicates and Quantifiers.

## **UNIT II: ALGEBRAIC STRUCTURES**

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's –Normal subgroup and Cossets – Lagrange's theorem – Definitions and examples of Rings and Fields.

## **UNIT III: PROBABILITY**

Probability - The axioms of probability - Conditional probability - Baye' stheorem - Discrete and continuous random variables - Moments – Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

## **UNIT IV: TESTING OF HYPOTHESIS**

Sampling distributions – Estimation of parameters – Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means – Tests based on t, Chi-square and F distributions for variance.

## **UNIT V: DESIGN OF EXPERIMENTS**

Basic Principles of Design of Experiments - Randomization, Replication, Local Control, Analysis of Variance - One - way and Two-way Classification - Completely Randomized Design and Randomized Block Design.

**PERIODS: 45**

## **SUGGESTED READINGS:**

1. .P.Tremblay. R. Manohar "Discrete Mathematical Structures with applications to Computer Science "Tata Mc-Graw-Hill Publishing company pvt. Ltd. New Delhi, 35thedition, 2008.
  2. Veerajan.T, Discrete Mathematics with Graph Theory and Combinatorics", 10<sup>th</sup> edition, Tata Mc-Graw-Hill Companies, 2010.
  3. An Introduction to Probability Theory and Its Applications: By William Feller
  4. Probability and statistics for engineers and scientists: By Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye
  5. Fundamentals of Statistics by P.R. Vital-2000
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25UHV001

UNIVERSAL HUMAN VALUES AND ETHICS

Semester – III  
2H – 2C

Instruction Hours / week: L: 2 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**Course Objectives:**

1. To understand the need, basic guidelines, content, and process of value education.
2. To develop right understanding and relationship at all levels of living.
3. To understand harmony in the human being, family, society, and nature.
4. To relate the holistic understanding with professional ethics.
5. To apply value-based principles in personal and professional life.

**Course Outcomes:**

- CO1:** Demonstrate understanding of the holistic development of a human being.  
**CO2:** Distinguish between physical needs and the needs of the self.  
**CO3:** Apply human values in family and societal interactions.  
**CO4:** Analyze nature and existence in terms of mutual harmony and co-existence.  
**CO5:** Integrate ethical human conduct in their professional practice.

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	2	1	3	3	3	3	3	3	3	3	2	3	3	2	2
CO 2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3
CO 3	3	3	2	2	1	3	3	3	1	3	3	2	3	3	2	3
CO 4	3	2	3	3	3	2	3	2	2	3	3	3	1	3	2	3
CO 5	2	3	1	3	2	3	2	3	3	2	3	3	3	2	1	2

1 - low, 2 - medium, 3 - high

**Unit 1: Introduction to Value Education**

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.

**Unit 2: Harmony in the Human Being**

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.

**Unit 3: Harmony in the Family and Society:**

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.

**Unit 4: Trees and Graphs:**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

**Unit 5: Implications of the Holistic Understanding – a Look at Professional Ethics:**

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, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession..

**PERIODS: 45**

**SUGGESTED READINGS:**

1. Gaur, R.R., Sangal, R., & Bagaria, G.P., A Foundation Course in Human Values and Professional Ethics, Publisher: Excel Books, New Delhi, 2022.
2. Sharma, S. B., Education for Values, Environment and Human Rights, Publisher: Lotus Press, New Delhi, 2022
3. Pathania, A. , Value Education: Perspectives and Practices, Pearson Education India, 2023
4. The Textbook 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

25ITU321

**PRINCIPLES OF OPERATING SYSTEMS**

**Semester – III  
5H – 4C**

**Instruction Hours / week: L: 3 T: 0 P: 2**

**Marks: Internal: 40**

**External: 60 Total: 100**

**End Semester Exam: 3 Hours**

To understand the basic concepts of major operating system components and its design principles.

- To provide an in-depth exposure to process management.
- To understand various memory management techniques.
- To understand storage management concepts
- To be familiar with the basics of virtual machines and Mobile OS.

**COURSE OUTCOMES:**

At the end of this course, the students will be able to:

**CO1:** Analyze various scheduling algorithms and process synchronization

**CO2:** Explain deadlock prevention and avoidance algorithms

**CO3:** Compare and contrast various memory management schemes

**CO4:** Explain the functionality of file systems, I/O systems, and Virtualization

**CO5:** To compare iOS and Android Operating systems

**CO's-PO's & PSO's MAPPING**

CO s	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	3	2	2	2	3	2	3	1	1	2	2
2	2	2	3	1	1	2	2	1	2	1	1	2	2	1	1
3	1	3	2	2	1	2	2	1	2	2	1	1	1	2	1
4	1	3	3	3	2	2	3	1	1	2	1	2	1	3	2
5	3	1	2	1	1	3	3	2	3	2	3	2	2	2	1
AVg.	2	2	2	2	1.6	2.2	2.4	1.4	2	2	2	2	1	2	1.4

1 - low, 2 - medium, 3 - high, ‘-‘- no correlation

**UNIT 1: INTRODUCTION**

Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Operating-System Services. User and Operating-System Interface, System Calls, Types of System Calls, System Programs.

**UNIT 2: PROCESS MANGEMENT**

Process Concept, Process Scheduling, Operations on Processes, Inter-process communication, Multicore Programming, Multithreading Models. Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms. The Critical-Section Problem, Peterson’s Solution, Semaphores, Classic Problems of Synchronization. Deadlock: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.

### **UNIT 3: MEMORY MANAGEMENT**

Swapping, Contiguous Memory Allocation. Segmentation, Paging, Structure of the Page Table, Demand Paging, Page Replacement, Allocation of Frames, Thrashing.

### **UNIT 4: STORAGE MANAGEMENT**

File Concept, Access Methods, File-System Mounting, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods. Disk Structure, Disk Attachment, Disk Scheduling. I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software.

### **UNIT 5: VIRTUAL MACHINES AND MOBILE O.S**

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.

**PERIODS: 60**

#### **PRACTICAL EXERCISES:**

1. Installation of windows operating system
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exit, Getpid, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphore
7. Write C programs to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
11. Write C programs to implement the following Memory Allocation Methods  
a. First Fit b. Worst Fit c. Best Fit
12. Write C programs to implement the various Page Replacement Algorithms
13. Write C programs to Implement the various File Organization Techniques
14. Implement the following File Allocation Strategies using C programs  
a. Sequential b. Indexed c. Linked

**PERIODS: 60**

#### **SUGGESTED READINGS:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.
3. Ramaz Elmasri, A. Gil Carrick, David Levine, " Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010
4. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.

25ITU301

INFORMATION STORAGE AND MANAGEMENT

Semester – III  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES:**

- Evaluate storage architectures and key data center elements.
- Explain physical and logical components of a storage infrastructure.
- Explain storage networking technologies
- Understand and articulate business continuity solutions
- Explain key characteristics, services, deployment models and infrastructure components for a cloud computing.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Describe and apply storage technologies

**CO2:** Identify storage technologies that provide cost effective IT solutions

**CO3:** Describe important features such as availability, replication, scalability and performance

**CO4:** Identify and implement storage virtualization technologies

**CO5:** Design, Analyze and manage cluster of resources.

**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	2

1 - low, 2 - medium, 3 - high, ‘-‘- no correlation

**UNIT I: STORAGE SYSTEM**

Introduction to information storage, Virtualization and cloud computing, Key data center elements, Compute, application, and storage virtualization, Disk drive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual

provisioning)

## **UNIT II : STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**

Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCSI and FCIP as an IP-SAN solutions, Converged networking option – FCoE, Network Attached Storage (NAS) – components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.

## **UNIT III: BACKUP, ARCHIVE AND REPLICATION**

Business terminologies, planning and solutions, Backup and recovery – methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection.

## **UNIT IV: CLOUD COMPUTING**

Characteristics and benefits, Services and deployment models, Cloud infrastructure components, Cloud migration consideration.

## **UNIT V: SECURING AND MANAGING**

Storage Infrastructure Security threats and countermeasures in various domains, Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle Management (ILM) and storage tiering.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Education Services, Wiley, May 2012
2. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, "Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE, 2nd Edition, Wiley, July 2009
3. Information Storage and Management: Storing, Managing, and Protecting Digital Information, EMC Education Services, Wiley, January 2010

25ITU322

DATABASE MANAGEMENT SYSTEM AND SERVICES

Semester – III  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To learn the fundamentals of data models, relational algebra and SQL
- To represent a database system using ER diagrams and to learn normalization techniques
- To understand the fundamental concepts of transaction, concurrency and recovery processing
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To have an introductory knowledge about the Distributed databases, NOSQL and database security.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Explain the key principles, the structures, and the organization of relational databases and to formulate query using relational algebra/ SQL.

**CO2:** Identify the methodology of conceptual modelling through ER Model and use formal techniques like normalization to design a database schema.

**CO3:** Demonstrate the transactions and estimate the procedures for controlling the consequences of concurrent data access.

**CO4:** Analyze the database storage structures, access and query processing techniques.

**CO5:** Understand and differentiate the principles and common features of the distributed, and NoSQL databases

**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

**UNIT I: RELATIONAL DATABASES**

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Introduction to Relational Databases – Relational Model – Keys – Relational Algebra – Relational Calculus – SQL Fundamentals – Advanced SQL features – Triggers – Embedded SQL.

## **UNIT II : RELATIONAL DATABASE DESIGN AND QUERY PROCESSING**

Entity-Relationship Model – ER Diagrams – Functional Dependencies – Non-Loss Decomposition  
Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form –  
Dependency Preservation – Boyce/Codd Normal Form – Multi-Valued Dependencies and Fourth  
Normal Form – Join Dependencies and Fifth Normal Form

## **UNIT III : TRANSACTION MANAGEMENT**

Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels –  
Concurrency Control – Need for Concurrency – Lock-Based Protocols - Timestamp-Based  
Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm -  
ARIES

## **UNIT IV: IMPLEMENTATION TECHNIQUES**

Overview of Physical Storage Media – RAID – File Organization – Organization of Records in Files  
– Indexing and Hashing – Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic  
Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Query  
Optimization

## **UNIT V: ADVANCED TOPICS**

Overview of Distributed Databases – Data Fragmentation – Replication – NOSQL Database:  
Characteristics – CAP theorem – Types of NoSQL Data stores: Column Oriented, Document, Key-  
Value and Graph Types – Introduction to MongoDB – Data Model - JSON and BSON -  
Polymorphic Schemas - Basic Querying

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

1. Create a database table, add constraints (primary key, unique, check, NOT NULL), insert rows, update, and delete rows using SQL DDL and DML commands.
2. Create set of tables, add foreign key constraints, and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Query the database tables and explore natural, equi, and outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Execute complex transactions and realize DCL and TCL commands.
8. Write SQL Triggers for insert, delete, and update operations in database table.
9. Create View and index for database tables with large number of records.
10. Create Document, column, and document - based data using NOSQL database tools

### **SUGGESTED READINGS:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2020.

2. Shakuntala Gupta Edward and Navin Sabharwal, "Practical MongoDB: Architecting, Developing and Administering MongoDB", Apress, 2015.
3. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006
4. Raghuram Ramakrishnan, Johannes Gehrke, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010

25ITU323

DESIGN AND ANALYSIS OF ALGORITHMS

Semester – III  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To learn about the process of problem solving.
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To learn to write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Analyze algorithms based on time and space complexity**CO2:** Design efficient Divide and conquer and its variants for solving problems.**CO3:** Apply greedy methods and dynamic programming strategies for solving real- world problems**CO4:** Design and implement Linear programming, backtracking, and branch and bound techniques towards efficient problem-solving**CO5:** Understand the computational theory and the methods to prove NP-complete problems.**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	3	2	2	2	3	2	3	1	1	2	2
2	2	2	3	1	1	2	2	1	2	1	2	2	2	1	2
3	1	3	2	2	1	2	2	1	2	2	2	1	1	2	1
4	1	3	3	3	2	2	3	1	1	2	1	2	1	3	2
5	3	1	2	1	1	3	3	2	3	2	3	2	2	2	1
AVG.	2	2	2	2	1.6	2.2	2.4	1.4	2	2	2.2	2	1	2	1.6

1 – low, 2 – medium, 3 – high, ‘-’- no correlation

**UNIT I: FUNDAMENTALS**

The Role of Algorithms in Computing – Designing Algorithms – Algorithmic Thinking – Fundamental stages of Problem-solving - Analyzing Algorithms – Iterative Algorithms - Step Count and Operation Count— measuring of Input size, Measuring Run time – Best, worst and average case complexity – Rate of growth - Recursive Algorithms: Formulation and solving recurrence equations – Guess and Verify method – Substitution method - Asymptotic analysis – asymptotic Notations – Asymptotic complexity classes.

**UNIT II : DIVIDE AND CONQUER AND ITS VARIANTS**

Introduction to Divide and Conquer - Merge Sort – Quicksort - Long Integer Multiplication – Divide and Conquer recurrences - Recursion Tree Method – Master Theorem – Transform and Conquer Approach: Gaussian Elimination Method – LU and LUP Decomposition – Solving set of equations using LUP – Matrix Inverse and Determinant using LUP approach - Decrease and Conquer Paradigm - Binary Search and Insertion Sort.

### **UNIT III: GREEDY ALGORITHMS AND DYNAMIC PROGRAMMING APPROACH**

Greedy Strategy—Generic Greedy Algorithm—Activity Selection—Fractional Knapsack—Dynamic Programming—Elements of Dynamic Programming—Principle of Optimality—Computing Binomial Coefficient—Matrix Chain Multiplication—Longest Common Subsequence—String Edit Distance—Solving Knapsack problem using dynamic programming approach.

### **UNIT IV: INCREMENTAL APPROACH, BACKTRACKING AND BRANCH & BOUND**

Linear Programming: Formulation of LPPs – Iterative development – Applications of Linear Programming - Standard form – Simple solutions using Graph techniques - Simplex Algorithm – Maximization and Minimization problems – Duality. Backtracking: Basics of Backtracking- 8-queen problem- Sum of Subsets, Branch and Bound: Least- cost Branch and Bound - 0/1 Knapsack.

### **UNIT V: COMPUTATIONAL COMPLEXITY**

Understanding Computational Complexity – Solvability - Tractability - Decision Problems - Decidability - NP-Hardness – NP-Completeness – Reducibility-Satisfiability Problem and Cook's Theorem - NP-Completeness Proofs for problems like SAT - 3CNF - Clique – Overview of Randomized Algorithm – Randomized Quicksort – Overview of approximation algorithms – set cover.

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

1. Design of simple problems, sample problems in Hackerrank, like, diagonal difference in matrices. Computation of step count and operation count for merge sort and Quicksort. Implementation of time complexity in Python .
2. Design and implement Merge sort, Quick sort, Insertion sort and Binary search algorithms.
3. Design and implement solution using dynamic programming for knapsack problem.
4. Implementation of matrix inverse using Gaussian Elimination problem
5. Design and Implement solution for 8 queens problem.
6. Design and Implementation of Simplex algorithm.
7. Design and Implementation of approximation algorithm for set cover problem

### **SUGGESTED READINGS:**

1. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, "Introduction to Algorithms" 4th Edition, The MIT Press Cambridge, Massachusetts London, England, 2022.
2. Antany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012
3. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2010.
4. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education, 2011.

25ITU302

EMBEDDED SYSTEM AND IOT

Semester – III  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.
- To apply the concept of Internet of Things in real world scenario

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Explain the architecture of embedded processors.**CO2:** Design and Implement embedded C programs**CO3:** Design simple embedded applications**CO4:** Compare the communication models in IOT**CO5:** Design IoT applications using Arduino/Raspberry Pi /open platform.**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVG.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

**UNIT I: 8-BIT EMBEDDED PROCESSOR**8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports  
– Timers and Serial Port – Interrupt Handling

## **UNIT II : EMBEDDED C PROGRAMMING**

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

## **UNIT III: IOT AND ARDUINO PROGRAMMING**

Introduction to the Concept of IoT Devices – IoT Devices Versus

Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

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## **UNIT IV: IOT COMMUNICATION AND OPEN PLATFORMS**

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

## **UNIT V:**

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems, Pearson Education, Second Edition, 2014
2. Robert Barton, Patrick Grossetete, "IoT Fundamentals: Networking Technologies Protocols, and Use Cases for the Internet of Things
3. Michael J. Pont, "Embedded C". Pearson Education, 2007
4. Wayne Wolf, "Computers as Components: Principles of Embedded Computer system design", Elsevier, 2006

25MAC311

YOGA

Semester-III  
1H – 0C

Instruction Hours / week: L: 0 T: 0 P: 1

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives**

- Articulate and Focus on goal sand move away from demotivating and corrosive environment.
- Explain the concept and dimensions of wellness which help in pursuing their goals
- Demonstrate the practices that can promote wellness.
- Plan and follow a daily routine that includes Physical Exercises, Yoga, and Meditation.
- Demonstrate behavior’s aligned to universal HumanValues.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Articulate and Focus on goals and move away from demotivating and corrosive environment	Apply
CO2	Explain the concept and dimensions of wellness which help in pursuing their goals.	Apply
CO3	monstrate the practices that can promote wellness	Understand
CO4	Plan and follow a daily routine that includes Physical Exercises, Yoga, and Meditation	Apply
CO5	Demonstrate behaviours aligned to universal Human Values.	Apply

**CO-PO Mapping**

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS 01	PS 02	PS 03
CO 1	3	1	2	2	3	2	2	2	3	2	3	1	1	2	2
CO 2	2	2	3	1	1	2	2	1	2	1	2	2	2	1	2
CO 3	1	3	2	2	1	2	2	1	2	2	2	1	1	2	1
CO 4	1	3	3	3	2	2	3	1	1	2	1	2	1	3	2
CO 5	3	1	2	1	1	3	3	2	3	2	3	2	2	2	1

1 - low, 2 - medium, 3 – high

**UNIT I: PHYSICAL HEALTH**

Introduction to SKY -Education as a means of Youth Empowerment-Simplified Physical exercises- Yogasanas(Rules-SunSalutation-Dandasana-Chakrasana-Vrichasana-Trikonasana-Vajrasana-Pranayama-NadiSuddhi-ClearancePractice).

## **UNIT II: STRENGTHENING THE LIFE FORCE**

Reasons for Diseases-Philosophy of Kaya Kalpa –Maintaining Youthfulness & Postponing Aging – Transformation of Food in to seven Body Constituents-Greatness of Seminal Fluid-Limit and Method in Five Factors- Kaya Kalpa Practice.

## **UNIT III: WELLNESS OF MIND**

Classification of Mind Waves-Agna Meditation-Shanthy Meditation-Thuriya Meditation-Blessing and Benefits-Virtues: Individual Virtues and Societal Virtues -Morals (Importance of Introspection, Six Temperaments and Manoverring, Benefits of Meditation).

## **UNIT IV: PROSPERITY B OF MIND-PART I**

Philosophy of Life (Purpose of Life,Philosophy of Life, Five Duties-Safe guarding Natural Resources)- Analysis of Thoughts (Ten stages of the Mind-The Five Kosas-Thoughts-Analysis of thoughts and practice)- Moralisation of Desires(Desires-Explanation, Nature, Reasons, Moralisation Practice).

## **UNIT V: PROSPERITY OF MIND-PART II**

Neutralisation of Anger (Anger-Reasons, Effects, Peace, Tolerance and Forgiving, Neutralisation) – Eradication of Worries(Reasons,Effects,Correctivemeasures,Eradication)-DiversityinMen-LoveandCompassion .

## SEMSTER-IV

B.E., B.Tech. (Common to all Branches)

2025-2026

25ITU421

OBJECT ORIENTED MODELING & DESIGN

Semester – IV  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

### COURSE OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To Perform software requirements analysis
- To gain knowledge of the System Analysis and Design concepts using UML.
- To understand software testing and maintenance approaches
- To work on project management scheduling using DevOps

### COURSE OUTCOMES

At the end of this course, the students will be able to:

**CO1:** Compare various Software Development Lifecycle Models

**CO2:** Evaluate project management approaches as well as cost and schedule estimation strategies

**CO3:** Perform formal analysis on specifications

**CO4:** Use UML diagrams for analysis and design

**CO5:** Architect and design using architectural styles and design patterns, and test the system

### CO's-PO's & PSO's MAPPING

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	3	2	2	2	3	2	3	1	1	2	2
2	2	2	3	1	1	2	2	1	2	1	2	2	2	1	2
3	1	3	2	2	1	2	2	1	2	2	2	1	1	2	1
4	1	3	3	3	2	2	3	1	1	2	1	2	1	3	2
5	3	1	2	1	1	3	3	2	3	2	3	2	2	2	1
AVg.	2	2	2	2	1.6	2.2	2.4	1.4	2	2	2.2	2	1	2	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

### UNIT I: SOFTWARE PROCESS AND AGILE DEVELOPMENT

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process-Case Study

### UNIT II : REQUIREMENTS ANALYSIS AND SPECIFICATION

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petri nets - Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram- CASE TOOLS.

### **UNIT III: SOFTWARE DESIGN**

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model: view-controller – Publish-subscribe , Adapter, Command, Strategy, Observer, Proxy, Facade – Architectural styles – Layered, Client Server, Tiered, Pipe and filter- User interface design-Case Study

### **UNIT IV:**

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking- Case Study

### **UNIT V:**

Software Project Management- Software Configuration Management - Project Scheduling- DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture, Building and Testing-Deployment- Tools- Case Study

**PERIODS : 60**

### **SUGGESTED READINGS :**

1. Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering: Using UML, Patterns and Java”, Third Edition, Pearson Education, 2009.
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014.

25ITU401

WEB APPLICATION DEVELOPMENT

Semester – IV  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To learn the basic object oriented concepts using Java language
- To understand the advanced features of Java language
- To understand the essential client side technologies for web programming.
- To develop applications using database connectivity and server side programming in Java environment.
- To develop smart device based web application and deploy in different platforms

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Implement Object-Oriented concepts in Java programming**CO2:** Design and implement Generics and GUI based application development.**CO3:** Implement and solve problems using collections, I/O and Reflections in Java.**CO4:** Develop dynamic web applications with database connectivity using server-side technologies**CO5:** Design and develop applications using advanced frameworks and web services**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

1 - low, 2 - medium, 3 - high

**UNIT I: JAVA FUNDAMENTALS**

Overview of Java – OOPS Fundamentals in Java: Classes, Objects, Methods and Strings–Array and Array Lists - Static methods – Abstract classes- Overloading Constructors – Method Overriding - Inheritance – Polymorphism – Interfaces: Implementing and extending interfaces – Threaded model - Multiple threads - Thread Priority - Thread Synchronization using synchronized methods - Packages – Exception Handling –Types of Exceptions.

**UNIT II : JAVA GUI AND FILE STREAMS**

Predefined Libraries - Using String class - Working with Data & Time - Utility framework - Java I/O - AWT & Swings – Regular Expressions – Files, Streams and Object Serialization – Generic collections – Generic Classes and Methods-Java Applet Basics- Graphics and Animation in Applet- Event Handling and Applet Communication-Reflections in Java.

### **UNIT III: JDBC AND WEB APPLICATION DEVELOPMENT**

Overview of JDBC API - Establishing a connection with the database- Servlet : Servlet Architecture – Servlet lifecycle – Generic Servlet – HttpServlet –Servlet interface-Server-Side Includes Overview of JSP – JSP Components – JSP Implicit Objects- Java Server Faces - MVC Architecture of JSF Apps – Common JSF Components.

### **UNIT IV: ADVANCED FRAMEWORKS**

MVC framework – JPA/Hibernate - Introduction to ORM, JPA and Hibernate – Using Annotations – JPA: SessionFactory, Session, Transaction - Performing CRUD Operations with Annotations - Different ID Generation Strategies - Hibernate with Inheritance Hibernate Query language – ORM mapping – Spring Framework – Spring Bean Factory and application Context- Spring Boot - Introduction to STS (Spring Tool Suite) – Dependency Injection with STS – MVC - AOP

### **UNIT V: WEB SERVICES**

Spring Web Services - Introduction to Web Service - Basics of REST APIs – Spring REST – Micro services with Spring Boot and Spring Cloud - Introduction to MicroService architecture - Advantages of MicroService over Monolithic architecture - Developing and Deploying MicroService application in localhost -Introduction to DevOps and its advantages- DevOps Tools.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Paul J. Deitel, Harvey Deitel, “Java How to Program”, Eleventh Edition, Pearson Education, 2017.
2. “Core and Advanced Java Black Book”, Dreamtech Press, 2018.
3. Herbert Schildt, “Java the complete Reference”, Eighth Edition, Tata Mc Graw Hill 2011.
4. Cay.S.Horstmann, “Core Java Volume I & II”, Pearson Education,2018
5. Uttam K Roy, “Advanced Java Programming”, Oxford University Press,2015.

25ITU402

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Semester – IV  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- Develop a comprehensive understanding of the foundations of artificial intelligence, including its history, key concepts, and the structure of intelligent agents
- Gain proficiency in problem-solving techniques and search strategies, both uninformed and informed, to find solutions to complex problems in AI.
- Learn the principles of knowledge-based agents, propositional and first-order logic, and various reasoning systems to enable intelligent decision-making
- Explore classical planning methods, algorithms, and heuristics to design and analyze planning approaches for AI systems
- Understand and apply probabilistic reasoning, Bayesian networks, and decision methods to represent and reason with uncertainty in AI.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

CO1: Design and implement various search strategies for intelligent agents to solve complex problems.

CO2: Develop knowledge-based systems using propositional and first-order logic for effective theorem proving and model checking.

CO3: Apply classical and hierarchical planning algorithms to develop solutions for domain-independent planning problems.

CO4: Utilize Bayesian networks and hidden Markov models for accurate probabilistic reasoning and inference in uncertain domains.

**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	1
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	1
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.4

1 - Low, 2 - medium, 3 – high

**UNIT I: INTELLIGENT AGENT AND SEARCH**

Foundations of AI - History of AI - Agents and Environments – Good Behavior: The Concepts of Rationality, The Nature of Environment - Structure of Agent - Problem solving Agents - Example Problems, Searching for solutions – Performance. Uninformed Search Strategies: Breadth First - Depth First - Depth Limited - Iterative Deepening - Bidirectional Search - Comparison of uninformed searches, Informed Search: Heuristic Search – Greedy Search.

### **UNIT II: REASONING METHODS WITH LOWER ORDER LOGICS**

Knowledge Based Agents - Propositional Logic : Syntax - Semantics - Theorem proving - Horn Clauses and Definite Clauses - Forward and Backward chaining - Model Checking. First Order Logic - Syntax - Semantics - Knowledge Engineering - Knowledge Engineering Process - Electronic Circuit Domain. Inference: Unification - Forward Chaining - Backward Chaining - Resolution - Ontological Engineering - Categories and Objects - Events - Mental Objects and Modal Logic - Reasoning systems for Categories.

### **UNIT III: AUTOMATED PLANNING**

Definition of Classical Planning - Example domains, Algorithms: Forward search - Backward search- Boolean Satisfiability, Heuristics for planning – Domain- independent Heuristics - State abstraction, Hierarchical planning: High level actions , Searching for primitive solutions and abstract solutions, Planning in non-deterministic domains, Time schedule and resources - Analysis of planning approaches.

### **UNIT IV: PROBABILISTIC REASONING AND PROGRAMMING**

Bayes Rule - Naive Bayes Model, Representing Knowledge in an Uncertain Domain - The Semantics of Bayesian Networks - Exact Inference in Bayesian Networks - Approximate Inference in Bayesian Networks - Inference by Markov chain Simulation - Hidden Markov Model.

### **UNIT V: DECISION MAKING**

Combining Beliefs and Desires under Uncertainty, The Basis of Utility Theory - Utility Functions - Multiattribute Utility Functions - Decision Networks - Sequential Decision Problems - Algorithms for Markov Decision Process - Bandit Problems - Partially Observable MDPs - Introduction to Learning Methods.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Fourth Edition, Pearson Publishers, 2021.
2. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2013
3. Artificial Intelligence (NPTEL) by Prof. Dasgupta, IIT Kharagpur, <https://nptel.ac.in/courses/106105079>
4. Artificial Intelligence (SWAYAM/ NPTEL) by Prof. Deepak Khemani, IIT Madras, [https://onlinecourses.nptel.ac.in/noc21\\_cs79/preview](https://onlinecourses.nptel.ac.in/noc21_cs79/preview).

25ITU403

COMPUTER NETWORKING

Semester – IV  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To understand the components required to build different types of networks.
- To learn concepts related to network addressing and routing.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Identify the appropriate application layer and transport layer protocols required to implement various network applications**CO2:** Identify better routes by applying appropriate intra AS protocols and inter AS protocols**CO3:** Apply effective address management techniques and configure IPv6 protocols**CO4:** Select the appropriate LAN technology and MAC layer protocols**CO5:** Select the type of medium and frequency range for data transmission**CO's-PO's & PSO's MAPPING**

CO s	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

1 - low, 2 - medium, 3 - high, '-' - no correlation

**UNIT I: INTRODUCTION AND APPLICATION LAYER**

Data communication systems - Building networks – Network Edge, Access and Core – Layered Architecture – OSI Model – Internet Architecture (TCP/IP) Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways – Top-down Approach – Application layer - Sockets – Application Layer protocols – HTTP – FTP- Email Protocols – DNS.

**UNIT II : TRANSPORT LAYER**

Transport Layer functions – End to end semantics – Multiplexing and Demultiplexing – User Datagram Protocol – UDP Applications – Transmission Control Protocol – Connection establishment and release – Flow Control – Retransmission Strategies – Congestion Control – Quality of Service

### **UNIT III: NETWORK LAYER**

Network Layer: Switching concepts – Packet switching - Routing – Distance Vector and Link State Algorithms – Routing Information Protocol, Open Shortest Path First and Broder Gateway Protocol – Congestion Control mechanisms in Routers – Software Defined Networks – Control Plane and Data Plane.

### **UNIT IV: IP ADDRESSING**

IPV4 Packet Format and Addressing – Subnetting – Classless Inter-Domain Routing – Variable Length Subnet Mask – Dynamic Host Configuration Protocol – Network Address Translation – Internet Control Message Protocol – Need for IPv6 – Addressing methods and types in IPv6 – IPv6 header – Transition from IPv4 to IPv6.

### **UNIT V: DATA LINK AND PHYSICAL LAYERS**

Data Link Layer – Framing – Flow control – Error control – Media Access Control – Ethernet Basics – Carrier Sense Multiple Access / Collision Detection – Virtual LAN – Wireless LAN - 802.11 variants – MAC Layer – CSMA/CA - Physical layer – Signals – Bandwidth and Data Rate – Encoding – Multiplexing – Shift Keying – Transmission Media.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down and Approach", Eighth Edition, Pearson Education, 2022.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Sixth Edition, Morgan Kaufmann Publishers Inc., 2022.

25ITU403

COMPUTER NETWORKING LABORATORY

Semester – IV  
4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**COURSE OBJECTIVES:**

- To study the basic networking commands.
- To understand the working principle of various communication protocols.
- To analyze the various routing algorithms
- To know the concept of data transfer between nodes

**PRACTICAL EXERCISES:**

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets
6. Write a code simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/ Link State Routing algorithm.
10. Simulation of an error correction code (like CRC)

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**COURSE OBJECTIVES:**

- Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites
- Create simple PHP scripts
- Design and deploy simple web-applications

**PRACTICAL EXERCISES:**

1. Write a PHP script to print prime numbers between 1-50
2. Write a PHP script to
  - a. Find the length of a string.
  - b. Count no of words in a string.
  - c. Reverse a string.
  - d. Search for a specific string.
3. Write a PHP script to merge two arrays and sort them as numbers, in descending order.
4. Write a PHP script that reads data from one file and write into another file.
5. Develop static pages (using Only HTML) of an online book store. The pages should resemble:www.amazon.com. The website should consist the following pages.
  - a) Home page
  - b) Registration and user Login
  - c) User Profile Page
  - d) Books catalog
  - e) Shopping Cart
  - f) Payment By credit card
  - g) Order Conformation
6. Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
7. Create and save an XML document on the server, which contains 10 users information. Write a program, which takes User Id as an input and returns the user details by taking the user information from the XML document
8. Install TOMCAT web server. Convert the static web pages of assignments 2 into dynamic webpages using servlets and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml. Each user should have a separate Shopping Cart.
9. Redo the previous task using JSP by converting the static web pages of assignments 2 into dynamic web pages. Create a database with user information and books information. The books catalogue should be dynamically loaded from the database. Follow the MVC architecture while doing the website

## SEMESTER-V

B.E., B.Tech. (Common to all Branches)

2025-2026

25ITU501

FUNDAMENTALS OF MACHINE LEARNING

Semester – V  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

### COURSE OBJECTIVES:

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications
- To understand unsupervised learning like clustering and EM algorithms
- To understand the theoretical and practical aspects of probabilistic graphical models

To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

### COURSE OUTCOMES

At the end of this course, the students will be able to:

**CO1:** Disseminate the key elements of machine learning and the basics of concept learning.

**CO2:** Apply regression analysis, decision tree models and neural networks for regression and classification problems.

**CO3:** Implement SVM, ensembling methods for an appropriate application

**CO4:** Apply clustering methods for learning with unsupervised data.

**CO5:** Describe Reinforcement learning and use a tool to implement Deep learning algorithms.

### CO's-PO's & PSO's MAPPING

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	1
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	1
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.4

1 - low, 2 - medium, 3 – high

### UNIT I: INTRODUCTION

Basic Concepts in Machine Learning – Types of Machine Learning – Supervised, Unsupervised, Semi-supervised and Reinforcement Learning - Applications of Machine Learning - Basics of

Learning Theory – Concept Learning – Challenges of Machine Learning – Feature Engineering - Linear Regression – Single and Multiple Variable Regression – Polynomial Regression – Bias and variance - Logistic regression

## **UNIT II: SUPERVISED LEARNING - I**

Linear Regression – Multiple variable regression – Logistic regression – Regularization techniques - LASSO, Ridge, and Elastic Net Regression - Decision Tree Learning- ID3 - C4.5 – CART - Instance based Learning - K-Nearest Neighbor Algorithm - Neural Networks- Perceptron - Feed-Forward Networks for binary and multi-class classification - Multi Layer Perceptron - Back Propagation.

## **UNIT III: SUPERVISED LEARNING II AND UNSUPERVISED LEARNING**

Basics of Neural Networks – Biological and Artificial Neurons - Perceptron – Perceptron Rule Feedforward networks – backpropagation Algorithms – Classification using Neural networks- Challenges in ANN - Support Vector Machine – Optimal Hyperplane – hard and Soft margin SVM – Non-Linear SVM –Kernels – Support Vector Regression.

## **UNIT IV: PROBABILISTIC GRAPHICAL MODELS**

Probability-based learning – Classification using Bayes Model - Naive Bayes Algorithm- Gibbs Algorithm - Bayes Classifier for continuous variables - Probabilistic Graphical models- Bayesian Belief Network – Construction of Bayesian Network – Bayesian Inference -Markov Chain – Markov Models - Hidden Markov Models – Applications of HMM.

## **UNIT V: ADVANCED LEARNING**

Introduction to Clustering - Hierarchical Clustering – Single Linkage – Complete Linkage – Average Linkage – Partitional Clustering Algorithms – K-means - Expectation Maximization Algorithm – Linear Discriminant Analysis – Principal Component Analysis – Gaussian Mixture Models – Latest Trends – Overview and Scope of Reinforcement Learning– Components of reinforcement Learning – Model-based and Model-free models – Q-Learning Algorithm.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Christopher Bishop, “Pattern Recognition and Machine Learning”, First Edition, Springer, 2006
2. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997
3. Sridhar S, Vijayalakshmi M, “Machine Learning”, First Edition, Oxford University Press, 2022.

25ITU502

NEXT GENERATION WIRELESS NETWORKS

Semester – V  
3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES:**

- To learn the fundamentals of 5G internet.
- To understand the concept of small cells in 5G mobile networks.
- To learn the MAC layer protocol in 5G network context.
- To understand the role of cognitive radios in 5G networks.
- To learn the advances cellular networks and evolution of 6G.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Understand the concepts of the 5G network. .**CO2:** Identify suitable small cells for different applications in 5G networks**CO3:** Understand MAC protocols associated with 5G.**CO4:** Understand the various applications in the 5G domain**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

1 - low, 2 - medium, 3 – high

**UNIT I: 5G INTERNET AND LEAP TO 6G**

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – The 6G Vision – 6G Vertical Industries – Technologies enabling 6G – 6G for Industry 5.0 - Other 6G Considerations.

**UNIT II: 5G SYSTEM, ARCHITECTURE AND MOBILE NETWORKS**

5G System Concepts - Machine-Type Communication – Dynamic Radio Access -Basic RAN Architecture – High level and Functional Architecture 5G -- Introduction to Small Cells – Capacity

Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs Capacity – Small Cell Challenges - Microcell vs Small Vs Femtocell

### **UNIT III: COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS**

Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding - Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G

### **UNIT IV: NETWORKING TECHNIQUES AND APPLICATIONS FOR 5G NETWORK**

5G RAN Architecture: C-RAN with NGFI- User-Centric Wireless Network for 5G - Energy Harvesting Based Green Heterogeneous Wireless Access for 5G -Resource Allocation for Cooperative D2D Communication Networks - Fog Computing and Its Applications in 5G - A Conceptual 5G Vehicular Networking -Communications Protocol Design for 5G Vehicular Networks -Next-Generation High-Efficiency WLAN -Shaping 5G for the Tactile Internet

### **UNIT V: TECHNOLOGICAL ASPECTS OF 6G**

6G Spectrum composition – mmWAVE - TeraHertz Communication-Network Slicing and Management - Beamforming Techniques - Aerial and satellite Components of 6G Networks - Underwater Communication Components of 6G Networks - 6G Networks-Radar Sensing - Imaging and Sensing-Localization - Other verticals 6G IoT.

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
2. Xie, Xianzhong, Bo Rong, and Michel Kadoch, eds. 6G wireless communications and mobile networking. Bentham Science Publishers, 2021
3. Božanić, Mladen, and Saurabh Sinha, “Mobile Communication Networks: 5G and a Vision of 6G”, Springer, 2021
4. Dahlman, Erik, Stefan Parkvall, and Johan Skold. 5G NR: The next generation wireless access technology. Academic Press, 2020
5. Saad Z. Asif, “5G Mobile Communications: Concepts and Technologies” First Edition, CRC Press, 2018.
6. Peterson, Larry, and Oğuz Sunay. 5G mobile networks: A systems approach. Morgan & Claypool Publishers, 2020
7. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Prentice Hall, 2014.
8. Osseiran, Afif, Jose F. Monserrat, and Patrick Marsch, eds. 5G mobile and wireless communications technology. Cambridge University Press, 2016.

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**25ITU521 ESSENTIAL OF CLOUD INFRASTRUCTURE CLOUD COMPUTING**
**Semester – V****5H – 4C****Instruction Hours / week: L: 3 T: 0 P: 2****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES:**

- To use virtual machines on Windows and Linux.
- To Deploy and manage Cloud infrastructure
- To understand the importance of Cloud security and storage services
- To understand DevOps in cloud and micro services

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Explain the cloud concepts and its models.**CO2:** Use virtual machines on Windows and Linux**CO3:** Deploy and manage Cloud infrastructure**CO4:** Understand the importance of Cloud security and storage services**CO5:** Understand DevOps in cloud and micro services**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	2

1 - low, 2 - medium, 3 - high, ‘-‘- no correlation

**UNIT 1: INTRODUCTION TO CLOUD COMPUTING**

Introduction to Cloud Computing – Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture– Architectural Design Challenges – Deployment Models: Public, Private and Hybrid Clouds – Service Models: IaaS – PaaS – SaaS – Cloud Service Providers: Amazon Web Services-Microsoft Azure- Google Cloud Platform

## **UNIT II: VIRTUALIZATION AND CONTAINERIZATION**

Introduction to Web Service and Service Oriented Architecture – SOAP – REST – Basics of Virtualization – Full and Para Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization- Containers- Orchestrators of Containers -Docker- DevOps and continuous Integration.

## **UNIT III: CLOUD INFRASTRUCTURE AND STORAGE**

Physical Data Centers- Cloud infrastructure management tools- Virtual machines in Cloud- Networking infrastructure for cloud management and resource allocation- Load balancing and auto-scaling- Cloud Storage: Provisioning Cloud Storage – Managed and Unmanaged Cloud Storage – Cloud Backup Solutions – Cloud Storage Interoperability- Mobile Cloud: Mobile Market – Smartphones with the cloud – Mobile web services – Service types – Service Discovery

## **UNIT IV: CLOUD MANAGEMENT AND SECURITY**

Resource Provisioning Methods – Inter Cloud Resource Management-Global exchange of Cloud resources- Cloud Management Products — Cloud Security: Overview – Security and Privacy Compliance and Governance– Access Control- Identity and Access Management- Vulnerability management- Security logging and Monitoring-Virtual Machine Security-Security Standards - Incident Response

## **UNIT V: CLOUD SOFTWARE AND COMPUTING PLATFORMS**

Google App Engine (GAE) – Programming Environment for GAE – Architecture of GFS – Case Studies: Openstack, Heroku, and Docker Containers –Amazon EC2, AWS, Microsoft Azure, Google Compute Engine - DevOps Practices in Cloud- Infrastructure as Code –Microservices in Cloud applications.

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

Use Eucalyptus or Open Nebula or equivalent to set up the cloud and demonstrate.

1. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
2. Find procedure to attach virtual block to the virtual machine and check whether it holds .The data even after the release of the virtual machine.
3. Install a C compiler in the virtual machine and execute a sample program.
4. Show the virtual machine migration based on the certain condition from one node to the other.
5. Find procedure to install storage controller and interact with it.
6. Find procedure to set up the one node Hadoopcluster.
7. Mount the one node Hadoop cluster using FUSE.
8. Write a program to use the API's of Hadoop to interact with it.
9. Write a wordcount program to demonstrate the use of Map and Reduce tasks
10. Install Google App Engine And Create A Web Applications Using Java
11. Simulate A Cloud Scenario Using Cloudsim and Run A Scheduling Algorithm

### **SUGGESTED READINGS:**

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, John Wiley, 2011.

2. John W. Rittinghouse, James F. Ransome, "Cloud Computing "Cloud Computing: Implementation: Management Security", CRC Press, 2010.
3. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley, 2011.

**25ITU511****ARTIFICIAL INTELLIGENCE AND MACHINE  
LEARNING LABORATORY****Semester – V  
4H – 2C****Instruction Hours / week: L: 0 T: 0 P: 4      Marks: Internal: 40      External: 60 Total: 100  
End Semester Exam: 3 Hours****COURSE OBJECTIVES:**

- To provide hands-on experience in implementing basic AI and Machine Learning algorithms using suitable programming platforms.
- To enable students to explore open-source libraries and tools such as Python, Scikit-learn, TensorFlow, Keras, or other AI/ML frameworks.
- To familiarize students with practical aspects of supervised, unsupervised, and reinforcement learning techniques.
- To encourage critical thinking in evaluating model performance, tuning parameters, and improving prediction accuracy.

**PRACTICAL EXERCISES:**

1. Implement A\* search algorithm
2. Implement AO search algorithm
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

**SEMESTER -VI**

**B.E., B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU621**

**FULL STACK DEVELOPMENT**

**Semester – VI  
5H – 4C**

**Instruction Hours / week: L: 3 T: 0 P: 2**

**Marks: Internal: 40**

**External: 60 Total: 100**

**End Semester Exam: 3 Hours**

**COURSE OBJECTIVES:**

- To understand the collaborative version control and Node applications
- To develop front end application using React
- To use Typescript in web applications
- To use Webpack for creating web applications
- To deploy applications through containers

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Understand the collaborative version control and Node applications

**CO2:** Develop front end application using React

**CO3:** Use Typescript in web applications.

**CO4:** Use Webpack for creating web applications

**CO5:** Deploy applications through containers

**CO's-PO's & PSO's MAPPING**

CO s	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

**1 - low, 2 - medium, 3 – high**

**UNIT 1: SERVER SIDE ACTION**

Node and NPM - Installation - Commands - Packaging – file system - http/ https - OS - Path - Process - Node.js basics - Node Package Manager - Node.js Web server – Frameworks of Node.js - Collaborative version control system- git- Packaging using NPM

**UNIT II: CLIENT SIDE ACTION**

ReactJS Introduction - React JSX - Understanding Components and Props – Props – React State – Component Lifecycle - React Hooks - Event Delegation - React Forms - React CSS - React Router - State Management with Redex – Async / await – Promises - Fetch API - Handling errors in React applications.

### **UNIT III: TYPESCRIPT**

Introduction to Typescript - Programming structures - Boolean - Arrays - Tuples - enum - function - Classes - Inheritance - Interfaces - Namespaces - Modules - Decorators - Debugging Typescript apps - Development of a web application with Typescript.

### **UNIT IV: WEBPACK**

Introduction to Web pack - Dependency graph – Entry point – Output - Plugins – Loaders - Configurations-Modules – Module Resolution and Federation –Targets - Hot module replacement - The Manifest- Immediately Invoked Function Expressions(IIFE) - Automatic Dependency Collection - Under the Hood-REST Endpoint Creation and Use- Consuming REST API in React and Axios-Mailer App.

### **UNIT V: DEPLOYMENT THROUGH CONTAINERS**

Containerization - Installation of Docker - Pulling Images - Creating Images – Image building practices-Deploying to Docker hub – Multi container App- Bind mounts - Docker Compose - Development and deployment of js applications in Docker- Deployment and Orchestration: Kubernetes-Swarm- Cloud integrations.

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

1. Install Node.js and NPM, demonstrate basic commands  
Develop a simple Node.js server using HTTP module  
Perform file system operations using Node.js (Read, Write, Append)
2. Setup a basic React Application using create-react-app  
Implement React Forms with input validation  
Develop multi-page navigation using React Router  
Handle API requests using Fetch API and Promises
3. Install and configure TypeScript in a project  
Develop Classes and implement Inheritance in TypeScript  
Build a simple web application using TypeScript
4. Setup a project with Webpack  
Configure Loaders for handling CSS and Images  
Implement Hot Module Replacement (HMR)  
Create and consume REST API using Axios in React  
Develop a Mailer Application integrating backend API
5. Install Docker and run containerized applications  
Build custom Docker images for Node.js/React projects  
Develop and run a multi-container application using Docker Compose  
Deploy a full stack application using Docker

25ITU622

FOUNDATIONS OF DATA SCIENCE

Semester – VI  
5H – 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES:**

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

**COURSE OUTCOMES**

- At the end of this course, the students will be able to:
- **CO1:** Define the data science process
- **CO2:** Understand different types of data description for data science process
- **CO3:** Explain relationships between data
- **CO4:** Use the Python Libraries for Data Wrangling
- **CO5:** Apply visualization Libraries in Python to interpret and explore data

**CO's-PO's & PSO's MAPPING**

CO's	PO's												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	1	
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	1	
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2	
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2	
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1	
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	2	1	2	1.4

1 - low, 2 - medium, 3 – high

**UNIT I: INTRODUCTION**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model–

presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data

## **UNIT II : DESCRIBING DATA**

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

## **UNIT III: DESCRIBING RELATIONSHIPS**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of  $r^2$  –multiple regression equations –regression towards the mean

## **UNIT IV: PYTHON LIBRARIES FOR DATA WRANGLING**

Basics of NumPy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

## **UNIT V: DATA VISUALIZATION**

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

**PERIODS : 60**

## **PRACTICAL EXERCISES:**

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Working with NumPy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
  - a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
  - b. Bivariate analysis: Linear and logistic regression modeling
  - c. Multiple Regression analysis
  - d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.

- a. Normal curves
- b. Density and contour plots
- c. Correlation and scatter plots
- d. Histograms
- e. Three dimensional plotting

## 7. Visualizing Geographic Data with Basemap

**Tools:** Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

**Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.**

### **SUGGESTED READINGS:**

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tree Press 2014

25ITU623

CRYPTOGRAPHY AND NETWORKING SECURITY

Semester – VI

5H– 4C

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES:**

- To explore the basics of security and number theory.
- To study about the symmetric key cryptography and algorithms.
- To study about the asymmetric key cryptography and algorithms.
- To understand the security issues and application to design.
- To plan the security mechanisms required by system.

**COURSE OUTCOMES**

At the end of this course, the students will be able to:

**CO1:** Understand the basic concepts of security and number theory.

**CO2:** Understand and implement symmetric cryptographic algorithms.

**CO3:** Understand and implement asymmetric cryptographic algorithms.

**CO4:** Apply SSL and TLS in secured applications.

**CO5:** Manage firewalls and design intrusion detection and prevention systems.

**CO's-PO's & PSO's MAPPING**

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	2	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	2
5	3	1	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.4	2	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	2

1 - low, 2 - medium, 3 - high, '-'- no correlation

**UNIT I: INTRODUCTION TO SECURITY AND NUMBER THEORY**

Basics of Security – CIA Triad – Threats, Attacks and Services – Classical Cryptography – Substitution and Transposition ciphers – One-time Pad– Number Theory – Modular Arithmetic – Euclidean Theorem – Extended Euclidean Theorem – Algebraic Structures – Galois Field – Primality test –Pseudo randomness - Fermat's Theorem – Euler's Theorem – Chinese Remainder theorem – Logarithms – Elliptic Curve Arithmetic

**UNIT II : SYMMETRIC CRYPTOGRAPHY** Modern Cryptography – Symmetric Cipher – Block and Stream Cipher – Feistel Ciphers – Data Encryption Standard – DES Structure – Key Generation – Simplified DES – Linear and Differential cryptanalysis – CPA, CCA– Advanced Encryption Standard - Analysis of AES.

### **UNIT III: ASYMMETRIC KEY CRYPTOGRAPHY**

Public Key Cryptosystems – RSA Algorithm – ElGamal Cryptosystems – Diffie-Hellman key exchange -Elliptic curve cryptography – Hash functions – Hash algorithms – Secure Hash Algorithm: SHA – MD5 – Message Authentication Codes – zero knowledge protocols - Introduction to Quantum Cryptography– Threshold Cryptography.

### **UNIT IV: SECURITY APPLICATION**

Digital Signatures Schemes– Digital Certificate – Key Management – Kerberos – Key Agreement and Distribution – PKI – X.509 Certificate – E-Mail Security – PGP – S/MIME – IP security – Virtual Private Network – Web Security – Secure Socket Layer – Transport Layer Security – Secure Electronic Transaction.

### **UNIT V: SYSTEM SECURITY**

Malwares –Internet scanning worms - Mobile Malware and Botnets- Password Management – Access Control in Operating Systems: Discretionary, Mandatory and Role Based Access Control - Firewall – Intrusion Detection System and types – Intrusion Prevention System — Penetration testing: concept, types, steps – OWASP top ten vulnerabilities – Secure Coding

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

1. Implement basic mathematical requirements for cryptography.
2. Write a program to perform encryption and decryption of classic cryptosystems.
3. Perform cryptanalysis using Brute-force Attack.
4. Write a program to demonstrate symmetric key encryption process using DES algorithm (academic versions). Also perform cryptanalysis using CCA, CPA.
5. Write a program to demonstrate symmetric key encryption process using AES algorithm.
6. Write a program to implement RSA algorithm and demonstrate the key generation and encryption process and analyze the same using factorization attack.
7. Write a program to generate message digest for the given message using the SHA/MD5 algorithm and verify the integrity of message.
8. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like kali Linux.
9. Study and exploration of Wireshark tool
  - (i) To analyze network traffic for various protocols, e.g. ping, DNS and telnet.
  - (ii) To learn about setting up ssh keys and configure the ssh client.
  - (iii) To verify whether the data are encrypted or not.
10. Study and exploration of Metasploit tool to learn about cracking of hashed files in Windows environment.
11. Configure a firewall on Ubuntu platform.

**SUGGESTED READINGS:**

1. Wenbo Mao, "Modern Cryptography Theory and Practice", Pearson Education, 2004.
2. Pfleeger and Pfleeger, "Security in computing", Third Edition, PHI/Pearson, 2003.
3. Behourz Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2010
4. Gilles van Assche, "Quantum Cryptography and Secret-Key Distillation", Cambridge University Press, 2010
5. Patrick Engebretson, "The basics of Hacking and Penetration Testing", Elsevier, 2011.

## SEMESTER -VII

B.E., B.Tech. (Common to all Branches)

2025-2026

25ITU721

**AGILE SOFTWARE DEVELOPMENT**

**Semester – VII  
5H – 4C**

Instruction Hours / week: L: 3 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

**End Semester Exam: 3 Hours**

### COURSE OBJECTIVES:

- Organize Agile Software Development, Extreme Programming and Software Development Rhythms.
- Describe their unique features relative to traditional software practices.
- Examine their applications in the real world and address their impacts on developing software.

### COURSE OUTCOMES

At the end of this course, the students will be able to:

**CO1:** Summarize the agile methodologies: extreme programming, scrum, and feature driven programming.

**CO2:** Apply the Twelve XP Practices and Illustrate pair programming and its characteristics.

**CO3:** Apply XP to a small project.

**CO4:** Examine Feature-Driven Development and Regaining Control.

**CO5:** Relate Agile Modeling and RUP and Choose Tools to help with Agile Development

### CO's-PO's & PSO's MAPPING

COs	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	2	1	3	2	3	1	1	2	2
2	2	2	3	1	1	2	1	1	2	1	1	2	2	1	2
3	3	3	2	2	1	2	1	1	2	2	1	1	1	2	2
4	2	3	3	3	2	3	1	1	1	2	1	2	1	3	1
5	3	3	2	1	1	2	1	1	3	2	3	2	2	2	1
AVg.	2.6	2.8	2	2	1.4	2.2	1.2	1	2	2	2	2	1	2	1.6

1 - low, 2 - medium, 3 – high

### UNIT I: INTRODUCTION TO AGILE SOFTWARE DEVELOPMENT

Introduction: Agile Methods, Agile Manifesto, and Agile Modeling. XP: Extreme Programming, DSDM, SCRUM, Feature-Driven Development, Modeling Misconceptions, Agile Modeling, Tools for addressing Misconceptions, Updating Agile Models.

## **UNIT II : EXTREME PROGRAMMING**

Extreme Programming: Introduction, Core XP Values, The Twelve XP Practices, Overview of Extreme Programming, Planning XP Projects, Test First Coding, Making Pair Programming Work

## **UNIT III: AGILE MODELING AND XP**

Agile Modeling and XP: Introduction, The Fit, Common Practices, Modeling Specific Practices, XP Objections to Agile Modeling, Agile Modeling and Planning XP Projects, XP Implementation Phase.

## **UNIT IV: FEATURE-DRIVEN DEVELOPMENT**

Feature-Driven Development: Introduction, Incremental Software Development, Regaining Control: The Motivation behind FDD, Planning an Iterative Project, Architecture Centric development, FDD and XP.

## **UNIT V: AGILE METHODS WITH RUP AND PRINCE2 AND TOOLS**

Agile Methods with RUP and PRINCE2 and Tools: Agile Modeling and RUP, FDD and RUP, Agile Methods and Prince2, Tools to Help with Agile Development, Eclipse: An Agile IDE, Obstacles to Agile Software Development, Management Intransigence, The Failed Project Syndrome, Contractual Difficulties, Familiarity with Agility

**PERIODS : 60**

### **PRACTICAL EXERCISES:**

1. Tool Exploration – Survey of Popular Agile Modeling Tools (e.g., Visual Paradigm, Lucidchart)
2. Develop a Simple Application Using Test-First Coding (TDD) Approach
3. Develop a program to implement Pair Programming – Document Experience and Observations
4. Implement a Mini XP Project with User Stories and Iterations
5. Create Lightweight UML Models for a Sample Application Using Agile Modeling Practices
6. Execute an XP Project by Integrating Agile Modeling Principles
7. Implement an XP Project Phase Focusing on Agile Modeling Artifacts
8. Prepare a Feature List for an Application (e.g., Library Management, Online Store)
9. Plan an Iterative Development Cycle Using FDD Principles
10. Demonstrate with program how Eclipse IDE Supports Agile Development (Version Control, Continuous Integration)
11. Develop a small real-world application using either Scrum methodology demonstrating Agile practices across iterations, modeling, testing, and delivery.

### **SUGGESTED READINGS:**

1. The Art of Agile Development — James Shore & Shane Warden (2nd Edition, 2021), O'Reilly Media, Inc.
2. Essential Scrum: A Practical Guide to the Most Popular Agile Process — Kenneth S. Rubin (2012), Addison-
3. Agile Project Management: Creating Innovative Products — Jim Highsmith (2004), Pearson Education / Addison-Wesley
4. Organizational Patterns of Agile Software Development — James O. Coplien & Neil B. Harrison (2004), Pearson Prentice Hall.

## VERTICAL -1: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

B.E. / B.Tech. (Common to all Branches)

2025-2026

25ITU531A

SOFT COMPUTING

3H – 3C

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To give students knowledge of soft computing theories and fundamentals.
- To understand fuzzy sets and fuzzy logic for problem solving.
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems.
- To familiarize with genetic and other optimization algorithms while seeking global optimum in self-learning situations.
- To implement hybrid systems using fuzzy, neural networks and optimization algorithms

### At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Identify and describe soft computing techniques and the role of Artificial Neural Networks in building intelligent machines.	Understand
CO2	Design neural networks for pattern classification and regression problems.	Apply
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.	Apply
CO4	Apply evolutionary algorithms to optimization problems.	Apply
CO5	Implement hybrid soft computing algorithms.	Apply

### CO-PO Mapping

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	3	2	2	2	3	2	1	1	1	1	2	3	2	2
CO2	3	2	3	2	2	2	3	1	1	1	1	1	3	3	2
CO3	2	3	2	3	2	3	2	1	1	1	1	1	3	2	2
CO4	3	2	2	3	3	2	2	1	1	1	1	2	3	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	2	2	3	2

1 - low, 2 - medium, 3 - high

## **UNIT I: FUNDAMENTALS OF NEURAL NETWORKS**

Hard and Soft Computing - Biological neuron and its working-Nerve structure and Synapse – Artificial Neuron and its Model – Activation Functions – Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Learning Techniques: supervised, unsupervised, reinforcement - Back Propagation Networks Architecture - Back Propagation Learning Methods – Effect of Learning Rule Co Efficient: Single Layer and Multilayer Perceptron - Auto-Associative and Hetero-Associative Memory.

## **UNIT II: COMPETITIVE NEURAL NETWORKS**

Kohonen's Self Organizing Map – SOM Architecture, learning procedure – Application; Learning Vector Quantization, Learning by LVQ – Adaptive Resonance Theory – Learning procedure – Weight updating – Sample problems – Applications.

## **UNIT III: FUZZY COMPUTING**

Basic Concepts of Fuzzy Logic – Fuzzy Sets and Crisp Sets – Fuzzy Set Theory and Operations – Properties of Fuzzy Sets – Fuzzy and Crisp Relations – Membership Functions – Fuzzy If-Then Rules, Fuzzy propositions, implications and inferences - Aggregation of fuzzy outputs - Defuzzification methods– Fuzzy Controller design– Industrial Applications.

## **UNIT IV: EVOLUTIONARY ALGORITHM**

Introduction to optimization problems – Genetic Algorithm - Working Principle – Procedures of GA – Flow Chart of GA – Genetic Representation: (Encoding) Initialization and Selection – Genetic Operators: Reproduction, Crossover, Mutation- Particle Swarm Optimization – Ant colony Optimization – Algorithmic steps and implementation - Convergence of Evolutionary Algorithm– Multi objective optimization problems.

## **UNIT V: HYBRID CONTROL SCHEMES**

Fuzzification and rule base using ANN – Neuro fuzzy systems - ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm – Tuning Neural network parameters using Evolutionary algorithms - Introduction to Support Vector Machine - Case study of hybrid techniques – Familiarization of Neural Network, Fuzzy logic and ANFIS controller's toolbox.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India, 2010.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.
3. Satish Kumar, "Neural Networks : A Classroom Approach", Second Edition McGrawHill, 2017.
4. James.A.Freeman, David.M Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques" (Computation and Neural Systems Series), Addison Wesley, 1991
5. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India, 2007.
6. Siman Haykin, "Neural Networks", Prentice Hall of India, 1999.
7. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley Publications, 2016.
8. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2008.
9. Melanie Mitchell, "An Introduction to Genetic Algorithms", MIT Press, 2000
10. Corinna Cortes and V. Vapnik, "Support - Vector Networks, Machine Learning" 1995.
11. Snehashish Chakraverty, Deepti Moyi Sahoo, Nisha Rani Mahato, "Concepts of Soft Computing: Fuzzy and ANN with Programming", Springer, 2019.

25ITU532A

DEEP LEARNING

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives**

- Understand the basics of neural networks.
- Know the basics of Deep learning for computer vision.
- Understand LSTM and Autoencoders for Deep learning.
- Understand the architectures of Transformers.
- Know about the application of Reinforcement learning using Deep neural networks.

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Understand the basics of Shallow Neural Networks and Deep Neural Networks.	Understand
CO2	Get familiar with concepts of Machine Vision and deep learning models for Image classification and Object Detection.	Understand
CO3	Understand sequence data and RNN networks and its variants.	Understand
CO4	Understand generative Adversarial Networks and Transformer Architectures like BERT and GPT.	Understand
CO5	Design and implement Deep-Q learning and DQN algorithms.	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	3	2	2	3	3	2	1	1	1	1	2	3	2	2
CO2	3	2	3	2	2	2	3	1	1	1	1	3	3	3	2
CO3	2	3	2	3	2	3	2	1	1	1	1	3	3	2	2
CO4	3	2	2	2	3	2	2	1	1	1	1	2	3	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	2	2	3	2

1 - low, 2 - medium, 3 - high

## **UNIT I: BASICS OF NEURAL NETWORKS**

Basic concept of Neurons – Biological neurons and Artificial neurons - Perceptron Algorithm–Feed Forward and Back Propagation Networks – Activation Functions – ReLU, sigmoidal, Tanh - Loss Functions – Mean Square Error – Cross-entropy Error - Optimizers – Stochastic Gradient – Adaptive Gradient Descent – Momentum – AdaGrad – Adam - Regularization Techniques – Bias and Variance – Drop out – Data Augmentation – Batch Normalization.

## **UNIT II : DEEP LEARNING FOR COMPUTER VISION**

CNN Architectures – Convolution – Layers – Convolutional Layers - Pooling Layers – LeNet - Advanced CNN Architectures – AlexNet – VGG – ResNet – GoogleNet - Transfer Learning – Pretrained Models as Classifier – Feature Extractor – Fine-Tuning - Image Classification using Transfer Learning – Object Detection – R-CNN – Fast R-CNN - Faster R-CNN - Networks – YOLO.

## **UNIT III : DEEP LEARNING FOR SEQUENCE DATA**

Introduction to Sequence Data – RNN – Architecture – Deep RNN – Bidirectional RNN – Long Short Term Memory – Forget Gate – Input Gate – Output Gate - GRU – Update and Reset Gate – Sequence2Sequence models - Encoder/Decoder Architecture - Autoencoders – Standard - Variational Auto Encoders.

## **UNIT IV: TRANSFORMERS AND INTRODUCTION TO LLMS**

Generative Adversarial network – Generator – Discriminator – Minimax Optimization – GAN Adversarial Training – GAN Losses – GAN Architectures – Conditional GAN – Progressive GAN - Transformers Architecture -Encoder – Decoder - Attention Models – Large Language Models - BERT – GPT – Prompt Engineering - LLM Application Development.

## **UNIT V: DEEP REINFORCEMENT LEARNING**

Introduction to Reinforcement Learning – Multi-arm Bandit – Markov Processes – Markov Decision Process – Optimal Policy — Dynamic Programming with MDP - Value and Policy Iteration - Deep Q Networks – Deep Q Algorithm – Function approximation – Double DQN – Policy-Based Methods – REINFORCE - Actor-Critic Method.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning,” MIT Press, 2017.
2. Andrew Glassner, “Deep Learning – A visual Approach,” No Starch Press, 2021.
3. Francois Chollet, “Deep Learning with Python,” Manning Publications, 2018.
4. Jon Krohn,” Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”.

25ITU631A

NATURAL LANGUAGE PROCESSING

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Understand the foundational concepts of Natural Language Processing.
- Learn key text processing tasks such as tokenization, POS tagging, parsing, and semantic analysis.
- Apply machine learning and deep learning techniques for NLP tasks.
- Develop language models and text classification systems.
- Explore advanced topics like sentiment analysis, chatbots, and question answering systems.

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Explain the structure and syntactic features of natural languages using formal models.	Understand
CO2	Implement fundamental NLP tasks such as tokenization, stemming, lemmatization, POS tagging, and parsing.	Apply
CO3	Build and evaluate statistical and neural language models.	Apply
CO4	Apply machine learning techniques for NLP tasks such as sentiment analysis, topic modeling, and entity recognition.	Apply
CO5	Design and develop NLP applications like chatbots and information retrieval systems using modern NLP libraries.	Apply

**CO-PO Mapping**

CO / PO	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	3	2	2	3	3	2	1	1	1	1	2	3	2	2
CO 2	3	2	1	2	2	2	3	1	1	1	1	3	3	3	2
CO 3	2	3	2	3	3	3	2	1	1	1	1	3	3	1	2
CO 4	3	3	3	2	3	3	2	1	1	1	1	2	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	2	2	3	2

1 - low, 2 - medium, 3 - high

**UNIT I INTRODUCTION TO NLP AND TEXT PREPROCESSING** Introduction to Natural Language Processing – Challenges of NLP – Role of Linguistics in NLP – Regular Expressions for Text Processing – Words and Corpora – Text Encoding Standards – Unicode and Character Normalization – Word Tokenization – Sentence Segmentation – Word Normalization –

Lemmatization and Stemming – Stopword Removal – Text Cleaning Techniques – Overview of NLP Libraries (NLTK, spaCy, TextBlob).

## **UNIT II VECTOR SEMANTICS AND WEIGHTING SCHEMES**

Vector Semantics and Embeddings – Lexical Semantics – Word Similarity and Relatedness – Vector Semantics – Words as Vectors – One-Hot Encoding and its Limitations – Cosine Similarity for Measuring Semantic Distance – TF-IDF: Term Frequency-Inverse Document Frequency – Term Weighting Schemes – Pointwise Mutual Information (PMI) – Co-occurrence Matrix Construction – Applications of the TF-IDF or PPMI Vector Models – Evaluation of Vector Quality.

## **UNIT III WORD EMBEDDINGS AND REPRESENTATION LEARNING**

Distributed Representations – Dense Word Embeddings – Word2Vec (CBOW and Skip-Gram Models) – Training Objectives and Context Windows – Negative Sampling and Hierarchical Softmax – Visualizing Embeddings – Analogy Reasoning with Word Vectors – Semantic Properties of Embeddings – Bias and Fairness in Embeddings – GloVe: Global Vectors – FastText and Subword Embeddings – Evaluation of Embedding Models – Pretrained Embeddings and Transfer Learning

## **UNIT IV SYNTACTIC PROCESSING AND NAMED ENTITY RECOGNITION**

Parts of Speech Tagging – Rule-Based and Statistical Taggers – Hidden Markov Models – Named Entity Recognition – Entity Types and Tagging Schemes – Feature Engineering for NER – Chunking and Shallow Parsing – Constituency and Dependency Parsing – Context-Free Grammars – Treebanks – SyntaxNet and spaCy Dependency Parser – Evaluation of POS and NER Systems – Ambiguities in Syntax.

## **UNIT V SENTIMENT ANALYSIS AND SEMANTIC APPLICATIONS**

Sentiment and Opinion Analysis – Subjectivity and Polarity – Rule-Based vs. Machine Learning Approaches – Lexicon-Based Sentiment Scoring – Supervised Sentiment Classification – Word Sense Disambiguation – Lesk Algorithm and Similarity-Based Methods – Semantic Role Labeling – Frame Semantics – Building and Annotating NLP Datasets – Corpus Creation and Guidelines – Annotation Tools and Formats – Applications in Chatbots, Search Engines, Summarization, and Question Answering.

**PERIODS : 45**

### **SUGGESTED READINGS:**

- **Daniel Jurafsky and James H. Martin**, *Speech and Language Processing*, 3rd Edition (Draft available online at <https://web.stanford.edu/~jurafsky/slp3/>) – A comprehensive and authoritative textbook covering both classical and deep learning-based NLP methods.
- **Steven Bird, Ewan Klein, and Edward Loper**, *Natural Language Processing with Python* (O'Reilly Media) – A hands-on guide to NLP using the NLTK library, ideal for beginners and intermediate learners.
- **Chris Manning and Hinrich Schütze**, *Foundations of Statistical Natural Language Processing*, MIT Press – A classic text on statistical and probabilistic models foundational to NLP.
- **Yoav Goldberg**, *Neural Network Methods in Natural Language Processing*, Morgan & Claypool – An in-depth yet concise overview of deep learning techniques specifically applied to NLP.
- **Jacob Eisenstein**, *Natural Language Processing*, MIT Press (2022) – A modern book covering fundamental and advanced topics in NLP including recent neural architectures.
- **Stanford CS224n: Deep Learning for NLP**, <http://web.stanford.edu/class/cs224n/> – Lecture series, notes, and assignments from Stanford's renowned NLP course.

- **Hugging Face Transformers Documentation**, <https://huggingface.co/docs/transformers> – Official documentation for using transformer-based language models like BERT, GPT, RoBERTa, and more.
- **spaCy Documentation**, <https://spacy.io/> – Documentation and tutorials for spaCy, a fast and industrial-strength NLP library in Python.
- **NLTK Documentation**, <https://www.nltk.org/> – Official site for the Natural Language Toolkit, widely used for teaching and basic NLP tasks.
- **Fast.ai NLP Course**, <https://course.fast.ai/> – Practical, code-first NLP training with state-of-the-art models using PyTorch.

25ITU632A

COMPUTER VISION AND IMAGE RECOGNITION

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100  
 End Semester Exam: 3 Hours

**Course Objectives**

- To introduce fundamental concepts of computer vision and image processing.
- To understand the mathematical and algorithmic basis of image representation and transformation.
- To explore classical and modern techniques for feature extraction and object recognition.
- To apply deep learning models for image classification, detection, and segmentation. To develop practical experience in implementing computer vision solutions for real-world problems.

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Understand the principles of image formation, processing, and representation.	Understand
CO2	Apply key algorithms for image filtering, edge detection, and transformation.	Apply
CO3	Extract and analyze visual features for object classification and recognition.	Analyze
CO4	Implement and evaluate deep learning models for image recognition tasks.	Apply
CO5	Design and deploy computer vision systems for real-world applications.	Apply

**CO-PO Mapping**

CO / PO	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS 01	PS 02	PS 03
CO 1	2	3	2	2	3	3	2	1	1	1	1	2	3	2	2
CO 2	3	2	1	2	2	2	3	1	1	1	1	1	3	3	2
CO 3	2	3	2	3	3	3	2	1	1	1	1	1	3	1	2
CO 4	2	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

**UNIT I FUNDAMENTALS OF IMAGE FORMATION AND REPRESENTATION**

Introduction to Computer Vision – Human and Machine Vision – Digital Image Formation – Image Sampling and Quantization – Color Models – RGB, HSV, and Grayscale Conversion – Image Representation – Histograms – Point Processing – Image Enhancement – Brightness and Contrast Adjustment – Histogram Equalization – Image Noise – Signal-to-Noise Ratio – Basic Intensity Transformations.

## **UNIT II IMAGE FILTERING AND FEATURE DETECTION**

Convolution and Correlation – Smoothing Filters – Gaussian, Median, and Bilateral Filters – Edge Detection – Sobel, Prewitt, Canny, and Laplacian Operators – Gradient Computation – Thresholding and Binarization – Morphological Operations – Dilation and Erosion – Connected Components – Contours and Boundary Detection – Hough Transform for Line and Circle Detection.

## **UNIT III FEATURE EXTRACTION AND IMAGE MATCHING**

Keypoint Detection – Harris Corner Detector – SIFT, SURF, and ORB Features – Feature Descriptors – BRIEF and FREAK – Feature Matching – Euclidean and Hamming Distance – Homography and Perspective Transform – RANSAC for Outlier Removal – Image Alignment and Stitching – Applications in Panorama Creation and Augmented Reality.

## **UNIT IV IMAGE RECOGNITION WITH DEEP LEARNING**

Introduction to Convolutional Neural Networks – Architecture of CNNs – Convolution, Pooling, and Fully Connected Layers – Activation Functions – Training CNNs – Loss Functions – Transfer Learning – Fine-Tuning Pretrained Models – Object Detection with R-CNN, Fast R-CNN, and YOLO – Semantic Segmentation – U-Net and Mask R-CNN – Evaluation Metrics: Precision, Recall, IoU, mAP.

## **UNIT V APPLICATIONS AND ADVANCED TOPICS IN VISION**

Face Detection and Recognition – Gesture and Emotion Recognition – Image Captioning – Optical Character Recognition (OCR) – Visual Tracking – Scene Understanding – Depth Estimation – Video Processing and Motion Detection – Autonomous Vehicles and Navigation – Ethics in Computer Vision – Dataset Bias – Privacy and Surveillance Issues – Building End-to-End Vision Pipelines.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. **Richard Szeliski**, *Computer Vision: Algorithms and Applications*, Springer  
A comprehensive resource that balances theory with practical computer vision algorithms.
2. **Gonzalez and Woods**, *Digital Image Processing*, 4th Edition  
A foundational text covering image fundamentals, enhancement, filtering, and transforms.
3. **Simon J.D. Prince**, *Computer Vision: Models, Learning, and Inference*  
Explores machine learning techniques applied to computer vision with a statistical approach.
4. **Adrian Rosebrock**, *Deep Learning for Computer Vision with Python*  
A practical guide to implementing deep learning models for image classification and object detection.
5. **Ian Goodfellow, Yoshua Bengio, and Aaron Courville**, *Deep Learning*, MIT Press  
Covers core deep learning theory used in image recognition and vision applications.
6. **Francois Chollet**, *Deep Learning with Python*, 2nd Edition  
Focuses on real-world deep learning techniques using the Keras API for computer vision problems.

25ITU731A

RESPONSIBLE AI

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- To understand AI basics, misconceptions, responsible AI principles, and challenges in implementation.
- To understand and analyze biases in AI, fairness metrics, and mitigation techniques. To understand explainability, challenges, methods, and evaluation for interpretable machine learning models.
- To understand AI safety, security, privacy, and resilience, including model and data protection.
- To explore ethical issues and implications of AI in various real-world applications.

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	State the aspects of Responsible AI, such as fairness, bias, privacy etc.	Understand
CO2	Enforce fairness in models and mitigate bias in data.	Apply
CO3	Understand the importance of explainability and interpretability in AI systems.	Understand
CO4	Implement strategies to manage safety, security and privacy in AI systems.	Apply
CO5	Evaluate the societal impact of AI applications.	Apply

**CO-PO Mapping**

CO / PO	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	2	3	2	2	3	3	2	1	1	1	1	2	3	2	2
CO 2	3	2	1	2	2	2	2	1	1	1	1	1	3	3	2
CO 3	2	3	2	3	2	3	2	1	1	1	1	1	2	1	2
CO 4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

**UNIT I INTRODUCTION TO RESPONSIBLE AI**

Overview of AI – Common misconception of AI – Introduction to Responsible AI – Characteristics of Responsible AI – Key principles of responsible AI - Challenges in implementing responsible AI - ELSI Framework and AI - Safety and Alignment – Fairness and Privacy.

## **UNIT II FAIRNESS AND BIAS**

Human Bias - Types of biases - Effects of biases on different demographics - Bias vs Fairness - Sources of Biases - Exploratory data analysis - Bias Mitigation Techniques - Pre-processing techniques - In processing techniques - Post-processing techniques - Bias detection tools - Overview of fairness in AI - Demographic parity - Equalized odds - Simpson’s paradox and the risks of multiple testing - Group fairness and Individual fairness - Counterfactual fairness - Fairness metrics - Bias and disparity mitigation with Fair Learn.

## **UNIT III EXPLAINABILITY & INTERPRETABILITY**

Importance of Explainability and Interpretability – Challenges - Interpretability through simplification and visualization - Intrinsic interpretable methods - Post Hoc interpretability – Interpretability Evaluation methods - Explainability through causality - Model agnostic Interpretation - LIME (Local Interpretable Model-agnostic Explanations) - SHAP (SHapley Additive exPlanations).

## **UNIT IV SAFETY, SECURITY, AND PRIVACY**

Overview of safety – security – privacy - resilience - Taxonomy of AI safety and Security - Adversarial attacks and mitigation - Model and data security - The ML life cycle - Adopting an ML life cycle MLOps and ModelOps - Model drift - Data drift - Concept drift - Privacy-preserving AI techniques- Differential privacy - Federated learning.

## **UNIT V CASE STUDIES**

COMPAS Algorithm - Google Photos Tagging Controversy - ProPublica’s Analysis of Recidivism Predictions - Amazon’s AI Recruiting Tool - Facial Recognition Technology Misidentification - AI in Healthcare: Predictive Analytics in Patient Care - Tesla Autopilot and Ethical Implications of Autonomous Vehicles.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Virginia Dignum, “Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way”, 2019.
2. Adnan Masood, Heather Dawe, “Responsible AI in the Enterprise”, 2023.
3. Beena Ammanath, “Trustworthy AI”, O’ Reilly, 2022.
4. Christoph Molnar “Interpretable Machine Learning”, 1st edition, 2019.
5. I Almeida, “Responsible AI in the Age of Generative Models: Governance, Ethics and Risk Management”, 2024.
6. Silja Voenky, Philipp Kellmeyer et. al, “The Cambridge Handbook of Responsible Artificial Intelligence”, Cambridge University Press, 2022.

25ITU732A

LARGE LANGUAGE MODELS (LLM)

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives**

- Understand the basics of Large Language Models.
- Know about the LLM pretraining methods.
- Understand the concept of tuning methods.
- Understand and apply prompt Engineering.
- Know about the evaluation methods for LLM.

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Develop an understanding of the basics of Transformers and LLM Models.	Apply
CO2	Know about LLM pretraining Methods.	Understand
CO3	Know about Prompt Engineering.	Understand
CO4	Implement efficient tuning techniques to adapt LLMs with minimal parameter updates.	Apply
CO5	Know about Evaluation methods.	Understand

**CO-PO Mapping**

CO / PO	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2	PS O3
CO 1	3	3	2	2	3	3	2	1	1	1	1	2	3	2	2
CO 2	3	2	3	2	2	2	2	1	1	1	1	1	3	3	2
CO 3	2	3	2	3	2	2	2	1	1	1	1	2	2	3	2
CO 4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

**UNIT I: BASICS OF MODERN LLMS**

Language Models (LM) Basics – Overview of Language Models – Building blocks of Language Models Language Models Architecture – Transformer Architecture- Encoders and Decoders –

Attention Mechanisms – Attention is all You Need – Autoencoding Methods – Autoregression Methods – Seq2seq Tasks.

## **UNIT II: LLM PRETRAINING METHODS**

Encoder-Decoder – Pretraining and Language Modeling – Autoregressive language modeling – Autoencoder language modeling – Early experiments with Encoder-Decoder – Masked Language Modeling – BERT Pretraining and Masked LM – LLM Pretraining Data – Processing clear texts – Scaling up of web data – Decoding Strategies.

## **UNIT III: PARAMETER EFFICIENT TUNING METHODS**

The basics of PETM include prefix tuning, Prompt tuning, Adapters, Compactors, Layer Freezing, Bias, Fine Tuning, Pruning, Reparameterization, Low-Rank Adaptation (LoRA), Advantages and Disadvantages, Explainability and LLMs, and Ethical Considerations.

## **UNIT IV: PROMPT ENGINEERING**

In-context learning – Fine-Tuning – Zero-Shot Learning – Few Shot Learning – Basics of Prompting – Instruction prompting – Chain of Thought prompting – Prompt Selection – Automatic Prompt design – Case Study – Visual Question and Answering system – Sentiment Training with multi-language dataset – CLIP, Learning Transferable Visual Models from natural language supervision.

## **UNIT V: GENERATION BASED AUTOMATIC EVALUATION METHODS**

Evaluation – Human Evaluation – Intrinsic Vs Extrinsic evaluation- Ranking – Multiple Metrics – General Language Understanding Evaluation (GLUE) – Grammar Error Correction (GEM) – Beyond metrics – Human evaluation methods – RLHF – Extrinsic evaluation – Quantitative and Qualitative evaluation – Human annotation – Reporting – Challenges in evaluation – Evaluation metrics like accuracy, MAE, ranking Evaluation – Correlation Evaluation.

**PERIODS : 45**

## **SUGGESTED READINGS:**

1. Ozdemir, Quick Start to Large Language Models: Strategies and Best practices for using ChatGPT and other LLMs, Addison Wesley, Pearson,2024
2. Thimura Amaratunga, Understanding Large Language Models Learning and their underlying concepts and technologies, Apress, 2023.
3. Francois Chollet, “Deep Learning with Python,” Manning Publications, 2018.
4. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning,” MIT Press, 2017

## VERTICAL 2 – CYBERSECURITY

B.E. / B.Tech. (Common to all Branches)

2025-2026

25ITU531B

ETHICAL HACKING

3H – 3C

**Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To explore the concepts of security testing and the knowledge required to protect against the hacker and attackers.
- To understand reconnaissance and the publicly available tools used to gather information on potential targets.
- To discover the scanning techniques used to identify network systems open ports.
- To identify network system vulnerabilities and confirm their exploitability.
- To explore techniques for identifying web application vulnerabilities and attacks.

### Course Outcomes

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Use the various security tools to assess the computing system	Apply
CO2	Predict the vulnerabilities across any computing system using penetration testing.	Apply
CO3	Identify prediction mechanism to prevent any kind of attacks	Understand
CO4	Protect the system from malicious software and worms.	Apply
CO5	Evaluate the wireless network flaws and able to apply security patches	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	2	3	3	2	1	1	1	1	1	3	2	2
CO2	3	2	2	2	2	2	2	1	1	1	1	1	3	3	2
CO3	2	2	2	3	2	2	2	1	1	1	1	1	2	3	2
CO4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3

CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2
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**1 - low, 2 - medium, 3 - high**

### **UNIT I: INTRODUCTION TO HACKING**

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports.

### **UNIT II: INFORMATION GATHERING AND SCANNING**

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Trace route – ICMP Trace route – TCP Trace route – Usage – UDP Trace route – Enumerating and Fingerprinting the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

### **UNIT III: NETWORK ATTACKS**

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing Promiscuous versus No promiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing – ARP Spoofing Attack - Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.

### **UNIT IV: ATTACK EXPLOITATION**

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E-Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post-Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force - Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.

### **UNIT V: WIRELESS AND WEB HACKING**

Wireless Hacking – Introducing Aircrack-ng– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types Authentication – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating It with Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross Site Scripting) – Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2019.

2. Kevin Beaver, "Ethical Hacking for Dummies", Sixth Edition, Wiley, 2018.
3. Simpson, Michael T., Kent Backman, and James Corley. Hands-on ethical hacking and network defense. Course Technology Press, 2012.
4. Hickey, Matthew, and Jennifer Arcuri. Hands on Hacking: Become an Expert at Next Gen Penetration Testing and Purple Teaming. John Wiley & Sons, 2020.
5. Hoffman, Andrew. Web Application security: exploitation and countermeasures for modern web applications. O'Reilly Media, 2020.
6. Black Hat Python: Python Programming for Hackers and Pentesters. Seitz, Justin, and Tim Arnold. No starch press, 2021.
7. Jon Erickson, "Hacking: The Art of Exploitation", Second Edition, Rogunix, 2008.

**25ITU532B SECURITY INCIDENT RESPONSE AND MANAGEMENT**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

**Course Objectives**

The main objectives of this course are to:

1. Introduce the principles and processes of incident response and management.
2. Familiarize students with the stages of incident handling and cyber-attack lifecycle.
3. Develop skills in identifying, containing, eradicating, and recovering from incidents.
4. Emphasize the importance of communication, documentation, and post- incident activities.
5. Provide practical exposure to tools, frameworks, and standards in security incident management.

**Course Outcomes**

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Define and explain the incident response lifecycle and its importance in cyber security.	Understand
CO2	Identify and categorize different types of security incidents.	Understand
CO3	Apply techniques for incident detection, containment, eradication, and recovery.	Apply
CO4	Utilize incident response tools and frameworks for managing real-world incidents.	Apply
CO5	Evaluate post incident activities including lessons learned, reporting, and legal compliance	Apply

**CO-PO Mapping**

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	2	2	3	2	1	1	1	1	1	2	2	2
CO2	3	2	2	2	2	2	2	1	1	1	1	1	3	2	2
CO3	2	3	2	3	2	2	2	1	1	1	1	1	2	2	2
CO4	3	2	3	2	2	3	2	1	1	1	1	1	3	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 – high**

### **UNIT I: INTRODUCTION TO INCIDENT RESPONSE**

Definition and goals of incident response, Types of security incidents (databreaches,malware infections, DoS ,insider threats), Incident Response Lifecycle (NISTSP800-61), Roles and

responsibilities in an incident response team(IRT),Legal and ethical considerations

### **UNIT II: PREPARATION PHASE**

Building an Incident Response Capability, Creating and training Incident Response Teams (IRT/CSIRT),Asset identification and risk assessment ,Establishing policies ,procedures, and communication plans, Security tool sand log management setup.

### **UNIT III: DETECTION AND ANALYSIS**

Incident detection techniques: log analysis ,IDS/IPS ,antivirus, end point detection, Indicators of compromise (IOCs) and threat intelligence, Event correlation and prioritization, Root cause analysis ,Initial incident classification and notification procedures

### **UNIT IV: CONTAINMENT, ERADICATION, AND RECOVERY**

Short-term vs. lonterm containment strategies, Removing malicious artifacts and restoring systems, Patch management and system hardening, Recovery planning and business continuity, Validating systems post recovery

### **UNIT V: POST-INCIDENTACTIVITIESANDCONTINUOUS IMPROVEMENT**

Conducting ,lessons-learned reviews, Report writing and forensic documentation, Communication with stake holder sand regulatory bodies, Metrics for measuring incident response effectiveness, Updating incident response plans and security posture

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. NIST SP 800-61 Rev. 2, Computer Security Incident Handling Guide
2. SANS Reading Room Papers and SANS FOR508 Course Materials
3. MITRE ATT&CK Framework, MITRE Corporation, <https://attack.mitre.org>
4. ISO/IEC 27035:2016, Information Security Incident Management, ISO Standards
5. FIRST.org, CSIRT Services Framework, <https://www.first.org>
6. RFC 2350, Expectations for Computer Security Incident Response, IETF
7. National Cyber Security Centre (NCSC), Incident Management Guidance, <https://www.ncsc.gov.uk>

25ITU631B

BLOCKCHAIN AND CRYPTOCURRENCY

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100  
 End Semester Exam: 3 Hours

**Course Objectives**

- To explore the working mechanism of Blockchain technology
- To understand distribution consensus related techniques
- To learn bit coin related methodologies.
- To explore the emerging development tools, framework in Blockchain networks
- To develop decentralized applications using various tools

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the technology components of Blockchain and decentralized Applications	Understand
CO2	Understand distributed ledger technology and consensus mechanisms	Understand
CO3	Develop smart contracts Ethereum with an understanding of the components of Ethereum.	Apply
CO4	Understand Bitcoin and its limitations	Understand
CO5	Demonstrate usage of different blockchain development frameworks	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	2	3	3	2	1	1	1	1	1	2	2	2
CO2	3	2	2	2	2	2	2	1	1	1	1	1	3	2	2
CO3	2	3	2	3	2	2	2	1	1	1	1	1	2	3	2
CO4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 - high**

### **UNIT I: INTRODUCTION TO BLOCKCHAIN**

The history of blockchain and Bitcoin - Electronic cash - Peer-to-peer- structure-genesis block Distributed ledger-Cryptographically-secure Append-only - Updatable via consensus - Generic elements of a blockchain - How blockchain works -How blockchain accumulates blocks-Benefits and limitations -Tiers of blockchain technology -Features -Types of blockchain.

### **UNIT II: DISTRIBUTED LEDGERS**

Distributed Ledger Technology - Public blockchains-Private blockchains- Semiprivate blockchains-Sidechains - Permissioned ledger- Shared ledger - Fully private and proprietary blockchains - Tokenized blockchains - Tokenless blockchains – Consensus-Consensus mechanism - Types of consensus mechanisms- Consensus in blockchain

### **UNIT III: DECENTRALIZATION**

Methods of decentralization – Disintermediation -Contest-driven decentralization - Routes to decentralization - The decentralization framework example - Blockchain and full ecosystem decentralization -Storage – Communication -Computing power and decentralization - Smart contracts Decentralized Organizations - Decentralized Autonomous Corporations - Decentralized Application DApp examples -OpenBazaar - Platforms for decentralization -Ethereum -MaidSafe – Lisk

### **UNIT IV: BITCOIN – CRYPTOCURRENCY**

Bitcoin definition - Digital keys and addresses - Private keys in Bitcoin -Public keys in Bitcoin - Addresses in Bitcoin – Transactions- The transaction life cycle - Transaction fee- Transaction pools -The transaction data structure -Metadata-Inputs -Outputs -Verification - The script language -Types of transactions -Coinbase transactions – Contracts - Tasks of the miners - Mining rewards - Proof of Work (PoW)

### **UNIT V: DEVELOPMENT TOOLS AND FRAMEWORK**

Ethereum network – Mainnet- Testnet - Private net - Ether cryptocurrency / tokens (ETC and ETH) - Ethereum Virtual Machine (EVM) -Solidity language-types-function types - reference types -control structures - Introducing Web3 - Contract deployment - POST requests- Truffle -Interaction with the contract – Oracles -Deployment on decentralized storage using IPFS – Hyperledger-reference architecture - Hyperledger Fabric - Membership services -Blockchain services -consensus services

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Third Edition, Packt Publishing, 2020.
  2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press ,2016. Elaine Shi , Foundations of Distributed Consensus and Blockchains, Book Draft.
  3. Antonopoulos, ‘Mastering Bitcoin’. Second Edition , O’Reilly Publishers .2017.
  4. D. Drescher, ‘Blockchain Basics’ First Edition , Apress, 2017. Antonopoulos and G. Wood, Mastering Ethereum, First Edition, 2018
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25ITU632B

SOFTWARE DEFINED NETWORKS

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100  
 End Semester Exam: 3 Hours

### Course Objectives

- To understand the concept of SDN and its architecture.
- To learn about the need for separate control and data plane in SDN and also about various SDN Controllers
- To understand the concept of NFV and its impact in network resource utilization
- To explore about various NFV use cases and its impact in 5G
- To know about various SDN applications and simulators

### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamentals of Software Defined Networks .	Understand
CO2	Understand the functionalities of data and control planes.	Understand
CO3	Implement network services using Network Function Virtualization	Apply
CO4	Understand virtualization functionalities associated with NFV.	Understand
CO5	Design and develop network applications using SDN tools	Apply

### CO-PO Mapping

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	2	3	3	2	1	1	1	1	1	2	2	2
CO2	3	2	2	2	3	2	2	1	1	1	1	1	2	2	2
CO3	2	3	2	3	2	2	2	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	3	2	1	1	1	1	1	2	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 - high**

### **UNIT I: SDN INTRODUCTION**

Evolving Network Requirements – Need and History of SDN– The SDN Approach – SDN architecture – SDN Software Stack- SDN Data Plane,-Control plane and Application Plane- SDN APIs-Open Networking Foundation- SDN Devices.

### **UNIT II : SDN DATA PLANE AND CONTROL PLANE**

Data Plane functions and protocols - OpenFlow Overview -Open Flow controller- Open Flow ports - Flow Table - OpenFlow Protocol -Proactive and Reactive Flow - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers – Application of Open Flow in SDN Controller- Mininet

### **UNIT III: NETWORK FUNCTION VIRTUALIZATION**

Network Virtualization -Challenges-Building Blocks-Virtual Network Encapsulation- Virtual Switches- Microsegmentation- Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

### **UNIT IV: NFV FUNCTIONALITY**

NFV Infrastructure – InLine Network Functions- Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV in 5G – Service Function Chaining - Core Network Function Virtualization- Virtualized Evolved Packet Core (vEPC).

### **UNIT V: SDN APPLICATIONS**

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering and Path Efficiency- Wide Area Traffic Management– Measurement and Monitoring – Security – Data Center Networking-Tunneling Technologies for Data Center - SDN Simulators.

**PERIODS : 45**

### **SUGGESTED READINGS:**

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.
2. Larry Peterson, Carmelo Cascone, Brian O’Connor, Thomas Vachuska, and Bruce Davie, “Software-Defined Networks: A Systems Approach”, Second Edition, Systems Approach LLC Publisher, November 2021.
1. 1.Sahoo, Kshira Sagar, Bibhudatta Sahoo, and Brojo Kishore Mishra, eds. "Software-defined Networking for Future Internet Technology: Concepts and Applications." Apple Academic Press 2021.
2. Wang, David. Software defined-WAN for the digital age: a bold transition to next generation networking. CRC Press, 2018.
3. Zhang, Ying. Network Function Virtualization: Concepts and Applicability in 5G Networks. John Wiley & Sons, 2018.
4. Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016.
5. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.

**25ITU731B LEGAL, ETHICAL AND SOCIAL ISSUES IN INFORMATION SECURITY 3H– 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

**Course Objectives**

1. Introduce students to the legal frameworks governing information security.
2. Analyze ethical dilemmas and responsibilities in handling data and security incidents.
3. Explore social implications of security practices, privacy issues, and surveillance.
4. Understand intellectual property rights, digital forensics, and cybercrime.
5. Foster responsible decision-making and policy development in information systems.

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
CO1	Understand and explain the legal frameworks and standards that apply to information security.	Understand
CO2	Identify and evaluate ethical issues and professional responsibilities in cybersecurity	Apply
CO3	Analyze the social impacts of cybersecurity practices and technology use.	Analyze
CO4	Apply knowledge of intellectual property, privacy, and compliance in real-world security cases	Apply
CO5	Develop ethical and legal strategies for managing information security policies and incidents.	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	3	2	2	3	3	2	1	1	1	1	1	2	2	2
CO2	3	2	2	3	3	2	2	1	1	1	1	1	2	2	2
CO3	2	3	3	3	2	2	2	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	3	2	1	1	1	1	2	2	2	3

CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2
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**1 - low, 2 - medium, 3 - high**

**UNIT I: INTRODUCTION TO CYBER LAW AND ETHICS**

Introduction to Cyber Law and Ethics, Importance of Legal and Ethical Compliance in IT, Core Principles of Ethics (Utilitarianism, Deontology, Virtue Ethics), Professional Codes of Conduct (ACM, IEEE), Case Studies on Ethical Decision-Making.

**.UNIT II: LEGAL ASPECTS OF CYBERSECURITY**

Overview of National and International Cyber Laws, IT Act (India), GDPR (EU), HIPAA, and other frameworks, Cybercrime Classifications: Hacking, Fraud, Identity Theft, Legal Procedures and Evidentiary Considerations, Roles of Law Enforcement and Cybercrime Units

**UNIT III: PRIVACY, SURVEILLANCE, AND SOCIAL IMPLICATIONS**

Definition and Dimensions of Privacy, Surveillance Technologies and Ethics, Government vs. Individual Rights, Social Media and User Data Exploitation, Whistleblowing and Freedom of Expression

**UNIT IV: INTELLECTUAL PROPERTY AND DIGITAL RIGHTS**

Copyrights, Patents, and Trademarks in IT, Software Licensing and Open Source Issues, Digital Rights Management (DRM), Infringement and Legal Remedies, Case Studies on Piracy, Plagiarism, and IP Violations

**UNIT V: SECURITY POLICIES, COMPLIANCE, AND PROFESSIONAL RESPONSIBILITY**

Developing Organizational Security Policies, Compliance Requirements (ISO/IEC 27001, NIST), Ethics in Penetration Testing and Vulnerability Disclosure, Forensics and Incident Response Ethics, Emerging Issues: AI Ethics, Data Bias, and Algorithmic Justice.

**PERIODS : 45**

**SUGGESTED READINGS:**

1. Michael E. Whitman and Herbert J. Mattord, *Ethical Hacking and Countermeasures*.
2. George Reynolds, *Ethics in Information Technology*.
3. Jonathan Rosenoer, *Cyberlaw: The Law of the Internet*.
4. Pavan Duggal, *Cyberlaw: The Indian Perspective*.
5. Selected Government Acts and Case Studies.

Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**Course Objectives**

1. Understand the foundations of cybercrime, types of attacks, and motivations behind them.
2. Learn about national and international legal instruments related to cybercrime.
3. Explore the principles, processes, and tools used in digital forensic investigations.
4. Apply forensic techniques to computer systems and networks.
5. Address forensic issues in emerging technologies and analyze future challenges.

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the nature, scope, and impact of cybercrimes in the digital world	Understand
CO2	Learn the legal and ethical aspects of cybercrime investigation and prosecution	Apply
CO3	Gain foundational knowledge in digital forensics and evidence handling	Understand
CO4	Apply forensic tools and techniques to analyze and investigate digital crimes	Apply
CO5	Explore real-world case studies and trends to understand the practical challenges in cybercrime prevention and forensic investigation	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	2	2	3	3	2	1	1	1	1	1	2	2	2
CO2	2	2	2	2	3	2	2	1	1	1	1	1	3	2	2

CO 3	2	3	3	3	2	2	2	1	1	1	1	2	2	2	2
CO 4	3	3	3	2	2	3	2	1	1	1	1	2	2	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 - high**

#### **UNIT I: INTRODUCTION TO CYBERCRIME**

Definition and characteristics of cybercrime, Categories of cybercrimes: Financial crimes, Cyberterrorism, Cyberbullying and harassment, Identity theft and phishing, Cybercriminal profiles and motivations.

#### **UNIT II: CYBERCRIME LAWS AND LEGAL FRAMEWORK**

Overview of Cyber Laws (National & International), Indian IT Act 2000 (Amendments of 2008 and beyond), Legal procedures for investigation and prosecution, Cybercrime reporting and legal challenges, Role of law enforcement agencies, Privacy, ethics, and human rights in cyberspace.

#### **UNIT III: DIGITAL FORENSICS FUNDAMENTALS**

Introduction to digital forensics, Phases of digital forensic investigation, Types of digital evidence, Chain of custody and evidence handling, Forensic tools and software overview, Forensics readiness and incident response.

#### **UNIT IV: DIGITAL FORENSICS PROCESS AND TECHNIQUES**

Acquisition and imaging of digital evidence, Disk forensics, Memory forensics, and Network forensics, File systems and log analysis, Email and mobile device forensics, Malware forensics, Anti-forensics techniques and countermeasures.

#### **UNIT V: CASE STUDIES AND EMERGING TRENDS**

Real-life cybercrime case studies (National & International), Role of CERT-IN and other cyber agencies, Emerging trends in cybercrime (Dark Web, Deepfakes, Ransomware, AI-driven attacks), Digital forensics in Cloud and IoT environments, Future of cybercrime prevention and investigation.

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Niranjan Reddy, *Cyber Crime and Cyber Security*, Notion Press;
2. Bill Nelson, Amelia Phillips, Christopher Steuart,
3. *Guide to Computer Forensics and Investigations*, Cengage Learning;
4. Alfred Basta, Nadine Basta, Mary Brown, *Cyber Security and Cyber Laws*, Cengage.

### VERTICAL 3 - Data Science and Cloud Computing

B.E. / B.Tech. (Common to all Branches)

2025-2026

25ITU531C

SERVERLESS COMPUTING

3H – 3C

**Instruction Hours / week: L: 3 T: 0 P: 0      Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

#### Course Objectives

- Understand the fundamentals of serverless computing
- Explore the serverless ecosystem
- Design and build serverless applications
- Manage scalability, performance, and reliability
- Optimize cost and performance

#### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	To understand the basic concepts of Serverless Computing and SDKs.	Understand
CO2	To implement Serverless computing with AWS Lambda.	Apply
CO3	To deploy Serverless applications on AWS	Understand
CO4	To create Serverless Application on Microsoft Azure.	Understand
CO5	To deploy Serverless applications on Google Cloud	Understand

#### CO-PO Mapping

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	2	2	3	3	2	1	1	1	1	1	2	3	2
CO2	2	2	2	2	3	2	2	1	1	1	1	2	3	2	2
CO3	3	3	3	3	2	2	2	1	1	1	1	2	2	2	2

CO 4	3	2	3	2	2	3	2	1	1	1	1	2	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 - high**

**Unit I: INTRODUCTION :**

Serverless Computing: Serverless and event-driven collision-Function-as-a-Service (FaaS) – Benefits and Limitations - Comparison with Server based Computing - Development Environment, Tools : Visual Studio Code - Node.js – Postman - Serverless framework with Node.js and Core concepts - SDKs: AWS Node.js - Microsoft Azure Node.js - Google Cloud Node.js.

**Unit II: SERVERLESS COMPUTING WITH AWS LAMDA:**

AWS Serverless architecture and its component services- AWS Lambda & Serverless: Getting Started- Execution process - Tools to create & Test Lambda-based Applications- Configuring Options- Lambda function - Lambda function using AWS CLI- Lambda using AWS Cloud formation -AWS Lambda Use Cases – Securing AWS Lambda using IAM.

**Unit III: SERVERLESS APPLICATION ON AWS:**

Triggers: API Gateway- Alexa- CloudFront - CloudWatch- Code Commit – Cognito - AWS Config- Kinesis- S3- SNS - Event Bridge and Step Functions - Serverless Application Model (SAM): Creation of Serverless App - Deployment and Testing using SAM - Serverless Orchestration on AWS.

**Unit IV: SERVERLESS COMPUTING ON MICROSOFT AZURE:**

AZURE: Functions and Configuration-Serverless platform-Azure Portal- Triggers and Bindings in Azure- Serverless Application: Creating HTTP Trigger based Function-Testing and managing Azure functions- Automation Script generation- Serverless App using Azure Function Core Tools - Testing and Deployment.

**Unit V: SERVERLESS APPLICATION ON GOOGLE CLOUD :**

Google Cloud Functions and App Engine- Serverless Platform: Google Cloud Console and Triggers gCloud Serverless Application: Technical requirements-Creation-Testing and deployment of GL Server App- gCloud CLI- Reference architecture for a web App.

**PERIODS : 45**

**SUGGESTED READINGS:**

**TEXTBOOKS:**

- Kuldeep Chowhan, " Hands-On Serverless Computing, Packt Publishing, 2018
- Scott Patterson, "AWS Serverless Computing", Packt Publishing, 2019.
- Miguel A. Calles, "Mastering AWS Serverless: Architecting, developing, and deploying serverless solutions on AWS", BPB Publication, 2024.

B.E. / B.Tech. (Common to all Branches)

2025-2026

25ITU532C

Cloud Security

3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours

**Course Objectives:**

- Understand the fundamentals of cloud security
- Identify cloud security challenges and threats
- Apply security principles to cloud environments
- Ensure data protection and privacy in the cloud
- Evaluate cloud security services and frameworks

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand basic cloud computing models and security challenges.	Understand
CO2	Apply cloud security architecture principles like IAM and secure access.	Apply
CO3	Identify threats and apply mitigation techniques in cloud environments.	Understand
CO4	Implement security controls like encryption, IDS/IPS, and VM isolation.	Apply
CO5	Evaluate cloud compliance standards, risk management, and governance.	Apply

**CO-PO Mapping**

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
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CO 1	2	2	2	2	3	3	2	1	1	1	1	3	2	3	2
CO 2	2	2	2	2	3	2	2	1	1	1	1	2	3	2	2
CO 3	3	3	3	3	2	2	2	1	1	1	1	3	2	2	2
CO 4	3	2	3	2	2	3	2	1	1	1	1	2	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

### **UNIT I: INTRODUCTION TO CLOUD COMPUTING AND SECURITY**

Cloud computing models: IaaS, PaaS, SaaS, FaaS, Deployment models: Public, Private, Hybrid, Community, Shared responsibility model in cloud security, Cloud security challenges and risks, Threat landscape in cloud environments, Overview of compliance requirements (GDPR, HIPAA, PCI DSS, ISO 27001).

### **UNIT II: IDENTITY, ACCESS, AND DATA SECURITY**

Identity and Access Management (IAM), Authentication and authorization mechanisms, Role-based and attribute-based access control, Multi-factor authentication, Data security and privacy concerns in cloud, Data protection techniques: Encryption at rest, in transit, and during processing, Key management and secure storage.

### **UNIT III: CLOUD NETWORK AND INFRASTRUCTURE SECURITY**

Virtualization and hypervisor security issues, Securing cloud infrastructure and workloads, Network security in cloud: Firewalls, VPNs, VPCs, IDS/IPS, Security groups and network segmentation, Zero Trust security model in cloud environments, Cloud perimeter security vs. traditional perimeter models.

### **UNIT IV: MONITORING, INCIDENT RESPONSE, AND COMPLIANCE**

Cloud monitoring tools and techniques, Logging and auditing in cloud environments, Intrusion detection and prevention systems, Threat intelligence and SIEM (Security Information and Event Management), Incident response and disaster recovery in cloud, Cloud forensics: challenges and approaches, Governance, Risk, and Compliance (GRC) in cloud.

### **UNIT V: ADVANCED TOPICS AND EMERGING TRENDS IN CLOUD SECURITY**

Security in containerized and microservices architectures (Docker, Kubernetes), Serverless computing security issues, Cloud-native security tools and frameworks (CSA CCM, NIST guidelines), Security in multi-cloud and hybrid cloud environments, AI/ML for cloud security and automated threat detection, Case studies: Real-world cloud security breaches and lessons learned, Best practices for designing secure cloud architectures.

**PERIODS : 45**

### **SUGGESTED READINGS:**

- **Cloud Security and Privacy** – Tim Mather, Subra Kumaraswamy, and Shahed Latif (O'Reilly)
- **Cloud Computing: Concepts, Technology & Architecture** – Thomas Erl
- **AWS Certified Security – Specialty Exam Guide** – Stuart Scott (useful for practical cloud)



CO 1	2	2	3	2	3	3	2	1	1	1	1	3	2	3	2
CO 2	2	2	2	2	3	2	2	1	1	1	1	2	3	2	2
CO 3	3	2	2	3	2	2	2	1	1	1	1	2	2	2	2
CO 4	3	2	3	2	2	3	2	1	1	1	1	2	3	2	3
CO 5	3	2	3	3	2	2	2	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

#### **Unit I: DATA WAREHOUSE**

Data Warehousing – Operational Database Systems versus Data Warehouses – Multidimensional Data Model – Schemas for Multidimensional Databases – OLAP operations – Data Warehouse Architecture – Indexing – OLAP queries & Tools.

#### **Unit II: DATA MINING & DATA PREPROCESSING**

Introduction to KDD Process – Knowledge Discovery from Databases – Need for Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

#### **Unit III: ASSOCIATION RULE MINING:**

Introduction – Data Mining Functionalities – Association Rule Mining – Mining FrequentItem sets with and without Candidate Generation – Mining various Kinds of Association Rules – Constraint – Based Association Mining.

#### **Unit IV: CLASSIFICATION & PREDICTION:**

Classification versus Prediction – Data Preparation for Classification and Prediction –Classification by Decision Tree – Bayesian Classification – Rule Based Classification – Classification by Back Propagation Support Vector Machines – Associative Classification – Lazy Learners – Prediction – Accuracy and Error Measures – Ensemble Methods – Model Section

#### **Unit V: CLUSTERING:**

Cluster Analysis – Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Model Based Clustering Methods – Clustering High-Dimensional Data – Constraint Based Cluster Analysis – Outlier Analysis.

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Jiawei Han, Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.
2. K. P. Soman, Shyam Diwakar, V. Ajay, “Insight into Data mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, Third Edition, 2014.
4. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Second Edition, Elsevier, 2015

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU731C**

**BIG DATA ANALYTICS**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

**Course Objectives**

- To know the fundamental concepts of big data and analytics.
- To gain knowledge to work with MapReduce big data frameworks.
- To learn the basic and advanced features of open-source big data tools and frameworks.
- To study various analytics on stream data.
- To understand the fundamentals of recommender systems and social networks.

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Understand the basics of Big Data	Understand
<b>CO2</b>	Know about Hadoop and MapReduce	Apply
<b>CO3</b>	Know about Big Data Technology, Tools, and Algorithms	Understand
<b>CO4</b>	Analyze the stream data and Link analysis.	Analyze
<b>CO5</b>	Know about the role of big data in Recommender systems and social network analysis	Apply
<b>CO6</b>	Design and Implementation of basic data intensive applications.	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	2	3	3	2	1	1	1	1	2	2	3	2
CO2	2	2	2	2	3	2	3	1	1	1	1	2	2	2	2
CO3	3	2	2	3	2	2	2	1	1	1	1	2	2	2	2
CO4	3	2	3	2	2	3	2	1	1	1	1	2	3	2	3
CO5	3	2	3	3	2	2	2	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

#### **Unit I: INTRODUCTION TO BIG DATA**

Introduction to Big Data - Need for processing Big Data – Need for analytics- Characteristics of big data, Domain-specific examples of big data, Big Data Stack – Introduction to Hadoop - Setting up of Hadoop.

#### **Unit II: MAPREDUCE AND NEW SOFTWARE STACK**

Distributed File System – MapReduce, algorithms using MapReduce - Extensions to MapReduce – Communication-cost model – Complexity Theory for MapReduce - Overview of Spark.

#### **Unit III: BIG-DATA TECHNOLOGY OVERVIEW**

Big Data Collection Systems – Apache Flume – Big data Storage – HDFS Systems – Pig and Hadoop – Grunt – Data Model – pig Latin – Hive Overview – Hive QL – Overview of HBase - Overview of Workflow – Workflow and Scheduling using Apache Oozie - Introduction to NoSQL Databases – Basics of MongoDB.

#### **Unit IV: STREAMING ANALYTICS AND LINK ANALYSIS**

Introduction to Stream analytics – Stream data model – Sampling Data – filtering streams – Count distinct elements in a stream, Counting ones, Estimating moments – Decaying windows – Link Analysis – PageRank Computation – Market Basket model – Limited pass algorithms for Frequent Item sets.

#### **Unit V: RECOMMENDER SYSTEMS AND SOCIAL NETWORK MINING**

Advertising on the Web – Online Algorithms – Matching problem – Adwords problem and Implementation – recommendation systems – Collaboration filtering – Dimensionality reduction – Mining Social Network graphs – Clustering of social network graphs – Partitioning of graphs – Simrank – Counting Triangles – Neighborhoods properties of Graphs.

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Third Edition, Cambridge University Press, New Delhi.
  2. Arshdeep Bagha and Vijay Madiseti, "Big Data Science & Analytics - A Hands-on Approach", New Delhi, 2016.
  3. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013.
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**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU732C**

**Edge and Fog Computing**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

**Course Objectives**

- Understand the fundamentals of Edge and Fog Computing
- Analyze the need for decentralized computing
- Design edge and fog architectures
- Apply security and privacy mechanisms
- Develop and deploy edge/fog-enabled applications

**Course Outcomes (COs)**

**At the completion of the course the student will be able to**

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Understand the fundamentals of edge and fog computing architectures.	Understand
<b>CO2</b>	Analyze the role of edge devices and fog nodes in distributed computing.	Analyze
<b>CO3</b>	Design low-latency applications using edge/fog frameworks.	Understand
<b>CO4</b>	Evaluate resource management, orchestration, and scalability techniques.	Apply
<b>CO5</b>	Apply edge/fog solutions for real-time IoT and smart system use cases.	Apply

**CO-PO Mapping**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	2	3	3	2	1	1	1	1	2	2	3	2
CO2	2	2	2	2	3	2	3	1	1	1	1	2	2	2	2
CO3	3	2	3	3	2	3	2	1	1	1	1	2	2	2	2
CO4	3	2	3	2	2	3	2	1	1	1	2	2	3	2	3
CO5	3	2	3	3	2	2	3	1	1	1	2	3	2	3	2

1 - low, 2 - medium, 3 - high

**UNIT I: INTRODUCTION TO EDGE AND FOG COMPUTING**

Overview of cloud, edge, and fog computing, Comparison: Cloud vs Edge vs Fog, Need for edge computing, Edge computing in IoT and cyber-physical systems, Fog computing architecture and features.

**UNIT II: EDGE/FOG ARCHITECTURE AND COMPONENTS**

Edge computing reference models, Fog nodes and edge devices, Communication models, Data preprocessing and storage at edge/fog, Edge analytics and micro data centers.

**UNIT III –EDGE AND FOG TECHNOLOGIES**

Edge/fog hardware and software platforms, Middleware and virtualization, Containerization: Docker, Kubernetes, Edge/fog network protocols: MQTT, CoAP, Edge AI and ML

**UNIT IV: RESOURCE MANAGEMENT AND SECURITY**

Resource allocation and scheduling, QoS, load balancing, and service orchestration, Security threats in edge/fog computing, Data privacy and encryption techniques, Authentication and access control.

**UNIT V –APPLICATIONS AND CASE STUDIES**

Smart cities and real-time surveillance, Smart healthcare and energy systems, Industrial IoT (IIoT), Autonomous vehicles and edge intelligence, Case studies on edge/fog deployments.

**PERIODS : 45**

**SUGGESTED READINGS:**

- Rajkumar Buyya, Satish Narayana Srirama – *Fog and Edge Computing: Principles and Paradigms*, Wiley, 2019.
- Amir Vahid Dastjerdi, Rajkumar Buyya – *Internet of Things: Principles and Paradigms*, Elsevier, 2016.
- Pethuru Raj, Anupama C. Raman – *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017.
- Flavio Bonomi, Rodolfo Milito – *Fog Computing: A Platform for Internet of Things and Analytics*, Springer, 2017.
- Online materials, whitepapers from Cisco, IBM, and Microsoft on Edge and Fog Computing.

## VERTICAL 4 – DIGITAL MEDIA TECHNOLOGIES

B.E. / B.Tech. (Common to all Branches)

2025-2026

25ITU531D

IMAGE PROCESSING AND COMPUTER VISION

3H – 3C

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

### Course Objectives

- To provide knowledge about fundamentals of computer vision.
- To understand the basics of image enhancement techniques.
- To familiarize the student with the image restoration techniques.
- To understand and implement various segmentation and feature extraction techniques.
- To appreciate the use of compute vision techniques in various applications.

### At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Implement basic image processing operations.	Apply
CO2	Apply and develop new techniques in the areas of image enhancement and frequency transforms.	Apply
CO3	Restore images from noise and to extract edges and boundaries.	Apply
CO4	Understand the image segmentation algorithms and identify features from images.	Understand

<b>CO5</b>	Apply classifiers and clustering algorithms for image classification and clustering.	Apply
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### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	2	2	3	2	1	1	1	2	2	3	3	2
CO2	2	2	2	2	3	2	3	1	1	1	2	2	2	3	2
CO3	3	2	3	2	2	3	2	1	1	1	2	2	2	2	2
CO4	3	2	3	2	2	3	2	1	1	1	2	2	3	2	3
CO5	3	2	3	3	2	2	3	1	1	1	2	3	2	3	2

1 - low, 2 - medium, 3 - high

### UNIT I: FUNDAMENTALS OF IMAGE PROCESSING

Introduction – Applications of Image Processing – Steps in Image Processing Applications – Human vision and color perception- Digital Imaging System – Imaging Sensors - Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats – Image Operations.

### UNIT II: IMAGE ENHANCEMENT AND TRANSFORMS

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – Wavelet Transforms - Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing – Spatial Filtering – Smoothing and Sharpening – Frequency Domain: Filtering in Frequency Domain.

### UNIT III: RESTORATION AND BOUNDARY DETECTION

Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration - Morphological operations- dilation-erosion-opening-closing- edge detection- corner detection - detection of Discontinuities Edge Linking and Boundary Detection.

### UNIT IV: IMAGE SEGMENTATION AND FEATURE EXTRACTION

Image Segmentation — Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature extraction – SIFT, SURF – Feature reduction algorithms- PCA.

### UNIT V: IMAGE CLASSIFIER AND APPLICATIONS

Image Classifiers – Supervised Learning – maximum likelihood-minimum distance-parallelepiped Support Vector Machines, Image Clustering – Unsupervised Learning – kMeans -Hierarchical and Partition based Clustering Algorithms – ANN - Deep learning image classifier.

**PERIODS : 45**

## SUGGESTED READINGS:

1. Rafael Gonzalez, Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018.
2. S. Sridhar, "Digital Image Processing", Second Edition, Oxford University Press, 2016.
3. Digvirs.Jayas, "Image Processing: Advance in Application and Research", Nova Publication, 2023.
4. Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, 2011.
5. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI, 2011.
6. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and Machine Vision", Fourth Edition, Cengage India, 2017.

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU532D**

**MULTIMEDIA AND ANIMATION**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

### Course Objectives

- To understand the fundamental concepts and components of multimedia systems.
- To explore the principles of image, audio, and video processing.
- To gain insight into animation techniques, tools, and production pipelines.
- To learn multimedia data formats, compression methods, and delivery mechanisms.
- To develop the ability to design interactive multimedia and animation applications.

### At the completion of the course the student will be able to

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Explain the architecture and components of multimedia systems.	Understand
<b>CO2</b>	Analyze and process multimedia elements such as text, images, audio, and video.	Analyze
<b>CO3</b>	Apply 2D and 3D animation principles using industry-standard tools.	Apply
<b>CO4</b>	Understand multimedia compression standards and file formats.	Understand
<b>CO5</b>	Design and develop basic multimedia applications with animation and interactivity..	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	2	2	3	2	1	1	1	2	2	3	3	2
CO2	2	3	2	2	3	2	3	1	1	1	1	2	2	3	2
CO3	3	2	2	2	2	3	2	1	1	1	1	2	2	2	2
CO4	3	2	3	2	2	3	2	1	1	1	2	2	3	2	3
CO5	3	2	3	3	2	2	3	1	1	1	1	3	2	3	2

1 - low, 2 - medium, 3 - high

#### UNIT I: INTRODUCTION TO MULTIMEDIA SYSTEMS

Definition and Components of Multimedia – Multimedia Architecture – Applications of Multimedia – Multimedia Hardware and Software – Multimedia Authoring Tools – Multimedia System Design – Data Representation – Text, Image, Audio, Video – Storage and Retrieval – Synchronization and Integration – Multimedia Communication Systems – Challenges in Multimedia.

#### UNIT II: IMAGE AND AUDIO FUNDAMENTALS

Digital Image Representation – Color Models: RGB, CMYK, HSV – Image Acquisition and Scanning – Image Enhancement Techniques – File Formats: BMP, GIF, JPEG, PNG – Digital Audio Concepts – Sampling and Quantization – Audio File Formats: WAV, MP3, AAC – Audio Compression Techniques – MIDI – Psychoacoustics – Noise Reduction and Filtering.

#### UNIT III: VIDEO AND ANIMATION BASICS

Video Formats and Standards: MPEG, AVI, MP4 – Frame Rate and Resolution – Temporal and Spatial Redundancy – Video Compression: H.264, H.265 – Motion Estimation and Compensation – Basics of Animation – Types of Animation – Keyframing – Tweening – Timeline Animation – Frame-by-Frame Animation – Stop Motion – Onion Skinning – Storyboarding.

#### UNIT IV: 2D AND 3D ANIMATION TECHNIQUES

Principles of Animation – Squash and Stretch, Timing, Anticipation – 2D Animation Tools: Adobe Animate, Pencil2D – 3D Modeling and Animation – Coordinate Systems – Meshes and Textures – Rigging and Skinning – Forward and Inverse Kinematics – Keyframe Animation in 3D – Morphing – Particle Systems – Lighting and Rendering – Walk Cycles – Lip Sync.

#### UNIT V: MULTIMEDIA APPLICATIONS AND PROJECT DESIGN

Interactive Multimedia – User Interface Design – Multimedia Project Development Stages – Planning, Design, Production, Testing – Multimedia in Education, Advertising, Gaming, Virtual Reality – Animation in Film and Web – Real-Time Rendering – Mobile Multimedia – Delivery Platforms – Compression for Streaming – Case Studies in Multimedia Production – Ethical Issues in Digital Media.

PERIODS : 45

SUGGESTED READINGS:

1. **Tay Vaughan**, *Multimedia: Making It Work*, 9th Edition  
A well-structured introduction to multimedia systems, tools, and applications with practical insights.
2. **Ze-Nian Li and Mark S. Drew**, *Fundamentals of Multimedia*, Pearson  
Comprehensive coverage of multimedia technologies, formats, compression, and processing.
3. **John F. Koegel Buford**, *Multimedia Systems*, Pearson  
Covers system-level multimedia design, media types, and delivery networks.
4. **Nigel Chapman and Jenny Chapman**, *Digital Multimedia*, Wiley  
Explores key media elements, multimedia tools, interactivity, and project development.
5. **Jim Blinn**, *A Trip Down the Graphics Pipeline*, Morgan Kaufmann  
A deep dive into computer graphics, helpful for understanding 3D animation rendering.
6. **Isaac Kerlow**, *The Art of 3D Computer Animation and Effects*, Wiley  
An industry-oriented guide to 3D animation production, design principles, and workflows.

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU631D**

**GAME DESIGN AND DEVELOPMENT**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To train the students to acquire knowledge in game design and development
- To learn the mathematics behind game development
- To know the mechanics involved in game design
- To acquire knowledge about the algorithms related to game development
- To survey the gaming development environment and tool kits

### Course Outcomes (COs)

**At the completion of the course the student will be able to**

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Understand the concepts and techniques used in game development. CO 2.	Understand
<b>CO2</b>	Understand the mathematical and graphical concepts used for game development	Understand

<b>CO3</b>	Apply the physical and mechanical concepts for interactive and real time game development	Apply
<b>CO4</b>	Design and develop algorithms for effective gaming environments	Apply
<b>CO5</b>	Create and implement various applications for game development.	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
<b>CO1</b>	2	3	2	2	3	3	2	1	1	1	2	2	3	3	2
<b>CO2</b>	3	3	2	2	3	2	3	1	1	1	1	2	2	2	2
<b>CO3</b>	3	2	2	3	2	2	2	1	1	1	1	2	2	2	2
<b>CO4</b>	2	2	3	2	2	3	2	1	1	1	1	2	3	2	3
<b>CO5</b>	3	2	3	3	2	3	3	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

### UNIT I: INTRODUCTION TO GAME DESIGN

Games- Designing and Developing Games-Genres- Understanding: Players, Machine-Game: Concepts, Worlds-Creative and Expressive Play- Character Development-Storytelling—Screenplay-Storyboard Pre-visualizaition- Script-Creating User Experience-Game play- Introduction to Core Mechanics- Game Balancing- Level Design

### UNIT II: FOUNDATIONS TO GAME DESIGN

Cartesian Coordinate Systems-Vectors-Linear Interpolation- Multiple Coordinate Spaces-Matrices and Linear –Transformations - Polar Coordinate Systems-3D Rotations, Transformation, Scaling - Geometric Primitives-Viewing in 3D-Viewing Pipeline-Clipping Algorithms-Text Transformation.

### UNIT III: MECHANICS FOR GAME DESIGN

Linear Kinematics and Calculus –Linear and Rotational Dynamics –Curves and Surfaces- Curves in 3D – Lighting-Shading - Shadowing- Depth Cueing- Projections - Perspective - Orthogonal - Intersection Testing - Rigid Body Dynamics - Animation System – Controller based animation-Cameras Details.

### UNIT IV: ARCHITECTURE AND ALGORITHMS FOR GAME DEVELOPMENT

Foundation- Low-Level Engine System – State Based Behaviors – Strategy and Planning-Game Play - Path and Waypoints – Navigation – Behaviors - Collision Detection - Game Logic - Game Artificial Intelligence - Spatial Sorting - singleton - Object Pooling-Basic Sound – 3D Sound - Event-Based Input Systems

### UNIT V: LANGUAGES FOR GAME DEVELOPMENT

Scripting Languages and Data Format – PyGame/Unity-Networked Games – Sample Game – iOS, Windows, Android-Developing 2D and 3D interactive games using Unity - DirectX – Isometric and Tile Based Games - Puzzle games - Single Player games - Multi Player game-Marker Systems

**PERIODS : 45**

## SUGGESTED READINGS:

1. Adam Kramarzewski and Ennio De Nucci, " Practical Game Design: A modern and Comprehensive Guide to Video game Design" Packt Publishing Ltd.2023
2. Mastering Game Design with Unity 2021: Immersive Workflows, Visual Scripting, Physics Engine, Game Objects", BPB Publications, 2022
3. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013
4. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", First edition, Prentice Hall 2006
5. Sebastiano M.Cossu, "Beginning Game AI with Unity: Programming Artificial Intelligence with C#", Apress, 2020.
6. James M, Van Verth, Lars M.Bishop, "Essential Mathematics for Game anf Interactive Application", Third Edition, CRC Press, 2015
7. Michael Dawson, "Beginning C++ Through Game Programming", Fourth Edition, Cengage Learning PTR, 2015.
8. Jason Gregory, "Game Engine Architecture", Third Edition, A K Press, 2015. 5. Fletcher Dunn, LanParberry , " 3D Math Primer for Graphics and Game Development", Second Edition, CRC Press, 2011.

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

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**25ITU632D**

**AUGMENTED AND VIRTUAL REALITY**

**3H – 3C**

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**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To know the fundamentals of augmented and virtual reality.
- To acquire the knowledge about computing hardware related to VR.
- To understand the tools and techniques used in VR implementation.
- To understand the tools and techniques used in AR implementation.
- To explore various application domains of AR/VR.

### At the completion of the course the student will be able to

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Understand Virtual Reality and Augmented Reality technologies.	Understand
<b>CO2</b>	Apply knowledge of computing architectures in the development of Virtual Reality systems.	Apply
<b>CO3</b>	Create Virtual Reality models using various modelling techniques.	Apply

<b>CO4</b>	Utilize AR technologies for creating AR enabled applications.	Apply
<b>CO5</b>	Develop domain specific interactive and immersive experience applications.	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
<b>CO1</b>	2	2	2	2	2	3	2	1	1	1	2	2	3	3	2
<b>CO2</b>	2	3	2	2	3	2	3	1	1	1	1	2	2	2	2
<b>CO3</b>	3	2	2	2	2	2	2	1	1	1	1	2	2	2	2
<b>CO4</b>	2	2	3	2	2	3	2	1	1	1	2	2	3	2	3
<b>CO5</b>	3	2	3	3	2	2	3	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

### UNIT I: INTRODUCTION OF METAVERSE

Evolution of metaverse – Interoperability – Architectural components and technological foundation – Metaverse vs web 3.0, Augmented Reality(AR) / Virtual Reality (VR); Blockchain/cryptocurrency – Metaverse application ecology and economy.

### UNIT II: IMMERSIVE TECHNOLOGIES AND NFT

Roles of immersive technologies: AR, VR, MR - advancements in display technologies, haptics, audio – Virtual worlds within metaverse – Non-Fungible Tokens (NFT) for metaverse – Decentralized governance – NFT distribution channels – NFT-based metaverse revenue model.

### UNIT III: METAVERSE ESSENTIALS

Metaverse tokens and land - Identity and avatars in metaverse –AI mixed with Computer Generated Imagery- Photorealistic Avatars– social networks and communities – user engagement – virtual education and learning – Metaverse design dimensions and development process.

### UNIT IV: METAVERSE INTELLIGENCE

SDKs, tools – services for natural language processing, machine learning, data mining, and recommendation systems – services for cyberspace encryption, and federated learning - UI prototyping, and accessible and inclusive UX design.

### UNIT V: METAVERSE CASE STUDIES

Metaverse prototypes for expressive arts and NFT – Digital museums in Metaverse – NFT and artworks trading, expressive art creations – Live performance – Metaverse prototypes for healthcare and mental well-being, including teletherapy, teleoperation, rehabilitation.

**PERIODS : 45**

**SUGGESTED READINGS:**

1. Hackl, C., Lueth, D., & Di Bartolo, T. (2022). *Navigating the Metaverse: A Guide to Limitless Possibilities in a Web 3.0 World*. John Wiley & Sons.
2. Ball, M. (2022). *The Metaverse: And How It Will Revolutionize Everything*. Liveright Publishing Corporation.
3. Schlemmer, E., & Backes, L. (2014). *Learning in Metaverses: Co-Existing in Real Virtuality*. IGI Global.
4. Arnaldi, B., Guitton, P., & Moreau, G. (2014). *Virtual Reality and Augmented Reality: Myths and Realities*. John Wiley & Sons

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU731D**

**UI AND UX DESIGN**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

**Course Objectives**

- To survey the Content information based on people needs.
- To train the students to acquire knowledge in UI & UX design.
- To acquire knowledge in components of UI & UX design.
- To survey the various UI systems.
- To understand the user experience design techniques.

**At the completion of the course the student will be able to**

<b>COs</b>	<b>Course Outcomes</b>	<b>Blooms Level</b>
<b>CO1</b>	Understand the user needs and requirements to build an effective User Interface.	Understand
<b>CO2</b>	Implement UI design principles in the creation of a User Interface.	Apply

<b>CO3</b>	Design and implement perfect layouts for UI design to develop real world UX product.	Apply
<b>CO4</b>	Analyse various types of User Interface systems.	Analyze
<b>CO5</b>	Create User Interfaces by applying Design Principles and evaluate the UI design.	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	2	3	2	3	2	1	1	1	1	2	3	3	2
<b>CO2</b>	3	3	2	2	3	2	3	1	1	1	1	2	2	2	2
<b>CO3</b>	3	2	2	2	2	3	2	1	1	1	1	2	2	2	2
<b>CO4</b>	3	3	3	2	2	3	2	1	1	1	1	2	3	2	3
<b>CO5</b>	3	2	3	3	2	2	3	1	1	1	1	3	2	3	2

**1 - low, 2 - medium, 3 - high**

### UNIT I: DESIGN FUNDAMENTALS

Understanding the Information and Task Space–Navigation Models: Hub and spoke-fully connected multilevel-pyramid-flat navigation-Patterns-clear Entry Points-Menu pages- - Signposts-Way finding-Layout of screen Elements- Visual Style and Aesthetics-Visual Design for Enterprise Applications-Laws governing UI.

### UNIT II: DISPLAY AND ELEMENTS

Understanding the Information and Task Space–Navigation Models: Hub and spoke-fully connected multilevel-pyramid-flat navigation-Patterns-clear Entry Points-Menu pages- - Signposts-Way finding-Layout of screen Elements- Visual Style and Aesthetics-Visual Design for Enterprise Applications-Laws governing UI.

### UNIT III: DISPLAY AND ELEMENTS

Types of Display – Actions and Commands – Pinch-Buttons-Drop-Down Menus-Action-Hover-Keyboard Action-Direct Manipulation-Showing Complex Data – Forms and Controls – Labels - Menus - Tabs - Buttons - Accordion - Carousel - Breadcrumbs — pagination-Scrollers-Two Panel Selection-Text input fields-Builder and Editors-UX writing Tools.

### UNIT IV: UI SYSTEMS

UI Frameworks – Smart Systems- Connected Devices – Anticipatory Systems-Assistive Systems-Natural User Interfaces- Challenges and Opportunities of Model Design-Screen Design - Text Display – Representing Physical Environment – Location – Social Influence – Various Design Pattern-Desktop Applications-Mobile Interfaces.

### UNIT V: UX DESIGN

User Research-Interviews-Persons--Content Strategy-Transition-Design Principles-Site Maps and Task Flows-Sketching-Wireframes and Annotations-Prototyping-Design Testing with Users-Transition Measuring UX Content Effectiveness-Analytics.

## SUGGESTED READINGS:

1. Park, U. (2023). *Introduction to Design Thinking for UX Beginners*. Wiley.
2. Marsh, J. (2022). *UX for Beginners: A Crash Course in 100 Short Lessons*. O'Reilly Media.
3. Tidwell, J., Brewer, C., & Valencia, A. (2020). *Designing Interfaces: Patterns for Effective Interaction Design* (3rd Edition). O'Reilly Media.
4. Johnson, J. (2020). *Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules* (3rd Edition). Elsevier.
5. Yablonski, J. (2021). *Laws of UX: Using Psychology to Design Better Products & Services*. O'Reilly Media.
6. Podmajersky, T. (2019). *Strategic Writing for UX*. O'Reilly Media, Inc.
7. Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. M. (2012). *Designing the User Interface: Strategies for Effective Human-Computer Interaction* (5th Edition). Pearson.
8. Unger, R., & Chandler, C. (2012). *A Project Guide to UX Design: For User Experience Designers in the Field or in the Making* (2nd Edition). New Riders.

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU732D**

**DATA VISUALIZATION TECHNIQUES**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization depth tools.
- To acquire knowledge about the issues in data representation.
- To visualize the Data using tools Tableau
- To gain skill in designing real time interactive information visualization system.

### Course Outcomes (COs)

**At the completion of the course the student will be able to**

COs	Course Outcomes	Blooms Level
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<b>CO1</b>	Apply mathematics and basic science knowledge for designing information visualizing System.	Apply
<b>CO2</b>	Collect data ethically and solve engineering problem in visualizing the information.	Apply
<b>CO3</b>	Implement algorithms and techniques for interactive information visualization	Apply
<b>CO4</b>	Conduct experiments by applying various modern visualization tool and solve the space layout problem	Apply
<b>CO5</b>	Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.	Analyze

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	3	2	3	2	1	1	1	1	1	2	2	2
CO2	3	2	2	2	3	2	3	1	1	1	1	1	2	2	2
CO3	3	2	2	2	2	2	2	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO5	3	2	2	3	2	2	3	1	1	1	1	1	2	2	2

1 - low, 2 - medium, 3 – high

### UNIT I: INTRODUCTION

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools. Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs.

### UNIT II: VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES & GRAPHS

Mapping - Time series - Connections and correlations – Indicator-Area Chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics.

### UNIT III: TEXT AND DOCUMENT VISUALIZATION

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder ,Asynchronous Image Downloads, Web Techniques, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

### UNIT IV: INTERACTIVE DATA VISUALIZATION

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geo mapping – Exporting, Framework – D3.js, Tableau Dashboards.

### UNIT V – SECURITY IN DATA VISUALIZATION

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system.

**PERIODS : 45**

### SUGGESTED READINGS:

1. Spence, R. (2014). *Information Visualization: An Introduction* (3rd Edition). Pearson Education.
2. Ware, C. (2012). *Information Visualization: Perception for Design* (3rd Edition). Morgan Kaufmann Publishers.
3. Spence, R. (2006). *Information Visualization: Design for Interaction* (2nd Edition). Pearson Education.
4. Bederson, B. B., & Shneiderman, B. (2003). *The Craft of Information Visualization*. Morgan Kaufmann Publishers.
5. Strothotte, T. (1998). *Computational Visualization: Graphics, Abstraction and Interactivity*. Springer.
6. Ward, M. O., Grinstein, G., & Keim, D. (2015). *Interactive Data Visualization: Foundations, Techniques, and Applications* (2nd Edition). A.K. Peters / CRC Press.
7. Osarek, J. (2016). *Virtual Reality Analytics*. Gordon's Arcade.

### VERTICAL 5 - Next- Generation Technologies

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU531E**

**IOT AND SMART SYSTEMS**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### Course Objectives

- To study about Internet of Things technologies and its role in real time applications.
- To introduce the infrastructure required for IoT
- To familiarize the accessories and communication techniques for IoT.
- To provide insight about the embedded processor and sensors required for IoT
- To familiarize the different platforms and Attributes for IoT

## Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Analyze the concepts of IoT and its present developments.	Analyze
CO2	Compare and contrast different platforms and infrastructures available for IoT .	Apply
CO3	Explain different protocols and communication technologies used in IoT .	Apply
CO4	Analyze the big data analytic and programming of IoT .	Analyze
CO5	Implement IoT solutions for smart applications	Apply

## CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	3	2	3	2	1	1	1	1	1	3	3	2
CO2	3	3	2	2	3	2	3	1	1	1	1	1	2	2	2
CO3	3	2	2	2	2	3	2	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	3	2	1	1	1	1	1	3	2	3
CO5	3	2	3	3	2	2	3	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

### UNIT I: INTRODUCTION TO INTERNET OF THINGS

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

### UNIT II: IOT ARCHITECTURE

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

### UNIT III: PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

### UNIT IV: IOT PROCESSORS

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPBERRY PI and Arduino.

### UNIT V: CASE STUDIES

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

**PERIODS : 45**

**SUGGESTED READINGS:**

1. ArshdeepBahga and VijaiMadiseti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally“Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013.
9. Vijay Madiseti , ArshdeepBahga, “Internet of Things (A Hands on-Approach)”, 2014.
10. Zach Shelby, Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet”, John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, “Smart Grid applications, communications and security”, Wiley, 2015.
12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, “ Smart Grid Technology and Applications”, Wiley, 2015.

**B.E / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU532E**

**5G and Future Wireless Technologies**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0    Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**

**Course Objectives**

- Understand the fundamentals of next-generation wireless networks
- Analyze 5G architecture and enabling technologies
- Explore protocols and standards
- Apply 5G in real-world applications
- Address security, privacy, and regulatory aspects

**Course Outcomes (COs)**

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
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<b>CO1</b>	Understand the evolution, architecture, and objectives of 5G technology.	Apply
<b>CO2</b>	Explore 5G spectrum, radio access techniques, and mmWave communications.	Apply
<b>CO3</b>	Analyze 5G core network structure, protocols, and virtualization methods.	Understand
<b>CO4</b>	Apply 5G use cases in smart industries, IoT, and edge computing.	Apply
<b>CO5</b>	Investigate future wireless trends like 6G, AI integration, and THz communication.	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
<b>CO1</b>	3	2	2	3	2	3	3	1	1	1	1	1	3	3	2
<b>CO2</b>	3	3	2	2	3	2	3	1	1	1	1	1	2	2	2
<b>CO3</b>	3	2	3	2	2	3	3	1	1	1	1	1	2	2	1
<b>CO4</b>	3	3	2	2	2	3	2	1	1	1	1	1	3	2	3
<b>CO5</b>	3	2	2	2	2	2	3	1	1	1	1	1	2	3	2

**1 - low, 2 - medium, 3 - high**

### UNIT I: INTRODUCTION TO 5G

Evolution from 1G to 5G, 5G Vision, Requirements, and Challenges, Key Use Cases: eMBB, URLLC, mMTC, Overview of IMT-2020 and 3GPP Specifications, 5G Network Architecture: RAN and Core

### UNIT II: RADIO ACCESS TECHNOLOGIES

Millimeter Wave (mmWave) Communication, Massive MIMO and Beamforming, OFDM-based Waveforms, Carrier Aggregation and Dynamic Spectrum Sharing, Licensed and Unlicensed Spectrum

### UNIT III: 5G CORE NETWORK & VIRTUALIZATION

Service-Based Architecture (SBA), SDN (Software Defined Networking) and NFV (Network Function Virtualization), Network Slicing and Multi-Access Edge Computing (MEC), Control/User Plane Separation (CUPS), Protocol Stack and Interfaces in 5G.

### UNIT IV: FUTURE WIRELESS TECHNOLOGIES

5G for Smart Cities, Smart Healthcare, Smart Vehicles, Industrial Automation and Remote Surgery, IoT and M2M Communication, Private 5G Networks, 5G Security Challenges and Solutions.

### UNIT V: FUTURE WIRELESS TECHNOLOGIES

Vision and Research Challenges of 6G, Terahertz (THz) Communication, Artificial Intelligence in Wireless Networks, Satellite-based Internet (LEO Constellations), Open RAN and Next Generation Wireless Innovation

**PERIODS : 45**

**SUGGESTED READINGS:**

1. Theodore S. Rappaport – *Millimeter Wave Wireless Communications*, Pearson
2. Jonathan Rodriguez – *Fundamentals of 5G Mobile Networks*, Wiley
3. Martin Sauter – *From GSM to LTE-Advanced Pro and 5G*, Wiley
4. Sassan Ahmadi – *5G NR: Architecture, Technology, Implementation*, Academic Press
5. 3GPP, ITU, IEEE Papers – Official standards and whitepapers

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**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU631E**

**QUANTUM COMPUTING**

**3H – 3C**

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**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

**Course Objectives**

- To Understand the basics of quantum mechanics.
- To Understand the concepts of Quantum Gates and quantum computation
- To learn the concepts of quantum error correction.

- To learn the Quantum Algorithms and analyze the computation models.
- To understand Cryptographic system.

### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basics of quantum mechanics.	Understand
CO2	Understand the concepts of Quantum Gates and be able to model the circuits using quantum computation.	Understand
CO3	Understand the Quantum Algorithms and analyze the computation models	Understand
CO4	Learn about Quantum operations and environments and understand the Quantum Information theory.	Apply
CO5	Understand the concepts of quantum error correction and quantum cryptography.	Understand

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	3	2	3	3	1	1	1	1	1	3	3	2
CO2	3	3	2	2	3	2	2	1	1	1	1	1	1	2	2
CO3	3	2	3	2	2	3	3	2	1	1	1	1	1	2	1
CO4	3	3	2	2	2	3	2	1	1	1	1	1	3	2	3
CO5	3	2	2	2	2	2	3	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

### UNIT I: QUANTUM COMPUTING BASIC CONCEPTS

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits.

### UNIT II: QUANTUM GATES AND CIRCUITS

Universal logic gates - Universal Quantum Gates: Basic single qubit gates - Multiple qubit gates - Reversible gates- Circuit development - Superpositions - Quantum entanglement - Quantum Teleportation.

### UNIT III: QUANTUM ALGORITHMS

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm - Shor's Factoring Algorithm.

#### **UNIT IV: QUANTUM INFORMATION THEORY**

Quantum Operations - Shannon Entropy - Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels - Quantum Information over noisy Quantum Channels.

#### **UNIT V: QUANTUM ERROR-CORRECTION AND QUANTUM CRYPTOGRAPHY**

Theory of Quantum Error Correction - Constructing Quantum Codes - Stabilizer Codes - Quantum Cryptography: Quantum Key Distribution - BB84 - Ekert 91.

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition, 2020.
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3. Chris Bernhardt, "Quantum Computing for Everyone", The MIT Press; Reprint edition, 2020.
4. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
5. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU632E**

**EXTENDED REALITY**

**3H – 3C**

**Instruction Hours / week: L: 3 T: 1 P: 0.**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

#### **Course Objectives**

- To provide fundamental concepts of virtual reality (VR), augmented reality (AR), and mixed reality (MR)
- To understand hardware, software and interaction techniques for XR systems
- To learn modeling, programming, and application development for XR frameworks
- To explore XR applications across domains such as education, health, entertainment and industry

- To understand design, safety, and human-factor considerations in XR implementation

### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand core concepts of VR, AR, MR and XR systems	Understand
CO2	Model and render 3D environments for XR applications	Apply
CO3	Use programming toolkits to build XR applications	Apply
CO4	Analyze human factors and application domains for XR systems	Analyze
CO5	Design interactive AR, VR or MR applications using modern tools	Apply

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	3	2	3	3	1	1	1	1	1	3	3	2
CO2	3	2	2	2	3	3	2	1	1	1	1	1	1	2	2
CO3	3	2	3	2	2	2	3	2	1	1	1	1	1	1	1
CO4	3	2	2	2	2	3	2	1	1	1	1	1	2	2	3
CO5	3	2	2	2	2	2	3	1	1	1	1	1	2	3	2

1 - low, 2 - medium, 3 - high

### UNIT I: INTRODUCTION TO XR

Definitions and fundamentals of VR, AR and XR- (Hybrid/Mixed Reality)

Trajectories-hybrid space concepts-Three "I"s of VR- (Immersion, Interaction, Imagination)VR vs. 3D computer graphics; benefits & components of XR systems-AR technologies: 3D position trackers- input (gesture interfaces) and output devices (visual, audio)-Human visual & auditory systems- relevant to XR

### UNIT II: XR MODELING

Geometric modeling: object shapes, appearance, hierarchies-Kinematics modeling: transformation matrices- object position and invariants-Viewing & navigation of 3D world; physical modeling (collision detection, surface deformation, force computation & smoothing )Behavior modeling; model management

### UNIT III: XR PROGRAMMING

XR programming toolkits & scene graphs-Examples: WorldToolKit, Java 3D-Comparison & practical uses in XR development

### UNIT IV: XR APPLICATIONS & HUMAN FACTORS

Human factors and safety considerations in XR-Applications in medical, education, military, manufacturing, robotics, information visualization, business, entertainment

### **UNIT V: AUGMENTED REALITY & INTERACTION**

AR technologies: computer vision, modeling & annotation, navigation, wearable- XR devices  
Interaction design -principles for immersive experiences

**PERIODS : 45**

#### **SUGGESTED READINGS:**

1. Charles Palmer & John Williamson, Virtual Reality Blueprints, Packt, 2018
2. Dieter Schmalstieg & Tobias Hollerer, Augmented Reality: Principles & Practice, Addison-Wesley, 2016
3. John Vince, Introduction to Virtual Reality, Springer, 2004
4. William R. Sherman & Alan B. Craig, Understanding Virtual Reality: Interface, Application, Design, Morgan Kaufmann, 2003

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**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

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**25ITU731E      AMAZON WEB SERVICES: FUNDAMENTALS & APPLICATIONS 3H – 3C**

**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**  
**End Semester Exam: 3 Hours**

#### **Course Objectives**

- Understand AWS fundamentals
- Design and deploy cloud solutions
- Manage security and compliance in AWS

- Optimize performance and cost
- Leverage automation and DevOps tools

### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the architecture and core services of AWS	Apply
CO2	Explore storage and computing services in AWS.	Apply
CO3	Manage cloud-based networks and security features.	Understand
CO4	Implement databases and automation in AWS.	Apply
CO5	Develop, deploy, and monitor scalable cloud applications.	Apply

### CO-PO Mapping

CO / PO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	3	2	3	3	1	1	1	1	1	3	2	2
CO2	3	2	3	3	3	3	2	1	1	1	1	1	1	2	2
CO3	3	2	3	2	3	2	3	1	1	1	1	1	1	1	1
CO4	3	2	2	2	2	3	2	1	1	1	1	1	2	2	3
CO5	3	2	2	2	2	2	3	1	1	1	1	1	2	2	2

1 - low, 2 - medium, 3 - high

#### UNIT I: INTRODUCTION TO AWS

Overview of Cloud Computing, AWS Global Infrastructure, AWS Free Tier, EC2 Basics, Elastic Load Balancing, Auto Scaling, IAM: Identity and Access Management

#### UNIT II: STORAGE AND COMPUTE SERVICES

Amazon S3, EBS, EFS, EC2 Instance Launch and Management, AML, Key Pairs, Instance Types, Lambda Basics (Serverless), AWS Elastic Beanstalk

#### UNIT III: NETWORKING AND MONITORING

VPC – Subnets, Internet Gateway, NAT, Route Tables, Network ACL, Security Groups, CloudWatch and CloudTrail, AWS Config, Trusted Advisor

#### UNIT IV: Database and Automation

RDS, DynamoDB, Redshift, AWS Backup and Restore Services, CloudFormation Basics, AWS CLI and SDKs, ElastiCache and Aurora

#### UNIT V: DEVOPS AND DEPLOYMENT

CI/CD on AWS, CodeCommit, CodeBuild, CodePipeline, AWS SAM (Serverless Application Model), Deployment Strategies (Blue/Green), AWS Billing, Cost Explorer, Budgets

**PERIODS : 45**

## SUGGESTED READINGS:

- **Mark Wilkins** – *AWS Certified Solutions Architect Study Guide*, Wiley
- **Amazon Official Documentation**
- **Joe Baron, Hisham Baz** – *AWS Certified Cloud Practitioner Study Guide*, Wiley

**B.E. / B.Tech. (Common to all Branches)**

**2025-2026**

**25ITU732E**

**GENERATIVE AI**

**3H – 3C**

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**Instruction Hours / week: L: 3 T: 0 P: 0**

**Marks: Internal: 40 External: 60 Total: 100**

**End Semester Exam: 3 Hours**

### **Course Objectives**

- Understand the fundamentals of Generative AI
- Explore generative models and architectures
- Apply generative AI techniques to real-world tasks

- Integrate generative AI into applications
- Address ethical, legal, and societal implications

### Course Outcomes (COs)

At the completion of the course the student will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basics of Generative AI.	Understand
CO2	Know the basics of Text Generation.	Understand
CO3	Understand the process of generating videos.	Understand
CO4	Know about GAN and its variants.	Understand
CO5	Understand and Apply Gen AI tools.	Understand

### CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	3	2	3	3	1	1	1	1	1	2	3	2
CO2	3	2	3	3	3	3	2	1	1	1	1	1	2	2	2
CO3	3	2	3	2	3	2	3	1	1	1	1	1	2	3	3
CO4	3	2	2	2	2	3	2	1	1	1	1	1	2	2	3
CO5	3	2	2	2	2	2	3	1	1	1	1	1	2	2	2

1 - low, 2 - medium, 3 - high

### Unit I: INTRODUCTION TO GEN AI

Historical Overview of Generative modeling - Difference between Gen AI and Discriminative Modeling – Importance of generative models in AI and Machine Learning – Types of Generative models – GANs, VAEs, autoregressive models and Vector quantized Diffusion models - Understanding if probabilistic modeling and generative process - Challenges of Generative Modeling – Future of Gen AI – Ethical Aspects of AI – Responsible AI – Use Cases.

### Unit II: GENERATIVE MODELS FOR TEXT

Language Models Basics – Building blocks of Language models - Transformer Architecture – Encoder and Decoder – Attention mechanisms - Generation of Text – Models like BERT and GPT models – Generation of Text - Autoencoding – Regression Models – Exploring ChatGPT – Prompt Engineering – Designing Prompts– Revising Prompts using Reinforcement Learning from Human Feedback (RLHF) - Retrieval Augmented Generation – Multimodal LLM – Issues of LLM like hallucination.

### Unit III: GENERATION OF IMAGES

Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium – Variational Autoencoders – Encoder-Decoder Architectures - Stable Diffusion Models – Introduction to Transformer-based Image Generation – CLIP – Visual Transformers ViT- Dall-E2 and Dall-E3, GPT 4V – Issues of Image Generation models like Mode Collapse and Stability.

### Unit IV: GENERATION OF PAINTING, MUSIC, AND PLAY:

Variants of GAN – Types of GAN - Cyclic GAN – Using Cyclic GAN to Generate Paintings – Neural Style Transfer – Style Transfer - Music Generating RNN – MuseGAN – Autonomous agents – Deep Q Algorithm – Actor-critic Network.

**Unit V: OPEN SOURCE MODELS AND PROGRAMMING FRAMEWORKS:**

Training and Fine tuning of Generative models – GPT4All - Transfer learning and Pretrained models - Training vision models – Google Copilot - Programming LLM – LangChain – Open Source Models – Llama - Programming for TimeSformer – Deployment – Hugging Face.

**PERIODS : 45**

**SUGGESTED READINGS:**

1. **Generative Deep Learning** by David Foster – A hands-on exploration of GANs, VAEs, and transformers with practical examples and code
2. **Generative AI on AWS** by Chris Fregly, Antje Barth & Shelbee Eigenbrode
3. **Generative AI in Practice** by Bernard Marr