# DEPARTMENT OF INFORMATION TECHNOLOGY

## BACHELOR OF TECHNOLOGY

## IN

## INFORMATION TECHNOLOGY

## CURRICULUM AND SYLLABUS

## IIITUGIT22

2022-2023

## SCHOOL OF COMPUTING

## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA,

## HIMACHAL PRADESH

# B. TECH.
# CURRICULUM and SYLLABUS
# BATCH 2022-2026
# INFORMATION TECHNOLOGY
# IIITUGIT22

## SCHOOL OF COMPUTING
## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
## UNA

# PERSONAL DETAILS

**Student's Name:**

**Roll Number:**

**Branch:**

**Residential Address:**

**Mobile Number:**

**E-mail ID:**

# TABLE OF CONTENTS

# HISTORY OF SCHOOL OF COMPUTING

| Program | Description |
|---|---|
| UG in B.Tech. (Computer Science and Engineering) | Started with 30 seats in 2014.<br>Intake increased to 66 in 2020. |
| UG in B.Tech. (Information Technology) | Started with 40 seats in 2017.<br>Intake increased to 44 in 2020.<br>Intake increased to 66 in 2022. |

# INSTITUTE VISION AND MISSION

**Institute Vision:**

To build a vibrant multicultural learning environment with value based academic principles and to achieve excellence in teaching and research and to contribute effectively and responsibly to the national and global community.

**Institute Mission:**

**M1:** To provide quality education to the students with practical orientation.

**M2:** To collaborate with industries and research institutions to solve socially relevant problems.

**M3:** To inspire students to become responsible citizens and competent professionals with ethical values.

# SCHOOL OF COMPUTING VISION AND MISSION

**School of Computing Vision:**

To become a center of excellence in emerging areas and train students to become professionals solving challenging societal problems.

**School of Computing Mission:**

**M1:** To impart state-of-the-art knowledge in computer science and information technology with emphasis on practical knowledge and to promote specialization in emerging streams.

**M2:** To participate in research and development in industries and research organizations.

**M3:** To make the students aware of ethics and apply them in solving social problems.

# PROGRAM EDUCATIONAL OBJECTIVES

**PEO1: Successful Career**: To enable students to pursue higher education and applied research, to become competent and build a successful career in industries or become entrepreneurs.
**PEO2: Professionalism:** To inculcate professionalism and infuse ethical practices and leadership skills among the students.
**PEO3**: **Life-long Learning**: To ensure that graduates adapt to latest tools and technologies to solve real world problems.

**PEO to Mission Mapping:**

| Mission / PEO | M1 | M2 | M3 |
|---|---|---|---|
| **PEO1** | 3 | 3 | 2 |
| **PEO2** | 2 | 3 | 2 |
| **PEO3** | 3 | 3 | 2 |

| PEO | Mission | Mapping Level | Justification |
|---|---|---|---|
| **PEO1** | **M1** | 3 | Mapped strongly as student state of the art knowledge is required for a successful career. |
| | **M2** | 3 | Mapped strongly as student participation in research and development is required for a successful career. |
| | **M3** | 2 | Mapped moderately as the students' needs to aware of ethics and apply them in social problems. |
| **PEO2** | **M1** | 2 | Mapped moderately as student state of art and practical knowledge is required for a professionalism. |
| | **M2** | 3 | Mapped strongly as student participation state of the art knowledge is required for a successful career. |
| | **M3** | 2 | Mapped moderately as student participation state of the art knowledge is required for a successful career. |
| **PEO3** | **M1** | 3 | Mapped strongly as student state of the art knowledge is required for a life-long learning. |
| | **M2** | 3 | Mapped strongly as student participation in research and development is required for a life-long learning. |
| | **M3** | 2 | Mapped moderately as student participation state of the art knowledge is required for a life-long learning. |

# PROGRAM SPECIFIC OUTCOMESS

**PSO1**: To design cost-effective hardware and software systems for the betterment of society.

**PSO2**: To identify and commercialize opportunities in the areas of Cyber security and Big Data and become a successful entrepreneur.

**PSO3**: To develop smart and innovative solutions in multidisciplinary areas of healthcare, agriculture, environment monitoring using ethical practices.

**PO/ PSO to PEO Mapping:**

| PO's | | PEO1 Career | PEO2 Professionalism | PEO3 Learning |
|---|---|---|---|---|
| **PO1** | Engineering Knowledge | 3 | 1 | 3 |
| **PO2** | Problem Analysis | 3 | 1 | 3 |
| **PO3** | Design/Development of solutions | 3 | 2 | 3 |
| **PO4** | Conduct investigations of complex problems | 3 | 1 | 3 |
| **PO5** | Modern tool usage | 3 | 2 | 3 |
| **PO6** | The engineer and society | 1 | 3 | 1 |
| **PO7** | Environment and sustainability | 1 | 2 | 3 |
| **PO8** | Ethics | 2 | 3 | 3 |
| **PO9** | Individual and Teamwork | 3 | 3 | 2 |
| **PO10** | Communication | 2 | 3 | 3 |
| **PO11** | Project management and finance | 1 | 2 | 2 |
| **PO12** | Lifelong Learning | 3 | 2 | 3 |
| **PSO1** | To design cost-effective hardware and software systems for the betterment of society. | 3 | 2 | 3 |
| **PSO2** | To identify and commercialize opportunities in the areas of Cyber security and Big Data and become a successful entrepreneur. | 2 | 3 | 2 |
| **PSO3** | To develop smart and innovative solutions in multidisciplinary areas of healthcare, agriculture, environment monitoring using ethical practices. | 1 | 2 | 3 |

# DESIGN OF CURRICULUM

The B.Tech. Course Curriculum has been designed conforming to the recommendations of ACM and guidelines of AICTE, including NEP 2020.

## CONFORMANCE TO NEP 2020

### I. Multiple Exit Options:

| Sl. No. | Exit Description | Exit Point | Degree/Certificate offered | Goal |
|---|---|---|---|---|
| 1. | First Exit | After completion of First year. | Certificate in IT | The student should be employable as Technical Assistant IT in any industry/organization. |
| 2. | Second Exit | After completion of Second year. | Diploma in IT | The student should be employable as Technician IT in any industry/organization. |
| 3. | Third Exit | After completion of Third year. | BS in IT | The student should be employable as Technical Supervisor IT in any industry/organization. |
| 4. | Normal Exit | After completion of Fourth year. | B. Tech. in IT | The student should be employable as Engineer IT in any relevant industry/organization. |

### II. Multiple Entry Options:

| Sl. No. | Entry Descriptions | Entry Point | Eligibility |
|---|---|---|---|
| 1. | Normal (First) Entry | I-Sem. of the program | 100% through JoSAA/ CSAB based on JEE main entrance. |
| 2. | Second Entry | III-Sem. of the program | The successful completion of first year with certificate in IT from our institute. |
| 3. | Third Entry | V-Sem. of the program | The successful completion of diploma in IT from our institute. |
| 4. | Fourth Entry | VII-Sem. of the program | The successful completion of BS in IT from our institute. |

**III.** No. of Maximum Exits: One other than Normal.
**IV.** No. of Maximum Entry: One other than Normal.
**V.** Maximum gap between Exit and Entry: Two Years (Integral only).
**VI.** The Academic Bank of Credits will be maintained.

The Course Curriculum consists of the following components of study:

**1. General Institute Requirements (GIR)**

This group of courses contain the basic subjects which all undergraduate students must complete.

i) Engineering Mathematics
ii) Engineering Physics
iii) Engineering Chemistry
iv) Introduction to Biotechnology
v) Professional Communication
vi) Basic Environmental Science and Engineering
vii) Humanities
viii) Basics of Programming in C
ix) Basic Electrical and Electronics Engineering
x) Electronics/Computer/IT Workshop
xi) Internship
xii) Project Work
xiii) Technical Clubs/ Sports/ Cultural/ Yoga/ NCC/ NSS
xiv) Industrial/ Expert Lectures

**2. IT Curriculum**

The IT curriculum is grouped into IT Program Core, Program Electives and Stream Electives.

- **Program Core (PC)**

The PC consist of 11 theory courses out of which 7 courses comprise labs. All the PC subjects will be covered in first two years which covers almost the GATE syllabus.

- **Program Elective (PE)**

The total number of 4 PE will be offered in V and VII semester. Student will have to choose one out of two subjects as per their choice.

- **Stream Electives (SE)**

The Institute offers Stream Electives common to all schools. The following are the streams offered by the IT department for study:

1. Applications
2. Security

Besides the above mentioned streams, students are also free to opt the Stream Electives offered by CSE and ECE departments. The Stream Electives are offered in V, VII and VIII semesters. If the student desires to specialize in any of the given streams, can select the courses in V, VII and VIII semesters from the specified stream respectively. The institute also supports Online Honors/Optional course from V semester onwards. Based on the eligibility, the student may choose either one of the online courses (Honors/Optional).

**3. Internship (IN)**

In VI semester the students are given the opportunity to experience the industry ambience through a minimum five months of internship. Internship in industries and premier academic institutions such as IISc, IITs, NITs and IIITs is to be carried out in this semester. Students are also encouraged to do internship in abroad. This course helps the students for the supervised practical application of the courses that they learn in specific semester.

**4. Practicum (PM)**

This is a semester project work included from I to IV semester. The practical course constitutes a minor project work based on the concurrently studied theory in that semester.

**5. Project Work (PW)**

The project work is designed for a total duration of three semesters (V, VII and VIII) as a single project involving detailed literature survey, implementation and experimentation plan.

**6. Online Courses (OC)**

- **Honors Online Courses**
  This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc,. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded grade must be submitted for the award of suitable letter grade in this course.
- **Optional Online Courses**
  This course is optional for students who opt for B.Tech. (Optional). Students who don't fulfil the eligibility criteria for Honors can opt for Optional Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc,. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

**7. L-T-P-C Notation**

L-T-P-C → Lecture-Tutorial-Practicum/Practical-Credit.

**8. Grading Criteria**

1. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades. All assessment of a course will be done on the basis of marks.
2. The students shall be placed in any of the bands with letter grades: 'S', 'A', 'B', 'C', 'D', 'E', 'I', 'L' and 'R' with the credit points of '10', '9', '8', '7', '6', '5', '0', '0',

'0' respectively.

3. The cut-off mark for completion of a course shall be calculated as $\frac{\overline{X}}{2}$ where $\overline{X}$ is the mean of the class. Students scoring marks above the cut-off mark shall be appropriately placed in top six bands typically 10, 15, 25, 25, 15, 10 percentages respectively. Students scoring less than cut-off mark shall be placed in lower most band ('I').
4. Teachers can adopt any one of the following logical methods to decide the grades: (a) Normalized curve, (b) Z-score, and (c) Gap theory.

## 9. Highlights of Curriculum

The students will study the curriculum with following features:

- More Practical Oriented Teaching and Learning.
- More hands on Projects.
- Stream Oriented Specialization.
- Multi-Disciplinary Electives/ Projects.
- Relative Grading.
- Soft Skill Enhancement.
- Overall Personality Development.
- Employable Graduates for Industries.
- Excellent Placements.

# CURRICULUM COMPONENTS

| S. No. | Category | Total Credits | %age of Credits |
|---|---|---|---|
| **1.** | General Institute Requirements: Theory | 31 | 20 |
| **2.** | General Institute Requirements: Lab | 14 | 09 |
| **3.** | Program Core: Theory | 34 | 22 |
| **4.** | Program Core: Lab | 14 | 09 |
| **5.** | Program Elective: Theory | 12 | 08 |
| **6.** | Program Elective: Lab | 06 | 04 |
| **7.** | Stream Electives | 15 | 09 |
| **8.** | Practicum | 12 | 08 |
| **9.** | Internship | 00 | 00 |
| **10.** | Project Work | 18 | 11 |
| | **Total** | **156** | **100** |

The Curriculum consists of 59% of Theory and 41% of Practical work.

# PROGRAM ELECTIVES

| S. No. | Program Electives (PE) |
|---|---|
| **1.** | Compiler Design* |
| **2.** | Computer Graphics* |
| **3.** | Microprocessor and Interfacing* |
| **4.** | Software Engineering* |
| **5.** | Advanced Operating Systems* |
| **6.** | Digital Image Processing* |
| **7.** | Distributed Database Systems |
| **8.** | Graph Theory |

*Includes Lab

| PROGRAM ELECTIVE – I | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Name** |
| **1.** | ITPE11 | Compiler Design* |
| **2.** | ITPE12 | Computer Graphics |

| PROGRAM ELECTIVE – II | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Name** |
| **1.** | ITPE21 | Microprocessor and Interfacing* |
| **2.** | ITPE22 | Software Engineering |

| PROGRAM ELECTIVE – III | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Name** |
| **1.** | ITPE31 | Advanced Operating Systems |
| **2.** | ITPE32 | Digital Image Processing |

| PROGRAM ELECTIVE – IV | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Name** |
| **1.** | ITPE41 | Distributed Database Systems |
| **2.** | ITPE42 | Graph Theory |

*GATE Subject

# STREAM ELECTIVES

| SUBJECTS | | |
|---|---|---|
| **S. No.** | **Stream** | **Departments** |
| **1.** | Applications | IT |
| **2.** | Artificial Intelligence And Machine Learning | CSE |
| **3.** | Database And Networking | CSE |
| **4.** | Security | IT |
| **5.** | Cyber Physical Systems | ECE |
| **6.** | Intelligent Systems | ECE |

| STREAM ELECTIVE – I : Applications | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1.** | ITSE11 | Mobile Applications Development | Computer Networks |
| **2.** | ITSE12 | Cloud Computing | Computer Networks |
| **3.** | ITSE13 | Internet of Things | Computer Networks |
| **4.** | ITSE14 | Big Data Analytics | Database Management Systems |
| **5.** | ITSE15 | Computer Vision | Probability and Random Processes, Linear Algebra, Digital Image Processing |

| STREAM ELECTIVE – II : Artificial Intelligence and Machine Learning | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1.** | CSSE11 | Machine Learning | Engineering Mathematics, Probability and Random Processes, Any high-level Programming Language |
| **2.** | CSSE12 | Deep Learning | Engineering Mathematics, Linear Algebra, Probability and Random Processes, Any high-level Programming Language |
| **3.** | CSSE13 | Artificial Intelligence | Engineering Mathematics, Probability and Random Processes, Any high-level Programming Language, |
| **4.** | CSSE14 | Soft Computing | Engineering Mathematics, Probability and Random Processes, Any high-level Programming Language, Design and Analysis of Algorithms |
| **5.** | CSSE15 | NLP with Deep Learning | Engineering Mathematics, Probability and Random Processes, Any high-level Programming Language |

| STREAM ELECTIVE – III : Database and Networking | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1.** | CSSE21 | Relational Database Management Systems | Database Management Systems |
| **2.** | CSSE22 | Advanced Database Management Systems | Database Management Systems |
| **3.** | CSSE23 | Database Security | Advanced Database Management Systems, Computer Networks |
| **4.** | CSSE24 | Mobile Computing and Communication | Computer Networks |
| **5.** | CSSE25 | Wireless Sensor Networks | Computer Networks |

| STREAM ELECTIVE – IV : Security | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1.** | ITSE21 | Information Security | -- |
| **2.** | ITSE22 | Principles of Cryptography | Discrete Structures |
| **3.** | ITSE23 | Network Security | Computer Networks |
| **4.** | ITSE24 | Applied Cryptography | Discrete Structures, Principles of Cryptography, Graph Theory |
| **5.** | ITSE25 | Cyber Physical Systems | -- |

| STREAM ELECTIVE – V : Cyber Physical Systems | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1** | ECSE11 | Introduction to IoT | Data communication and networks, Communication systems, Communication theory, Embedded systems |
| **2** | ECSE12 | Wireless Sensor Networks | Data communication and networks, Communication systems, Communication theory, Embedded systems |
| **3** | ECSE13 | Industrial IoT | Data communication and networks, Communication systems, Communication theory, Embedded systems. |
| **4** | ECSE14 | Principles of Cyber Physical Systems | Data communication and networks, Communication systems, Communication Theory, Control systems. |
| **5** | ECSE15 | Communication in Cyber Physical Systems | Data communication and networks, Communication systems, Communication theory, Control systems. |

| STREAM ELECTIVE – VI : Intelligent Systems | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Expected Prior Study** |
| **1.** | ECSE21 | Mobile Robots | Linear Algebra, Control Systems, Embedded systems. |
| **2.** | ECSE22 | Machine Vision and Perception | Linear Algebra, Probability |
| **3.** | ECSE23 | Pattern Recognition and Computational Intelligence | Artificial neural networks, Probability, Linear algebra. |
| **4.** | ECSE24 | Autonomous Mobile Robots | Control Systems, Embedded systems. |
| **5.** | ECSE25 | Reinforcement Learning | Artificial neural networks, Probability, Linear algebra. |

# SEMESTER-WISE STREAM ELECTIVES

| STREAM ELECTIVE – I | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Stream** |
| **1.** | ITSE11 | Mobile Applications Development | Applications |
| **2.** | CSSE11 | Machine Learning | Artificial Intelligence and Machine Learning |
| **3.** | CSSE21 | Relational Database Management Systems | Database and Networking |
| **4.** | ITSE21 | Information Security | Security |
| **5.** | ECSE11 | Introduction to IoT | Cyber Physical Systems |
| **6.** | ECSE21 | Mobile Robots | Intelligent Systems |

| STREAM ELECTIVE – II | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Stream** |
| **1.** | ITSE12 | Cloud Computing | Applications |
| **2.** | CSSE12 | Deep Learning | Artificial Intelligence and Machine Learning |
| **3.** | CSSE22 | Advanced Database Management Systems | Database and Networking |
| **4.** | ITSE22 | Principles of Cryptography | Security |
| **5.** | ECSE12 | Wireless Sensor Networks | Cyber Physical Systems |
| **6.** | ECSE22 | Machine Vision and Perception | Intelligent Systems |

| MANAGEMENT ELECTIVE | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Name** |
| **1.** | HME731 | Organizational Behavior |
| **2.** | HME732 | Entrepreneurship Development |
| **3.** | HME733 | E-commerce and Digital Marketing |
| **4.** | HME734 | Usability Analysis |

| STREAM ELECTIVE – III | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Stream** |
| **1.** | ITSE13 | Internet of Things | Applications |
| **2.** | CSSE13 | Artificial Intelligence | Artificial Intelligence and Machine Learning |
| **3.** | CSSE23 | Database Security | Database and Networking |
| **4.** | ITSE23 | Network Security | Security |
| **5.** | ECSE13 | Industrial IoT | Cyber Physical Systems |
| **6.** | ECSE23 | Pattern Recognition and Computational Intelligence | Intelligent Systems |

| STREAM ELECTIVE – IV | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Stream** |
| **1.** | ITSE14 | Big Data Analytics | Applications |
| **2.** | CSSE14 | Soft Computing | Artificial Intelligence and Machine Learning |
| **3.** | CSSE24 | Mobile Computing and Communication | Database and Networking |
| **4.** | ITSE24 | Applied Cryptography | Security |
| **5.** | ECSE14 | Principles of Cyber Physical Systems | Cyber Physical Systems |
| **6.** | ECSE24 | Autonomous Mobile Robots | Intelligent Systems |

| STREAM ELECTIVE – V | | | |
|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **Stream** |
| **1.** | ITSE15 | Computer Vision | Applications |
| **2.** | CSSE15 | NLP with Deep Learning | Artificial Intelligence and Machine Learning |
| **3.** | CSSE25 | Wireless Sensor Networks | Database and Networking |
| **4.** | ITSE25 | Cyber Physical Systems | Security |
| **5.** | ECSE15 | Communication in Cyber Physical Systems | Cyber Physical Systems |
| **6.** | ECSE25 | Reinforcement Learning | Intelligent Systems |

# SEMESTER-WISE CURRICULUM

| FIRST SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | MAC131 | Engineering Mathematics | 3 | 1 | 0 | 4 |
| **2.** | PHC132 | Engineering Physics | 3 | 0 | 4 | 5 |
| **3.** | BIC103 | Introduction to Biotechnology | 3 | 0 | 0 | 3 |
| **4.** | ITC104 | Basics of Programming in C | 3 | 0 | 4 | 5 |
| **5.** | ENC135 | Communication Skills | 3 | 0 | 4 | 5 |
| **6.** | ITL106 | Practicum-I | 0 | 0 | 6 | 3 |
| | | **Total** | **15** | **1** | **18** | **25** |

| SECOND SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | MAC231 | Probability and Random Process | 3 | 1 | 0 | 4 |
| **2.** | CYC232 | Engineering Chemistry | 2 | 0 | 4 | 4 |
| **3.** | EVC203 | Basic Environmental Science and Engineering | 3 | 0 | 0 | 3 |
| **4.** | EEC204 | Basic Electrical and Electronics Engineering | 3 | 0 | 4 | 5 |
| **5.** | ITL205 | IT Workshop | 0 | 0 | 4 | 2 |
| **6.** | ITL206 | Practicum-II | 0 | 0 | 6 | 3 |
| | | **Total** | **11** | **1** | **18** | **21** |

| THIRD SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | ITC301 | Discrete Structures | 3 | 0 | 0 | 3 |
| **2.** | ITC302 | Automata and Formal Languages | 3 | 1 | 0 | 4 |
| **3.** | ITC303 | Data Structures and Algorithms | 3 | 0 | 4 | 5 |
| **4.** | ITC304 | Computer Organization | 3 | 0 | 0 | 3 |
| **5.** | ITC305 | Digital Electronics | 3 | 0 | 4 | 5 |
| **6.** | ITL306 | Practicum-III | 0 | 0 | 6 | 3 |
| | | **Total** | **15** | **1** | **14** | **23** |

| FOURTH SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | ITC401 | Object Oriented Programming | 3 | 0 | 4 | 5 |
| **2.** | ITC402 | Computer Networks | 3 | 1 | 4 | 6 |
| **3.** | ITC403 | Operating Systems | 3 | 0 | 4 | 5 |
| **4.** | ITC404 | Database Management Systems | 3 | 1 | 4 | 6 |
| **5.** | ITC405 | Design and Analysis of Algorithms | 3 | 1 | 0 | 4 |
| **6.** | ITL406 | Practicum-IV | 0 | 0 | 6 | 3 |
| | | **Total** | **15** | **3** | **22** | **29** |

| FIFTH SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | XXXXXX | Program Elective-I | 3 | 0 | 4 | 5 |
| **2.** | XXXXXX | Program Elective-II | 3 | 0 | 4 | 5 |
| **3.** | XXXXXX | Stream Elective-I | 3 | 0 | 0 | 3 |
| **4.** | ENL531 | Professional Communication and Soft Skills | 0 | 0 | 4 | 2 |
| **6.** | ITL502 | Computational Tools and Techniques | 0 | 0 | 4 | 2 |
| **5.** | ITL503 | Project Phase-I | 0 | 0 | 6 | 3 |
| **6.** | ITO504 | Honors Online Course-I* | 5 | 1 | 0 | 3 |
| | | Optional Online Course-I* | 5 | 1 | 0 | 0-3 |
| | | **Total** | **9** | **0** | **22** | **20** |

| SIXTH SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | ITL601 | Internship | 0 | 0 | 40 | 0 |
| **2.** | ITO602 | Honors Online Course-II* | 5 | 1 | 0 | 3 |
| | | Optional Online Course-II* | 5 | 1 | 0 | 0-3 |
| | | **Total** | **0** | **0** | **40** | **0** |

*NPTEL/SWAYAM/MOOCs etc.

| SEVENTH SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | HMC701 | Professional Ethics | 1 | 0 | 0 | 0 |
| **2.** | XXXXXX | Program Elective-III | 3 | 0 | 4 | 5 |
| **3.** | XXXXXX | Program Elective-IV | 3 | 0 | 0 | 3 |
| **4.** | XXXXXX | Stream Elective-II | 3 | 0 | 0 | 3 |
| **5.** | HME7XX | Management Elective | 3 | 0 | 0 | 3 |
| **6.** | ITL702 | Project Phase-II | 0 | 0 | 12 | 6 |
| **7.** | ITO703 | Honors Online Course-III* | 5 | 1 | 0 | 3 |
| | | Optional Online Course-III* | 5 | 1 | 0 | 0-3 |
| | | **Total** | **13** | **0** | **16** | **20** |

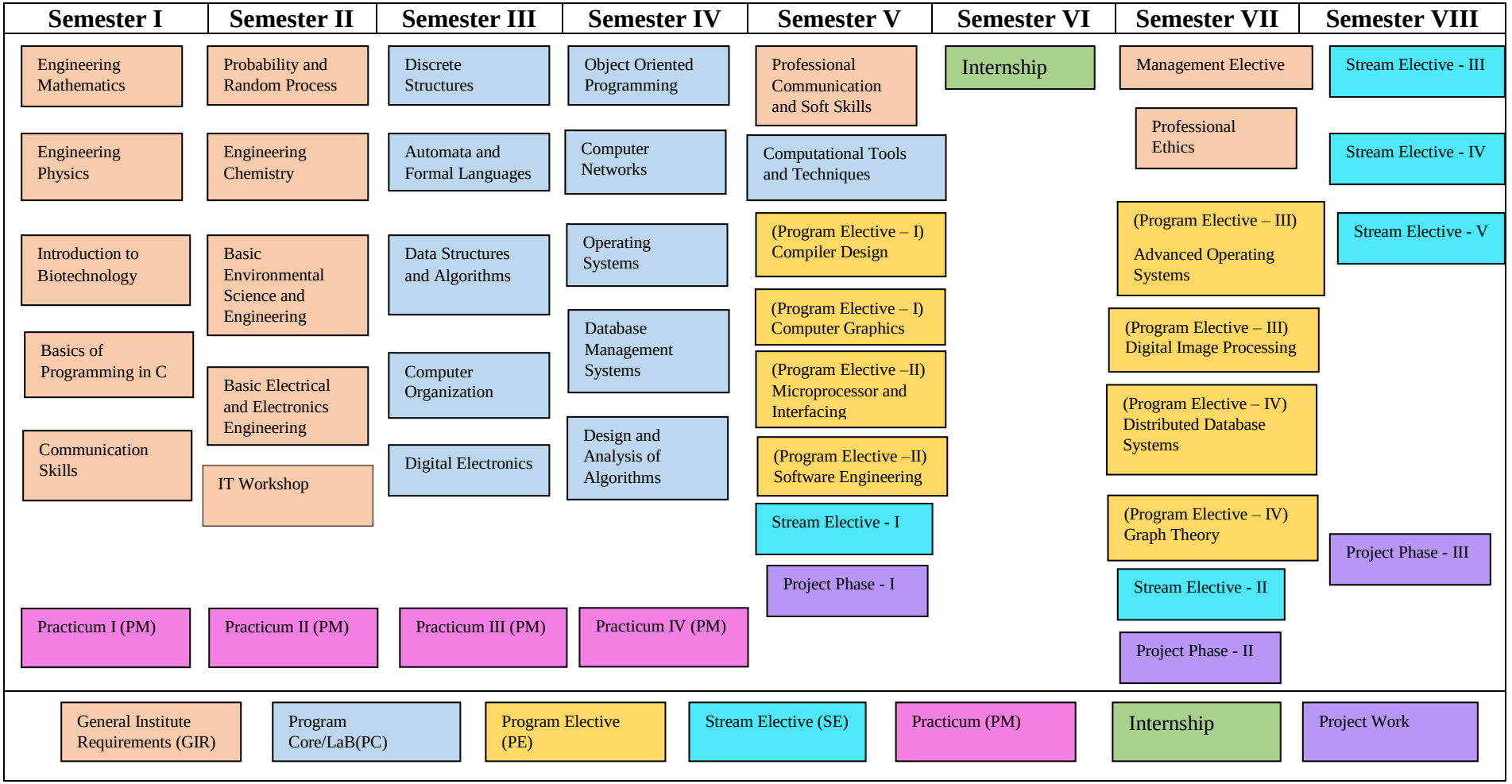
| EIGHTH SEMESTER | | | | | | |
|---|---|---|---|---|---|---|
| **S. No.** | **Code** | **Subject** | **L** | **T** | **P** | **Credits** |
| **1.** | XXXXXX | Stream Elective-III | 3 | 0 | 0 | 3 |
| **2.** | XXXXXX | Stream Elective-IV | 3 | 0 | 0 | 3 |
| **3.** | XXXXXX | Stream Elective-V | 3 | 0 | 0 | 3 |
| **4.** | ITL801 | Project Phase-III | 0 | 0 | 18 | 9 |
| **5.** | ITO802 | Honors Online Course-IV* | 5 | 1 | 0 | 3 |
| | | Optional Online Course-IV* | 5 | 1 | 0 | 0-3 |
| | | **Total** | **9** | **0** | **18** | **18** |

*NPTEL/SWAYAM/MOOCs etc.

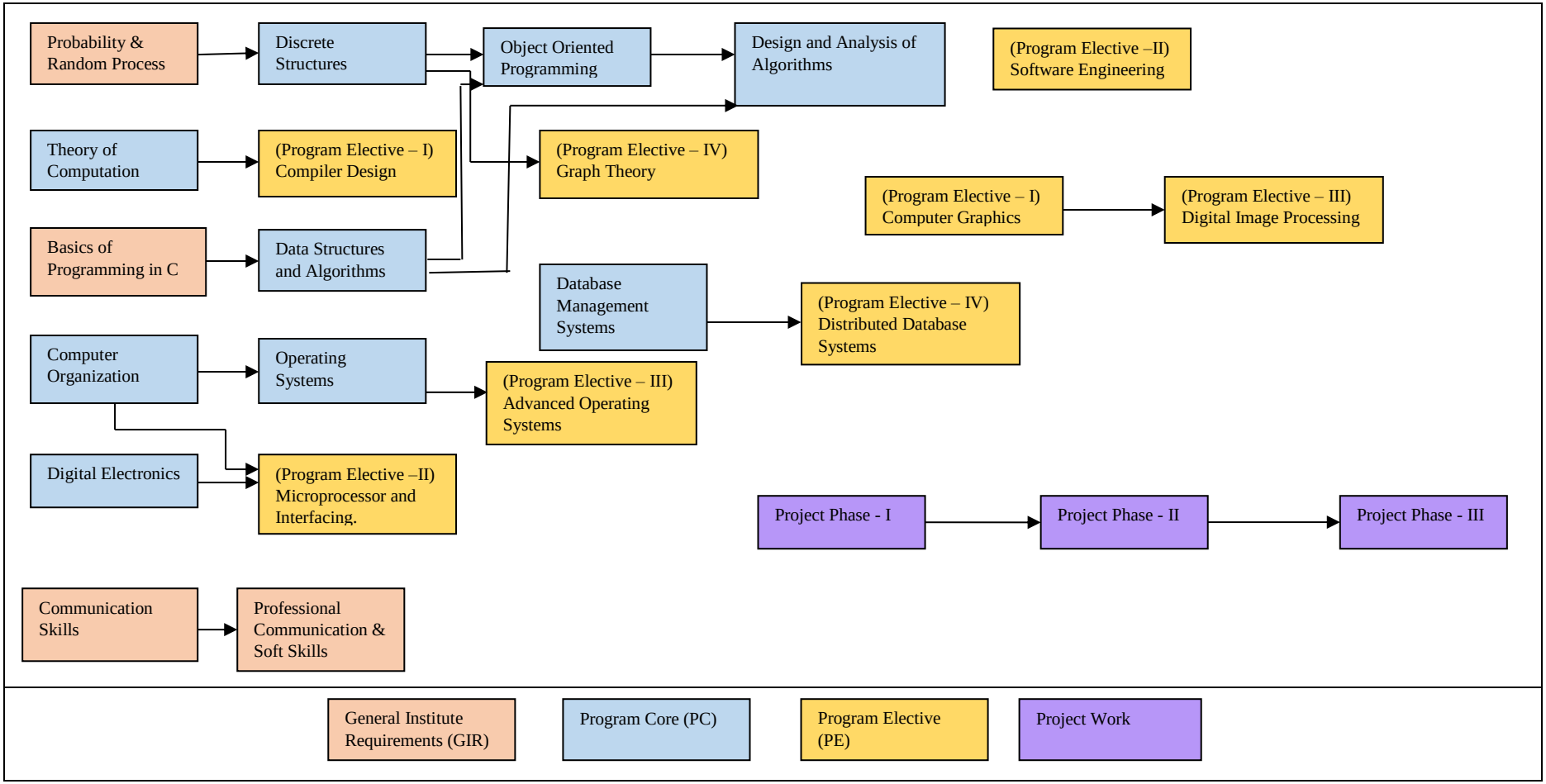
**SUMMARY**

| **Semester** | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| Credits | 25 | 21 | 23 | 29 | 20 | 00 | 20 | 18 | **156** |

## STUDY-CHART


Semester I
Engineering Mathematics
Engineering Physics
Introduction to Biotechnology
Basics of Programming in C
Communication Skills
Practicum I (PM)
Semester II
Probability and Random Process
Engineering Chemistry
Basic Environmental Science and Engineering
Basic Electrical and Electronics Engineering
IT Workshop
Practicum II (PM)
Semester III
Discrete Structures
Automata and Formal Languages
Data Structures and Algorithms
Computer Organization
Digital Electronics
Practicum III (PM)
Semester IV
Object Oriented Programming
Computer Networks
Operating Systems
Database Management Systems
Design and Analysis of Algorithms
Practicum IV (PM)
Semester V
Professional Communication and Soft Skills
Computational Tools and Techniques
(Program Elective – I) Compiler Design
(Program Elective – I) Computer Graphics
(Program Elective –II) Microprocessor and Interfacing
(Program Elective –II) Software Engineering
Stream Elective - I
Project Phase - I
Semester VI
Internship
Semester VII
Management Elective
Professional Ethics
(Program Elective – III) Advanced Operating Systems
(Program Elective – III) Digital Image Processing
(Program Elective – IV) Distributed Database Systems
(Program Elective – IV) Graph Theory
Stream Elective - II
Project Phase - II
Semester VIII
Stream Elective - III
Stream Elective - IV
Stream Elective - V
Project Phase - III
General Institute Requirements (GIR)
Program Core/LaB(PC)
Program Elective (PE)
Stream Elective (SE)
Practicum (PM)
Internship
Project Work

## DEPENDENCY-CHART



# B.TECH. – IT
# **SYLLABUS**

# FIRST SEMESTER

| | |
|---|---|
| **Course Code** | **MAC131** |
| **Course Title** | **Engineering Mathematics** |
| **Number of Credits** | **3-1-0-4** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn mathematical concepts and methods.
- To acquire fundamental knowledge.

## COURSE CONTENTS:

**UNIT I: MATRICES**

Matrices, Related matrices, Complex matrices, Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Consistency of a linear system of equations, Rouche's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of Eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form. **8**

**UNIT II: INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, Comparison test, D'A1embert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test, Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence. **8**

**UNIT III: ELEMENTARY CALCULUS**

Zeno's Paradox, Limit, Continuity and Differentiability, Uniform continuity, Maxima and Minima, Mean value theorem, Partial Derivatives, Integration. **8**

**UNIT IV: VECTOR SPACES**

Vector spaces, Sub Spaces, Linear Dependences and Independences of Vectors, Span, Bases and Dimensions, Direct Sum. **8**

**UNIT V: LINEAR TRANSFORMATIONS**

Linear Transformations, Linear Variety, Range Space and Rank, Null Space and Nullity, Homomorphism, Matrix of Linear Transformations, Matrix Representation of a linear transformation, Structure of the solutions of the matrix equation Ax = b, Change of bases. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Demonstrate qualitative problems based on matrix analysis such as rank, Eigen values, and Eigen vectors etc. (K2)

CO2 : Test the convergence of the series by approximating complicated functions appearing in different engineering models. (K4)

CO3 : Simplify the problems on differentiation of functions of two variables and know about the maximisation and minimization of these functions. (K4)

CO4 : Make use of the concepts of vector analysis such as linear independence and dependence of vectors etc. (K3)

CO5 : Interpret the use of linear transformation in real world problems. (K2)

## Text Books:

1. Jain R.K., lyengar S.R.K., *"Advanced Engineering Mathematics",* 5th Edition, Narosa Pub. House, 2016.
2. Ram P., *"Engineering Mathematics through Applications",* 2nd Edition, CBS Publications, 2015.

## Reference Books:

1. K. Hoffman and R. Kunze, *"Linear Algebra",* Prentice Hall, 2008.
2. G.Strang, *"Linear Algebra and its Applications",* 4th Edition, Thomson, 2006.
3. Wilfred Kaplan, *"Advanced Calculus",* Pearson, 2003.
4. Wylie, C.R. and Barrett, L.C., *"Advanced Engineering Mathematics",* 6th editlon, McGraw-Hill Inc.US, 1995.

## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | - | - | - | - | - | - | - | - | - | 10 | - | - |
| **COM*** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

* COM: Course Outcome Mapping

| | |
|---|---|
| **Course Code** | **PHC132** |
| **Course Title** | **Engineering Physics** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To impart knowledge about the limitations of Newtonian Mechanics and alternate formalism of Lagrange and Hamilton.
- To introduce students to the concept of special relativity and its applications to physical sciences and engineering.
- To study the basic principles of quantum mechanics: Learn how to solve the Schrödinger's equation and its applications and to make an understanding of concepts of quantum computing.
- To understand the basic framework of solid state physics.
- To recognize and classify the structures of Optical fiber and types.

## COURSE CONTENTS:

### UNIT I: CLASSICAL MECHANICS

Review of Newtonian Mechanics in Rectilinear Coordinate System, Motion in Plane Polar Coordinates, Conservation Principles, Inertial and Non-inertial Frames, Rigid Body Dynamics. Introductory ideas about Lagrangian and Hamiltonian and their simple applications. **8**

### UNIT II: SPECIAL THEORY OF RELATIVITY (STR)

Michelson-Morley Experiment, Postulates of STR, Galilean Transformation, Lorentz Transformation, Simultaneity, Length Contraction, Time Dilation, Relativistic Addition of Velocities, Mass-Energy Equivalence, Energy Momentum Relationships. **8**

### UNIT III: MODERN PHYSICS

**i) Basics of Quantum Physics:** Origin of Quantum Theory, Planck's Quantum Theory, Black Body Radiation, Photoelectric Effect, Compton Effect, Wave-Particle Duality: De Broglie Wavelength, Group and Phase Velocity, Heisenberg's uncertainty Principle, Double Slit Experiment, Schrödinger Equation, Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-Value Problem, Solution of Schrödinger Equation for simple boundary value problems, Reflection and Transmission Coefficients, Tunneling, Particle in a three Dimensional Box, Degenerate States.
**ii) Quantum Statistics:** Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Density of States. Applications of B-E statistics: LASER (Spontaneous and Stimulated Emissions and Absorption, Einstein's

Coefficients, Population Inversion, LASER Systems: Ruby LASER, He-Ne LASER, Semiconductor LASER-applications), Bose-Einstein Condensation. Applications of F-D Statistics: Free Electron Model of electrons in metals. Concept of Fermi Energy. Elementary Ideas of Band Theory of Solids (Bloch Theorem, Kronig-Penney Model), Quantum Computing. **8**

**UNIT IV: PHYSICS OF MATERIALS**

**i) Structure of Materials:** Space Lattice and Unit Cells, Crystal System, Symmetry Operation, Miller Indices, Packing Fractions, Structure Determination using X-ray Diffraction, Bragg's Law and Lattice Parameter Determination, Hall Effect, Exposure to Semiconductors, Superconductors: Meissner effect type I and II superconductors, BCS theory (qualitative), high temperature superconductors, Josephson effects applications.

**ii) Magnetic and Dielectric Properties of Materials:** Origin of Magnetism, Dia, Para, Ferro, Anti-Ferro and Ferrimagnetism, Soft and Hard Magnetic Materials, Dielectric Properties. **8**

**UNIT V: FIBER OPTICS**

Fermat's principle and Snell's law-optical fiber, principle and construction, acceptance cone, numerical aperture, V Number, types of fibers, Fabrication: Double Crucible Technique, fiber optic communication principle, fiber optic sensors. **8**

**PHYSICS LAB**

**List of Experiments:**

1. To find the moment of inertia of a given flywheel.
2. To find the value of charge carrier concentration and Hall coefficient.
3. To determine the value of Planck's constant.
4. To find the value of wavelength of a given light source using Michelson Interferometer.
5. To find the value of wavelength of a given light source using Newton's rings.
6. To verify the Biot-Savart Law using the circular coil carrying current.
7. To find the resonance frequency in a series LCR circuit.
8. To find the resonance frequency in a parallel LCR circuit.
9. To determine the value of Stefan's constant using black body radiation.
10. To determine the value of e/m ratio.
11. To find the energy gap of a material of p-n junction.
12. To study the Rutherford scattering of alpha particles.
13. To determine the plateau and optimal operating voltage of a Geiger-Müller

14. To determine the wavelength of a given LASER source using Diffraction Grating.
15. To study the interaction of high energy photons with matter.
16. To find the value of time constant of an RC circuit.
17. To study the charging and discharging of a Capacitor.
18. To study the I-V characteristics of a Solar cell.
19. To study the polarization of light.
20. To study the B-H hysteresis curve.

**Total Periods: 40+48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Identify the role of virtual work, Lagrange's and Hamilton's approach to the mechanics and develop skills to impart practical knowledge. (K3)

CO2 : Apply the knowledge of Special Theory of Relativity. (K3)

CO3 : Describe and analyze the dynamics of systems that move under the influence of given potential, and to make use of basics of Quantum Mechanics in Quantum Computing, and real time applications in engineering studies. (K4)

CO4 : Apply principles to determine crystal structure, thermal behavior of solids, dielectric, electric and magnetic behavior of solids, and develop skills to impart practical knowledge. (K3)

CO5 : Demonstrate optical fiber communication link, structure, propagation and transmission properties of an optical fiber. (K2)

## Text Books:


1. Kleppner, D., and Kolenkow, R. J. "*An Introduction to Mechanics*", Tata McGraw-Hill, New Delhi, 2000.
2. Griffiths, David J. "*Introduction to Quantum Mechanics, 2nd edition*", Pearson Education Ltd, 2014.
3. Kittel, Charles "*Introduction to Solid State Physics, 8th edition*", John Wiley and Sons, Inc, USA, 2005.


## Reference Books:


1. Goldstein, Herbert, Poole, Charles and Safko, John "*Classical Mechanics, 2nd edition*", Narosa, 1985.
2. Puri, R. K. and Babbar V. K. "*Solid State Physics*", S. Chand and Co. Pvt. Ltd, New Delhi, 2000.
3. Beiser, Arthur "*Concepts of Modern Physics*", Tata McGraw-Hill, New Delhi, 1995.
4. Resnick, R. "*Introduction to Special Relativity*" John Wiley, Singapore, 2000.

5. Avadhanulu, M. N. and Kashirsagar, P. G. "*A Text Book of Engineering Physics*", S. Chand and Co. Pvt. Ltd, New Delhi, 2008.
6. Ida, Nathan "Engineering Electromagnetics", Springer, 2005.
7. Feynman, R. P., Leighton, R. B. and Sands, M."*The Feynman Lectures on Physics, Vol. I*" Narosa Publishing House, 1998.
8. Kaye, Phillip, Laflamme, R. and Mosca M. "Introduction to Quantum Computing", Oxford University Press, New York, 2007.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | 2 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 2 | 2 | - | 2 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 2 | 2 | - | 3 | - | - | - | - | - | - | - | 2 | 2 | - | - |
| **CO4** | 2 | 2 | - | 2 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 10 | 6 | - | 9 | - | - | - | - | - | - | - | 2 | 10 | - | - |
| **COM** | 2 | 2 | - | 3 | - | - | - | - | - | - | - | 2 | 2 | - | - |

| | |
|---|---|
| **Course Code** | **BIC103** |
| **Course Title** | **Introduction to Biotechnology** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn the basics of biotechnology.
- To get familiarized with various routinely used biotechnological techniques.
- To know the applications of biotechnology in our daily life.
- To comprehend the environmental biotechnology processes for sustainable environment.
- To learn the biotechnological regulations and bioethics.

## COURSE CONTENTS:

### UNIT I: BASIC CONCEPT OF BIOTECHNOLOGY

Old and modern biotechnology: History of biotechnological developments with major milestones, Biotechnology tree, Types of biotechnology, Biotechnology workforce, Biotechnology and pharmaceutical companies and their products, Organization structure of a biotechnology company, Quality assurance and quality control.

Basics of molecular biotechnology: Review of cell structure, Biomolecules, Chromosome structure, Genes and genomes, DNA replication, DNA transcription, Genetic code, Translation, Post translation modification, Regulation of gene expression, Mutation: Causes and Consequences, Epigenome. **8**

### UNIT II: DNA AND PROTEIN BIOTECHNOLOGY

Recombinant DNA technology: DNA technology basics, Restriction enzymes, DNA cloning vectors, Genomics and cDNA libraries, Library screening, PCR, Cloning PCR products, DNA technology application to genomics, Next-generation sequencing, Gene microarrays, Genomics and bioinformatics, DNA database.

Introduction to proteins and their products: Protein structure, Protein production, Upstream processing, Downstream processing, Analytical techniques: Chromatography, and Electrophoresis, Post-purification analysis methods, Proteomics. **8**

## UNIT III: MICROBIAL, PLANT, AND ANIMAL BIOTECHNOLOGY

Microbial biotechnology: Structure of microbes, Microorganism as tools, Microbial applications: Food products, Fermenting microbes, Therapeutic proteins, Antimicrobial drug, Vaccines: types and production, Microbial genomes, Microbes for making biofuels, Microbial diagnostics, Combating bioterrorism.

Plant biotechnology: Plant tissue culture, Plant transgenics methods, Applications of plant biotechnology: Vaccines, Genetic pesticides, Herbicide resistance, Enhanced nutrition, Biofuels, Health and environmental concerns.

Animal Biotechnology: Regulations in animal research, Alternatives to the use of animals, Animal cloning: Transgenic animals and techniques, Applications of animal biotechnology: Enhanced agricultural production, Transgenic animals as bioreactors, Knockouts animals, Human antibodies in animals. **8**

## UNIT IV: ENVIRONMENTAL AND MEDICAL BIOTECHNOLOGY

Environmental biotechnology: Bioremediation basics, Chemicals in the environment, Fundamentals of cleanup reactions, Aerobic and anaerobic biodegradation, Bioremediation genomics programs, Phytoremediation, Cleanup sites and strategies, Genetically engineered strains for environmental remediation, Biosensors, Environmental disasters: Case studies in bioremediation, Challenges for bioremediation.

Medical biotechnology: Detecting and diagnosing human disease conditions, Medical products and applications: Gene therapy, Regenerative medicine, Organ transplantation, Cellular therapeutics, Tissue engineering, Stem cell technology. **8**

## UNIT V: BIOTECHNOLOGY REGULATIONS AND ETHICS

Biotechnology regulations: Regulatory framework, U.S. department of agriculture: Animal and plant health inspection service, Environmental protection agency, Food and drug administration, Legislation and regulation, Patents and patent filing process, International biotechnology regulation.

Biotechnology ethics: Approaches to ethical decision making, Ethics in biotechnological processes: Cells and products, GM crops, Animal husbandry or Animal tinkering, Synthetic genomes and synthetic biology, Regenerative medicine and personhood, Spare embryos for research versus Creating embryos for research, Gene doping, Debates on humans or other animals cloning for any reason, Economics: Role of science, and communication. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Demonstrate understanding of the biological systems. (K2)

CO2 : Solve the protein, and DNA sequences. (K3)

CO3 : Identify the protein production system in bacteria, plants, and animals. (K3)

CO4 : Apply bioengineering processes to meet the environmental and societal needs. (K3)

CO5 : Identify the ethical aspects of bioengineering fields. (K3)

## Text Book:


1. Thieman William J. and Palladino Michael A., *"Introduction to Biotechnology"*, 3rd Edition, Pearson New International Edition, 2014.


## Reference Books:


1. Renneberg R., Demin A. L. and Tom Papoport, *"Biotechnology for Beginners"*, Academic Press, Annotated Edition, 2007.
2. Ratledge C. and Kristiansen B., *"Basic Biotechnology"* 3rd Edition, Cambridge University Press, 2006.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 2 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| **CO4** | - | - | 2 | - | 1 | 2 | 2 | - | - | - | - | - | 2 | - | 2 |
| **CO5** | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | 2 |
| **Score** | 4 | 4 | 5 | 1 | 4 | 4 | 4 | 2 | - | - | - | - | 2 | - | 6 |
| **COM** | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 2 |

| | |
|---|---|
| **Course Code** | **ITC104** |
| **Course Title** | **Basics of Programming in C** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn algorithmic problem solving techniques.
- To learn the fundamentals of C programming.
- To compose programs in C using conditions, iterations and decompose a problem into functions.
- To construct programs in C using array, functions and pointers.
- To develop programs using advanced concepts like structure, file handling.

## COURSE CONTENTS:

**UNIT I: INTRODUCTION TO COMPUTERS, PROBLEM SOLVING TOOLS**

Computer Organization, Characteristics, Hardware and Software, Modes of operation, Types of programming languages, Developing a program. Algorithms, Characteristics, Flowcharts, Principles of Structured programming, Sequential, Selective structures, Repetitive structures, Bounded, Unbounded and Infinite iterations: Examples for each. **8**

**UNIT II: INTRODUCTION TO C PROGRAMMING**

C character set, Identifiers and Keywords, Data types, Constants, Variables, Declarations, Expressions, Statements, Symbolic constants, Operators, Library functions, Data input and output: Single character input and output, Entering input data, Writing output data, Gets and puts functions. **8**

**UNIT III: CONTROL STATEMENTS, ARRAY AND POINTERS**

Control statements, Branching: If-else, looping: While do-while for, Nested control structures, Switch statement, Break statement, Continue statement, Comma operator, Goto statement, Modular Programming, Functions and Procedures, Examples, Parameter passing methods. Arrays: defining an array, processing an array, Multidimensional arrays, Pointers, Variable definitions and initialization, Pointer operators, Pointer expressions and Arithmetic, Pointers and One-dimensional arrays. **8**

**UNIT IV**: **FUNCTIONS, STRING HANDLING**

Functions, Defining a function, Accessing a function, Function prototypes, Passing arguments to a function, Passing arrays to a function, Passing pointers to a function, Recursion. String Handling, Introduction to Strings, Sample Program, Standard String Library Functions, Array of String. **8**

**UNIT V**: **STRUCTURES, UNIONS AND FILE HANDLING**

Structures and Unions, Declaring and Instantiating Structures, Structures as Parameter and Pointer to Structures, Enumerated Data Types, Union, Bit Fields File Processing. Concept of Files, File Opening in Various Modes and Closing of a File, Reading from a File, Writing onto a File. **8**

**BASICS OF PROGRAMMING IN C LAB**

**List of Experiments:**

1. Implementation of basics of C programming.
2. Implementation of concepts of conditional statements in C programming.
3. Implementation of concepts of control statements in C programming.
4. Implementation of concepts of array and pointers in C programming.
5. Implementation of concepts of functions in C programming.
6. Implementation of concepts of strings handling functions in C programming.
7. Implementation of concepts of structures and union in C programming.
8. Implementation of concepts of file handling in C programming.

**Total Periods: 40+48= 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 **:** Explain the computer fundamentals and design an algorithm, flowchart and pseudo code for a given problem. (K2)

CO2 **:** Explain the basics and different constructs used in C programming. (K2)

CO3 **:** Apply the concepts of control structures, arrays, pointers to implement various algorithms and practice the skill of algorithmic thinking. (K3)

CO4 **:** Apply the concepts of functions and string handling using C programming. (K3)

CO5 **:** Apply the concepts of structures, unions and file handling in C programming. (K3)

CO6 **:** Solve real world problems utilizing different concepts in C programming. (K5)

**Text Books:**

1. Paul D. and Harvey D., "*C How to Program*", Prentice Hall London, 8th Edition, 2015.
2. Kernighan Brian W. and Ritchie Dennis M., *"The C Programming Language",* Prentice Hall, 2nd Edition, 2012.
3. Gottfried Byron S., *"Programming with C",* 2nd Edition, Schaum's Outlines, Tata McGraw-Hill, 2016.

**Reference Books:**

1. Dromey R.G., *"How to solve it by Computer",* Pearson Education, 4th Reprint, 2007.
2. Y.Kanetkar, *"Let us C"*, BPB Publication, 15th Edition, 2016.
3. Hanly J.R. and Koffman E.B., *"Problem Solving and Program Design in C"*, 6th Edition, Pearson Education, 2009.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO6** | 3 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 18 | 12 | 6 | 15 | - | - | - | - | - | - | - | - | 10 | - | - |
| **COM** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **ENC135** |
| **Course Title** | **Communication Skills** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To identify, rectify, and overcome mother tongue influence and sensitize usage of native English speech sounds, word accent, intonation and rhythm.
- To develop awareness about different forms of professional communication and social behaviour.
- To empower students with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

## COURSE CONTENTS:

**UNIT I: THE PROCESS OF COMMUNICATION**

1. Grammar Refresh: Synonyms and Antonyms, Homophones, Homonyms and Homographs, Tenses, Active Voice and Passive Voice, Idioms and Phrasal Verbs, Reported Speech.
2. Introduction to Communication, Communication Models, Noise in Communication, Nonverbal Communication, Channels of communication, Technical Communication, Downward-Upward Communication, Internal-External Communication, Horizontal-Diagonal Communication, Written vs. oral Communication, Conversational problems of second language users, Difference between conversation and other speech events.
3. How to write Accurately, Briefly, Clearly. Precis writing.
4. How to Read, Introduction to Comprehension Skills, Skills to improve Comprehension Skills.
5. Telephonic Communication, Templates for Telephonic Conversation, Do's and Don'ts of Telephonic Communication, Leaving a message. **8**

**UNIT II: JOB APPLICATIONS AND INTERVIEWS**

1. Format of Resume and Cover Letter, How to make a great Resume, How to write a Covering Letter to Resume.
2. Preparing for an Interview, Self-Introduction in Interview, Select Questions and how to answer them, Mock Interview.
3. What is Group Discussion, How to ace you GD, Do's and Don'ts of GD, Mock GD. **8**

**UNIT III: MANAGING ORGANIZATIONAL STRUCTURE**

1. Organizational Roles, Leadership and Management, Ad Hoc Committee, Roles and Responsibilities of Committee and its members.
2. Eustress and Distress, Regulating stress.
3. Simulated Conversation Template.

4. Drafting Formal/Corporate Emails. **8**

**UNIT IV: TAKING NOTES AND PREPARING MINUTES**

1. Planning a Meeting, Roles of the members, Meeting Etiquettes, How to draft Notice of a Meeting, How to draft Agenda of a Meeting, How to draft Minutes of a Meeting.
2. Elements of Report Writing, Procedure and Guidelines, Types and Format.
3. Taking notes, Note-taking skill: essential components. **8**

**UNIT V: PRESENTATION SKILLS AND NEGOTIATION SKILLS**

1. Parts of a Presentation Delivery, Starting a Presentation Delivery, Introduction: Hooking the Audience, Body of a Presentation Delivery, Structuring a Presentation Delivery, Conclusion of a Presentation, How to tackle Q&A from Audience, Podium Panic, Body Language, Do's and Don'ts of PD, Mock PD.
2. Types of Corporate Conversations, Negotiation, Mediation and Arbitration, Resolving arguments, Models of Negotiation Process, Types of Negotiation, Skills of a Negotiator, Steps of the Negotiation Process, Skills to improve Negotiation Process. **8**

**COMMUNICATION SKILLS LAB**

**List of Experiments:**

1. Introduction to Phonetics, Phonetic alphabet.
2. Introduction to Speech Sounds: Vowels and Consonants.
3. Structure of Syllables.
4. Extempore, Public Speaking.
5. Words and Phrasal Stress.
6. Stress and Rhythm.
7. Rhythms from Mainland.
8. Mock Telephonic Conversation.
9. Resume and Presentation Skills.
10. Group Discussion.
11. Interview Skills.

**Total Periods: 40+48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Develop skills of comprehension, writing and speaking in professional English and learn strategies to enhance independent language learning. (K3)

CO2 : Use the appropriate template, language and body language for group discussions, interviews and public speaking. (K3)

CO3 : Explain and apply the nuances of English professional communication in an organisation. (K3)

CO4 : Plan and execute Meetings, and draft minutes, reports and relevant documents. (K3)

CO5 : Develop public speaking skills essential for presentation deliveries, negotiations and corporate communications. (K3)

### Text Books:


1. Rizvi, M. A., *"Effective Technical Communication",* 2nd edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., *"Developing Communication Skills",* 2nd edition, Laxmi Publications, 2009.


### Reference Books:


1. Bhatacharya, I., *"An Approach to Communication Skills"*, Dhanpat Rai and Co., 2007.
2. Evans, D., *"Decision maker",* Cambridge University Press, 1997.
3. Thorpe, E., and Thorpe, S., *"Objective English",* Pearson Education, New Delhi, 2007.
4. Fisher, D*., "Communication in Organizations",* Jaico Publishing House, 2004.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | 3 |
| **Score** | - | - | - | - | - | - | - | - | 3 | 11 | - | - | - | - | 3 |
| **COM** | - | - | - | - | - | - | - | - | 3 | 3 | - | - | - | - | 3 |

| | |
|---|---|
| **Course Code** | **ITL106** |
| **Course Title** | **Practicum-I** |
| **Number of Credits** | **0-0-6-3** |
| **Course Type** | **PM** |

## COURSE OBJECTIVES:

- To develop a reverse engineering attitude for improvement in the existing utility products.
- To learn the fundamentals of basic electrical engineering.
- To learn the fundamentals of basic electronics engineering.
- To learn the engineering of electro-mechanical devices.
- To construct interdisciplinary working models.

## COURSE CONTENTS:

**UNIT I: REVERSE ENGINEERING IN UTILITY PRODUCTS**

Case study of water immersion rod, room heater, multi-point extension cord, electric iron, hair dryer, hair trimmer, hair straightener, air blower, electric fan, mobile/laptop charger, battery eliminator etc. **18**

**UNIT II: FUNDAMENTALS OF BASIC ELECTRICAL ENGINEERING**

Apply the basic concepts of electrical engineering to the routine appliances of daily use. **12**

**UNIT III: FUNDAMENTALS OF BASIC ELECTRONICS ENGINEERING**

Apply the basic concepts of electronics engineering to the routine appliances of daily use. **12**

**UNIT IV: ENGINEERING OF ELECTRO-MECHANICAL DEVICES**

Apply the basic concepts of mechanical engineering to the routine appliances of daily use. **12**

**UNIT V: CONSTRUCTING INTERDISCIPLINARY WORKING MODELS**

Developing the interdisciplinary working models and adding a feature for improving the performance of existing available products. **18**

**Total Periods: 72**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Apply the knowledge of reverse engineering to solve problems. | (K3) |
| CO2 | : | Apply the mathematical and scientific concepts to an engineering product. | (K3) |
| CO3 | : | Application of fundamentals of engineering on a product in real time. | (K3) |
| CO4 | : | Analyse a product to find the scope of improvements. | (K4) |
| CO5 | : | Improve the performance of existing products by adding a feature to it. | (K6) |

## Reference Books:


1. Marco Lino Calderón Saldierna, "*A collection of resources for the Study of Educational Reverse Engineering Activities in Engineering Design Education*", Universitat Politècnica de Catalunya, 2016.
2. Alexandru C.Telea (Eds), "*Reverse Engineering: Recent advances and applications*", IntechOpen, 2012.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | 1 | 2 | 2 | - | - | 3 | - | - | 2 | - | - |
| **CO2** | 2 | 2 | 3 | - | 3 | - | 2 | - | - | 2 | 3 | 3 | 2 | - | - |
| **CO3** | 2 | 2 | 3 | 3 | 3 | - | 3 | - | - | - | - | 3 | 2 | - | - |
| **CO4** | 2 | 2 | 3 | 3 | 2 | - | - | - | - | - | 2 | 3 | - | - | - |
| **CO5** | 2 | 2 | 3 | - | 3 | - | - | - | - | - | - | - | - | - | - |
| **Score** | 10 | 10 | 13 | 7 | 12 | 2 | 7 | - | - | 5 | 5 | 9 | 6 | - | - |
| **COM** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | - | - | 3 | 3 | 3 | 2 | - | - |

## SECOND SEMESTER

| | |
|---|---|
| **Course Code** | **MAC231** |
| **Course Title** | **Probability and Random Process** |
| **Number of Credits** | **3-1-0-4** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To understand probabilistic models that are employed in countless applications in all areas of science and engineering.
- To provide necessary mathematical support and confidence to tackle real life problems.

### COURSE CONTENTS:

**UNIT I: PROBABILITY AND RANDOM VARIABLE:**

Axioms of probability, Conditional probability, Total probability, Baye's theorem, Random variable, Probability mass function, probability density function, properties, Moments, Moment generating function and their properties. **8**

**UNIT II: STANDARD DISTRIBUTIONS:**

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties- Function of a random variable. Probability density function and its properties. **8**

**UNIT III: TWO DIMENSIONAL RANDOM VARIABLES:**

Joint distributions, Marginal and conditional distribution, Covariance, Correlation and regression, Transformation of random variables, Central limit theorem. **8**

**UNIT IV: RANDOM PROCESSES AND MARKOV CHAINS:**

Classification, Stationary process, Markov process, Poisson process, Birth and death process, Markov chains, transition probabilities, Limiting distributions. **8**

**UNIT V: INTRODUCTION TO QUEUEING THEORY:**

Markovian models, M /M/1, M/M/C, finite and infinite capacity, M/M/∞ queues, Finite source model, M/G/1 queue (steady state solution only), Pollaczek, Khintchine Formula-Special cases. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena. | (K2) |
| CO2 | : | Classify the function of random variables based on Discrete and Continuous Distributions, which can describe the real phenomenon. | (K2) |
| CO3 | : | Simplify the problems on Correlation and Regression and use these concepts in real world problems. | (K4) |
| CO4 | : | Make use of the concepts of random processes such as Markov Process, Poisson Process in real phenomenon. | (K3) |
| CO5 | : | Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models. | (K2) |

## Text Books:


1. Ross S., *"A First Course in Probability"*, 10th Edition, Pearson Education, 2015.
2. Taha H.A., *"Operations Research- An Introduction"*, 9th Edition, Pearson Education Edition Asia, 2014.


## Reference Book:


1. Medhi J., *"Stochastic Processes"*, 3rd Edition, New Age Publishers, 1994.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | 15 | - | - | - | - | - | - | - | - | 10 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CYC232** |
| **Course Title** | **Engineering Chemistry** |
| **Number of Credits** | **2-0-4-4** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn about hard-soft water and solve problems based on hardness estimation.
- To comprehend the structure, properties, synthesis and applications of polymers.
- To apply the electrochemical principles in batteries and understand the fundamentals of corrosion.
- To investigate engineering materials such as nanomaterials, fuels and lubricants.
- To understand the structure and properties of compounds using IR, UV, NMR, Thermal analysis and chromatography.
- To acquire skills to perform laboratory experiments, demonstrate safe and proper use of standard chemistry glassware and equipments.

## COURSE CONTENTS:

### UNIT I: WATER AND ITS TREATMENT

Sources, Hard and soft water, Estimation of hardness by EDTA method, softening of water, Boiler feed water, Treatment methods, specifications for drinking water, BIS and WHO standards, desalination processes. **5**

### UNIT II: POLYMER AND COMPOSITES

Introduction, functionality, classification, mechanism of polymerization, molecular weight, structure property relationship, moulding techniques, synthesis, properties and application of commercially important polymers, conducting polymers, Composites: Introduction classification, constituents, advantages and applications. **5**

### UNIT III: BASICS OF ELECTROCHEMISTRY AND ITS APPLICATIONS

Introduction to electrolytes, electrochemical cell and cell conductance, Electrolytic and galvanic cells, single electrode potential (origin and HDL), electrochemical series, Nernst equation, cell EMF, concentration cell; Batteries- types, working principle and uses, Corrosion Types, passivity, polarization, over-potential and its significance, factors affecting corrosion, protection from corrosion. **4**

### UNIT IV: ENGINEERING MATERIALS

Introduction to nanochemistry, synthesis, characteristics and applications of carbon nanostructures. Fuels: Classification, types of coal, determination of calorific value of solid fuels, Bomb calorimeter,

theoretical oxygen, proximate and ultimate analysis of coal, manufacture of metallurgical coke, flue gas analysis, Lubricants: Definition, theories, characteristics, additives to lubricants, solid lubricants. **5**

**UNIT IV: CHARACTERIZATION TECHNIQUES**

Introduction to spectroscopy; UV Visible spectroscopy Principle, Instrumentation and application; IR spectroscopy: Principle and applications; NMR: Principle, Instrumentation, applications of NMR; Thermal method-Instrumentation, fundamental principles and applications of TGA, DTA and DSC, Introduction to chromatographic techniques. **5**

## ENGINEERING CHEMISTRY LAB

**List of Experiments**

1. **Volumetric analysis (Titrations):**
   - i. To determine the total hardness of the given hard water using EDTA titration method.
   - ii. To estimate of total.
   - iii. To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method.
   - iv. To determine the strength of given solution of Mohr's salt.
   - v. To estimate amount of chlorine present in given sample of bleaching powder.
   - vi. To determine free residual chlorine in sample water by iodometric titration.
   - vii. To determine the Cu present in given brass sample by iodometrically.
   - viii. To determine the iron content in the given salt by using external indicator.
2. **Colorimetric analysis:**
   - i. To determine free residual chlorine content in given water sample.
   - ii. To estimate ferric ions in aqueous solution using thiocyanate solution.
   - iii. To find out the concentration of given KMnO4 solution spectrophotometrically.
   - iv. To estimate the amount of ferrous iron present in the given sample of cement by colorimetry using ammonium thiocyanate as the reagent.
   - v. To determine the concentration of Cr in unknown solution of K2Cr2O7 using calibration curve method.
3. **Physical Chemistry:**
   - i. To determine the strength of an acid by pH metric method.
   - ii. To determine the strength of hydrochloric acid solution by titrating against sodium hydroxide solution conductometrically.

iii. To identify given unknown liquid by surface tension measurement using Stalagmometer.
iv. To identify given unknown liquid by viscosity using Ostwald viscometer.
v. To determine the viscosity coefficient of the given polymer PEG and find out the composition of unknown solution.
vi. To separate the mixture of amino acids by thin layer chromatography.

4. **Lubricant analysis:**

i. To determine the flash point and fire point of given lubricant using Abel's/Pensky Martin closed cup apparatus.
ii. To determine the acid value of a given oil/fat sample.

5. **Organic synthesis:**

i. To prepare polymer of Bakelite.
ii. To prepare urea formaldehyde resin.
iii. To prepare a pure sample of Aspirin.

**Total Periods: 24 + 48 = 72**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Distinguish between hard/soft water and solve the day today problems associated with it. (K3)

CO2 : Explain the properties, structure, synthesis and applications of Polymers in engineering fields. (K2)

CO3 : Interpret the operation of electrochemical systems for the production of electric energy and identify the solutions to corrosion. (K3)

CO4 : Identify the different engineering materials and explain its usefulness in technological advancement. (K3)

CO5 : Analyse the structures of known and unknown compounds using different characterization techniques. (K4)

CO6 : Apply the concepts of Engineering Chemistry to real-world situations. (K3)

## Text Books:

1. Vairam, S., *"Engineering Chemistry- A textbook of chemistry for engineers"*, Wiley India Pvt. Ltd., 2018.
2. Palanna, O. G., *"Engineering Chemistry"*, Tata McGraw-Hill Publishing Company Ltd., 2017.

**Reference Books:**


1. Poole, J.R, Charles, P., and Frank J. owens, *"Introduction to nanotechnology"*, John Wiley and Sons, 2009.
2. Pavia, D.L., Lampman, G.M., Kriz, G.S., *"Introduction to spectroscopy: a guide for students of organic chemistry",* Philadelphia: W.B. Saunders Co., 1979.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | 3 | 2 | - | - | - | - | - | 2 | - | 2 |
| **CO2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | - | - | 2 | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO6** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 18 | 12 | - | 3 | - | 5 | 2 | - | - | - | - | - | 6 | - | 2 |
| **COM** | 3 | 2 | - | 3 | - | 3 | 2 | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **EVC203** |
| **Course Title** | **Basic Environmental Science and Engineering** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn the principles of renewable energy systems.
- To explore the environmental impact of various energy sources
- To comprehend the effects of different pollutants.
- To know the impacts of environmental biodiversity in our daily life.
- To understand the recent sustainable environmental engineering practices.

## COURSE CONTENTS:

**UNIT I: INTRODUCTION TO NON-CONVENTIONAL ENERGY SOURCES**

Present Energy resources in India and its sustainability, Different type of conventional Power Plant, Energy Demand Scenario in India, Advantage and Disadvantage of conventional Power Plants, Conventional vs Non-conventional power generation, Environment issues of various power plants, Industrial and transport emissions impacts. **8**

**UNIT II: ENVIRONMENTAL IMPACT OF VARIOUS ENERGY SOURCES**

Basics of Solar Energy, Solar thermal energy, Solar photovoltaic-advantages and disadvantages, Power and energy from wind turbines, India's wind energy potential, Types of wind turbines, Off Shore Wind energy, Fossil fuels energy, Biomass energy, Geothermal energy, Ocean energy, Chemical energy sources, Thermonuclear fusion energy. **8**

**UNIT III: INTRODUCTION TO ENVIRONMENT AND POLLUTION**

Introduction to the Environment: Physical environment; biotic environment; biotic and abiotic interactions, Environmental pollution (water, air, soil and noise): Sources, effects, control, Air quality standards, International Standards for Drinking Water, Greenhouse gases effect, Acid rain **8**

**UNIT IV: IMPACT OF ORGANISMS ON THE ENVIRONMENT**

History (scientists and discoveries), Classification and nomenclature of microorganisms, Structural organization and multiplication of Microbes, Microscopic examination of microorganisms: light, fluorescent, dark

field, phase contrast, and electron microscopy, Stains and staining techniques, Microbial nutrition and growth, Control of microorganisms. **8**

**UNIT V: APPLICATIONS OF ENVIRONMENTAL TECHNOLOGY**

Aerobic wastewater treatment, Anaerobic wastewater treatment, Bioremediation of contaminated land and water, Biofertilizers, Biopesticides, Biosensors. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Classify the environmental impact of various energy sources. | (K2) |
| CO2 | : | Select a solution based on the energy source. | (K3) |
| CO3 | : | Explain the various aspects of several pollutants. | (K3) |
| CO4 | : | Examine the biodiversity through analytical tools. | (K4) |
| CO5 | : | Apply scientific solutions to preserve water and land from contaminations. | (K3) |

## Text Books:


1. Khan B.H., *"Non-Conventional Energy Resources"*, 3rd edition, Chennai: The McGraw Hill Education, 2017.
2. Rai G. D., "*Non-conventional Energy Sources"*, 6th edition, New Delhi: Khanna Publishers, 2018.
3. Pelczar M.J., Chan E.C.S., Krieg N. R., Microbiology, 6th Edition. McGraw Hill, India, 2018.
4. Thakur I.S., Environmental Biotechnology: Basic Concepts and applications, 2nd Edition, I.K. International Publishing House Pvt. Ltd., 2019.


## Reference Books:


1. Sargsyan G., Bhatia M., Banerjee S.G., Raghunathan K., and Soni R., Unleashing the Potential of Renewable Energy in India, World Bank Report, 2011.
2. Everett, G., Boyle, S., Peake, and Ramag J., Energy Systems and Sustainability. Power for a sustainable future. 2nd Edition, Oxford University Press, 2011.
3. Wang L.K., Tay J.H., Tay S.T.L., and Hung Y.T. Environmental Bioengineering, 1st Edition, Humana Press, 2010.
4. Evans G.G., and Furlong J., Environmental Biotechnology: Theory and Application, 2nd Edition, Wiley, 2018.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 2 | 1 | 1 | - | 2 | - | - | - | - | 2 | - | - | 2 |
| **CO3** | - | 2 | - | - | - | 2 | 2 | 3 | - | - | - | - | - | - | 2 |
| **CO4** | - | - | 2 | 2 | 1 | - | 2 | - | - | - | - | - | - | - | 2 |
| **CO5** | 3 | - | 2 | 2 | 1 | 2 | 2 | 3 | - | - | - | 2 | - | - | 2 |
| **Score** | 9 | 6 | 6 | 5 | 3 | 4 | 10 | 6 | - | - | - | 4 | - | - | 8 |
| **COM** | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | - | - | - | 2 | - | - | 2 |

| | |
|---|---|
| **Course Code** | **EEC204** |
| **Course Title** | **Basic Electrical and Electronics Engineering** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To learn the problem-solving techniques in RLC circuits and power measurements.
- To learn the fundamentals of alternating current and direct current machinery.
- To study the characteristics and use of PN junction diode and Zener diode.
- To study the various configurations of NPN and PNP transistors and their applications.
- To understand the JFET characteristics and its use as an amplifier.

## COURSE CONTENTS:

**UNIT I: ELECTRICAL CIRCUITS**

Kirchoff's Laws: KVL and KCL, Nodal and Mesh analysis, delta to wye and wye to delta transformations, RL, RC, and RLC circuits, sinusoids, AC fundamentals, self and mutual inductances, and energy in coupled circuit. **8**

**UNIT II: NETWORK THEOREMS**

Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem, Maximum power transfer theorem, Compensation theorem, Tellegen's theorem, and their applications. **8**

**UNIT III: SEMICONDUCTOR DIODES**

Operation of p-n junction diodes, Rectifier circuits, Zener diode and its characteristics, Zener diode as voltage regulator. **8**

**UNIT IV: BIPOLAR JUNCTION TRANSISTOR (BJTs)**

Simplified structure, operation of n-p-n and p-n-p transistors, BJT as an amplifier and as a switch, Input and Output Characteristics of CE, CB, and CC configurations. **8**

**UNIT V: JUNCTION FIELD EFFECT TRANSISTOR (JFET)**

Structure, Basic operation, Drain and Transfer Characteristics, JFET as an Amplifier and as a Switch, Comparison of BJT and FET. **8**

## BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

**List of Experiments:**

1. To calibrate a given wattmeter by direct loading, verify ohm's law for BPLL element,calibrate a voltmeter and ammeter, calibrate a single-phase energy meter by direct loading.
2. To verify the Kirchoff's laws.
3. To verify network theorems, polarity test, voltage ratio test, open circuit test, shortcircuit test, load test on single phase transformer.
4. To study DSO, Function generator, Multimeter, and DC power supply.
5. To observe the V I characteristics of PN Junction and Zener diode.
6. To study the half-wave and full-wave rectifier circuits without and with capacitor filter.
7. To observe the input and output characteristics of a transistor, DC biasing the transistorin common- emitter configuration and determine its operating point (i.e., various voltages and currents).
8. To draw the Transfer and Drain Characteristics of JFET.

**Total Periods: 40 + 48 =88**

### COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Apply the various laws and methods to solve the electrical problems. | (K2) |
| CO2 | **:** | Apply different network theorems to find the current and voltage in every branch of a given circuit. | (K3) |
| CO3 | **:** | Explain various semiconductor diodes to develop an electronic circuitry. | (K2) |
| CO4 | **:** | Develop different circuits using the BJT for various applications. | (K3) |
| CO5 | **:** | Make use of different types of FETs for developing an amplifier. | (K3) |

### Text Books:


1. Charles, K.A. and Sadiku, N.O., "*Fundamental of Electric Circuits",* Tata Mc-Graw Hill, Sixth Edition, 2018.
2. Hayt, W. H. and Kemmerly, J., "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013.
3. Boylestad, R. L. and Nashelsky, L., "*Electronic Devices and Circuits theory"*, 10th Edition, Pearson Education, 2013.

**Reference Books:**


1. Sudhakar, A. and Palli, S. S., “Circuits and Networks: Analysis and Synthesis”, McGraw-Hill Education, 2017.
2. Sedra and Smith K. C., "Microelectronics Circuits", 5th Edition, Oxford University, 2009.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | 8 | 15 | - | - | - | - | - | - | - | - | 10 | - | - |
| **COM** | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **ITL205** |
| **Course Title** | **IT Workshop** |
| **Number of Credits** | **0-0-4-2** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To impart the knowledge of various hardware components of a computer system
- To provide the skill of assembling the computer system.
- To impart knowledge about the troubleshooting and fault finding the computers and the peripherals.
- To impart the knowledge and usage of various tools such as Power Point, Word Excel, MS Outlook and Latex.
- To learn the basic commands in Linux operating system.
- To learn the basics of computer networks and different networking devices.

**List of Experiments:**

1. Introduction to Von-Neumann Architecture. Study and demonstrate the working of SMPS, Optical drive and Hard disc. The working of CPU processor, Memory Slots, System Buses, Heat Sinks. Working of IDE Connectors/PATA, SATA Connectors, COMOS Battery, Expansion Slots, I/O ports.
2. To study and demonstrate the working of Chip Set, BIOS chip, Capacitors, Inductors, Resistors, Hub and Switch, Repeater and Bridges, Router and NIC.
3. To assemble a PC.
4. Dual Booting (Warm Booting and cold booting).
5. Installation process of Windows, Linux operating system.
6. Study of Device Drivers and Installation process of Device Drivers.
7. Hardware Troubleshooting (Demonstration): Students have to be given a PC which does not boot due to improper assembly.
8. Defective peripherals, Identifying problem and fixing it for getting to working condition.
9. Software Troubleshooting (Demonstration): Students have to be given a malfunctioning CPU due to system software problems.
10. Introduction to MS Word, MS Excel, Power Point Presentation, MS Outlook, Latex.
11. Orientation and Connectivity Boot Camp and surfing the Web using Web Browsers.
12. Search Engines and Netiquette, Cyber Hygiene and issues related to Cyber Security.
13. Exercises on basic UNIX commands, file and directory handling.
14. Exercises on security and file permissions of UNIX, pipes, quotes, aliases, variables, filters, sed and awk.

**Total Periods: 48**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Describe various hardware components of a computer system. (K2)

CO2 : Identify existing configuration of the computer and peripherals and to troubleshoot common problems. (K3)

CO3 : Make use of various Microsoft tools to solve the problems. (K3)

CO4 : Experiment with basic commands in Linux operating system. (K3)

CO5 : Explain the basics concepts related to computer networks and identify different networking devices. (K3)

## Text Books:


1. Mueller, Scott, *"Upgrading and Repairing PCs"*, 22nd Edition", QUE, Pearson Education 2015.
2. Meyers, Mike, *"Introduction to PC Hardware and Troubleshooting",* Tata McGraw Hill, New Delhi 2003.
3. Zacker, Craig and Rourke, John, *"The complete reference: PC hardware"*, 1st Edition", Tata McGraw Hill, New Delhi 2001.


## Reference Books:


1. Govindarajulu, B., "*IBM PC and Clones hardware trouble shooting and maintenance, 2nd Edition*", Tata McGraw-Hill, New Delhi, (13th reprint) 2008.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO2** | 3 | - | - | - | - | - | - | - | 3 | 3 | - | - | 1 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | - | - | - | - | - | - | - | 3 | 3 | - | - | - | - | - |
| **Score** | 15 | 4 | - | 6 | - | - | - | - | 6 | 6 | - | - | 4 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | 3 | 3 | - | - | 1 | - | - |

| | |
|---|---|
| **Course Code** | **ITL206** |
| **Course Title** | **Practicum-II** |
| **Number of Credits** | **0-0-6-3** |
| **Course Type** | **PM** |

## COURSE OBJECTIVES:

- To introduce Matlab/Simulink software as an engineering tool for numerical computations and simulations.
- To study the basics of Linux, Virtual machines, networking and data analytics and Python programming.
- To expose the students and gain more knowledge about interfacing of devices with Arduino.
- To equip the students with a deeper understanding of basic principles of 3-D printing and PCB designing.
- Ability to analyse and apply the knowledge to solve the problems in electrical, computer and electronics engineering.

## COURSE CONTENTS:

**UNIT I: BASICS OF MATLAB/SIMULINK**

1. MATLAB Basics.
   i. Introduction to MATLAB and its programming.
   ii. Arithmetic and logical operations.
   iii. Handling matrix.
   iv. Common MATLAB functions.
   v. Plotting.
   vi. MATLAB editor.
2. Solving RC, RL, RLC networks.
3. Solution of network problems (Solution of linear differential equations).
4. Introduction to SIMULINK.
   i. Creating a Simulink model.
   ii. Simulink solution of differential equation.
   iii. Storing/saving data.
   iv. Observing variables during simulation.
5. Modelling of half wave rectifiers in MATLAB/SIMULINK with different types of filters.
6. Modelling of full wave rectifiers in MATLAB/SIMULINK with different types of filters.
7. Arrays and its significance in MATLAB.
8. Vector handling and its application.
9. Flow controls and functions.
10. Data visualisation and its interpretation. **18**

**UNIT II: BASICS OF COMPUTER PROGRAMMING**

1. Study and implement Basic Linux Commands, What is Linux File System? Getting familiar with Linux Commands related to Creating, Moving, Removing and Listing Files/Directories including various flags.
2. Linux Ownership and File Permissions, Getting familiar with Setting/Removing Linux File/Directory Permissions, Finding patterns in a File/string, Shell Script: Implementing basic programs in Shell.
3. To create and set up a virtual machine using Virtual Box, To for communication between Virtual machines in various modes and accessing Internet in each virtual machine formed, Getting familiar with the basic commands of networking.
4. Study basics of Python, Execute basic operations: read a csv/data file, display the content of a file; data visualisation (plot various graphs). **18**

**UNIT III: BASICS OF ARDUINO TECHNOLOGY**

1. Interfacing of LED with Arduino.
2. Interfacing of Buzzer with Arduino.
3. Interfacing of Ultra-sonic sensor with Arduino.
4. Interfacing of LCD with Arduino.
5. Interfacing of Seven Segment display with Arduino.
6. Interfacing of DC Stepper motor with Arduino.
7. Arduino based Mini Project. **18**

**UNIT IV: BASIC PRINCIPLES OF 3-D PRINTING AND PCB DESIGN**

1. Study of 3-D printing tools and software.
2. Design of prototypes using 3-D printer.
3. Study of PCB design software.
4. Design of custom PCB using PCB design software.

**18**

**UNIT V: ENGINEERING APPLICATIONS**

Application of Matlab/Simulink, data analytics, Python, Linux and arduino technology, computer and electronics engineering.

**Lab Hours: 72**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Ability to analyse the performance of electrical systems through simulation results. | (K3) |
| CO2 | : | Develop and visualise the models with basic programs in Linux, Shell scripting, Networking and Python. | (K3) |
| CO3 | : | Experiment with Arduino and the various interfaced Input/Output devices. | (K3) |
| CO4 | : | Study of 3-D printing, study and design of PCB using PCB design. | (K6) |
| CO5 | : | Constructing a solution for the estimation and designing of the Electronic or Electrical system and Computational tool using the Matlab, Python, Arduino interfacing. | (K6) |

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 3 | 2 | - | 2 | - | - | 3 | 3 | 3 | - | - | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 3 | - | 3 | - | - | - |
| **CO3** | 3 | 2 | 3 | 3 | 2 | - | 2 | - | - | 3 | - | 3 | 3 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | 3 | 3 | 3 | 2 | 3 |
| **Score** | 15 | 10 | 14 | 15 | 10 | - | 4 | - | - | 9 | 6 | 12 | 6 | 6 | 7 |
| **COM** | 3 | 2 | 3 | 3 | 2 | - | 2 | - | - | 2 | 2 | 3 | 2 | 2 | 2 |

## THIRD SEMESTER

| | |
|---|---|
| **Course Code** | **ITC301** |
| **Course Title** | **Discrete Structures** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To study the objects that, have discrete as opposed to continuous values including the foundations of logic, algorithms and their complexity.
- To study mathematical reasoning, relations, graphs, trees and combinatorics.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO PRELIMINARIES AND PREDICATE CALCULUS

Basic concepts of discrete mathematics and related problems, Propositions and predicates, Disjunction and conjunction, Tautologies and contradiction, Laws of equivalence, Rules of substitution and transitivity, Normal forms, Proof techniques. **8**

### UNIT II: SET THEORY AND FUNCTIONS

Basic concepts, Venn Diagrams, set operations, power set, methods of proof for sets, Relations and ordering, Types of relations, Graph and matrix of a relation, properties of a relation. Functions: definitions and notation, one to one, onto, one to one and onto, composition, Identity and inverse, related results. Counting: Principle of Inclusion and Exclusion, Division and Euclidean Algorithm in Integers, Elements of Probability, Recurrence Relations. **8**

### UNIT III: GRAPH THEORY

Basic concepts of graph theory, multigraphs and weighted graphs, Bipartite graph, walk, path and circuits. Warshall's algorithm: Shortest path, Eulerian paths and circuits, Hamiltonian paths and circuits, Factors of a graph and planar graphs, Graph colorings, Graph isomorphism. **8**

### UNIT IV: BINARY TREES

Introduction, complete and extended binary tree, Traversing binary tree, binary search tree, Minimum spanning trees, Heaps, Huffman's algorithm. **8**

**UNIT V: BASICS OF STRUCTURES**

Mathematical induction, Algebraic structures properties, Semi group, Monoid, Group and Sub group - examples and standard results, Generators and evaluation of powers, cosets and Langrange's theorem, Rings, Integral domains, fields. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the basics of discrete mathematics, predicate calculus. | (K3) |
| CO2 | : | Understand set theory, relations and functions and recurrence relation. | (K2) |
| CO3 | : | Illustrate the concepts of graph theory. | (K2) |
| CO4 | : | Experiment with trees to solve problems like minimum spanning tree - traversal of binary tree. | (K3) |
| CO5 | : | Explain different algebraic structures. | (K3) |

## Text Books:


1. Tremblay, J. P. and Manohar, R., "*Discrete Mathematical structures with applications to Computer Science*", McGraw Hill, 2017.
2. Liu, C.L., "*Elements of Discrete Mathematics*", McGraw Hill, 2012.


## Reference Books:


1. Scheinerman, Edward, "*Mathematics: A Discrete Introduction, 3rd Edition*", Cengage, 2012.
2. Rosen, Kenneth h., "*Discrete Mathematics and Its Applications*", McGraw Hill, 2012.
3. Graham, L. R., Donald, E. K. and Patashnik, O., *"Concrete Mathematics: A Foundation for Computer Science",* 2nd Edition, Addison Wesley, 28 February 1994.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 |
| **CO2** | 2 | 3 | 2 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 | - | - | 3 |
| **CO3** | 2 | - | 3 | 3 | 3 | 2 | - | 2 | - | - | 3 | - | 3 | 3 | 2 |
| **CO4** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 10 | 8 | 11 | 6 | 6 | - | - | 2 | 3 | 3 | 9 | 3 | 3 | 3 | 7 |
| **COM** | 2 | 3 | 3 | 3 | 3 | - | - | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITC302** |
| **Course Title** | **Automata and Formal Languages** |
| **Number of Credits** | **3-1-0-4** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To learn fundamentals of different model of computations.
- To understand regular languages, Context free languages and their properties.
- To learn regular languages.
- To learn and understand context sensitive languages.
- To understand various models of Turing machines.

## COURSE CONTENTS:

### UNIT I: MACHINES

Introduction: Alphabets, Strings and Languages, Automata and Grammars, Deterministic finite Automata (DFA), State transition graph, Transition table, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Moore and Mealy machine, Minimization of Finite Automata. **8**

### UNIT II: REGULAR EXPRESSION (RE)

Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non-Regular Languages, Pumping Lemma for regular languages, Application of Pumping Lemma, Closure properties of Regular Languages. **8**

### UNIT III: CONTEXT-FREE GRAMMAR (CFG) AND CONTEXT-FREE LANGUAGES (CFL)

Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs. **8**

### UNIT IV: PUSH-DOWN AUTOMATA (PDA)

Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG. **8**

**UNIT V: TURING MACHINES (TM)**

Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, Recursive and recursively enumerable languages, Halting problem, Introduction to Un-decidability, Undecidable problems with TMs, Post correspondence problem (PCP). **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of automata theory and build finite state machines for real-world problems. | (K2) |
| CO2 | : | Construct a deterministic finite state machine for the given regular expression. | (K3) |
| CO3 | : | Illustrate context-grammar and context-free languages. | (K2) |
| CO4 | : | Design pushdown automata for real-world problems. | (K3) |
| CO5 | : | Compare various Turing machine models. | (K4) |

## Text Books:


1. Hopcroft, John E., Motwani, Rajeev and Ullman, Jaffrey D. *"Introduction to Automata Theory, Languages and Computation",* 3rd edition". Pearson Education, 2014.
2. Linz, Peter, "*An Introduction to Formal Language and Automata"*, Narosa Pub House, 2011.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | 3 | - | - | - | - | - | 3 | - | - | 3 | - | 3 |
| **CO2** | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 2 | 2 | - | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 2 | 2 | - | 3 | 3 | - | - | - | 3 | - | - | - | - | - | - |
| **CO5** | 2 | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - | 3 |
| **Score** | 11 | 12 | 1 | 9 | 8 | - | - | - | 3 | 3 | - | - | 6 | - | 9 |
| **COM** | 3 | 3 | 1 | 3 | 2 | - | - | - | 3 | 3 | - | - | 3 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITC303** |
| **Course Title** | **Data Structures and Algorithms** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To impart the basic concepts of data structures and algorithms.
- To understand writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
- To understand concepts about searching and sorting techniques.
- To be familiar with basic techniques of algorithm analysis.
- To learn and implement various data structures and algorithms.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO DATA STRUCTURES

Data types, Data structures, Abstract data types, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures. Types of data structures: linear and nonlinear, The running time of a program, Asymptotic notations, Analysis of algorithms: Time and Space complexity. **8**

### UNIT II: STACKS AND QUEUES

Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations: infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues, array and linked list, operations on queues, Types of queues: queue, double ended queue and priority queue. **8**

### UNIT III: DEVELOPMENT OF ALGORITHMS, ARRAYS AND LINKED LIST

Notations and Analysis, Storage structures for arrays, sparse matrices, structures and arrays of structures, Singly linked lists, Linked stacks and queues, operations on Polynomials, Doubly Linked Lists, Circularly Linked Lists, Operations on linked lists: Insertion, deletion and traversal, dynamic **8**

### UNIT IV: TREES AND GRAPHS

Basic terminology, General Trees, Binary Trees, Tree Traversing: in-order, pre-order and post-order traversal, building a binary search tree, Operations on Binary Trees, Height Balanced Trees(AVL), B-trees, B+ -trees. Graphs: Flavors of Graphs, Data Structures for Graphs, Traversing a Graph, Breadth First Search and its applications, Depth First Search and its applications, Depth First search on Directed Graphs, Directed and undirected graphs, the

single-source shortest path problem, the all-pair shortest path problem, traversals of directed and undirected graphs, DAGs, strong components, minimum cost spanning tress, articulation points and bi-connected components, graph matching. **8**

**UNIT V: SORTING AND SEARCHING**

Applications and Pragmatics of Sorting, Bubble sort, Insertion sort, Selection sort, Heap Sort, Fast sorting via Data Structures, Merge Sort, Sorting by Divide and Conquer, Quick sort: Sorting by Randomization, Distribution Sort: Sorting by Bucketing, Binary Search and Related Algorithms. **8**

## DATA STRUCTURES LAB

**List of Experiments**

1. Array Operations.
2. Matrix Operations.
3. Searching.
4. Sorting.
5. Queues.
6. Stacks and Linked Lists.
7. Singly, doubly and circular linked list and insertion, deletion, traversal operations.
8. Infix to postfix expression using stack data structure.
9. Tree traversal algorithms of trees.
10. Create a binary search tree of given integers and perform different traversal operations.
11. Insertion into a B-tree.
12. Knuth-Morris- Pratt pattern matching algorithm.
13. DFS, BFS graph traversal algorithms.
14. Reverse the elements in the stack using recursion.

**Total Periods: 40 + 48= 88**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Explain the fundamentals of data structures and algorithms. | (K2) |
| CO2 | **:** | Build data structures for a given problem. | (K3) |
| CO3 | **:** | Illustrate applications and use of tree data structures. | (K3) |
| CO4 | **:** | Compare algorithms for graph data structures. | (K4) |
| CO5 | **:** | Compare the basic algorithmic techniques and choose a suitable for a given problem. | (K5) |

## Text Books:


1. Skiena Steven S., "*The Algorithm Design Manual*", Springer, 2nd edition, 2008.
2. Cormen, T., Lieserson, C., Rivest, R., and Stein, C., *"Introductions to Algorithms*", Prentice-Hall India, 3rd edition, 2009.


## Reference Books:


1. Dasgupta, Sanjoy, Papadimitriou, Christos H. and Vazirani, Umesh V. *"Algorithms"*, Tata McGraw-Hill, 2008.
2. Kruse, Tondo and Leung, "*Data Structures and Program Design in C*", 2nd edition, Prentice-Hall, 1997.
3. Lipschutz, Seymour, "*Data structures*", McGraw Hill revised first edition, 2014.
4. Skiena Steven S., "*The Algorithm Design Manual*", 2nd edition, Springer, 2008.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | - | - | - | - | - | - | - | 3 | - | - | 3 | - | 3 |
| **CO2** | 3 | 2 | - | 3 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | 3 | - | - | - | - | 3 | - | - | - | - | - | - |
| **CO5** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 13 | 11 | - | 9 | 3 | - | - | - | 3 | 3 | - | - | 6 | - | 6 |
| **COM** | 3 | 3 | - | 3 | 3 | - | - | - | 3 | 3 | - | - | 3 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITC304** |
| **Course Title** | **Computer Organization** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To learn the basics of Computer System Architecture.
- To understand the core concepts of Processor Design.
- To learn and demonstrate the basics of Computer Arithmetic and Control Design.
- To learn about the structure and organisation of Memory in Computer Systems.
- To understand the concepts of Parallelism in Computer Systems.

## COURSE CONTENTS:

**UNIT I: GENERAL SYSTEM ARCHITECTURE**

Stored Program control concept (Von-Neumann architecture principle), Flynn's Classification of computers (SIMD, MISD, MIMD), Structure organization (CPU, Caches, Main memory, Secondary memory unit and I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic and logical, Data transfer, Control flow), Instruction set format, Instruction Set Architecture (Instruction set based classification of processor i.e. RISC, CISC, RISC vs CISC Comparison). **8**

**UNIT II: PROCESSOR DESIGN**

Arithmetic and logic unit, Stack organization, CPU Architecture types, Accumulator Based Register, Stack Memory, Register, Detailed data path of a typical register-based CPU, Fetch, Decode, and Execute Cycle. **8**

**UNIT III: COMPUTER ARITHMETIC AND CONTROL DESIGN**

Addition and Subtraction, Multiplication Algorithms (Booth's Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations, Control Design: Microprogrammed and Hard-wired control options, Hard-wired design methods, State table method, Multiplier control, CPU control unit. Microprogrammed, Basic concepts, control Memory, Address Sequencing. **8**

**UNIT IV: MEMORY HIERARCHY AND I/O ORGANIZATION**

Memory Hierarchy, need for Memory Hierarchy, locality of reference principle, cache memory, main and secondary, Memory parameters, access cycle time, cost per unit, concept of virtual memory. Programmed, Interrupt driven I/O, Direct Memory Access, Synchronous and asynchronous data transfer. **8**

**UNIT V: INTRODUCTION TO PARALLELISM**

Goals of parallelism, Instruction level parallelism, pipelining, super scaling, Processor level parallelism, Multiprocessor system overview. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Explain the concepts of Computer Architecture such as Principles, Instructions Set, Addressing Modes, etc. (K2)

CO2 : Outline the principles Processor design. (K2)

CO3 : Explain and demonstrate the various approaches followed in performing Computer Arithmetic. (K3)

CO4 : Interpret the organisation and working of various memories in Computer Systems. (K2)

CO5 : Explain the relevance of Parallelism in Computer Systems. (K2)

## Text Books:


1. Hayes J.P, *"Computer architecture and Organization"*, 3rd Edition, McGraw Hill, 2017.
2. Hamacher, C., Vranesic, Z. and Zaky, S., *"Computer Orgnization"*, 5th Edition, McGraw Hill Education; 4 November 2011.


## Reference Books:


1. Patterson, David A and Hennessy, John. L, *"Computer Organization and Design"*, Morgan Kaufmann; 3rd Edition, 27 July 2007.
2. Stallings, William, *"Computer Organization and Architecture Designing for Performance"*, 6th Edition, Pearson Education Asia, 2003.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 2 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | - | 3 | - | - |
| **CO4** | 2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 11 | - | - | 10 | 3 | - | - | - | 3 | 3 | - | - | 3 | - | - |
| **COM** | 3 | - | - | 3 | 3 | - | - | - | - | 3 | - | - | 3 | - | - |

| | |
|---|---|
| **Course Code** | **ITC305** |
| **Course Title** | **Digital Electronics** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- Able to implement simple logical operations using combinational logic circuits.
- Able to design sequential logic circuits and analyze the sequential systems in terms of state machines.
- To understand basics of VHDL language and its use in logic designing.

## COURSE CONTENTS:

### UNIT I: NUMBER SYSTEM

Introduction to various number systems and their Conversion. Arithmetic Operation using 1's and 2's Compliments, Signed Binary and Floating Point, Number Representation Introduction to Binary codes and their applications, Boolean Algebra and Logic Gates: Data Representation and Processing, Basic Logic Operations, Basic Identities, Algebraic Laws, NOR and NAND Gates, Useful Boolean Identities, Algebraic Reductions, Complete Logic Sets, IEEE Logic Gate Symbols. **8**

### UNIT II: COMBINATIONAL LOGIC DESIGN

Canonical Logic Forms, Extracting Canonical Forms, The Exclusive-OR and Equivalence Operations, Logic Arrays, BCD and 7 Segment Displays, K-Maps, 3-Variable K-Maps, 4-Variable K-Maps, The role of logic Designer. Digital Hardware: Voltages as Logic Variables, Digital Integrated Circuits, Logic Delay Times, Basic Electric Circuits, Transmission Lines, Logic Families, Hardware Designer. **8**

### UNIT III: SEQUENTIAL LOGIC NETWORKS

Concept of a Sequential Network, Analysis of Sequential Networks, Sequential Network Design, Binary Counters, Importance of State Machines. Shift resistors: Principle of 4-bit shift resistors, Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO resistors. **8**

**UNIT IV: LOGIC COMPONENTS**

Concept of a Digital Component, An Equality Detector, BCD Validity Detector, Line Decoders, Multiplexers, Demultiplexers, Binary Adders, Subtraction, Multiplication, Transmission Gate Logic, Memory Elements and Arrays: General Properties, Latches, Clock and Synchronization, Master-Slave and Edge-Triggered Flip-Flops, Registers, Random Access Memory (RAM), Read-only Memory (ROM). **8**

**UNIT V: FIRST CONCEPTS IN VHDL**

Introduction, Defining Modules in VHDL, Structural Modelling, Learning VHDL, CMOS Logic Circuits: NOT Function in CMOS, Logic Formation using MOSFETs. **8**

## DIGITAL CIRCUITS AND SYSTEMS LAB

**List of Experiments**

1. Introduction of Digital Logic Gates: Investigate logic behaviour of NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.
2. Gate-level minimization: Two level and multi-level implementation of Boolean functions.
3. Combinational Circuits design, assemble and test: adders and subtractors.
4. Code Converter: BCD to Excess-3 code converter, gray code to binary converter, binary to gray code converter.
5. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
6. Design of multiplexers and de-multiplexers.
7. Design of encoders and decoders.
8. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce an 8-bit product.
9. Parallel adder and accumulator: design, implement and test.
10. Flip-Flop: assemble, test and investigate operation of S-R, D and J-K flip-flops.
11. Counters: Design, assemble and test various Asynchronous and Synchronous binary counter with parallel load.
12. Shift Registers: Design and investigate the operation of all types of shift registers with parallel load.

**Total Periods: 40 + 48= 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Describe the different number systems**,** solve logic expressions and circuits using Boolean laws. | (K2) |
| CO2 | : | Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency. | (K4) |
| CO3 | : | Develop ability in combinational logic problem formulation and logic optimization. | (K3) |
| CO4 | : | Develop ability to understand synchronous and asynchronous sequential circuits. | (K3) |
| CO5 | : | To design digital circuits using VHDL. | (K6) |

## Text Book:

1. M. M. Mano and M. D. Ciletti, *"Digital Design: With an Introduction to the Verilog HDL*", 5th Edition, Pearson Education, 2013.

## Reference Book:

1. S. M. Kang and Y. Leblebici, *"CMOS Digital Integrated Circuits Analysis and Design",* 3rd Edition, McGraw Hill Education", 2002.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 3 | - | - | - | 2 | - | - | - | - | - | 3 | - | 2 | - |
| **CO3** | 2 | 2 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO4** | - | 2 | 3 | 3 | - | 2 | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 2 | 2 | - | 3 | - | 2 | - | - | - | 2 | - | 1 | - | - | - |
| **Score** | 6 | 11 | 5 | 9 | - | 6 | - | - | - | 2 | - | 4 | - | 6 | 3 |
| **COM** | 2 | 3 | 2 | 3 | - | 2 | - | - | - | 2 | - | 2 | - | 2 | 3 |

| | |
|---|---|
| **Course Code** | **ITL306** |
| **Course Title** | **Practicum-III** |
| **Number of Credits** | **0-0-6-3** |
| **Course Type** | **PM** |

## COURSE OBJECTIVES:

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

It consists of a practical problem or a project based on combination of different labs studied till III semester.

### COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Demonstrate a sound technical knowledge of the selected domain. | (K3) |
| CO2 | : | Survey research studies and demonstrate a solution of a complex engineering problem. | (K6) |
| CO3 | : | Experiment with state-of-the-art methods and analyze the available solutions. | (K4) |
| CO4 | : | Construct and implement the proposed solution utilizing the systematic approach. | (K6) |
| CO5 | : | Evaluate results using various performance metrics and compare it with the available solutions. | (K5) |

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 2 | - | - | - | - | 3 | 3 | - | 3 | - | - | 3 |
| **CO2** | 3 | 3 | 1 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 0 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 15 | 14 | 6 | 14 | 2 | 5 | 6 | 3 | 15 | 15 | 12 | 15 | 12 | 12 | 15 |
| **COM** | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

## FOURTH SEMESTER

| | |
|---|---|
| **Course Code** | **ITC401** |
| **Course Title** | **Object Oriented Programming** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To learn algorithmic problem solving techniques.
- To learn the fundamentals of object-oriented programming.
- To compose programs in C++ using conditions, iterations and decompose a problem into function.
- To design, write, compile, test and execute programs using high level language.

## COURSE CONTENTS:

**UNIT I: INTRODUCTION TO OBJECT ORIENTED PROGRAMMING**

Introduction to object oriented design and development (steps and example). Comparison of structured and object-oriented concepts, Implementation to Arrays, Pointers and Functions, Storage of arrays in memory, Multi-Dimensional Arrays, Pointers, accessing array elements through pointers, passing pointers as function arguments, Arrays of pointers, Pointers to pointers, Functions, Arguments, Inline functions, Function Overloading Polymorphism. **8**

**UNIT II: CLASSES AND OBJECTS**

Data types, operators, expressions, control structures, arrays, strings, Classes and objects, access specifiers, constructors, destructors, operator overloading, type conversion. Storage classes: Fixed vs Automatic declaration, Scope, Global variables, register specifier, Dynamic memory allocation. **8**

**UNIT III: INHERITANCE**

Inheritance, single Inheritance, Multiple Inheritance, Multi-level inheritance, hierarchical inheritance, hybrid inheritance, Virtual functions and Polymorphism. Exception Handling: List of exceptions, catching exception, handling exception. **8**

**UNIT IV: STREAMS AND FILES:**

Opening and closing a file, File pointers and their manipulations, Sequential Input and output operations, multi-file programs, Random Access, command line argument, string class, Date class, Array class, List class, Generic Class.**8**

**UNIT V: STANDARD TEMPLATE LIBRARY**

Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, Container Classes, General Theory of Operation, Vectors. **8**

## OBJECT ORIENTED PROGRAMMING LAB

**List of Experiments:**

1. Implementation of array and pointers.
2. Implementation of functions.
3. Implementation of classes and objects.
4. Implementation of functions in classes.
5. Implementation of operator overloading.
6. Implementation of different types of inheritance.
7. Implementation of streams.
8. Implementation of various operations on files.
9. Implementation of exception handling.
10. Implementation of STL.

**Total hours: 40 + 48 = 88**

### COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the basics of object-oriented programming and develop programs solving the basic programming concepts. | (K3) |
| CO2 | : | Experiment with classes, objects and different techniques for solving problems. | (K3) |
| CO3 | : | Evaluate the best inheritance method and apply exception handling. | (K5) |
| CO4 | : | Make use of operations on files. | (K3) |
| CO5 | : | Develop the standard template library for user applications. | (K3) |

### Text Books:


1. Paul D.and Harvey Deital., *"C++: How to Program",* 9th edition, Pearson India, 2015.
2. Strustrup B., "*The C++ programming Language*", 4th Edition, Addison Wesley, 2013.
3. Balagurusamy E., "*Object Oriented programming with C++*", 7th Edition, Tata McGraw Hill, 2017.


### Reference Book:


1. Lafore R., "*Object Oriented Programming in Turbo C++*", Pearson Education, 2001.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | 3 | - | - | - | - | - | - | - | 3 | - | - |
| **CO2** | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | - | - |
| **CO3** | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | - | - |
| **CO4** | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 15 | 12 | - | - | 3 | - | - | - | - | - | - | - | 9 | - | - |
| **COM** | 3 | 3 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | - |

| | |
|---|---|
| **Course Code** | **ITC402** |
| **Course Title** | **Computer Networks** |
| **Number of Credits** | **3-1-4-6** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To understand the concept of layering and various data communication techniques.
- To learn the basic MAC protocols in Computer Networks.
- To learn and implement the addressing schemes and routing protocols for a given scenario in Computer Networks.
- To learn the role and working of TCP and UDP protocols.
- To understand various application layer protocols.

## COURSE CONTENTS:

### UNIT I: LAYERED NETWORK ARCHITECTURE

ISO-OSI Model, TCP/IP, Data Communication Techniques: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes. **8**

### UNIT II: DATA LINK LAYER

DLC services, Data Link Protocols: Stop and Wait protocols, Noise free and Noisy Channels, Performance and Efficiency, Sliding Window protocols, HDLC, PPP, MAC Sublayer: The Channel Allocation Problem, Carrier Sense multiple Access Protocols, Collision Free Protocols, Gigabit Ethernet. **8**

### UNIT III: NETWORK LAYER

Design Issues: Virtual Circuits and Datagrams, Routing Algorithms, Optimality principle, Shortest path routing Algorithms, Flooding and Broadcasting, Distance Vector Routing, Link State Routing, Flow Based Routing, Multicast Routing; Flow and Congestion Control: General Principles, Congestion control in datagram subnets, Choke Packets, Load Shedding, Jitter Control, RSVP, Interworking: Bridges, Routers and Gateways, IP packet, IP routing, VLAN **8**

### UNIT IV: TRANSPORT LAYER

Design Issues, Quality of Services, Introduction to sockets, Connection Management: Addressing, Connection Establishment and Releases, Use of Timers, Flow Control and Buffering, Multiplexing, the internet Transport Protocols: User Datagram protocol UDP/TCP Layering, Segment Format, Checks Sum, Timeout Connection Management. **8**

## UNIT V: APPLICATION LAYER

World Wide Web, HTTP, FTP, Electronic Mail, Domain Name System (DNS), Real-Time Interactive Protocols, P2P Networks, Distributed Hash Table (DHT), Chord, BitTorrent. **8**

## COMPUTER NETWORKS LAB

**List of Experiments:**

1. Types of Network Cables.
2. Wired and Wireless NIC.
3. Install and configure Network Devices: HUB, Switch and Routers.
4. Creating a Local Area Network.
5. Configure Host IP, Subnet Mask and Default Gateway in a System in LAN (TCP/IP Configuration).
6. Network Commands: Ipconfig, Ping / Tracer and NetStat.
7. Network Debugging.
8. Transferring files in LAN.
9. Print server in a LAN, Sharing the Printer.
10. Router Configuration Using Packet Tracer.
11. Connection oriented Client server applications with TCP Assignment.
12. Connectionless Client server applications with UDP Assignment.
13. Programs using RPC remote procedure call.
14. Client server applications using concurrent server, Multi-protocol server and super server.
15. Chat and mail server implementation.
16. Error Detection and Error Correction Techniques.
17. Stop and Wait Protocol and Sliding Window.
18. Go back-N and Selective Repeat Protocols.
19. High-Level Data Link Control.
20. Socket Programming and Client Server Model.
21. Network Topologies.
22. Distance Vector Routing Protocol and Link State Vector Routing Protocol.
23. Address Resolution Protocol.
24. Simulate the Implementing Routing Protocols using Border Gateway Protocol (BGP).
25. Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.

**Total period: 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the role of various layers of ISO/OSI model and various data communication techniques. | (K2) |
| CO2 | : | Explain the basic MAC protocols and various design issues in Computer Networks. | (K2) |
| CO3 | : | Select a suitable IP addressing scheme, subnetting/VLAN and routing protocol implementation for a given scenario. | (K4) |
| CO4 | : | Explain the role and working of TCP and UDP protocols. | (K3) |
| CO5 | : | Experiment with various Application Layer protocols and build an application using the same. | (K4) |

## Text Books:


1. Forouzan, A., "*Data Communication and Networking*, 4th Edition", McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., "*Computer Networks*, 5th Edition ", Prentice Hall, India, 2013.


## Reference Books:


1. Olifer, Natalia and Olifer V., "*Computer Network: Principles, Technologies and Protocols for network design*", Wiley India Publication, 2006.
2. Kurose, James F. and Ross, Keith W., *"Computer Networking: A Top-Down Approach",* 6th edition, Pearson Education; 30 June 2017.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 2 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | - | - | - | 3 |
| **CO4** | 2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | - | - | - | - | - | - | - | 3 | 3 | 3 | - | 3 | - | 3 |
| **Score** | 11 | - | - | 7 | 3 | - | - | - | 6 | 6 | 3 | - | 3 | - | 6 |
| **COM** | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | 3 | - | 3 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITC403** |
| **Course Title** | **Operating Systems** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To introduce the major concepts and components of Operating Systems.
- To provide knowledge about the services rendered by operating systems.
- To provide a detailed discussion of the various memory management techniques.
- To discuss the various file-system design and implementation issues.
- To discuss how the protection domains, help to achieve security in a system.

## COURSE CONTENTS:

### UNIT I: OPEARTING SYSTEMS

Definition, Types, Functions, Abstract view of OS, System Structures, System Calls, Virtual Machines, Process Concepts, Threads, Multithreading. CPU Scheduling: Scheduling concepts, Scheduling Algorithms, Multiple Processor Scheduling, Real Time Scheduling. **8**

### UNIT II: PROCESS SCHEDULING

Process Co-ordination, Synchronization, Semaphores, Monitors Hardware, Deadlocks, Prevention, Avoidance, Detection and Recovery, Combined approach to deadlock handling, Precedence Graph. **8**

### UNIT III: MEMORY MANAGEMENT

Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Segmentation, non-Contiguous allocation, Page Placement and Replacement Policies. **8**

### UNIT IV: FILE SYSTEM

Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security**.** **8**

### UNIT V: NETWORKS, SECURITY AND DESIGN PRINCIPLES

Network operating system, distributed operating system, external security, operational security, password protection, access control, security kernels, hardware security, layered approach, design principle. **8**

## OPERATING SYSTEMS LAB

**List of Experiments:**

1. System calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
2. I/O system calls of UNIX OS (open, read, write, etc.).
3. CPU scheduling algorithms to find turnaround time and waiting time.
4. Simulating multi-level queue scheduling algorithm.
5. I/O system calls of UNIX operating system a) Process Creation b) Executing a command c) Sleep command d) Sleep command using getpid e) Signal handling using kill k) Wait command.
6. File allocation strategies. a) Sequential b) Indexed c) Linked.
7. MVT and MFT memory management techniques.
8. Contiguous memory allocation for Worst-fit, Best-fit, First-fit technique.
9. Different file organization techniques.
10. Bankers algorithm for the purpose of deadlock avoidance.
11. Different disk scheduling algorithms.
12. Different page replacement algorithms.
13. Producer-consumer problem using semaphores.

**Total Periods: 40 + 48= 88**

### COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Illustrate functions of Operating Systems, and Analyse and Compare performances for different CPU scheduling algorithms. | (K4) |
| CO2 | : | Analyse and Compare performances for different synchronization approaches and deadlock management techniques. | (K4) |
| CO3 | : | Analyse and Compare different memory management approaches for better data access. | (K4) |
| CO4 | : | Identify device management approaches, and Make use of various file-system designs and identify the implementation. | (K3) |
| CO5 | : | Identify the design issues of network and distributed operating systems, and various security threats and practises to cover them. | (K3) |
| CO6 | : | Design and develop basic Operating System functionalities. | (K6) |

### Text Books:


1. Tanenbaum, Andrew, "*Modern Operating Systems"*, 4th Edition, Pearson Publications 2014.
2. Galvin, Silberschatz and Gagne, "*Operating System Concepts"*, 10th Edition, John Wiley and Sons, 2018.

## Reference Book:

1. Stallings, William, "*Operating Systems –Internals and Design Principles",* 8th Edition, Pearson Publications, 2014.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 1 | 3 | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 1 | 3 | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 1 | 3 | 2 |
| **CO4** | 2 | 3 | 3 | - | 1 | - | - | - | - | - | - | 3 | 1 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | - | 1 | 2 | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO6** | 2 | 2 | 3 | 3 | 3 | 2 | - | 3 | - | - | - | 3 | 2 | 3 | 3 |
| **Score** | 12 | 16 | 17 | 12 | 8 | 4 | - | 12 | - | - | - | 18 | 9 | 18 | 13 |
| **COM** | 2 | 3 | 3 | 3 | 2 | 2 | - | 3 | - | - | - | 3 | 2 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITC404** |
| **Course Title** | **Database Management Systems** |
| **Number of Credits** | **3-1-4-6** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To learn data models, conceptualize and depict a database system using ER diagram.
- To understand the internal storage structures in a physical DB design.
- To know the fundamental concepts of transaction processing techniques.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION

Purpose of Database System, Views of data**,** Data models, Database management system, Three-schema architecture of DBMS, Components of DBMS. E/R Model, Conceptual data modeling, Entities, Entity types, Attributes, Relationships, Relationship types, E/R diagram notation, examples. **8**

### UNIT II: RELATIONAL MODEL

Relational Data Model, Concept of relations, Schema-instance distinction, keys, Referential integrity and Foreign keys, Relational algebra operators, SQL - Introduction, Data definition in SQL, Table, Key and foreign key definitions, Update behaviors, Querying in SQL, Notion of aggregation, Aggregation functions Group by and Having clauses, Embedded SQL. **8**

### UNIT III: DATABASE DESIGN

Dependencies and Normal forms, Dependency theory, Functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, Decompositions and Desirable properties of them, Algorithms for 3NF and BCNF normalization, 4NF, and 5NF. **8**

### UNIT IV: TRANSACTIONS:

Transaction processing and Error recovery, Concepts of transaction processing, ACID properties, Concurrency control, Locking based protocols for CC, Error recovery and logging, Undo, Redo, Undo-redo logging and Recovery methods. **8**

## UNIT V: IMPLEMENTATION TECHNIQUES

Data Storage and Indexes, File organizations, Primary, Secondary index structures, Various index structures, Hash-based, Dynamic hashing techniques, Multi-level indexes, B+ trees. **8**

## DATABASE MANAGEMENT SYSTEMS LAB

**List of Experiments:**

1. Introduction to SQL and installation of SQL server/oracle.
2. Data Definition Language (DDL) commands in RDBMS.
3. Data Manipulation Language (DML) and Data Control Language (DCL).
4. Data types and create a database and write the program to carry out the operations.
5. Create tables with required constraints.
6. Working with null values, matching the pattern from the table.
7. Aggregate functions: grouping the result of a query.
8. Set operators, Nested Queries, Joins and Sequences.
9. Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
10. Automatic Backup of Files and Recovery of Files.

**Total = 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of DBMS and build conceptual models of real-world problems. | (K3) |
| CO2 | : | Design database schema for real world problems and construct complex SQL queries. | (K6) |
| CO3 | : | Develop a database using normalization for real world applications. | (K6) |
| CO4 | : | Illustrate transaction processing, concurrency control and recovery techniques. | (K2) |
| CO5 | : | Analyse file structures and indexing techniques and select the suitable one for a given application. | (K5) |

## Text Books:


1. Silberschatz, A., Korth, Henry F., and Sudharshan, S., "*Database System Concepts",* 5th Edition, Tata McGraw Hill, 2016.
2. Elmasri, Ramez and Navathe, Shamkant B., "*Fundamentals of Database Systems",* 7th Edition, Pearson, 2015.


## Reference Book:


1. Date, C. J, Kannan, A. and Swamynathan, S., "*An Introduction to Database Systems,"* 8th edition, Pearson Education, 2012.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | 3 | - | - | - | 2 | - | - |
| **CO4** | 3 | - | - | - | - | - | - | - | - | 3 | - | - | 2 | - | - |
| **CO5** | 3 | 3 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 12 | 6 | 9 | 4 | - | - | - | 3 | 3 | - | - | 2 | - | - |
| **COM** | 3 | 3 | 3 | 3 | 2 | - | - | - | 3 | 3 | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **ITC405** |
| **Course Title** | **Design and Analysis of Algorithms** |
| **Number of Credits** | **3-1-0-4** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To design algorithms for a given problem.
- To write a simple and rigorous proof of the correctness of algorithms.
- To understand the asymptotic performance of algorithms.
- To apply important algorithmic design paradigms for solving real-world problems.
- To understand several complexity classes and implement algorithms.

## COURSE CONTENTS:

### UNIT I: ALGORITHM DESIGN PARADIGMS

Motivation, the concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Structure of divide-and-conquer algorithms: sets and disjoint sets, Union and Find algorithms, quick sort, Finding the maximum and minimum, Quick Sort, Merge sort, Heap, and heap sort. **8**

### UNIT II: GREEDY ALGORITHMS

Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm, Huffman codes. **8**

### UNIT III: DYNAMIC PROGRAMMING

Overview, the difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, 0/1 knapsack. **8**

### UNIT IV: BACKTRACKING

8-Queen Problem, Sum of subsets, graph coloring, Hamiltonian cycles. Branch and bound: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Traveling Salesman Problem. **8**

### UNIT V: COMPUTATIONAL COMPLEXITY

Complexity measures, Polynomial Vs non-polynomial time complexity; NP-hard and NP-complete classes, examples. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of algorithms and develop efficient algorithms for real-world problems. | (K5) |
| CO2 | : | Construct a greedy paradigm for a given problem. | (K3) |
| CO3 | : | Illustrate dynamic programming concepts. | (K2) |
| CO4 | : | Develop backtracking algorithms for real-world problems. | (K5) |
| CO5 | : | Compare complexity classes for a given problem and implement algorithms. | (K5) |

## Text Books:


1. E. Horowitz, S. Sahni and Rajasekaran, *"Fundamentals of Computer Algorithms",* Universities Press, 2008.
2. Cormen T. H., Leiserson C. E. and Rivest R. L. and Stein Clifford, *"Introduction to Algorithms"*, Third Edition, Prentice Hall of India, 2010.
3. Skiena Steven S., *"The Algorithm Design Manual",* 2nd edition, Springer, 2008.


## Reference Book:


1. A.V. Aho, J.E. Hopcroft and J.D. Ullman, *"The Design and Analysis of Computer Algorithms"*, Addison Wesley, 2009.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **CO2** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 3 | 1 | 2 | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | - | 3 |
| **Score** | 15 | 13 | 9 | 13 | 9 | - | - | - | - | - | - | - | 12 | - | 6 |
| **COM** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 2 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITL406** |
| **Course Title** | **Practicum-IV** |
| **Number of Credits** | **0-0-6-3** |
| **Course Type** | **PM** |

## COURSE OBJECTIVES:

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

It consists of a practical problem or a project based on combination of different labs studied till IV semester.

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Demonstrate a sound technical knowledge of the selected domain. | (K3) |
| CO2 | **:** | Survey research studies and demonstrate a solution of a complex engineering problem. | (K6) |
| CO3 | **:** | Experiment with state-of-the-art methods and analyze the available solutions. | (K4) |
| CO4 | **:** | Construct and implement the proposed solution utilizing the systematic approach. | (K6) |
| CO5 | **:** | Evaluate results using various performance metrics and compare it with the available solutions. | (K5) |

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 2 | - | - | - | - | 3 | 3 | 0 | 3 | - | - | 3 |
| **CO2** | 3 | 3 | 1 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | - | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 15 | 14 | 6 | 14 | 2 | 5 | 6 | 3 | 15 | 15 | 12 | 15 | 12 | 12 | 15 |
| **COM** | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

# FIFTH SEMESTER

| | |
|---|---|
| **Course Code** | **ENL531** |
| **Course Title** | **Professional Communication and Soft Skills** |
| **Number of Credits** | **0-0-4-2** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To develop awareness about different forms of professional communication and social behaviour.
- To hone the employability related communication skills of the students by empowering them with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

## COURSE CONTENTS:

**UNIT I: INTRODUCTION TO SOFT SKILLS AND PROFESSIONAL ETHICS**

Aspects of Soft Skills, Effective Communication Skills, Personality Development, Importance of Professional Ethics. **5**

**UNIT II: TEAM BUILDING**

Understanding nature of team, mapping personal and professional goals of team members, working effectively in a team through building relations and interpersonal communication. **5**

**UNIT III: ART OF NEGOTIATION**

What is negotiation, Ways of negotiating, Understanding the power of language and non-verbal communication. **5**

**UNIT IV: ORGANIZING MEETINGS**

How to call a meeting, How to organize a meeting, How to design the agenda and prepare minutes of the meeting. **5**

**UNIT V: PRESENTATION SKILLS**

Researching for a presentation, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation. **6**

**UNIT VI: STRESS MANAGEMENT AND TIME MANAGEMENT**

Kinds of stress, identifying the right reasons of stress, How to handle the pressure, Techniques to cope with the stressful situation at a workplace, Goal setting, understand the importance of time and how to prepare the time line. **5**

**UNIT VII: GROUP DISCUSSION AND PUBLIC SPEAKING**

Nature of discussion, Ways to form and present the arguments. Public speaking skills and being successful in it. **5**

**Total Periods: 36**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 **:** Develop awareness about personality development, social behaviour and professional ethics. (K3)

CO2 **:** Understand and recognise the importance of interpersonal skills and team dynamics, and strengthen individual expression in collaborative peer activities. (K2)

CO3 **:** Apply concepts of negotiation to a workplace situation and effectively plan a negotiation using appropriate verbal and nonverbal cues. (K3)

CO4 **:** Plan and execute Meetings, and draft minutes, reports and relevant documents (K3)

CO5 **:** Develop coherence, cohesion and competence essential for presentation deliveries. (K3)

CO6 **:** Become more effective through stress management, time management, goal/target setting and self-motivation. (K3)

CO7 **:** Develop critical thinking, clarity of expression and proactive participation in group discussion. (K3)

### Text Books:


1. Rizvi, M. A., *"Effective Technical Communication",* 2nd edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., *"Developing Communication Skills",* 2nd edition, Laxmi Publications, 2009.

**References Books:**


1. Dale, C., *"How to Win Friends and Influence People",* New York: Simon and Schuster,1998.
2. Coleman, D., *"Emotional Intelligence".* Bantam Book, 2006.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| **CO2** | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO7** | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| **Score** | - | - | - | - | - | - | - | 3 | 6 | 6 | - | - | - | - | 3 |
| **COM** | - | - | - | - | - | - | - | 3 | 3 | 3 | - | - | - | - | 3 |

| | |
|---|---|
| **Course Code** | **ITL502** |
| **Course Title** | **Computational Tools and Techniques** |
| **Number of Credits** | **0-0-4-2** |
| **Course Type** | **PC** |

## COURSE OBJECTIVES:

- To develop a practical approach to mathematical problem solving.
- To understand the usage of network simulations.
- To understand many commonly used tools and techniques.

## COURSE CONTENTS:

**UNIT I: NETWORK SIMULATION USING NS2 and NS3**

Study of Network simulation and analysis tool NS2.
Study of Network simulation and analysis tool NS3. **8**

**UNIT II: NETWORK SIMULATION USING OMNET++**

Study of Network simulation and analysis tool OMNET++. **8**

**UNIT III: DATA MINING**

Study of Data Mining with Python. **8**

**UNIT IV: MATLAB**

Study of Image Processing tool MATLAB. **8**

**UNIT V: SCILAB**

Study of Image Processing tool SCILAB. **8**

**Total Period: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Understand a broad range of methods and techniques for analysis and problem solving within relevant fields of study. | (K2) |
| CO2 | : | Apply theory to the development of methods and techniques for problem solving. | (K5) |
| CO3 | : | Understand data mining using PYTHON. | (K2) |
| CO4 | : | Implement image processing algorithms using MATLAB. | (K3) |
| CO5 | : | Implement image processing algorithms using SCILAB. | (K3) |

## Reference Books:


1. Witten Ian H. et. al, "*Data Mining: Practical Machine Learning Tools and Techniques*", Morgan Kaufmann, 4th Edition, 2017.
2. Gilat Amos, *"MATLAB: An Introduction with Applications*", 3rd Edition, John Wiley and Sons, 2008.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 3 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | - | - | - | - | - | 2 | - |
| **Score** | 15 | 15 | 15 | 10 | - | 2 | 3 | 3 | - | - | - | - | - | 4 | - |
| **COM** | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | - | - | - | - | - | 2 | - |

| | |
|---|---|
| **Course Code** | **ITL503** |
| **Course Title** | **Project Phase-I** |
| **Number of Credits** | **0-0-6-3** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

The project work is designed for a total duration of three semesters as a single project involving detailed literature survey, implementation and experimentation plan. At the end of the V semester the work done will be evaluated. It is expected that approx. 20-30% of the overall project work should have been completed and demonstrated in this semester. The remaining 70-80% has to be completed and demonstrated in VII and VIII semester as project phase-II and III as per the clause 10.3 of *Academic Rules and Regulations.*

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Demonstrate a sound technical knowledge of the selected project topic. | (K2) |
| CO2 | **:** | Survey research studies, find research gaps, and formulate a complex engineering problem. | (K6) |
| CO3 | **:** | Experiment with state-of-the-art methods and identify the available solutions. | (K4) |
| CO4 | **:** | Analyze and compare the available solutions. | (K4) |
| CO5 | **:** | Plan, propose and implement the proposed solution. | (K6) |

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 2 | 1 | 2 | 2 | - | 3 | 3 | - | 3 | - | - | 3 |
| **CO2** | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | - | 3 | 1 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 15 | 14 | 6 | 14 | 9 | 9 | 9 | 6 | 15 | 15 | 12 | 15 | 12 | 12 | 15 |
| **COM** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITO504** |
| **Course Title** | **Honors Online Course-I** |
| **Number of Credits** | **5-1-0-3** |
| **Course Type** | **OC** |

This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

| | |
|---|---|
| **Course Code** | **ITO504** |
| **Course Title** | **Optional Online Course-I** |
| **Number of Credits** | **5-1-0-(0-3)** |
| **Course Type** | **OC** |

This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students having SGPA<8.0 (Semester I to IV) are eligible for the Online Course. The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

## PROGRAM ELECTIVE-I

| | |
|---|---|
| **Course Code** | **ITPE11** |
| **Course Title** | **Compiler Design** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To introduce the major concepts of language translation and compiler design.
- To enrich the knowledge in designing and implementing compilers.
- To illustrate various parts of compiler and its use.
- To apply standard techniques to solve basic problems that arise in compiler construction.
- To implement the fundamental algorithms used in compiler construction.
- To provide practical programming skills, necessary for constructing a compiler.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO COMPILERS AND LEXICAL ANALYSIS

Introduction, Phases, Compiler construction tools, Simple one-pass compiler: overview, Syntax definition, Syntax direct translation, Parsing, a translator for simple expressions. Lexical analysis, Input buffering, Simplification and recognition of tokens, Finite automata and Regular expression, Implementing transition diagrams, Language for specifying lexical analyzers. **8**

### UNIT II: SYNTAX ANALYSIS

Role of the parser, Writing grammars, CFG, Top-down parsing-recursive descent parsing, Predictive parsing, Bottom-up parsing-shift reduce parsing, Operator precedent parsing, LR, SLR, Canonical LR and LALR parser, Syntax directed definition, Construction of syntax trees, Bottom-up evaluation of S- attributed definitions. **8**

### UNIT III: INTERMEDIATE CODE GENERATION

Intermediate languages, Declarations, Assignment statements, Boolean expressions, Case statements, Back patching, Procedure calls. **8**

### UNIT IV: CODE OPTIMIZATION AND RUN TIME ENVIRONMENT

Introduction, Principal sources of Optimization, Optimization of basic blocks, DAG representation, Global data flow analysis, Runtime environments, source language issues, Storage organization and Allocation

strategies, Access to non-local names, Parameter passing, Error detection and recovery. **8**

**UNIT V: CODE GENERATION**

Issues in the design of code generator, The target machine, Runtime storage management, Basic blocks and flow graphs, Next-use information, A simple code generator, Peephole optimization. **8**

**COMPILER DESIGN LAB**

**List of Experiments:**

1. Implementation of symbol table.
2. Implementation of Lexical analysis.
3. Conversion of infix notation to postfix notation.
4. Implementation of type checking.
5. Construction of DFA to simulate the given regular expression
6. Implementation of lexical analyzer.
7. Computation of FIRST AND FOLLOW set.
8. Construction of LL (1) parsing.
9. Construction of recursive descent parsing.
10. Implementation of Predictive Parsing Table.
11. Implementation of Shift Reduce Parsing.
12. Implementation of Operator Precedence Parsing.
13. Implementation of LR Parsing.
14. Implementation LALR parsing.
15. Construction of abstract syntax tree for the given mini language.
16. Construction of machine code.
17. Construction of DAG.
18. Implementation of Simple code optimization and generation procedure.

**Total Periods: 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 **:** Explain the principles and functions of compiler design. (K2)

CO2 **:** Apply Syntax Analysis techniques to comply with and transform input according to the grammar of the language. (K3)

CO3 : Construct machine alike codes by applying Intermediate Code generation techniques on syntax-directed transformed codes. (K3)

CO4 : Analyze different optimization techniques for code optimization. (K4)

CO5 : Design and Develop code generator and mini compiler for a language. (K6)

## Text Book:


1. Aho, Alfred V., Lam, Monica S., Sethi, Ravi and Ullman, Jeffrey D. "*Compilers Principles, Techniques and Tools*". Pearson Education Limited Boston, 2014.


## Reference Books:


1. Appel, Andrew W. and Palsberg, Jens. *"Modern compiler implementation in Java"* Cambridge University Press, 2nd Edition, 2002.
2. Louden, Kenneth C. "*Compiler Construction: Principles and Practice*". Course Technology, 1997.
3. Hollub, Allen I. "*Compiler Design in C*". Prentice-Hall Inc. New Jersey, 1990
4. Bennet, J.P. "*Introduction to Compiler Techniques*". Tata McGraw-Hill, 1990.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | - | 1 | - | - | - | - | - | - | - | 1 | 3 | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | - |
| **CO5** | 2 | 3 | 3 | 3 | 1 | - | - | - | 1 | 3 | - | 3 | 3 | 3 | 3 |
| **Score** | 10 | 15 | 15 | 12 | 5 | - | - | - | 1 | 3 | - | 12 | 13 | 15 | 9 |
| **COM** | 2 | 3 | 3 | 3 | 1 | - | - | - | 1 | 3 | - | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITPE12** |
| **Course Title** | **Computer Graphics** |
| **Number of Credits** | **3-0-4-5** |
| **Type of Course** | **PE** |

## COURSE OBJECTIVES:

- To understand the basics of various inputs and output computer graphics hardware devices.
- To know 2D raster graphics techniques, 3D Modelling, geometric transformations, 3D viewing and rendering.

## COURSE CONTENTS:

### UNIT I: BASICS OF COMPUTER GRAPHICS

Applications of computer graphics, Display devices, Random and Raster scan systems, working of CRT, Graphics interactive input devices. **8**

### UNIT II: GRAPHICS PRIMITIVES

Points, lines, Circles as primitives, Scan conversion algorithms for primitives, Fill area scan-line polygon filling, Inside-outside test, Boundary and flood-fill, character generation methods, Anti-aliasing. **8**

### UNIT III: 2D TRANSFORMATION AND VIEWING

Transformations, Matrix representation, Homogeneous coordinates, Composite transformations, Reflection and shearing, Viewing pipeline and coordinates system, Window-to-viewport transformation, Clipping including point clipping, Line clipping, polygon clipping, Text Clipping. **8**

### UNIT IV: 3D CONCEPTS AND OBJECT REPRESENTATION

3D display methods, polygon surfaces, Tables, Cubic spline interpolation methods, Bezier curves and surfaces, B-spline curves and surfaces. 3D transformation, Viewing pipeline and coordinates, Parallel and perspective projection. **8**

### UNIT V: ADVANCED TOPICS

Visible surface detection concepts, Back-face detection, Painter's Algorithm, depth buffer Algorithm, Area subdivision method, Illumination, light sources,

illumination methods, Color models: Properties of light, XYZ, RGB, YIQ and CMY color models. **8**

**Total Periods: 44**

## COMPUTER GARPHICS LAB

**List of Experiments:**

1. Digital Differential Analyzer Algorithm.
2. Bresenham's Line Drawing Algorithm.
3. Midpoint Circle Generation Algorithm.
4. Ellipse Generation Algorithm.
5. Creating various types of texts and fonts.
6. Creating two dimensional objects.
7. Two Dimensional Transformations.
8. Coloring the Pictures.
9. Three Dimensional Transformations.
10. Curve Generation.
11. Simple Animations using transformations.
12. Key Frame Animation.

### Text Books:


1. Rogers D. F. and Adams J. A., "*Mathematical elements for Computer Graphics*", McGraw-Hill International Education, Second Edition, 2017.
2. Hearn D., Baker M. P and Carithers Warren, *"Computer Graphics with OpenGL"*, Pearson Education, Fourth Edition, 2011.


### Reference Books:


1. Hill F. S. Jr. and Kelley Stephen M. "*Computer Graphics using OpenGL*", Pearson Education, Third Edition, 2006.
2. Foley J. D., Van Dam A., Feiner S. K. and Hughes J. F., *"Computer Graphics: Principles and Practice"*, Second Edition in C, Addison-Wesley, 2004.


### COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | |
|---|---|---|
| CO1 | Demonstrate understanding of the basics of Computer Graphics. | (K2) |
| CO2 | Develop understanding and underlying techniques and algorithms of Graphics Primitives, Display Methods and Visible surface detection concepts. | (K3) |
| CO3 | Develop understanding of frequency domain processing techniques. | (K3) |
| CO4 | Develop understanding of modelling techniques used to restore images. | (K3) |

CO5 Develop understanding of color image processing and compressing (K3) techniques.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | - |
| **CO2** | 2 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | 2 | - | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | 1 | - | - | 3 | - | - | - | - | - | - | - |
| **Score** | 10 | 12 | 13 | 12 | 11 | 8 | 2 | 3 | - | - | - | - | 6 | 4 | 4 |
| **COM** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 3 | 3 | 3 |

## PROGRAM ELECTIVE-II

| | |
|---|---|
| **Course Code** | **ITPE21** |
| **Course Title** | **Microprocessor and Interfacing** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To learn the fundamentals of Microprocessors.
- To study the architecture of 8085 Microprocessor.
- To learn assembly language programming and working of timing diagrams.
- To study various interrupts.
- To learn various data transfer techniques.
- To study the architecture of 8086 Microprocessor.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO MICROPROCESSOR

History and Evolution, Types of microprocessors, Block diagram of 8085, Pin Diagram of 8085, Addressing modes, Types of Instructions. **8**

### UNIT II: ASSEMBLY LANGUAGE PROGRAMMING AND TIMING DIAGRAM

Assembly language programming in 8085, Macros, Labels and Directives, Microprocessor timings, Instruction cycle, Machine cycles, T states, Timing diagram for different machine cycles. **8**

### UNIT III: SERIAL I/O AND INTERRUPTS

Serial I/O using SID and SOD, Interrupts in 8085, Issues in implementing interrupts, multiple interrupts and priorities, Daisy chaining, Interrupt handling, Enabling, disabling and masking of interrupts. **8**

### UNIT IV: DATA TRANSFER TECHNIQUES

Programmed data transfer, Parallel data transfer using 8155. Programmable parallel ports and handshake input/output, Programmable interrupt controller 8259A. DMA transfer, cycle stealing and burst mode of DMA, 8257 DMA controller. **8**

**UNIT V: MICROPROCESSOR INTERFACING TECHNIQUES INTERFACING MEMORY AND I/O DEVICES**

Addressing memory, Interfacing static RAMs, Interfacing and refreshing dynamic RAMs, interfacing a keyboard, interfacing a printer, Interfacing A/D converters, D/A converters. Architecture of 8086: Pin diagram of 8086, addressing modes, Comparison of 8086 and 8088, Minimum mode maximum mode, system timing, introduction to Pentium and further series of microprocessors **8**

## MICROPROCESSORS AND MICROCONTROLLERS LAB

**List of Experiments**

1. Introduction of microprocessor 8085 trainer kit – 85AD.
2. The addition of two 8-bit numbers.
3. The subtraction of two 8-bit numbers.
4. The addition with carry of two 8-bit numbers.
5. The subtraction with barrow of two 8-bit numbers.
6. The addition of two BCD numbers.
7. The subtraction of two BCD numbers.
8. The multiplication of two 8-bit numbers by repeated addition method.
9. The multiplication of two 8-bit numbers by bit Rotation method.
10. The division of two 8-bit numbers by repeated addition method.
11. The division of two 8-bit numbers by bit rotation method.
12. The square of given numbers in array.
13. To find largest number in an array.
14. Study of 8086 microprocessor kit.
15. The addition of two 16-bit numbers.

**Total Periods: 40 + 48= 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Describe the internal organization/architecture of 8085 microprocessor. | (K2) |
| CO2 | **:** | Apply programming techniques in developing the assembly language program for microprocessor applications. | (K3) |
| CO3 | **:** | Understand various types of interrupts and their working. | (K3) |
| CO4 | **:** | Examine different types of data transfer techniques. | (K4) |
| CO5 | **:** | Design and construct Microprocessor and Microcontroller based systems. | (K6) |

## Text Books:


1. Gaonkar, Ramesh S, "*Microprocessor architecture, Programming and applications with 8085"*, 6th Edition, Prentice Hall, 2018.
2. Brey, Barry B., "*The Intel Microprocessor, 8086/8088, 8018/80188, 80286, 80386, 80486, Pentium and Pentium pro-processors – architecture, Programming and interfacing"*, 8th Edition, Prentice Hall 2020.


## Reference Book:


1. Ufferbeck John, "*The 8080/85 Family: Design, Programming and Interfacing"*, PHI India, 2019.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 3 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | - | - | - | - | - | 2 | - |
| **Score** | 15 | 15 | 15 | 10 | - | 2 | 3 | 3 | - | - | - | - | - | 4 | - |
| COM | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | - | - | - | - | - | 2 | - |

| | |
|---|---|
| **Course Code** | **ITPE22** |
| **Course Title** | **Software Engineering** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To impart the knowledge of Software Engineering Practices and various Process Models such as waterfall and evolutionary models.
- To understand the software requirements and SRS document.
- To provide the skill of software project management.
- To learn to design software products using the appropriate design methodologies and UML such as function oriented design and object oriented design.
- To impart knowledge of software engineering approach to design and develop high quality software products.
- To learn to develop, test software products using the appropriate theory, principles, tools and processes.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION

Problem domain, Software engineering challenges, Software engineering approach, Software process, Characteristics of software process, Software development process models, Software Configuration management and other processes. **6**

### UNIT II: SOFTWARE REQUIREMENTS ANALYSIS AND SPECIFICATION

Software requirements, Problem analysis, Requirements specification, functional specification with use cases, Validation, Matrices. Software Architecture: Role of software architect, Architecture views, Component and connector view, Architecture style for C and C view, Discussion and Evaluating architectures. **8**

### UNIT III: PLANNING A SOFTWARE PROJECT

Effort estimation, Project scheduling and Staffing, Software configuration management plan, Quality assurance plan, Risk management, Project monitoring plan. **8**

### UNIT IV: DESIGN

Function oriented design: Design principles, Module level concepts, Design notation and specification, Structured design methodology, Verification,

metrics, Object oriented design OO concepts, Design concept, Unified Modelling Language, Design methodology, Metrics. Detailed Design, Software Measurements, metrics and Models Detailed design and PDL, verification, Metrics and their scope, Introduction to Agile Development and design. **8**

**UNIT V: QUALITY**

Qualities of a good Software metrics, Classification of metrics, Cost estimation models COCOMO, Quality attributes, SQA, Quality Standards, ISO 9000 and CMM. **5**

**UNIT VI: CODING AND TESTING**

Programming principles and guidelines, Coding process, Refactoring, verification, and metrics, Testing fundamentals, Black box testing, White box testing, Testing process, Defect analysis and prevention, Metrics - reliability estimation. CASE Tools Types of CASE tools, Advantages and Components of CASE tools. **5**

**SOFTWARE ENGINEERING LAB**

**List of Experiments:**

1. Prepare the following documents and develop the software project start up, prototype model, using software engineering methodology for at least two real time scenarios or for the sample experiments:
   - Problem Analysis and Project Planning: Thorough study of the problem, Identify Project scope, Objectives and Infrastructure.
   - Software Requirement Analysis: Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
   - Data Modelling: Use work products, data dictionary.
   - Software Designing: Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
   - Prototype model: Develop the prototype of the product.
     The SRS and prototype model should be submitted for end semester examination.

*List of Sample Experiments:*

1. **Course management system (CMS):** A course management system (CMS) is a collection of software tools providing an online environment for course interactions.

2. **Easy Leave:** This project is aimed at developing a web based Leave Management Tool, which is of importance to either an organization or a college.
3. **E-Bidding:** Auctions are among the latest economic institutions in place. In this project, explore the efficiency of common auctions when values are interdependent.
4. **Electronic Cash counter:** This project is mainly developed for the Account Division of a Banking sector to provide better interface of the entire banking transactions.

**Total Periods: 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the Software Engineering Approach and various Process Models. | (K2) |
| CO2 | : | Analyse and identify user requirements in SRS. | (K4) |
| CO3 | : | Apply software project planning and management skills to develop software products. | (K3) |
| CO4 | : | Use UML and show designing of software products. | (K3) |
| CO5 | : | Apply different Quality Standards and testing techniques to design and develop high quality software products. | (K3) |
| CO6 | | Plan, Design, develop prototype and test small software products using software engineering principles, tools and process models. | (K6) |

## Text Books:


1. Jalote P., "*Software Project Management in practice"*, Pearson Education, New Delhi, 2002.
2. Mall R., "*Fundamentals of Software Engineering*", 3rd Edition, PHI Publication, 2009.
3. Pressman R. S., "*Software Engineering: A Practitioners Approach",* 7th edition, McGraw Hill, 2010.


## Reference Book:


1. Sommerville I., "*Software Engineering*", 9th Edition, Addison-Wesley, 2011.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | 3 | - | - | - | - | - | 3 | 3 | - | - | - | - | - |
| **CO3** | 3 | - | - | - | - | - | - | - | 3 | - | 3 | - | - | - | - |
| **CO4** | 3 | 2 | 2 | - | - | - | - | - | 3 | 2 | - | - | 1 | - | - |
| **CO5** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO6** | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 3 | - | - |
| **Score** | 18 | 13 | 14 | 3 | - | - | - | - | 12 | 8 | 6 | - | 4 | - | - |
| COM | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 | - | 2 | - | - |

# SIXTH SEMESTER

| | |
|---|---|
| **Course Code** | **ITL601** |
| **Course Title** | **Internship** |
| **Number of Credits** | **0-0-40-0** |
| **Course Type** | **GIR** |

The curriculum has support for Industrial/Academic/R&D training for a minimum period of 5 months from December to May in any of the reputed industries/institutions. The students may identify the industry/institute suitable for them, considering their career choice. However, the institute may also offer its services. The evaluation will be as per the Clause 10.2 of *Academic Rules and Regulations.*

| | |
|---|---|
| **Course Code** | **ITO602** |
| **Course Title** | **Honors Online Course-II** |
| **Number of Credits** | **5-1-0-3** |
| **Course Type** | **OC** |

This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in V Semester are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

| | |
|---|---|
| **Course Code** | **ITO602** |
| **Course Title** | **Optional Online Course-II** |
| **Number of Credits** | **5-1-0-(0-3)** |
| **Course Type** | **OC** |

This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

# SEVENTH SEMESTER

| | |
|---|---|
| **Course Code** | **HMC701** |
| **Course Title** | **Professional Ethics** |
| **Number of Credits** | **1-0-0-0** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVE:

- To enable the students to create on awareness on Engineering Ethics and Human Values, to instil Moral and Social Values and loyalty and to appreciate the rights of others

## COURSE CONTENTS:

### UNIT I: HUMAN VALUES

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management. **3**

### UNIT II: ENGINEERING ETHICS

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry – Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories. **3**

### UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law. **2**

### UNIT IV: SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Importance of Plagiarism, Discrimination. **4**

**UNIT V: GLOBAL ISSUES:**

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility. **3**

**Total Periods: 15**

## COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1 **:** Distinguish between ethical and non-ethical situations. (K4)

CO2 **:** Practice moral judgment effectively handling the conditions of dilemma. (K3)

CO3 **:** Develop cognitive skills in solving social problems and apply the code of ethics to social experimentation. (K3)

CO4 **:** Apply risk and safety measures in various engineering fields. (K3)

CO5 **:** Explain corporate social responsibility and understand the concern for ethical contribution for the global society. (K2)

## Text Books:


1. Govindarajan M., Natarajan S., Senthilkumar V.S., "*Engineering Ethics",* Prentice Hall of India, 2013.
2. Martin Mike W., Schinzinger Roland, "*Ethics in engineering*", 4th Edition, Tata Mc Graw Hill, 2005.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| **Score** | - | - | - | - | - | 2 | 2 | 9 | - | - | - | - | - | - | 3 |
| COM | - | - | - | - | - | 2 | 2 | 3 | - | - | - | - | - | - | 3 |

| | |
|---|---|
| **Course Code** | **ITL702** |
| **Course Title** | **Project Phase-II** |
| **Number of Credits** | **0-0-12-6** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

This Project work is in continuation of the work done in V semester. The project work is designed for a total duration of three semesters as a single project involving detailed literature survey, implementation and experimentation plan.
At the end of the VII semester the work done will be evaluated. It is expected that approx. 70-80% of the overall project work should have been completed and demonstrated. The remaining work has to be completed and demonstrated VIII semester as project phase-III as per the clause 10.3 of *Academic rules and regulations*.

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Illustrate a sound technical knowledge of the selected project domain. | (K2) |
| CO2 | : | Survey research studies, find research gaps, and formulate a complex engineering problem. | (K6) |
| CO3 | : | Experiment with state-of-the-art methods and identify the available solutions. | (K4) |
| CO4 | : | Demonstrate and compare the available solutions. | (K4) |
| CO5 | : | Construct and implement the proposed solution. | (K6) |

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 2 | 1 | 2 | 2 | - | 3 | 3 | - | 3 | - | - | 3 |
| **CO2** | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | - | 3 | 1 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 15 | 14 | 6 | 14 | 9 | 9 | 9 | 6 | 15 | 15 | 12 | 15 | 12 | 12 | 15 |
| COM | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITO703** |
| **Course Title** | **Honors Online Course-III** |
| **Number of Credits** | **5-1-0-3** |
| **Course Type** | **OC** |

This course is optional for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in V and VI Semesters are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

| | |
|---|---|
| **Course Code** | **ITO703** |
| **Course Title** | **Optional Online Course-III** |
| **Number of Credits** | **5-1-0-(0-3)** |
| **Course Type** | **OC** |

This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

## PROGRAM ELECTIVE-III

| | |
|---|---|
| **Course Code** | **ITPE31** |
| **Course Title** | **Advanced Operating Systems** |
| **Number of Credits** | **3-0-4-5** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To introduce the advanced concepts of operating systems.
- To study a broad range of behaviours arising from complex system design, including: resource sharing and scheduling, low-level operating systems, separation of mutually distrusting parties on a common platform, network-protocol design and implementation.
- To develop the perspective for modern day computing applications.
- To enrich the knowledge in distributed systems.

## COURSE CONTENTS:

### UNIT I: OVERVIEW OF ADVANCED OPERATING SYTEMS

Introduction, Functions of OS, Design approaches, Types of advances OS. **8**

### UNIT II: ARCHITECTURE OF DISTRIBUTED OS

Introduction, Motivations, System Architecture Types, Distributed OS, and Issues in distributed OS, Communication Networks and Primitives. **8**

### UNIT III: INTERPROCCESS COMMUNICATION

APIs for Internet Protocols, External Data Representations, Client-Server Communication, Group Communication, Distributed Objects. **8**

### UNIT IV: DISTRIBUTED FILE SYSTEMS

Introduction, Architecture, Design Issues, Case Studies: Sun Network File System, Andrew File System. Time and Global State: Physical and Logical Time, Internal and External Synchronization protocols like Cristian's Algorithm, Berkeley Algorithm, Network Time Protocol, Lamport's Logical Clocks, Vector Clocks, Casual Ordering of Message, Global State, Cuts of a Distributed Computation, Termination Detection. **8**

## UNIT V: DISTRIBUTED MUTUTAL EXCLUSION AND ELECTION

Simple and Multicast based Mutual Exclusion Algorithms: Centralized, Ring based, Ricart Agrawala's Algorithm, Maekawa's Algorithm, Election Algorithms: Ring based, Bully's Algorithm, Multicast Communication. **8**

## ADVANCED OPERATING SYSTEMS LAB

**List of Experiments:**

1. Managing users.
2. Managing systems.
3. File managements.
4. Shell Scripting: syntax and execution.
5. Creating new process.
6. Counting maximum number of processes, a system can handle at a time.
7. Handling system calls; inter process communication through pipes and message passing, Zombie process, orphan process.
8. Handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.
9. Study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).
10. Multiple sleeping barber problem.
11. Semaphores in multiprocessor operating systems.
12. Multithreading in multiprocessor operating systems.

**Total Periods: 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain functions, design approaches and advancements in Operating Systems. | (K2) |
| CO2 | : | Illustrate the motivations, architectures and issues in Distributed Operating Systems. | (K2) |
| CO3 | : | Construct External Data Representations and Inter-process Communication in Distributed Systems. | (K3) |
| CO4 | : | Analyze design issues and performances of different Distributed File Systems and Timing approaches for Distributed Synchronization. | (K4) |
| CO5 | : | Design and Develop a Distributed Computing facility and analyze various Distributed Mutual Exclusion approaches. | (K6) |

## Text Books:

1. G. Coulouris, J. Dollimore, and T. Kindberg, "*Distributed Systems: Concepts and Design*", 2nd Edition, Pearson Education, 2010.
2. Signal M. and Shivaratri N., "*Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems"*, McGraw Hill International Edition, 1993.

## Reference Book:

**1.** Sinha R.K., "*Distributed Operating Systems*", Prentice Hall, 2012.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 1 | 1 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 1 | 1 | - | - | - | - | - | - | 3 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 2 | - | 3 | - | - | - | 3 | 2 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 3 | 2 | 2 |
| **CO5** | 3 | 2 | 3 | 3 | 3 | 2 | - | 3 | - | - | - | 3 | 3 | 3 | 3 |
| **Score** | 15 | 12 | 15 | 9 | 7 | 4 | - | 9 | - | - | - | 12 | 12 | 11 | 11 |
| COM | 3 | 3 | 3 | 2 | 2 | 2 | - | 3 | - | - | - | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITPE32** |
| **Course Title** | **Digital Image Processing** |
| **Number of Credits** | **3-0-4-5** |
| **Type of Course** | **PE** |

## COURSE OBJECTIVES:

- To learn the basics of image processing.
- To get familiarized with various routinely used digital image processing tools and techniques.
- To understand the role of image processing applications in our daily life.
- To comprehend and adapt the digital image processing techniques for application in different devices.
- To learn the frameworks and additional tools for development of digital image processing applications aiming at improving human life.

## COURSE CONTENTS:

**UNIT I: INTRODUCTION**

What is DIP? Fundamental: Digital Image Representation, Reading, Displaying and Writing images, Data Classes, Image Types, Converting between data classes and image types, array indexing, Some important standard arrays. **8**

**UNIT II: IMAGE TRANSFORMATIONS AND SPATIAL FILTERING**

Intensity Transformation functions, Histogram processing and function plotting, Spatial filtering, Image processing toolbox, Standard spatial filters. **8**

**UNIT III: FREQUENCY DOMAIN PROCESSING**

The 2D discrete Fourier transform, Filtering in the frequency domain, obtaining frequency domain filters form spatial filters, generating filters directly in the frequency domain, Sharpening frequency domain filters. **8**

**UNIT IV: IMAGE RESTORATION**

A model of the image degradation/ Restoration process, Noise models, Restoration in the presence of noise only, Periodic noise reduction by frequency domain filtering, Modeling the degradation function, Direct Inverse Filtering, Wiener Filtering, **8**

## UNIT V: COLOR IMAGE PROCESSING AND IMAGE COMPRESSION

Color Image representation, converting to other color spaces, the basic of color image processing, Color transformations, Spatial Filtering of color images, working directly in RGB Vector Space. Image Compression: Coding redundancy, Inter pixel redundancy, Psycho-visual redundancy, JPEG Compression **8**

### DIGITAL IMAGE PROCESSING LAB

**List of Experiments:**

1. Developing, creating and display of Gray Scale Images.
2. Implementing the Histogram Equalization.
3. Implementing design techniques of Non-linear Filtering.
4. Determination of Edge detection using Operators.
5. Implementing 2-D DFT and DCT.
6. Implementing techniques of Filtering in frequency domain.
7. Developing, creating and display of colour images.
8. Implementing Conversion between colour spaces.
9. Implementing DWT of images.
10. Implementing Segmentation using watershed transform.

**Total Periods: 40 + 48 = 88**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Demonstrate understanding of the fundamentals of digital image processing. | (K2) |
| CO2 | **:** | Develop understanding and underlying techniques of Image transformations and filtering. | (K3) |
| CO3 | **:** | Develop understanding of frequency domain processing techniques. | (K3) |
| CO4 | **:** | Develop understanding of modelling techniques used to restore images. | (K3) |
| CO5 | **:** | Develop understanding of color image processing and compressing techniques. | (K3) |

## Text Book:

1. Gonzalez Rafael C., Woods Richard E. and Eddins Steven L., "*Digital Image Processing using MATLAB*", Gatesmark Publishing, 2nd Edition, 2009.

## Reference Book:

1. Tinku A. and Ray Ajoy K., "*Image Processing Principles and Applications*", John Wiley and Sons Publishers, 2005.

## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 2 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| **CO4** | - | - | 2 | - | 1 | 2 | 2 | - | - | - | - | - | 2 | - | 2 |
| **CO5** | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| **Score** | 6 | 4 | 5 | 1 | 4 | 4 | 4 | 2 | - | - | - | - | 2 | - | 4 |
| **COM** | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 2 |

## PROGRAM ELECTIVE-IV

| | |
|---|---|
| **Course Code** | **ITPE41** |
| **Course Title** | **Distributed Database Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To enrich the previous knowledge of database systems and exposing the need for distributed database technology to confront with the deficiencies of the centralized database systems.
- To introduce basic principles and implementation techniques of distributed database systems.
- To equip students with principles and knowledge of parallel and object-oriented databases.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION

Introduction, Distributed Data Processing, Distributed Database System, Promises of DDBS, Problem areas. Distributed DBMS Architecture: Architectural Models for Distributed DBMS, DDMBS Architecture. Distributed Database Design: Alternative Design Strategies, Distribution Design issues, Fragmentation, Allocation. **8**

### UNIT II: QUERY PROCESSING AND DECOMPOSITION

Query processing objectives, Characterization of query processors, Layers of query processing, Query decomposition, Localization of distributed data. Distributed query Optimization: Query optimization, Centralized query optimization, Distributed query optimization algorithms. **8**

### UNIT III: TRANSACTION MANAGEMENT

Definition, properties of transaction, Types of transactions, Distributed concurrency control: Serializability, Concurrency control mechanisms and algorithms, Time stamped and Optimistic concurrency control Algorithms, Deadlock Management. **8**

### UNIT IV: DISTRIBUTED DBMS RELIABILITY

Reliability concepts and measures, Fault-tolerance in distributed systems, Failures in Distributed DBMS, Local and Distributed reliability protocols,

Site failures and Network partitioning. Parallel Database Systems: Parallel database system architectures, Parallel data placement, Parallel query processing, Load balancing, Database clusters. **8**

**UNIT V: DISTRIBUTED OBJECT DATABASE MANAGEMENT SYSTEMS**

Fundamental object concepts and models, Object distributed design, Architectural issues, Object management, Distributed object storage, Object query Processing. Object Oriented Data Model: Inheritance, Object identity, Persistent programming languages, Persistence of objects, Comparison OODBMS and ORDBMS. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Understand distributed database systems architecture and design. | (K2) |
| CO2 | : | Apply methods and techniques for distributed query processing and optimisation. | (K3) |
| CO3 | : | Understand the broad concepts of distributed transaction process. | (K2) |
| CO4 | : | Design and implement parallel database systems with evaluating different methods of storing, managing of parallel database. | (K3) |
| CO5 | : | Understand the design aspects of object-oriented database system and related development. | (K2) |

## Text Books:


1. M. Tamer OZSU and Patuck Valduriez:, *"Principles of Distributed Database Systems"*, Pearson Edn. Asia, 2001.
2. Ceri Stefano and Pelagatti Giuseppe: "*Distributed Databases*," McGraw Hill. 2017.
3. Silberschatz, Korth, and Sudarshan, "*Database system Concepts"*, 4th edition", Tata-Mc-Graw Hill, 2011.


## Reference Book:


1. Hector Garcia-Molina, Ullman Jeffrey D., Widom Jennifer: *"Database Systems: The Complete Book"*, 2nd Edition, Pearson International Edition.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 3 | - | - |
| **CO4** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| **CO5** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 3 | - |
| **Score** | 15 | 10 | 4 | 2 | - | - | - | - | - | - | - | - | 9 | 6 | - |
| **COM** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 3 | - |

| | |
|---|---|
| **Course Code** | **ITPE42** |
| **Course Title** | **Graph Theory** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **PE** |

## COURSE OBJECTIVES:

- To impart the basic concepts of graph theory.
- To understand the applications of graphs in computer science.
- To understand concepts about graph coloring and graph covering.
- To be familiar with basic graph algorithms.
- To learn and implement various graph algorithms.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION

Graphs, Isomorphism, Walks, Paths, Circuits, Trees, Properties of Trees, Cotrees and Fundamental Circuits, Cut Sets, Fundamental Cut Sets and Cut Vertices, Planar and Dual Graphs, Metric Representation of Graphs. **8**

### UNIT II: COLORING, COVERING AND PARTITIONING OF A GRAPH

Chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem. **8**

### UNIT III: DIRECTED GRAPHS

Types of directed graphs, Directed paths, and connectedness, Euler digraphs, trees with directed edges, fundamental circuits in digraph, matrices A, B and C of digraphs adjacency matrix of a digraph, enumeration, types of enumeration, counting of labeled and unlabeled trees, polya's theorem, graph enumeration with polya's theorem. **8**

### UNIT IV: GRAPH ALGORITHMS

Elementary Graph Algorithms, Representations of graphs, Kruskal's and Prim's algorithm for minimum spanning trees, Single-Source Shortest Paths: The Bellman-Ford algorithm, Single source shortest paths in directed acyclic graphs, Difference constraints and shortest paths, All-Pairs Shortest Paths: Shortest paths and matrix multiplication, Johnson's algorithm for sparse graphs, and A general framework for solving path problems in directed graphs. **8**

**UNIT V: MAXIMUM FLOW**

Flow networks, The Ford-Fulkerson method, Maximum bipartite matching, Preflow-push algorithms, The lift-to-front algorithm. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of graph theory. | (K2) |
| CO2 | : | Build and learn techniques related to graph coloring and covering. | (K3) |
| CO3 | : | Illustrate the uses of directed graphs. | (K3) |
| CO4 | : | Compare algorithms for graphs. | (K4) |
| CO5 | : | Compare the basic algorithmic techniques and choose a suitable for a given problem. | (K5) |

## Text Books:


1. Deo N., *"Graph Theory with Applications to Engineering and Computer Science",* Prentice Hall of India, 2004.
2. Cormen T. H., Leiserson C. E. and Rivest R. L. and Stein Clifford, *"Introduction to Algorithms",* 3rd Edition, Prentice Hall of India, 2010.


## Reference Book:


1. West D. B., *"Introduction to Graph Theory",* Prentice Hall of India, Second Edition, 2002.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | - | - | - | - | - | - | - | 3 | - | - | 3 | - | 3 |
| **CO2** | 3 | 2 | - | 3 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | 3 | - | - | - | - | 3 | - | - | - | - | - | - |
| **CO5** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 13 | 11 | - | 9 | 3 | - | - | - | 3 | 3 | - | - | 6 | - | 6 |
| **COM** | 3 | 3 | - | 3 | 3 | - | - | - | 3 | 3 | - | - | 3 | - | 3 |

# EIGHTH SEMESTER

| | |
|---|---|
| **Course Code** | **ITL801** |
| **Course Title** | **Project Phase-III** |
| **Number of Credits** | **0-0-18-9** |
| **Course Type** | **GIR** |

## COURSE OBJECTIVES:

- To explore project domain and state objectives clearly and concisely
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To solve real world problems using state-of-the-art techniques.

This Project work is in continuation of the work done in V and VII semesters. The project work is designed for a total duration of three semesters as a single project involving detailed literature survey, implementation and experimentation plan.
It is expected that the complete Project should be demonstrated at the end of VIII semester.

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Demonstrate a sound technical knowledge of the selected project domain. | (K2) |
| CO2 | : | Survey research studies, find research gaps, and formulate a complex engineering problem. | (K6) |
| CO3 | : | Experiment with state-of-the-art methods and analyze the available solutions. | (K4) |
| CO4 | : | Construct and implement the proposed solution utilizing the systematic approach. | (K4) |
| CO5 | : | Evaluate results using various performance metrics and compare it with the available solutions. | (K6) |

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 2 | 1 | 2 | 2 | - | 3 | 3 | - | 3 | - | - | 3 |
| **CO2** | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | - | 3 | 1 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 2 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 15 | 14 | 6 | 14 | 9 | 9 | 9 | 6 | 15 | 15 | 15 | 15 | 12 | 12 | 15 |
| **COM** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITO802** |
| **Course Title** | **Honors Online Course-IV** |
| **Number of Credits** | **5-1-0-3** |
| **Course Type** | **OC** |

This course is for students who opt for B.Tech. (Honors). The students having SGPA≥8.0 (Semester I to IV) and SGPA≥8.5 in V, VI and VII Semesters are eligible for the Honors Course. The students can also choose online courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

| | |
|---|---|
| **Course Code** | **ITO802** |
| **Course Title** | **Optional Online Course-IV** |
| **Number of Credits** | **5-1-0-(0-3)** |
| **Course Type** | **OC** |

This course is optional for students who are not eligible to opt for B.Tech. (Honors). The students can choose online courses from NPTEL/SWAYAM/MOOCs/etc. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

# STREAM ELECTIVE –I
# **APPLICATIONS**
(Offered by IT Department)

| | |
|---|---|
| **Course Code** | **ITSE11** |
| **Course Title** | **Mobile Applications Development** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of android development.
- To get familiarized with various routinely used mobile application development tools and techniques.
- To know the development and utility of android applications in our daily life.
- To comprehend and adapt the android environment for mobile application development.
- To learn the frameworks and additional tools for development of applications aiming at improved user experience.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO ANDROID

Native Android Application, SDK Features, Introduction to Open Handset Alliance, Development Framework, Application Fundamentals, Device Compatibility, System permissions. **8**

### UNIT II: USER INTERFACE AND APPLICATION COMPONENTS

Basic UI Design, Fragments, Widget Toolbox, Creating New View, Introduction to Intents, Intent Filters and broadcast Receivers, Activities, Services, Content Providers, Application Widgets, Processes and Threads. **8**

### UNIT III: FILES AND DATABASE HANDLING

Saving Application Data; Shared Preferences; Preference Framework and Activity, Static File as Resource, File System, Introduction to SQLite Database, Querying SQLite, Storage options, Data backup. **8**

### UNIT IV: USER EXPERIENCE ENHANCEMENT

Action Bar, Menus and Action Bar Items, Settings, Dialogs, Customizing Toast, Notifications, Search, Drag and Drop. **8**

**UNIT V: MULTIMEDIA, WIRELESS CONNECTIVITY AND TELEPHONY**

Audio and Video Handling; Manipulating Raw Audio, Sound Effects, Camera Programming, Video Recording, Managing Wireless Connectivity: WiFi, Bluetooth, Near Field Communication, Hardware Support for Telephony, Telephony Management, SMS and MMS. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 **:** Demonstrate understanding of the fundamentals of android environment. (K2)

CO2 **:** Develop user interface with proposed tools for best user experience. (K3)

CO3 **:** Develop a database capable of efficient storage and access to data. (K3)

CO4 **:** Applying development techniques for best user interface and experience in the android application. (K3)

CO5 **:** Applying suitable connectivity controls to the android application. (K3)

## Text Books:


1. Reto M. and Ian L., *"Professional Android",4th* Edition, Wrox, 2018.
2. Matt G., *"Phone Gap Mobile Application Development Cookbook"*, PACKT, 2012.


## Reference Book:


1. Kosmaczewski Adrian, *"Mobile JavaScript Application Development"*, 1st Edition, O'RELLY, 2012.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 2 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| **CO4** | - | - | 2 | - | 1 | 2 | 2 | - | - | - | - | - | 2 | - | 2 |
| **CO5** | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| **Score** | 6 | 4 | 5 | 1 | 4 | 4 | 4 | 2 | - | - | - | - | 2 | - | 4 |
| **COM** | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 2 |

| | |
|---|---|
| **Course Code** | **ITSE12** |
| **Course Title** | **Cloud Computing** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the fundamentals of cloud computing
- To study different cloud computing technologies.
- To learn the functionality of cloud storage and standards.
- To study various case studies.
- To design efficient and reliable cloud environment.

## COURSE CONTENTS:

### UNIT I: CLOUD COMPUTING BASICS

Cloud Computing overview, Applications, Internets and the Cloud, First moves in the Cloud, Benefits, Limitations and Security Concerns in the Cloud. **8**

### UNIT II: CLOUD COMPUTING TECHNOLOGY

Hardware and Infrastructure: Clients, Security, Network, Services. Accessing the Cloud: Platforms, Web Applications, Web APIs, Web Browsers. **8**

### UNIT III: CLOUD STORAGE AND STANDARDS

Cloud Storage Overview, Cloud Storage Providers. Standards: Application, Client, Infrastructure, Service. **8**

### UNIT IV: CLOUD COMPUTING AT WORK

Software as a Service: Overview, Driving Forces, Company Offerings, Industries. Developing Applications: Google, Microsoft, Intuit Quick Base, Cast Iron Cloud, Bungee Connect, Development. **8**

### UNIT V: ORGANIZATIONS AND CLOUD COMPUTING

Cloud Computing with the Titans: Google, EMC, NetApp, Microsoft, Amazon, IBM, Partnerships, The Business case for going to the Cloud. **8**

**Total Periods : 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | |
|---|---|---|
| CO1 | Explain the fundamentals of Cloud Computing. | (K3) |
| CO2 | Examine the functionality of different cloud technologies. | (K4) |
| CO3 | Analyse the role and functioning of various cloud storage platforms. | (K5) |
| CO4 | Analyse the working of cloud environment. | (K5) |
| CO5 | Examine the working of different cloud services. | (K4) |
| CO6 | Deploy Cloud network. | (K6) |

## Text Books:


1. Sosinsky Barrie, "*Cloud Computing: Bible*", Wiley Publication, First Edition 2018.
2. Velte Anthony T., Velte Toby J. and Elsenpeter Robert, "*Cloud Computing: A Practical Approach*", McGraw Hill, First Edition, 2018.


## Reference Book:


**1.** Rajkumar B., James B. and Goscinski A., "*Cloud Computing: Principles and Paradigms*", Wiley Publication, First Edition 2011.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | 3 | 3 | 3 | 3 |
| **CO2** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | 3 | - | 3 | - | 2 | 2 |
| **CO3** | 2 | 2 | 3 | 3 | 1 | - | - | - | - | 3 | - | 3 | 3 | 2 | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 | - | 2 | 2 |
| **CO5** | 2 | 3 | 3 | 1 | - | - | - | - | - | 3 | - | 3 | - | 2 | 2 |
| **CO6** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 12 | 17 | 17 | 16 | 12 | 6 | 4 | 4 | 2 | 18 | 9 | 18 | 9 | 14 | 14 |
| **COM** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITSE13** |
| **Course Title** | **Internet of Things** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of internet of things and its architecture.
- To understand the architecture and networking in internet of things.
- To study the various IoT communication protocols.
- To gain insights about the fog and cloud computing in IoT framework.
- To study the real-life applications of IoT.

## COURSE CONTENTS:

### UNIT I: IoT INTRODUCTION AND FUNDAMENTALS

Basics of networking (types of networks, layered models, addressing, TCP/IP transport layer). Introduction to the architecture of wireless sensor networks, Machine-to-Machine (M2M) communication and cyber physical systems. Introduction to IoT and its comparison with M2M, WSN and CPS. IoT networking components. Addressing strategies in IoT. **8**

### UNIT II: IoT ARCHITECTURE AND NETWORKING

Introduction to IoT Sensors and their characteristics, Sensing types and their considerations. Introduction to IoT Actuators, their types and characteristics, IoT processing topologies, their types and its importance, Data formatting, Processing topologies, IoT device design and selection considerations, Processing offloading. IoT connectivity technologies. **8**

### UNIT III: IoT COMMUNICATION TECHNOLOGIES

Introduction to nodes. Constrained nodes and network; and the type of devices. Low power and lossy networks, Infrastructure protocols. Discovery protocols. Data protocols. Identification protocols, Device management protocols, Sematic protocols, IoT interoperability standards and frameworks. **8**

### UNIT IV: CLOUD AND FOG COMPUTING IN IoT

Introduction to cloud computing, Virtualization. Cloud Models, SLA in cloud computing, Cloud implementation, Sensor – cloud, Introduction to fog computing and its architecture, Fog computing in IoT, Application of fog computing in IoT. **8**

### UNIT V: IoT APPLICATIONS AND DATA ANALYTICS

IoT applications in agriculture, vehicular networks and healthcare. IoT analytics. Uses of machine learning in IoT. Advantages and challenges of ML in IoT, ML algorithms for IoT applications. Performance metrices for evaluating ML algorithms. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Associate and classify the architecture of various communication systems. | (K2) |
| CO2 | **:** | Elaborate the IoT infrastructure and data processing methodologies. | (K2) |
| CO3 | : | Interpret the various networking protocols used in IoT. | (K2) |
| CO4 | : | Acquire the concepts of fog and cloud computing in IoT | (K3) |
| CO5 | : | Illustrate the various real-life applications of IoT. | (K3) |

## Text Books:


1. Misra, Sudip, Mukherjee A., and Roy Arijit, "*Introduction to IoT*", Cambridge University Press, 2021.
2. Serpanos, Dimitrios, and Marilyn Wolf, "*Internet-of-things (IoT) systems: architectures, algorithms, methodologies"*, Springer, 2017.


## Reference Books:


1. Xiao, Perry, "*Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed"*. John Wiley and Sons, 2018.
2. Hersent, Olivier, Boswarthick D., and Elloumi O., "*The internet of things: Key applications and protocols*" John Wiley and Sons, 2011.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **CO2** | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **CO4** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| **Score** | 10 | 14 | 14 | - | - | - | - | - | - | - | - | - | 6 | 13 | 13 |
| **COM** | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **ITSE14** |
| **Course Title** | **Big Data Analytics** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To know the fundamental concepts of Big Data and Analytics.
- To explore tools and practices for working with Big Data and stream computing.
- To understand the Big Data use cases.
- To apply analytics on structured and unstructured data with R.
- To provide comprehensive knowledge on developing and applying Machine Learning algorithms for massive real-world datasets in distributed frameworks.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO BIG DATA

Evolution of big data, best practices for big data analytics, big data characteristics; Validating, Promotion of the value of big data, big data use cases. Characteristics of big data applications, Perception and quantification of value, Big Data Tools and Techniques: Understanding big data storage, General overview of high-performance architecture, HDFS, Map Reduce and YARN, Map Reduce programming model, Review of basic data analytic methods using R. **8**

### UNIT II: REGRESSION AND CLASSIFICATION

Advanced analytical theory and methods, Regression: Linear regression, Logistic regression; Classification: Decision trees, Overview of a decision tree, Decision tree algorithms, Evaluating a decision tree, Decision trees in R, Naïve Bayes, Bayes ‘theorem, Naïve Bayes classifier in R. **8**

### UNIT III: DATA STREAM ANALYSIS

Introduction to streams concepts: Stream data model and architecture, Stream computing, Sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, Decaying window, Real Time Analytics Platform (RTAP) applications, Case studies: Real time sentiment analysis, Stock market predictions. **8**

**UNIT IV: FREQUENT ITEMSET AND CLUSTERING**

Mining frequent itemset: Market based model, Apriori algorithm, handling large data sets in main memory, Limited Pass algorithm, counting frequent itemset in a stream, Clustering techniques: Hierarchical, k-Means, Clustering high dimensional data. **8**

**UNIT V: NOSQL DATA MANAGEMENT FOR BIG DATA**

NoSQL databases: Schema-less models, increasing flexibility for data manipulation, Key value stores, Document stores, Tabular stores, Object data stores, Graph databases; Hive; Sharding, HBase, Case Study: Analyzing big data with twitter, big data for E-Commerce Big data for blogs. **8**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the concept and significance of Big Data and its analysis. | (K2) |
| CO2 | : | Analyze regression and classification algorithms for Big Data analytics. | (K4) |
| CO3 | : | Apply the process of stream computing for data stream analysis. | (K3) |
| CO4 | : | Analyze different mining algorithms and clustering techniques for Big Data Analytics. | (K4) |
| CO5 | : | Design and develop big data-based analytics for real-word ubiquitous computing scenarios. | (K6) |

### Text Books:


1. Loshin D., "*Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph*", Morgan Kaufmann/Elsevier Publishers, 2013.
2. Anand R., Ullman Jeffrey David, "*Mining of Massive Datasets*", Cambridge University Press, 2012.


### Reference Books:


1. EMC Education Services, "*Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*", Wiley Publishers, 2015.
2. Baesens Bart, "*Analytics in a Big Data World: The Essential Guide to Data Science and its Applications*", Wiley Publishers, 2015.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 1 | 1 | - | - | 3 | - | - | - | - | 1 | 3 | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 3 | 3 | 2 |
| **Score** | 10 | 13 | 15 | 13 | 5 | - | - | 6 | - | - | - | 12 | 13 | 15 | 10 |
| **COM** | 2 | 3 | 3 | 3 | 1 | - | - | 3 | - | - | - | 3 | 3 | 3 | 2 |

| | |
|---|---|
| **Course Code** | **ITSE15** |
| **Course Title** | **Computer Vision** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of computer vision.
- To get familiarized with various routinely used computer vision tools and techniques.
- To understand the role of computer vision applications in our daily life.
- To comprehend and adapt the computer vision techniques for application in different devices.
- To learn the frameworks and additional tools for development of computer vision applications aiming at improved user experience.

## COURSE CONTENTS:

### UNIT I: CAMERA GEOMETRY

Transformations in 2D, Transformations in 3D, Composition of transformations in 2D and 3D, homogeneous coordinates in 2D and 3D. Pinhole camera, need for pinhole, geometry of perspective projection through pinhole camera. Camera calibration. **8**

### UNIT II: IMAGE ALIGNMENT

Motion models and degrees of freedom; non-parametric image alignment, Control point based image alignment using least squares, SIFT algorithm, Forward and reverse image warping bilinear and nearest neighbor interpolation, Image alignment using image similarity measures: mean squared error, normalized cross-correlation, Monomodal and multimodal image alignment. **8**

### UNIT III: ROBUST METHODS IN COMPUTER VISION

Least squares problems, Outliers in computer vision, Laplacian Distribution, the importance of heavy tailed distributions in robust statistics, mean versus median: L2 fit versus L1 fit, Least median of squares algorithm (LMedS), RanSaC (Random Sample Consensus) algorithm. **8**

**UNIT IV: STRUCTURE FROM MOTION**

Motion as a cue to inference of 3D structure from images**,** Motion factorization algorithm by Tomasi and Kanade, SVD: concept of SVD as a weighted summation of rank-one matrices. **8**

**UNIT V: OPTICAL FLOW**

Dealing with the aperture problem: regularization. Horn and Shunck method: algorithm using discrete formulation, steps of Jacobi's method for matrix inversion, and comments about limitations, Lucas-Kanade algorithm for optical flow, Applications of optical flow. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Demonstrate understanding of the fundamentals of camera geometry. | (K2) |
| CO2 | **:** | Develop understanding and underlying techniques of Image alignment. | (K3) |
| CO3 | **:** | Develop understanding of application of robust statistical techniques. | (K3) |
| CO4 | **:** | Develop understanding of techniques used to recover structure and motion from image sequences. | (K3) |
| CO5 | **:** | Develop understanding of optical flow techniques used for describing image motion. | (K3) |

## Text Books:


1. Forsyth and Ponce, "*Computer Vision: A Modern Approach"*, 2nd Edition, Pearson Education, 2015.
2. Richard S., *"Computer Vision: Algorithms and Applications",* Springer, 2011.


## Reference Book:


1. Emanuele T. and Alessandro V, "*Introductory Techniques for 3D Computer Vision*", Prentice Hall, 1998.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | - |
| **CO2** | 2 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | 2 | - | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 2 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | 1 | - | - | 3 | - | - | - | - | - | - | - |
| **Score** | 10 | 12 | 13 | 12 | 11 | 8 | 2 | 3 | - | - | - | - | 6 | 4 | 4 |
| **COM** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 2 | 2 | 2 |

# STREAM ELECTIVE –II

## ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(Offered by CSE Department)

| | |
|---|---|
| **Course Code** | **CSSE11** |
| **Course Title** | **Machine Learning** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To introduce the basic building blocks and general principles of machine learning techniques.
- To impart adequate knowledge about modelling and performance evaluation of machine learning algorithms.
- To understand the concepts of supervised, unsupervised, and reinforcement learning methods.
- To construct programs in Python to solve machine learning algorithms.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO MACHINE LEARNING

Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning. **8**

### UNIT II: MODELING

Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostics, learning curves, Accuracy and Error measures. **8**

### UNIT III: DECISION TREE AND LEARNING RULES

Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifiers. **8**

### UNIT IV: UNSUPERVISED LEARNING TECHNIQUES

Clustering Algorithms- Introduction, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners. **8**

## UNIT V: REINFORCEMENT LEARNING

Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of the machine learning and experiment with the standard machine learning models. | (K3) |
| CO2 | : | Test and evaluate the performance of supervised machine learning models using various performance metrics. | (K5) |
| CO3 | : | Experiment with decision trees and learning rules and analyse the performance of algorithms. | (K4) |
| CO4 | : | Identify the real-world problems and apply classification and clustering models on the datasets. | (K3) |
| CO5 | : | Illustrate reinforcement learning and solve problems using reinforcement learning algorithm. | (K3) |

## Text Books:


1. Tom, Mitchell, "*Machine Learning*", McGraw-Hill, 2017.
2. Shai, Shalev-Shwartz, Shai, Ben-David, *"Understanding Machine Learning from Theory to Algorithms*", Cambridge University Press, 2014.


## Reference Books:


1. Ethem, Alpaydin, "*Introduction to Machine Learning*", PHI, 2005.
2. Bishop, Christopher, "*Pattern Recognition and Machine Learning*", Springer, 2006.
3. Duda, R.O., Hart, P.E. and Stork, D.G., "*Pattern Classification*", 2nd Edition, Wiley-Interscience, November, 2000.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | - | - | - | 3 | - | - | - | - | - | - | - | 3 | - | - |
| **CO3** | 3 | - | 3 | 3 | - | - | - | - | - | 2 | - | 3 | - | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| **Score** | 15 | 4 | 3 | 3 | 6 | - | - | - | - | 2 | - | 6 | 3 | - | - |
| **COM** | 3 | 2 | 3 | 3 | 3 | - | - | - | - | 2 | - | 3 | 3 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE12** |
| **Course Title** | **Deep Learning** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of an artificial neuron.
- To learn the fundamentals of neural networks and their training process.
- To optimize the training of neural networks and recurrent neural networks.
- To learn architecture and training of convolutional neural networks and various generative models.
- To learn the architecture of generative models.

## COURSE CONTENTS:

### UNIT I: BASICS

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. **8**

### UNIT II: FEEDFORWARD NETWORKS

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training. **8**

### UNIT III: BETTER TRAINING OF NEURAL NETWORKS

Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization). Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs. **8**

### UNIT IV: CONVOLUTIONAL NEURAL NETWORKS

Introduction to CNNs, Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines. **8**

## UNIT V: RECENT TRENDS AND APPLICATIONS

Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning. Applications: Vision, NLP, Speech, Recent trends and Applications. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the basics of an artificial neuron, its origin, and the motivation behind AI. | (K2) |
| CO2 | : | Able to create a basic feedforward neural network, given a dataset. | (K3) |
| CO3 | : | Able to create, train and optimize a neural network, a recurrent neural network, and its variants. | (K6) |
| CO4 | : | Able to create, train and optimize a convolution neural network on different image processing tasks. | (K6) |
| CO5 | : | Construct new examples of input data using generative models. | (K6) |

## Text Book:

1. Goodfellow, Ian, Bengio, Yoshua and Courville, Aaron, "*Deep Learning*", MIT Press, 2017.

## Reference Book:

1. Bishop, Christopher, "*Pattern Recognition and Machine Learning*", Springer, 2006.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | 12 | - | - | - | - | - | - | - | - | 8 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE13** |
| **Course Title** | **Artificial Intelligence** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of Artificial Intelligence.
- To be able to mathematically represent knowledge.
- To learn the methods of solving problems in Artificial Intelligence.
- To learn various game playing and planning techniques.
- To learn the semantic analysis and its application in NLP.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO AI

Control strategies, Search strategies, Production system characteristics, Specialized production system, Problem solving methods, Problem graphs, Matching, Indexing, and Heuristic functions, Hill Climbing, Depth-first and Breadth-first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms. **8**

### UNIT II: KNOWLEDGE REPRESENTATION

Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other Logic-Structured representation of knowledge. **8**

### UNIT III: REASONING

Production-based system, Frame-based system. Inference, Backward chaining, forward chaining, Rule value approach, Fuzzy reasoning, Certainty factors, Bayesian Theory, Bayesian Network, Dempster-Shafer theory. **8**

### UNIT IV: GAME PLAYING AND PLANNING

Overview, MinMax search procedure, Alpha-beta cut-offs, Iterative Deepening, Components of planning system, goal stack planning, non-linear planning, hierarchal planning and other planning techniques, reactive system security. **8**

**UNIT V: UNDERSTANDING AND NLP**

Introduction to Understanding, Understanding as constraint satisfaction, Introduction to NLP, Syntactic and Semantic analysis, Statistical NLP, and Spell Checking **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Explain the basic concepts of artificial intelligence. (K2)

CO2 : Represent the knowledge using predicate calculus. (K2)

CO3 : Ability to identify problems that are amenably solved by AI methods. (K3)

CO4 : Apply various game-playing techniques in artificial intelligence. (K3)

CO5 : Ability to utilize semantic information in NLP applications. (K3)

## Text Book:

1. Night, Kevin and Rich, Elaine, Nair B., *"Artificial Intelligence (SIE), 3rd Edition*", McGraw Hill, 2017.

## Reference Book:

1. Kheemani, Deepak," *A First Course in Artificial Intelligence",* 1st Edition, McGraw Hill Education, 2017.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 8 | - | - | - | - | - | - | - | - | - | - | 8 | - | - |
| **COM** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE14** |
| **Course Title** | **Soft Computing** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To understand the concepts of feed forward and feedback networks.
- To impart adequate knowledge about Fuzzy Logic Controllers and Neural Networks.
- To understand the general principles of evolutionary computing algorithms.
- To understand the concepts of fuzzy classification and clustering techniques.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO SOFT COMPUTING

Soft computing vs. hard computing, applications of soft Computing, Various types of Soft Computing techniques, Neuron Nerve structure and Synapse, Neural network architecture, single layer and multilayer feed forward networks, McCulloch Pitts neuron model, perceptron model, MLP, back propagation learning methods, effect of learning rule coefficient. **8**

### UNIT II: EVOLUTIONARY COMPUTATION

Historical Development of EC, genetic Algorithms-Genetic programming-Evolutionary Strategies, Evolutionary programming, features of Evolutionary computation, Advantages and Applications of Evolutionary Computation, Basic concept of Genetic algorithm, Conventional Optimization and Search Techniques, Comparison of Genetic Algorithm with Other Optimization Techniques, Advantages, Applications and Limitations of Genetic Algorithm **8**

### UNIT III: TERMINOLOGIES AND OPERATORS OF GA

Introduction to basic Terms: Encoding, Breeding, Search Termination, Diploidy, Dominance and Abeyance, Classification of Genetic Algorithm, Simple Genetic Algorithm (SGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Parallel and Distributed Genetic Algorithm (PGA and DGA), Adaptive Genetic Algorithm (AGA), Fast Messy Genetic Algorithm (FmGA), Independent Sampling Genetic Algorithm (ISGA). **8**

### UNIT IV: INTRODUCTION TO FUZZY LOGIC

Utility, Limitations, Different faces of imprecision, inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Classical Sets and Fuzzy Sets, Classical

Relations and Fuzzy Relations, Properties of Membership Functions, Fuzzification, and Defuzzification. **8**

### UNIT V: AUTOMATED METHODS FOR FUZZY SYSTEMS

Batch Least square and recursive Least Square Algorithms, Clustering methods, Fuzzy system Simulation, fuzzy relational equations, Fuzzy associative memories. Fuzzy Classification and pattern recognition, Cluster analysis and validity, c-Means clustering, single sample Identification, Multi-feature pattern recognition and Image processing. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Experiment with various soft computing techniques and analyse the performance of neural network model using various evaluation metrics. | (K4) |
| CO2 | : | Explain evolutionary computation and apply it for solving optimization problems. | (K3) |
| CO3 | : | Experiment with genetic algorithm and apply genetic operators in various applications. | (K3) |
| CO4 | : | Explain fuzzy systems and contrast fuzzification and defuzzification techniques. | (K2) |
| CO5 | : | Classify and compare automated methods for fuzzy systems. | (K2) |

## Text Books:


1. Deepa, S.N. and Sivanandam, S.N., "*Principles of Soft Computing*, 2 nd Edition", Wiley India, 2011.
2. Tom, Mitchell, "*Machine Learning*", McGraw-Hill, 2017.
3. Zimmermann H. J. "*Fuzzy set theory and its Applications*" Springer international edition, 2011.


## Reference Books:


1. Timothy, J. Ross, "*Fuzzy Logic with Engineering Applications*, 3 rd Edition", Wiley India, 2010.
2. Shai, Shalev-Shwartz, Shai, Ben-David, "*Understanding Machine Learning from Theory to Algorithms*", Cambridge University Press, 2014.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | - | - | 3 | - | - | - | - | - | - | 3 | - | - | - |
| **CO2** | 2 | 2 | - | - | 3 | - | - | - | - | - | - | 3 | - | - | - |
| **CO3** | 2 | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| **CO4** | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Score** | 10 | 4 | - | - | 6 | - | - | - | - | - | - | 9 | - | - | - |
| **COM** | 2 | 2 | - | - | 3 | - | - | - | - | - | - | 3 | - | - | - |

| | |
|---|---|
| **Course Code** | **CSSE15** |
| **Course Title** | **NLP with Deep Learning** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn various representations of words.
- To learn to generate text using neural networks.
- To perform machine translation using recurrent neural networks.
- To learn the basics of attention mechanism.
- To learn the advanced model architectures for natural language processing.

## COURSE CONTENTS:

### UNIT I: VECTOR SEMANTICS AND EMBEDDINGS

Human language and word meanings, Words and vectors, Word2vec, Word2vec objective function, Skip-grams, Continuous bag-of-words, Word vectors similarity, Evaluating word vectors, Visualizing Embeddings, Data pre-processing and sentiment analysis with NLTK. **8**

### UNIT II: NEURAL LANGUAGE MODELS

Revisiting the basics of neural networks, gradient descent, backpropagation, N-gram language models, Feedforward neural language modeling, Training Neural Nets, An RNN language model, Training an RNN language model, Evaluating language models: Perplexity. **8**

### UNIT III: MACHINE TRANSLATION

Early Machine Translation (MT), Statistical MT, Neural Machine Translation (NMT), Sequence-to-Sequence (Seq2Seq) model architecture, Training an NMT system, Evaluating MT system: BLEU score. **8**

### UNIT IV: CNNs AND ATTENTION

From RNNs to CNNs: 1D convolution for text, Single layer CNNs for text classification. Purely character-level models, Sub-word models: Byte-Pair Encoding. Bottleneck problem in Seq2Seq architecture, Attention, Seq2Seq with attention. **8**

## UNIT V: PRE-TRAINING AND TRANSFORMERS

Pre-trained word embeddings, Encoder-Decoder architecture, Query, Key, and value, calculation of self-attention, Multi-head attention, Transformers for various NLP tasks, Transfer learning. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Construct word embeddings and make use of NLTK for various data pre-processing tasks. | (K3) |
| CO2 | : | Construct a simple neural network for language modeling task. | (K3) |
| CO3 | : | Build a machine translation system using sequence-to-sequence model architecture. | (K6) |
| CO4 | : | Construct neural network models with attention mechanism. | (K3) |
| CO5 | : | Make use of advanced deep neural architectures on various NLP tasks. | (K3) |

## Text Book:

1. Jurafsky, Daniel and Martin, James H., "*Speech and Language Processing*", 3rd Edition Draft, Pearson Education, 2022.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | 12 | - | - | - | - | - | - | - | - | 8 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

# STREAM ELECTIVE –III

## DATABASE AND NETWORKING

(Offered by CSE Department)

| | |
|---|---|
| **Course Code** | **CSSE21** |
| **Course Title** | **Relational Database Management Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To describe the basics of SQL and construct queries using SQL.
- To emphasize the importance of normalization in databases.
- To familiarize issues of concurrency control and transaction management.
- To understand different types of databases and recovery techniques.
- To discuss emerging database technologies and database applications.

## COURSE CONTENTS:

### UNIT I: QUERY PROCESSING AND OPTIMIZATION

Basic Algorithms for executing Query Operations, Using Heuristics in Optimization. Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System Concepts Desirable Properties of transaction, Schedules and recoverability, Serializability of schedules. **8**

### UNIT II: CONCURRENCY CONTROL TECHNIQUES

Locking Techniques for concurrency control Techniques Based on Time Stamp Ordering, Multiversion concurrency control Techniques, Validation Concurrency Control Techniques. Recovery techniques: Recovery Concepts, Recovery Techniques Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, and Recovery in Multi database Transaction. **8**

### UNIT III: DATABASE SECURITY AND AUTHORIZATION

Introduction to Database Security Issues, Discretionary Access Control Based on Privileges, Mandatory Access Control for Multilevel Security, Statistical Database Security. Advanced Data Modelling Concepts: Enhanced ER (ERR)-to-Relational Mapping, Data Abstraction and Knowledge Representation Concepts, Integrity Constraints in data modelling, EER Update Operations and Transaction Specification. **8**

### UNIT IV: OBJECT-ORIENTED DATABASES

Overview of Object-Oriented concepts, Object Identity, Object Structure and Type Constructor. Encapsulations of Operations, Methods and Persistence,

Type and Class Hierarchies and Inheritance, Complex Objects, Other O O concepts. **8**

**UNIT V: DEDUCTIVE DATABASES**

Introduction to Deductive Databases, Prolog/Data log Notation, Interpretation of Rules, Basic interference Mechanism for Logic Programs and their evaluation. The LDL System, Other Deductive Database Systems, Emerging Database Technologies and applications- Progression of Database Technology, Emerging Database Applications, Next Generation of Databases and Database Management Systems, Interfaces with other Technologies. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Learn and apply Structured query language (SQL) for database definition and database manipulation. | (K3) |
| CO2 | : | Explain various transaction processing, concurrency control mechanisms and database protection mechanisms. | (K2) |
| CO3 | : | Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. | (K2) |
| CO4 | : | Explain the concepts of object oriented databases. | (K2) |
| CO5 | : | Discuss deductive database and identify different types of Deductive Database Systems and next generation databases. | (K3) |

## Text Books:


1. Elmasri, Ramez, Navathe and Shamkant B, "*Fundamentals of Database Systems*" The Benjamin/Cummings Publishing company Narosa, Special Edition, 2016.
2. Dabir, Himanshu and Meher, Dipali, "*Advanced RDBMS Using Oracle"*, 2nd edition, *Vision Publications*; 2014.
3. Silberschatz A., Henry. Korth F., Sudarshan S., "*Data base System Concepts*", 6th edition, McGraw Hill Education (India) Private Limited l, 2011.

## Reference Book:

1. Ceri S. and Palagatti, G, *"Distributed Database: Principles and System*", McGraw Hill, 2017.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | 1 | - | 3 | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | 5 | - | 3 | - | - | - | - | - | - | - | 10 | - | - |
| **COM** | 3 | 2 | 1 | - | 3 | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE22** |
| **Course Title** | **Advanced Database Management Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type :** | **SE** |

## COURSE OBJECTIVES:

- To understand the different issues related to RDBMS.
- To familiarize with the distributed databases.
- To familiarize with the object-oriented databases.
- To understand the emerging database systems and the current issues.

## COURSE CONTENTS:

### UNIT I: RELATIONAL MODEL ISSUES

ER Model, Normalization, Query Processing, Query Optimization, Transaction Processing, Concurrency Control, Recovery, Database Tuning. **8**

### UNIT II: DISTRIBUTED DATABASES

Parallel Databases, Inter and Intra Query Parallelism, Distributed Database Features, Distributed Database Architecture, Fragmentation, Distributed Query Processing, Distributed Transactions Processing, Concurrency Control, Recovery, Commit Protocols. **8**

### UNIT III: OBJECT ORIENTED DATABASES

Introduction to Object Oriented Data Bases, Approaches Modelling and Design, Persistence, Query Languages, Transaction, Concurrency, Multi Version Locks, Recovery, POSTGRES, JASMINE, GEMSTONE, ODMG Model. **8**

### UNIT IV: EMERGING SYSTEMS

Enhanced Data Models, Client/Server Model, Data Warehousing and Data Mining, Web Databases, Mobile Databases, XML and Web Databases, MongoDB, No SQL. **8**

**UNIT V: CURRENT ISSUES**

Rules, Knowledge Bases, Active and Deductive Databases, Multimedia Databases Multimedia Data Structures, Multimedia Query languages, Spatial Databases. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Identify issues in the relational models. | (K3) |
| CO2 | : | Explain the basics of distributed database. | (K2) |
| CO3 | : | Explain the fundamentals of object-oriented database. | (K2) |
| CO4 | : | Analyze the emerging database systems. | (K4) |
| CO5 | : | Identify the issues in different database systems. | (K3) |

## Text Books:


1. Connolly, Thomas and Begg, Carlolyn, "*Database Systems: A Practical Approach to Design, Implementation, and Management*", 5th Edition, Addison-Wesley, 2014.


## Reference Books:


1. Elmasri, R. and Navathe, S. B. "*Fundamentals of Database Systems*", 5th Edition, Pearson/ Addison Wesley, 2017.
2. Silberschatz, Abraham, Korth, Henry F., and Sudharshan, S., "*Database System Concepts*", 6th Edition, Tata McGraw Hill, 2017.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | 12 | - | - | - | - | - | - | - | - | 8 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE23** |
| **Course Title** | **Database Security** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of database security.
- To learn the security models and security mechanism.
- To learn the secure software design.
- To understand the database protection.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION AND SECURITY MODELS

Introduction to Databases, Security Problems in Databases Security, Controls Conclusions, Security Models, Introduction, Access Matrix Model, Take-Grant Model, Acten Model, PN Model, Hartson and Hsiao's Model, Fernandez's Model Bussolati and Martella's Model for Distributed databases. **8**

### UNIT II: SECURITY MODELS AND MECHANISMS

Security Models - Bell and LaPadula's Model, Biba's Model, Dion's Model, Sea View Model, Jajodia and Sandhu's Model, The Lattice Model for the Flow Control conclusion, Security Mechanisms, Introduction User Identification/Authentication, Memory Protection, Resource Protection, Control Flow Mechanisms, Isolation Security, Functionalities in Some Operating Systems, Trusted Computer System Evaluation Criteria. **8**

### UNIT III: SECURITY SOFTWARE DESIGN

Security Software Design, Introduction, A Methodological Approach to Security, Software Design, Secure Operating System Design, Secure DBMS Design, Security Packages, Database Security Design. **8**

### UNIT IV: STATISTICAL DATABASE PROTECTION AND INTRUSION DETECTION SYSTEM

Introduction, Statistics Concepts and Definitions, Types of Attacks, Inference Controls, Evaluation Criteria for Control Comparison, Introduction IDES System RETISS System ASES System Discovery. **8**

## UNIT V: MODELS FOR PROTECTION OF NEW GENERATION DATABASE SYSTEM

Models for The Protection of New Generation Database Systems, Introduction, A Model for the Protection of Frame Based Systems, a Model for the Protection of Object Oriented Systems, SORION, Model for the Protection of Object-Oriented Databases, Models For The Protection Of New Generation Database Systems, A Model for the Protection of New Generation Database Systems: the Orion Model, Jajodia and Kogan's Model, A Model for the Protection of Active Databases Conclusions. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the basics of database security and understand the basics of security models. | (K3) |
| CO2 | : | Able to understand the database security models and mechanism. | (K3) |
| CO3 | : | Identify security threats in database systems. | (K3) |
| CO4 | : | Analyse and Evaluate the different attacks on statistical databases. | (K4) |
| CO5 | : | Test and evaluate secure database systems. | (K5) |

## Text Books:


1. Hassan A. Afyouni, "*Database Security and Auditing*", India Edition, CENGAGE Learning, 2009.
2. Castano et. al ,"*Database Security*", 2nd edition, Pearson Education, 1995.


## Reference Book:


1. Basta A., Zgola M., *"Database Security"*, Delomar Cengage learning, July, 2011.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO3** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO4** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO5** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| **Score** | 15 | 10 | - | 12 | - | - | - | - | - | - | - | - | 8 | - | - |
| **COM** | 3 | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |

| | |
|---|---|
| **Course Code** | **CSSE24** |
| **Course Title** | **Mobile Computing and Communication** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To learn the fundamentals of Wireless Networks
- To study different protocols.
- To learn the functionality of Wireless LAN.
- To study the working of mobile network layer.

## COURSE CONTENTS:

### UNIT I: WIRELESS TRANSMISSION

Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems, Frequency Management and Channel Assignment- types of hand-off and their characteristics. **8**

### UNIT II: MEDIUM ACCESS CONTROL

MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM, Architecture, Location tracking and call setup, Mobility Management Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000. **8**

### UNIT III: WIRELESS LAN

Infrared Vs Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture and protocols. **8**

### UNIT IV: MOBILE NETWORK LAYER

Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/ Fast recovery, Transmission / Time-out freezing, Selective retransmission, Transaction Oriented TCP. **8**

**UNIT V: MOBILITY**

WAP Model- Mobile Location based services, WAP Gateway, WAP protocols, WAP user agent profile, caching model, wireless bearers for WAP, WML, WML Scripts, WTA, iMode, SyncML **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of Wireless Transmission. | (K3) |
| CO2 | : | Examine the functionality of medium access control and global system for mobile communication. | (K3) |
| CO3 | : | Analyse the role of various wireless local area networks and architectures. | (K3) |
| CO4 | : | Analyse different architectures and protocols of wireless networks. | (K4) |
| CO5 | : | Examine the different Wireless application protocols. | (K5) |
| CO6 | : | Simulate real time data transmission over wireless network. | (K6) |

## Text Book:

1. Jochen, Schiller, "*Mobile Communication",* 2nd Edition, Pearson Education, 2018.

## Reference Books:

1. Theodore and Rappaport S., "*Wireless Communications, Principles, Practice*", PHI, 2015.
2. Tanenbaum Andrew S. and Wetherall S.J., "*Computer Networks*", Pearson Education, 5th edition, 2013.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | - | 3 | 3 | 3 | 3 |
| **CO2** | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | 3 | - | 3 | - | 2 | 2 |
| **CO3** | 2 | 2 | 3 | 3 | 1 | - | - | - | - | 3 | - | 3 | 3 | 2 | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 | - | 2 | 2 |
| **CO5** | 2 | 3 | 3 | 1 | - | - | - | - | - | 3 | - | 3 | - | 2 | 3 |
| **CO6** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Score** | 10 | 17 | 17 | 16 | 12 | 6 | 4 | 4 | 2 | 15 | 3 | 15 | 9 | 14 | 15 |
| **COM** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |

| | |
|---|---|
| **Course Code** | **CSSE25** |
| **Course Title** | **Wireless Sensor Networks** |
| **Number of Credits** | **3-0-0-3** |
| **Course Type** | **SE** |

## COURSE OBJECTIVES:

- To understand the fundamentals of Wireless Sensor Networks (WSN) technology and its relevance in the Scientific and Industrial context.
- To understand the basics of Wireless Communication, Sensor Operations and Management.
- To discuss the relevance, challenges, and open research issues in localization.
- To understand the core routing issues and algorithms in WSN.
- To understand the QoS challenges and current solutions for the same in WSN.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION AND FUNDAMENTALS

Introduction to sensor networks, Applications of WSNs, Difference between mobile ad-hoc networks and WSNs, Architecture of a WSN node, Hardware components, Energy consumption of WSN nodes, Operating systems and execution environments, Sensor network scenarios, Optimization goals in WSNs, Design principles of WSNs, Service interfaces and gateways in WSNs. **8**

### UNIT II: WSN COMMUNICATION PROTOCOLS

Physical layer, Wireless channel and communication fundamentals, Physical layer and trans-receiver design in WSNs, Fundamentals of wireless MAC protocols, Low duty cycle protocols, Contention based protocols, Schedule based protocol, IEEE 802.15.4 MAC protocol, Link layer protocols, Error control, framing and link management in WSNs. **8**

### UNIT III: LOCALIZATION AND POSITIONING OF WSN NODES

Fundamentals of naming and addressing of senor nodes, Assignment of MAC addresses, Distributed addressing, Content based and geographical addressing, Time synchronization of WSN nodes, Sync. Protocols for sender/receiver and receiver/receiver, Localization and positing procedures, Basics of lateration, Single-hop localization, Positing in multi-hop environments. Impacts of anchor placement. **8**

### UNIT IV: TOPOLOGY CONTROL AND ROUTING PROTOCOLS

Basics of topology control, Power control in flat networks, Hierarchical networks by dominating sets and clustering, Adaptive node activity, Routing in WSN nodes.

Gossiping and agent based unicast forwarding, Energy efficient unicast. Broadcasting and multicasting in WSN nodes, Geographical routing. Mobile nodes. **8**

**UNIT V: NETWORKING AND QOS IN WSN**

Datacentric and content-based networking, Data centric routing, Data aggregation and data centric storage, Transport layer in WSN, Coverage and deployment of WSN nodes, Reliability requirements in WSNs, Single packet and block delivery, Congestion and rate control in WSN. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the architecture of Wireless Sensor Networks. | (K2) |
| CO2 | : | Describe the various WSN communication protocols. | (K2) |
| CO3 | : | Experiment with the concepts of localization and positioning of WSN nodes. | (K3) |
| CO4 | : | Analyse the various routing and topology control algorithms in WSN. | (K4) |
| CO5 | : | Explain the QoS principles followed in WSN. | (K2) |

## Text Books:


1. Karl, Holger, and Willig A., "*Protocols and architectures for wireless sensor networks*", John Wiley and Sons, 2007.
2. Ibnkahla, Mohamed, "*Wireless sensor networks: a cognitive perspective*", CRC Press, 2012.


## Reference Books:


1. Dargie, Waltenegus, and Poellabauer C., "*Fundamentals of Wireless Sensor Networks: theory and practice",* John Wiley and Sons, 2010.
2. Rastko, R., Phoha Selmic, and Vir V. Serwadda, "*Wireless Sensor Networks: Security, Coverage, and Localization*", Springer, 2018.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 10 | 12 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 15 | 3 | 10 |
| **COM** | 3 | 2 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

# STREAM ELECTIVE –IV

# SECURITY

(Offered by IT Department)

| | |
|---|---|
| **Course Code** | **ITSE21** |
| **Course Title** | **Information Security** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To learn the basics of Information security.
- To get familiarized with various routinely used information security tools and techniques.
- To understand the role of information security approaches in our daily life.
- To comprehend and implement the information security techniques of data protection.
- To learn the frameworks and additional tools for development of information security techniques aiming at improved data security.

## COURSE CONTENTS:

### UNIT I: OVERVIEW OF INFORMATION SECURITY

Computer Security Concepts, Security Functional Requirements, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, Computer Security Strategy. **8**

### UNIT II: ACCESS CONTROL

Access Control Principles, Subjects-Objects and Access Rights, Discretionary Access Control, UNIX File Access Control, Role Based Access Control, Attribute Based Access Control, Trust Frameworks. Case Study: RBAC System for a Bank. **8**

### UNIT III: DATABASE SECURITY

The need for Database Security, RDBMS and SQL Injection attacks, Database Access Control, Inference, Database Encryption. **8**

### UNIT IV: AUTHENTICATION AND AUTHORIZATION

Introduction, Authentication Methods, Passwords, Biometrics, Two-Factor Authentication, Single Sign-On and Web Cookies. Steganography, Authorization: A Brief History, Access control Matrix, Multilevel Security Models, Covert Channels, Inference Control, CAPTCHA. **8**

**UNIT V: FIREWALLS AND INTRUSION DETECTION AND PREVENTION SYSTEMS**

Firewall Characteristics and Access Policy, Types of Firewall, Firewall Biasing, Firewall Location and Configuration, Intrusion Detection Systems, Intrusion Prevention Systems, Unified Threat Management Products. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Demonstrate understanding of the fundamentals of Information security. | (K2) |
| CO2 | : | Develop understanding of underlying principles of access control. | (K3) |
| CO3 | : | Develop understanding of database security techniques. | (K3) |
| CO4 | : | Develop understanding of techniques used for authentication and authorization models. | (K3) |
| CO5 | : | Develop understanding of firewall characteristics and intrusion detection and prevention techniques. | (K3) |

## Text Books:


1. Stallings William and Brown Lowrie, "*Computer Security: Principles and Practice*", 4th Edition, Pearson, 2018.
2. Stamp Mark, "*Information Security: Principles and Practices*", 2nd Edition, Wiley Publication, 2011.


## Reference Book:


1. Stallings William, "*Cryptography and Network Security: Principles and Practice*", 7th Edition, Pearson, 2017.


**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 2 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| **CO4** | - | - | 2 | - | 1 | 2 | 2 | - | - | - | - | - | 2 | - | 2 |
| **CO5** | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| **Score** | 6 | 4 | 5 | 1 | 4 | 4 | 4 | 2 | - | - | - | - | 2 | - | 4 |
| **COM** | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | - | 2 |

| | |
|---|---|
| **Course Code** | **ITSE22** |
| **Course Title** | **Principles of Cryptography** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To learn fundamentals of cryptography.
- To understand the application of cryptographic techniques in real world applications.
- To learn applications of cryptography.
- To learn and apply public and private key methods.
- To learn the notion of provable security and its implication with improved security.

## COURSE CONTENTS:

### UNIT-I CLASSICAL CRYPTOGRAPHY

Introduction: Some Simple Cryptosystems, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, Stream Ciphers, Cryptanalysis. **8**

### UNIT-II ADVANCED ENCRYPTION STANDARD

Introduction to DES, Finite field arithmetic, AES Structure, AES Transformation functions, AES Key expansion, An AES Example, AES Implementation. **8**

### UNIT-III THE RSA SYSTEM AND FACTORING

Introduction to Public-key Cryptography, Number Theory, The Euclidean Algorithm, The Chinese Remainder Theorem, The RSA Cryptosystem, Implementing RSA, Probabilistic Primality Testing, Attacks On RSA. **8**

### UNIT-IV ELLIPTIC CURVE CRYPTOSYSTEMS

The basic setup, Diffie-Hellman Key exchange, Massy-Omura Encryption, ElGama Public key encryption. **8**

### UNIT-V DIGITAL SIGNATURE SCHEMES

Introduction, The ElGamal Signature Scheme, The Digital Signature Standard, One-time Signatures, Undeniable Signatures, Fail-stop Signatures, Blind, Dual and ElGama Elliptic Curve signature scheme. Hash Functions: Signatures and Hash Functions, Collision-free Hash Functions, The Birthday Attack, The Discrete Logarithm problem, A Discrete Log Hash Function,

Extending Hash Functions, Hash Functions from Cryptosystems, The MD4 Hash Function. **8**

**Total Periods = 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | : | Explain the fundamentals of applied cryptography. | (K2) |
| CO2 | : | Explain the concepts of advance encryption techniques. | (K2) |
| CO3 | : | Illustrate applications of public key cryptographic algorithms. | (K2) |
| CO4 | : | Explain the Elliptic curve cryptosystems. | (K2) |
| CO5 | : | Compare various digital signature schemes. | (K5) |

## Text Book:

1. Schneier Bruce, *"Applied Cryptography: Protocols, Algorithms and Source Code in C"*, Wiley Publication, 2nd Edition, 2012.

## Reference Book:

1. Stallings W., *"Cryptography and Network Security: Principles and Practice"*, 7th Edition, Pearson, 2017.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | - | - | - | - | - | 3 | - | - | 3 | - | 3 |
| **CO2** | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 3 | 2 | - | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 2 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - | 3 |
| **Score** | 15 | 12 | 1 | 9 | 8 | - | - | - | - | 3 | - | - | 6 | - | 9 |
| **COM** | 3 | 3 | 1 | 3 | 2 | - | - | - | - | 3 | - | - | 3 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITSE23** |
| **Course Title** | **Network Security** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the various types of attacks and services related to network layer protocol.
- To discuss how to apply authentication techniques to safeguard the data transfer.
- To inspect the security requirements and standards for IP and web-based systems.
- To understand the design principles of authentication protocols.
- To investigate the security issues involved in wireless networks.

## COURSE CONTENTS:

### UNIT I: OVERVIEW OF NETWORK SECURITY

Security services, attacks, Security Issues in TCP/IP suite, Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, DNS security, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits. **8**

### UNIT II: DIGITAL SIGNATURES AND AUTHENTICATION

Requirements, Authentication functions, Message Authentication Codes, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures. **8**

### UNIT III: INTERNET PROTOCOL SECURITY AND STANDARDS

IP Security Overview and Architecture, Authentication Header, Encapsulating Security Payload, Secure E-mail and S/MIME, Domain Keys Identified Mail, Secure Socket Layers (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security. **8**

### UNIT IV: INTERNET AUTHENTICATION APPLICATIONS

Kerberos, X.509, Public Key Infrastructure. **8**

### UNIT V: WIRELESS NETWORK SECURITY

Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Firewall security. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Identify the various security services and attacks in network layer. (K3)

CO2 : Determine appropriate mechanisms to verify the integrity of the message. (K5)

CO3 : Relate how existing standards help to enable digital acceleration in network modernization. (K2)

CO4 : Analyse the need for automated tools for protecting files and other information stored on the networked system. (K4)

CO5 : Construct security solutions for a given wireless application or system. (K6)

## Text Books:


1. Stallings W. and Brown Lowrie, "*Computer Security: Principles and Practice*", 4th Edition, Pearson, 2018.
2. Stamp Mark, "*Information Security: Principles and Practices*", 2nd Edition, Wiley Publication, 2011.
3. Stallings W., "*Cryptography and Network Security: Principles and Practice*", 7th edition, Pearson, 2017.


## Reference Book:


1. Kahate A., "*Cryptography and Network Security*", 3rd Edition, Tata McGraw-Hill, 2013.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO3** | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO4** | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| **CO5** | - | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | - |
| **Score** | 2 | 6 | 4 | - | - | - | - | - | - | - | - | - | 3 | 6 | - |
| **COM** | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | - |

| | |
|---|---|
| **Course Code** | **ITSE24** |
| **Course Title** | **Applied Cryptography** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To learn fundamentals of applied cryptography.
- To understand the application of cryptographic techniques in real world applications.
- To learn applications of applied cryptography.
- To learn and apply public and private key methods.
- To learn the notion of provable security and its implication with improved security.

## COURSE CONTENTS:

### UNIT I: FOUNDATIONS

Terminology, Steganography, Substitution Cipher and Transposition Cipher, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers. Intermediate Protocols: Timestamping Services, Subliminal Channel, Undeniable Digital Signatures, Proxy Signatures, Group Signatures, Fail-Stop Digital Signatures, Computing with Encrypted Data, Bit Commitment, Fair Coin Flips, Mental Poker, One Way Accumulators, All-or-None Disclosure of Secrets. **8**

### UNIT II: CRYPTOGRAPHIC PROTOCOLS

Esoteric Protocols: Secure Elections, Secure Multiparty Computation, Anonymous Message Broadcast, Digital Cash. Key Length: Symmetric and Public-Key Key Length**,** Comparison, Birthday attacks against One-Way Hash Functions, Caveat Emptor. **8**

### UNIT III: CRYPTOGRAPHIC TECHNIQUES

Key Management: Generating Keys, Non-linear Keyspaces, Transferring Keys, Verifying Keys, Using Keys, Updating Keys, Storing Keys, Backup Keys, Compromised Keys, Lifetime of Keys, Destroying Keys, Public-key key Management. Using Algorithms: Choosing an Algorithm, Public-Key vs Symmetric Cryptography, Encrypted Communicatrions Channels, and Encrypting Data for Storage, Hardware vs Software Encryption, Detecting Encryption, Hiding Ciphertext in Ciphertext, Destroying Information. **8**

**UNIT IV: CRYPTOGRAPHIC ALGORITHMS**

Block Ciphers: Lucifer, Madryga, NewDES, FEAL, REDOC, LOKI, Khufu and Khafre, RC2, IDEA, MMB, CA-1.1, Skipjack. Combining Block Ciphers: Double and Triple Encryption, Doubling the Block Length, Other Multiple Encryption Schemes, CDMF Key Shortening, Whitening, Cascading Multiple Block Algorithms, Combining Multiple Block Algorithms. **8**

**UNIT V: THE REAL WORLD**

Example Implementation: IBM Secret Key Management Protocol, Kerberos, Privacy-Enhanced Mail, Pretty Good Privacy, Smart Cards, Universal Electronic Payment System. **8**

**Total Periods = 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Explain the fundamentals of applied cryptography. | (K2) |
| CO2 | **:** | Explain the concepts of cryptographic protocols. | (K2) |
| CO3 | : | Illustrate cryptographic techniques. | (K2) |
| CO4 | : | Explain cryptographic algorithms. | (K2) |
| CO5 | : | Compare various real world applications. | (K5) |

## Text Book:

1. Schneier Bruce, *"Applied Cryptography: Protocols, Algorithms and Source Code in C"*, Wiley Publication, Second Edition, 2012.

## Reference Book:

1. Stallings W., *"Cryptography and Network Security: Principles and Practice"*, Seventh Edition, Pearson, 2017.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | 3 | - | - | - | - | - | 3 | - | - | 3 | - | 3 |
| **CO2** | 2 | 2 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| **CO3** | 2 | 2 | - | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 2 | 2 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - | 3 |
| **Score** | 10 | 12 | 1 | 9 | 8 | - | - | - | - | 3 | - | - | 6 | - | 9 |
| **COM** | 2 | 3 | 1 | 3 | 2 | - | - | - | - | 3 | - | - | 3 | - | 3 |

| | |
|---|---|
| **Course Code** | **ITSE25** |
| **Course Title** | **Cyber Physical Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the mathematical models behind cyber physical systems.
- To utilize scheduling analysis techniques to verify timing effects of the systems.
- To identify the security issues and requirements to build secured cyber-physical systems.
- To understand the interactions and issues related to distributed cyber-physical systems.
- To get detailed insights on different cyber physical systems to expose new opportunities.

## COURSE CONTENTS:

**UNIT I: SYMBOLIC SYNTHESIS FOR CYBER-PHYSICAL SYSTEMS**

Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools. **8**

**UNIT II: SOFTWARE AND PLATFORM ISSUES IN FEEDBACK CONTROL SYSTEMS**

Introduction, Basic Techniques, Controller Timing, Controller Design for resource efficiency, Advanced Techniques, Logical Correctness of Hybrid Systems**:** Introduction, Basic Techniques, Discrete Verification, Advanced Techniques. **8**

**UNIT III: SECURITY OF CYBER PHYSICAL SYSTEMS**

Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches. **8**

**UNIT IV SYNCHRONIZATION IN DISTRIBUTED CYBER PHYSICAL SYSTEMS**

Challenges in Cyber- Physical Systems, A Complexity Reduction Technique for Synchronization, Basic Techniques. **8**

## UNIT V: CYBER PHYSICAL SYSTEMS APPLICATION DOMAIN

Medical Cyber-Physical Systems, Energy Cyber-Physical Systems, Cyber-Physical Systems Built on Wireless Sensor Networks. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

CO1 : Construct the symbolic models for a given cyber physical system. (K3)

CO2 : Design a controller system to improve resource efficiency. (K6)

CO3 : Inspect the security requirements of various cyber physical systems. (K4)

CO4 : Compare different synchronous and asynchronous architectures to improve the interactions of globally connected (distributed) CPS. (K2)

CO5 : Assess the existing challenges of various cyber physical systems. (K5)

## Text Book:

1. Rajkumar R., Dionisio de Niz and Klein M., "*Cyber-Physical Systems*", First Edition, Addison-Wesley Professional, 2017.

## Reference Books:

1. Rajeev Alur, "*Principles of Cyber-Physical Systems*", MIT Press, 2015.
2. Roy S. and Sajal K. Das, "*Principles of Cyber-Physical Systems: An Interdisciplinary Approach*", Cambridge University Press, 2020.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 3 | - | - |
| **CO3** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 2 | 2 | - | 3 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **Score** | 10 | 10 | 3 | 6 | 2 | - | - | - | - | - | - | - | 6 | - | - |
| **COM** | 2 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | - | - |

# STREAM ELECTIVE –V

## CYBER PHYSICAL SYSTEMS

(Offered by ECE Department)

| | |
|---|---|
| **Course Code** | **ECSE11** |
| **Course Title** | **Introduction to IoT** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of internet of things and its architecture.
- To understand the architecture and networking in internet of things.
- To study the various IoT communication protocols.
- To gain insights about the fog and cloud computing in IoT framework.
- To study the real-life applications of IoT.

## COURSE CONTENTS:

### UNIT I: IoT INTRODUCTION AND FUNDAMENTALS

Basics of networking (types of networks, layered models, addressing, TCP/IP transport layer). Introduction to the architecture of wireless sensor networks, Machine-to-Machine (M2M) communication and cyber physical systems. Introduction to IoT and its comparison with M2M, WSN and CPS, IoT networking components. Addressing strategies in IoT. **8**

### UNIT II: IoT ARCHITECTURE AND NETWORKING

Introduction to IoT Sensors and their characteristics, Sensing types and their considerations. Introduction to IoT Actuators, Their types and characteristics, IoT processing topologies, their types and its importance, Data formatting, Processing topologies, IoT device design and selection considerations, Processing offloading. IoT connectivity technologies. **8**

### UNIT III: IoT COMMUNICATION TECHNOLOGIES

Introduction to nodes. Constrained nodes and network, and the type of devices. Low power and lossy networks, Infrastructure protocols, Discovery protocols. Data protocols. Identification protocols, Device management protocols, Sematic protocols, IoT interoperability standards and frameworks. **8**

## UNIT IV: CLOUD AND FOG COMPUTING IN IoT

Introduction to cloud computing, Virtualization. Cloud Models, SLA in cloud computing, Cloud implementation, Sensor cloud, Introduction to fog computing and its architecture, Fog computing in IoT, Application of fog computing in IoT. **8**

## UNIT V: IoT APPLICATIONS AND DATA ANALYTICS

IoT applications in agriculture, Vehicular networks and healthcare, IoT analytics. Uses of machine learning in IoT, Advantages and challenges of ML in IoT, ML algorithms for IoT applications, Performance metrices for evaluating ML algorithms. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Associate and classify the architecture of various communication systems. | (K2) |
| CO2 | **:** | Elaborate the IoT infrastructure and data processing methodologies. | (K2) |
| CO3 | : | Interpret the various networking protocols used in IoT. | (K2) |
| CO4 | : | Acquire the concepts of fog and cloud computing in IoT. | (K3) |
| CO5 | : | Illustrate the various real-life applications of IoT. | (K3) |

## Text books:


1. Misra, Sudip, Anandarup Mukherjee, and Arijit Roy, "*Introduction to IoT*", Cambridge University Press, 2021.
2. Serpanos, Dimitrios, and Marilyn Wolf. *Internet-of-things (IoT) systems: architectures, algorithms, methodologies*. Springer, 2017.


## Reference Books:


1. Xiao, Perry, "*Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed"*, John Wiley and Sons, 2018.
2. Hersent, Olivier, Boswarthick D., and Elloumi O., *"The internet of things: Key applications and protocols"*, John Wiley and Sons, 2011.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 10 | 10 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE12** |
| **Course Title** | **Wireless Sensor Networks** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To understand the fundamentals of Wireless Sensor Networks (WSN) technology and its relevance in the Scientific and Industrial context.
- To understand the basics of Wireless Communication, Sensor Operations and Management.
- To discuss the relevance, challenges, and open research issues in localization.
- To understand the core routing issues and algorithms in WSN.
- To understand the QoS challenges and current solutions for the same in WSN.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION AND FUNDAMENTALS

Introduction to sensor networks, Applications of WSNs, Difference between mobile ad-hoc networks and WSNs, Architecture of a WSN node, Hardware components, Energy consumption of WSN nodes, Operating systems and execution environments, Sensor network scenarios, Optimization goals in WSNs, Design principles of WSNs, Service interfaces and gateways in WSNs. **8**

### UNIT II: WSN COMMUNICATION PROTOCOLS

Physical layer, Wireless channel and communication fundamentals, Physical layer and trans-receiver design in WSNs, Fundamentals of wireless MAC protocols, Low duty cycle protocols, Contention based protocols, Schedule based protocol, IEEE 802.15.4 MAC protocol, Link layer protocols, Error control, framing and link management in WSNs. **8**

### UNIT III: LOCALIZATION AND POSITIONING OF WSN NODES

Fundamentals of naming and addressing of senor nodes, Assignment of MAC addresses, Distributed addressing, Content based and geographical addressing, Time synchronization of WSN nodes, Sync. Protocols for sender/receiver and receiver/receiver, Localization and positing procedures, Basics of lateration, Single-hop localization, Positing in multi-hop environments. Impacts of anchor placement. **8**

### UNIT IV: TOPOLOGY CONTROL AND ROUTING PROTOCOLS

Basics of topology control, Power control in flat networks, Hierarchical networks by dominating sets and clustering, Adaptive node activity, Routing in WSN nodes.

Gossiping and agent based unicast forwarding, Energy efficient unicast. Broadcasting and multicasting in WSN nodes, Geographical routing, Mobile nodes. **8**

**UNIT V: NETWORKING AND QOS IN WSN**

Datacentric and content-based networking, Data centric routing, Data aggregation and data centric storage, Transport layer in WSN, Coverage and deployment of WSN nodes, Reliability requirements in WSNs, Single packet and block delivery, Congestion and rate control in WSN. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Generalize the architecture of wireless sensor networks. | (K2) |
| CO2 | **:** | Review the various WSN communication protocols. | (K2) |
| CO3 | : | Acquire the concepts of localization and positioning of WSN nodes. | (K3) |
| CO4 | : | Explore the concepts of routing and topology control in WSN. | (K3) |
| CO5 | : | Investigate the various routing protocols in WSN. | (K3) |

## Text Books:


1. Karl, Holger, and Andreas Willig, "*Protocols and architectures for wireless sensor networks*", John Wiley and Sons, 2007.
2. Ibnkahla, Mohamed, "*Wireless sensor networks: a cognitive perspective*", CRC Press, 2012.


## Reference Books:


1. Dargie, Waltenegus, and Christian Poellabauer, "*Fundamentals of wireless sensor networks: theory and practice",* John Wiley and Sons, 2010.
2. Rastko R., Selmic Phoha, and Serwadda Vir V., *"Wireless Sensor Networks: Security, Coverage, and Localization*", Springer, 2018.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 10 | 12 | - | - | - | - | - | - | - | - | - | 15 | 3 | 10 |
| **COM** | 3 | 2 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

| | |
|---|---|
| **Course Code** | **ECSE13** |
| **Course Title** | **Industrial IoT** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of industry 4.0 and IIoT.
- To understand the architecture of IIoT.
- To study the key enabling technologies in IIoT.
- To gain insights about the networking protocols in IIoT.
- To study the applications of AI and ML in IIoT.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO INDUSTRY 4.0

Overview of IoT, IoT architecture, Application-based IoT protocols, Cloud and fog computing in IoT. Sensor cloud, Introduction to Industry 4.0, CPS and IIoT. Prerequisites for IIoT and CPS, Design requirements and drivers of Industry 4.0., Sustainability assessments and cybersecurity in industries, Impacts of Industry 4.0. **8**

### UNIT II: BASICS OF IIoT

Introduction to IIoT, Industrial internet systems, Industrial sensing and processes, Business models and reference architecture of IIoT, Business models of IoT and IIoT. Reference architecture of IoT and IIoT, IIRA framework, Key performance indicators for safety and health in IIoT. **8**

### UNIT III: KEY TECHNOLOGIES IN IIoT

Introduction to Onsite technologies: Cloud and fog computing for IIoT, Introduction to On-site technologies: Augmented reality, Virtual reality, Big data and advanced analytics, Smart factories, Lean manufacturing systems. **8**

### UNIT IV: NETWORKING IN IIoT

Sensors in IIoT and their characteristics and categories, Actuators in IIoT and their types, Industrial data transmission protocols: fieldbus, profibus, HART, Interbus, Bitbus, CC-link, Modbus, CAN, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN, NB-IoT, IEEE 802.11AH, Industrial data acquisition: DCS, PLC and SCADA. **8**

**UNIT V: MACHINE LEARNING AND DATA SCIENCE IN IIoT AND APPLICATIONS**

Need for analytics in IIoT, IIoT analytics: categorization, usefulness, challenges, mapping with IIRA architecture, use of AI in analytics, Machine learning and data science in IIoT, Applications of deep learning in Industries, Applications of IIoT for: Healthcare applications, Inventory management and quality control and Plant safety and security. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Associate and classify the architecture of Industry 4.0 and IIoT. | (K2) |
| CO2 | **:** | Elaborate the IIoT infrastructure and data processing methodologies. | (K2) |
| CO3 | : | Interpret the key technologies used in IIoT. | (K2) |
| CO4 | : | Acquire the concepts of networking in IIoT. | (K3) |
| CO5 | : | Illustrate the applications of AI and data science in IIoT. | (K3) |

## Text Books:


1. Misra, Sudip, Chandana Roy, and Anandarup Mukherjee, "*Introduction to Industrial Internet of Things and Industry 4.0*",CRC Press, 2021.
2. Gilchrist, Alasdair, "*Industry 4.0: the industrial internet of things",* Apress, 2016.


## Reference Books:


1. Mahmood, Zaigham, "*The Internet of Things in the Industrial Sector*", Springer International Publishing, 2019.
2. Veneri, Giacomo, and Antonio Capasso, "*Hands-on industrial Internet of Things: create a powerful industrial IoT infrastructure using industry 4.0.",* Packt Publishing Ltd, 2018.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 10 | 10 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE14** |
| **Course Title** | **Principles of Cyber Physical Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the mathematical models behind cyber physical systems.
- To utilize scheduling analysis techniques to verify timing effects of the systems.
- To identify the security issues and requirements to build secured cyber physical systems.
- To understand the interactions and issues related to distributed cyber physical systems.
- To get detailed insights on different cyber physical systems to expose new opportunities.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO CYBER PHYSICAL SYSTEMS

Introduction and Motivation, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools, Open challenges in CPS. **8**

### UNIT II: CLASSICAL CONTROL AND HYBRID SYSTEMS

Introduction, Basic Techniques, Controller Timing, Controller Design for resource efficiency, Advanced Techniques, Logical Correctness of Hybrid Systems: Introduction, Basic Techniques, Discrete Verification, Advanced Techniques. **8**

### UNIT III: SECURITY AND SYNC. IN CPS

Introduction to Security of CPS. Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches. Sync. Challenges in CPS, Complexity reducing techniques. Basic and advanced techniques for synchronization: Formal software engineering, Distributed consensus algorithms, Sync. Lockstep functions, Time triggered architecture, physically asynchronous, logically synchronous systems. **8**

**UNIT IV: SCHEDULING AND INTEGRATION IN CPS**

Introduction and motivation for real-time scheduling in CPS, Basic and advanced techniques for real-time scheduling, Introduction and motivation for model integration in CPS, Causality, Sematic domains, Integration models for Computational Process, Schematics of CPS DSMLs. Advanced techniques like ForScec, CyPhyML, Formalization of semantics and language challenges. Open challenges in scheduling and integration of CPS. **8**

**UNIT V: APPLICATIONS OF CYBER PHYSICAL SYSTEMS**

System description, operational scenarios. Key technology drivers and quality attributes for Medical Cyber Physical Systems, Energy Cyber-Physical Systems and Cyber Physical Systems Built on Wireless Sensor Networks. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Characterize the basics of cyber physical systems. | (K2) |
| CO2 | **:** | Elaborate the concepts of control theory and hybrid systems in CPS framework. | (K2) |
| CO3 | : | Interpret the role of security and synchronization in CPS. | (K2) |
| CO4 | : | Acquire the concepts of scheduling and integration of CPS. | (K3) |
| CO5 | : | Illustrate the real-life applications of CPS. | (K3) |

## Text Books:


1. Rajkumar, Raj, Dionisio De Niz, and Mark Klein,"*Cyber-physical systems*", Addison-Wesley Professional, 2016.
2. Alur, Rajeev, "*Principles of cyber-physical systems*" MIT press, 2015.


## Reference Books:


1. Lee, Edward Ashford, and Sanjit Arunkumar Seshia, "*Introduction to embedded systems: A cyber-physical systems approach*", MIT Press, 2016.
2. Roy, Sandip, and Sajal K. Das, eds. *"Principles of Cyber-Physical Systems: An Interdisciplinary Approach*", Cambridge University Press, 2020.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 13 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE15** |
| **Course Title** | **Communication in Cyber Physical Systems** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of cyber physical systems (CPS).
- To understand the communication capacity requirements of CPS.
- To study the network topology design in CPS.
- To gain insights about the communication network operation in CPS.
- To study the physical layer design in CPS.

## COURSE CONTENTS:

### UNIT I: BASICS OF CPS

Elements of a CPS. Basics of Communication: Information measures, comm. Channels, source coding, modulation, networking and typical comm. systems. Modelling of controlled dynamical systems, Observability, controllability and optimal control, Typical cyber physical systems: power networks and robot networks. **8**

### UNIT II: COMMUNICATION CAPACITY REQUIREMENTS

Methodologies for communication, Basic Models, Deterministic Models: Stability. Stochastic systems: Estimation, Stochastic systems: Stability, Stochastic systems: reduction of Shannon entropy, Networked stochastic systems, Control communication complexity. **8**

### UNIT III: NETWORK TOPOLOGY DESIGN

WDM networks and design constraints, Optimization procedure, Optimization based on topology design, Formulation of objective function, Optimization of topology, Team decision theory and its application in optimal control **8**

### UNIT IV: COMMUNICATION NETWORK OPERATION FOR CPS

Hybrid system modelling for CPS, Optimization of scheduling policy, Mode provisioning, Model scheduling, Information based scheduling, Estimation oriented routing. System dynamics aware multicast routing. **8**

## UNIT V: PHYSICAL LAYER DESIGN FOR CPS

Physical layer in CPS, Adaptive modulation, Source coding in CPS: point-to-point case and distributed case, Physical dynamics-aware channel decoding. Control-oriented channel coding, Channel coding for interactive communication in computing. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Characterize the basics of communication in cyber physical systems. | (K2) |
| CO2 | **:** | Elaborate the communication capacity requirements in CPS framework. | (K2) |
| CO3 | : | Illustrate the network topology in CPS. | (K3) |
| CO4 | : | Investigate the operation of communication network in CPS. | (K3) |
| CO5 | : | Determine the physical layer requirements in CPS. | (K3) |

## Text Books:


1. Li, Husheng, Kaufmann Morgan,"*Communications for control in cyber physical systems: theory, design and applications in smart grids*", 2016.
2. Ferrari, Silvia, and Wettergren Thomas A., "*Information-driven Planning and Control*", MIT Press, 2021.


## Reference Books:


1. Hu, Fei. "*Cyber-physical systems: integrated computing and engineering design*", CRC Press, 2013.
2. Rodrigues, Joel JPC, and Amjad Gawanmeh, eds, "*Cyber-Physical Systems for Next-Generation Networks*", IGI Global, 2018.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 15 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

# STREAM ELECTIVE –VI

## INTELLIGENT SYSTEMS

(Offered by ECE Department)

| | |
|---|---|
| **Course Code** | **ECSE21** |
| **Course Title** | **Mobile Robots** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of mobile robotics.
- To understand the dynamic and kinematic modelling of mobile robots.
- To study the path and motion planning algorithms.
- To gain insights about the SLAM.
- To study the control aspects in mobile robots.

## COURSE CONTENTS:

### UNIT I: MOBILE ROBOTS GENERAL CONCEPTS AND SENSORS

Introduction to robotics and mobile robotics, Historical developments, Ground robot locomotion. Types of robot drives, Sensor Classification and Characteristics, Position and Velocity Sensors, Distance Sensors, LIDAR, Gyroscope. **8**

### UNIT II: MOBILE KINEMATICS AND DYNAMICS

Mobile robot kinematics, Direct and inverse robot kinematics, Homogeneous transformations, Nonholonomic constraints, Nonholonomic Mobile Robots: Unicycle, Differential drive WMR, Universal Omnidirectional WMR Kinematic Modeling, General robot dynamic modelling: Newton-Euler method and Lagrange method, Differential-Drive WMR. **8**

### UNIT III: PATH AND MOTION PLANNING

Introduction to robot planning, Path planning for mobile robots, Model-based robot path planning, Configuration Space, Road Map Path Planning Method, Integration of Global and Local Path Planning, Complete Coverage Path Planning, Mobile Robot Motion Planning, Motion Planning Using Vector Fields, Analytic Motion Planning, Mobile Robot Task Planning, Plan Representation and Generation. **8**

## UNIT IV: LOCALIZATION AND MAPPING

Basic concepts of robot localization, Stochastic modelling, Kalman filtering, and Bayesian estimation techniques, Sensor Imperfections. Relative Localization, Kinematic Analysis of Dead Reckoning, Kalman Filter-Based Localization and Sensor, Calibration and Fusion, Simultaneous Localization and Mapping. EKF, Bayesian estimator, PF SLAM, Omnidirectional Vision-Based SLAM. **8**

## UNIT V: CONTROL OF MOBILE ROBOTS

Generic intelligent control architectures, Design Characteristics of Mobile Robot Control Software Architectures, Introduction to and performance evaluation of Two Mobile Robot Control Software Architectures, Intelligent Human Robot Interfaces, Case study, Future developments in robotic control.

**8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Characterize the basics of mobile robots. | (K2) |
| CO2 | **:** | Investigate the kinematic and dynamic modelling of mobile robots. | (K2) |
| CO3 | : | Acquire the concepts of path and motion planning in mobile robotics. | (K3) |
| CO4 | : | Acquire the concepts of localization and mapping in mobile robotics. | (K3) |
| CO5 | : | Acquire the concepts of control of mobile robots. | (K3) |

## Text Books:


1. Tzafestas, Spyros G, "*Introduction to mobile robot control",* Elsevier, 2013.
2. Kagan, Eugene, Nir Shvalb, and Irad Ben-Gal, eds, "*Autonomous mobile robots and multi-robot systems: Motion-planning, communication, and swarming*", John Wiley and Sons, 2019.


## Reference Books:


1. Bräunl, Thomas, "*Embedded robotics: mobile robot design and applications with embedded systems*", Springer Science and Business Media, 2008.
2. Castellanos, Jose A., and Juan D. Tardos, "*Mobile robot localization and map building: A multisensor fusion approach"*, Springer Science and Business Media, 2012.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 14 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE22** |
| **Course Title** | **Machine Vision and Perception** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics machine vision and robotic sensors.
- To understand the basics of computer vision.
- To study the concepts of positioning and orientation.
- To gain insights about SLAM.
- To study the role of AI and ML in mobile robots.

## COURSE CONTENTS:

### UNIT I: ROBOTIC VISION SENSORS

Importance of robot vision, Classification of robotic sensors, Sensor Performance, Common sensors for mobile robots, Computer vision, Concepts of sensor fusion. **8**

### UNIT II: BASICS OF COMPUTER VISION

Fundamentals of Computer Vision: Image accusation and representation, image transformation, filtering, restoration, morphing, Camera Models, Calibration, Single view geometry, Multiple view geometry, Epipolar geometry, RANSAC **8**

### UNIT III: POSITION AND ORIENTATION

Feature based alignment, Pose estimation, Time varying pose and trajectories, Structure from motion, dense Motion Estimation, Visual Odometry (Semi-direct VO, direct sparse odometry), Bundle Assignment. **8**

### UNIT IV: LOCALIZATION AND MAPPING

Initialization, Tracking, Mapping, geometric SLAM formulations (indirect vs. direct error formulation, geometry parameterization, sparse vs. dense model, optimization approach), Relocalization and map Optimization, Visual SLAM, Examples: Indirect (Feature based) methods (MonoSLAM, PTAM, ORB-SLAM), Direct methods (DTAM, LSD-SLAM), Sensor combinations (IMU, mono vs. Stereo, RGB-Depth), Analysis and parameter studies, Multi-sensor perception and sensor fusion. **8**

## UNITV: RECOGNITION AND INTERPRETATIONS

Concepts of machine learning and deep learning, sequence modelling, Learning for robotic vision: Active learning, incremental and class incremental learning identify unknowns, uncertainty estimation, Embodiment for robotic vision: active vision, spatial and temporal embodiment, reasoning for object, scene and scene semantics. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

CO1 **:** Distinguish between various robotic vision sensors. (K2)

CO2 **:** Generalize the concepts of computer vision. (K2)

CO3 : Acquire the concepts of position and orientation using robotics vision. (K3)

CO4 : Acquire the concepts of localization and mapping using robotic vision. (K3)

CO5 : Examine the applications of AI in robotic vision systems. (K3)

### Text Books:


1. G. Dudek and M. Jenkin. "Inertial Sensors, GPS, and Odometry". In: Springer Handbook of Robotics. Springer, 2008, pp. 477–490.
2. Dahiya, Ravinder S., Valle, Maurizio, "*Robotic Tactile Sensing"*, Springer, 2013.
3. S. R. Deb, Sankha Deb, *"Robotics Technology and Flexible Automation"*, 2nd edition, McGraw Hill Education, 2017.


### Reference Books:


1. Buduma N., "*Fundamentals of Deep Learning, Designing Next-Generation Artificial Intelligence Algorithms"*, O'Reilly Media, June 2015.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision"*, Cengage, 3rd Edition, 2013.
3. Abdulmajeed Wael, Revan M., "*Visual Robot Slam of 2D and 3D Indoor Environment"*, LAP Lambert Academic Publishing, 2014.
4. Forsyth D. A. and Ponce J., *"Computer Vision, A Modern Approach"*, Pearson Education, 2003.
5. Ballard D. H. and Brown C. M., "*Computer Vision"*, Prentice Hall, 1982.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 15 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE23** |
| **Course Title** | **Pattern Recognition and Computational Intelligence** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of pattern recognition and computation intelligence.
- To understand the basics of fuzzy logic.
- To study the artificial immune systems.
- To gain insights about optimization theory.
- To study the basics of evolutionary computing.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO PATTERN RECOGNITION AND CI

Computational intelligence, basic concepts, Relation to Artificial Intelligence, Application of Pattern Recognition, Pattern classification, Regression. Polynomial Curve Fitting, Model Selection, Linear Model for Classification, Linear Model for Regression, Curse of Dimensionality, Feature extraction, PCA, Feature selection, data visualization, Object Detection, Facial and Voice Detection. **8**

### UNIT II: UNCERTAINTY BASED INFORMATION

Information AND Uncertainty, Non-specificity of Fuzzy and Crisp Sets, Fuzziness of Fuzzy Sets. Introduction of Neuro-Fuzzy Systems: Architecture of Neuro Fuzzy Networks. Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets, Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals and Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. **8**

### UNIT III: ARTIFICIAL IMMUNE SYSTEM

Natural Immune System, Artificial Immune Models, Clonal Selection Theory Models, Network Theory Models. **8**

### UNIT IV: OPTIMIZATION THEORY

Basic Ingredients of Optimization Problems, Constrained Optimization, Unconstrained Optimization, Multi-Solution Problems, Multi-Objective Optimization, Dynamic Optimization Problems. **8**

## UNIT V: EVOLUTIONARY COMPUTING

Genetic Algorithm: An Overview, GA in problem solving, Implementation of Genetic Programming, Differential Evolution, Evolution Strategies, Cultural Evolution, Computational Swarm Intelligence, Particle Swarm Optimization. Multi-objective genetic algorithm. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Infer the basics of pattern recognition and computational intelligence. | (K2) |
| CO2 | **:** | Generalize the concepts of fuzzy logic. | (K2) |
| CO3 | : | Acquire the concepts of artificial immune systems. | (K3) |
| CO4 | : | Acquire the concepts of optimization theory. | (K3) |
| CO5 | : | Acquire the concepts of evolutionary computing. | (K3) |

## Text Books:


1. Engelbrecht A., "*Computational Intelligence: An Introduction",* 2nd edition, John Willey and Sons, 2007.
2. Marsland S., *"Machine Learning: An Algorithmic Perspective",* 2nd edition, CRC Press, 2015.
3. G.J. Klir and B. Yuan, *"Fuzzy Sets and Fuzzy Logic*", 2nd Edition, PHI, 2015.


## Reference Books:


1. Craenen B., Eiben A., "*Computational Intelligence. In: Encyclopedia of Life Support Sciences",* EOLSS Publishers Co, 2013.
2. Russell S., Norwig P., "*Artificial Intelligence: A Modern Approach",* 3rd edition, Prentice Hall, 2010.
3. Melanie Mitchell, *"An Introduction to Genetic Algorithm",* PHI, 1998.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 15 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE24** |
| **Course Title** | **Autonomous Mobile Robots** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of kinematics of mobile robots.
- To understand the basics of perception.
- To study the concepts of positioning.
- To gain insights about SLAM.
- To gain insights about swarm robotics.

## COURSE CONTENTS:

### UNIT I: MOBILE ROBOT KINEMATICS

Motion of robotic systems, Key challenges in robotic movement, Legged mobile robots, Wheeled mobile robots, Kinematic models of mobile robots, Mobile robot manoeuvrability, Mobile robot workspace, Motion control of mobile robots. **8**

### UNIT II: PERCEPTION

Sensors for mobile robots: sensor classification, characteristics, motor sensors, heading sensors, ground-based beacons, ranging sensors, motion/speed sensors, vision-based sensors, Uncertainty representation. Feature extraction. **8**

### UNIT III: MOBILE ROBOT LOCALIZATION

Concept of localization, Challenges in localization, Navigation based localization. Belief representation. Map representation, Probabilistic map-based localization. Different types of localizations, Autonomous map building. **8**

### UNIT IV: PLANNING AND NAVIGATION

Competences for Navigation: Planning and Reacting, Path planning, Obstacle avoidance, Navigation Architectures, Modularity for code reuse and sharing. Control localization, Techniques for decomposition, Case studies: tiered robot architectures. **8**

## UNIT V: SWARM ROBOTICS

Introduction to swarm robotics and its need. Performance, communication and levels of swarm, Homogeneous and heterogenous swarms. Concepts of aggregation, clustering, dispersion, pattern formation, sorting and self-assembly, Collective construction, transportation and manipulation. Flocking, collective motion, foraging and task scheduling, Heterogenous swarms, Error detection, security and interfacing, Swarm robotics as field robotics. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

| | | | |
|---|---|---|---|
| CO1 | **:** | Characterize the kinematics of mobile robots. | (K2) |
| CO2 | **:** | Investigate the perception in autonomous robots. | (K2) |
| CO3 | : | Generalize the concept of localization in mobile robotics. | (K3) |
| CO4 | : | Acquire the concepts of navigation in autonomous robots. | (K3) |
| CO5 | : | Acquire knowledge of the swarm robotics. | (K3) |

## Text Books:


1. Siegwart, Roland, Nourbakhsh I. R., and Scaramuzza D., "*Introduction to autonomous mobile robots*", MIT press, 2011.
2. Hamann, Heiko, "*Swarm robotics: A formal approach*", Springer. 2018.


## Reference Books:


1. Choset, Howie, et al., "*Principles of robot motion: theory, algorithms, and implementations*", MIT press, 2005.
2. Lozano-Perez, Tomás., "*Autonomous robot vehicles*," Springer Science and Business Media, 2012.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO2** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 14 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

| | |
|---|---|
| **Course Code** | **ECSE25** |
| **Course Title** | **Reinforcement Learning** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **SE** |

## COURSE OBJECTIVES:

- To infer the basics of reinforcement learning (RL).
- To understand the basics of Bellman optimality and Monte Carlo methods.
- To study the concepts of function approximation.
- To study the applications of RL.

## COURSE CONTENTS:

### UNIT I: INTRODUCTION TO REINFORCEMENT LEARNING

Basics of neuroscience, Introduction to RL, RL Framework and applications. Immediate RL, Bandit optimalities, Value function based methods, UCB-1, Concentration bounds, UCB-1 theorem. PAC bounds, Median elimination. Thompson sampling. **8**

### UNIT II: MDP MODELLING AND BELLMAN OPTIMALITY

MDP modelling,Bellman equations and optimality proof, Cauchy sequence and Green's equation, Banach fixed point theorem and its convergence proof, LPI convergence, Value and policy iteration, Dynamic programming, Monte Carlo methods. Control in Monte Carlo., Off policy Monte Carlo, UCT, TD (0) and TD (0) control, Q – learning, Afterstates. **8**

### UNIT III: ELIGIBILITY TRACES AND FUNCTION APPROXIMATION

Eligibility trace and its backward view, Eligibility trace control, Thomson sampling. Function approximation, Linear parametrization, State aggregation methods. Function approximation and eligibility traces, LSTD and LSTDQ, LSPI and Fitted Q. **8**

### UNIT IV: POLICY GRADIENT APPROACHES

Policy Approximation and its Advantages, The Policy Gradient Theorem. REINFORCE: Monte Carlo Policy Gradient. REINFORCE with Baseline, Actor Critic Methods, Policy Gradient for Continuing Problems, Policy Parameterization for Continuous Actions. **8**

## UNIT V: APPLICATIONS OF RL AND CASE STUDIES

Case studies: TD–Gammon, Watson's Daily-Double wagering, Optimizing memory control, AlphaGo, Personalized web services, Applications of RL in healthcare, industries, agriculture, robotics, communication technologies, Future of AI. **8**

**Total Periods: 40**

## COURSE OUTCOMES:

After completing the course, the students will be able to:

CO1 **:** Characterize the basics of neuroscience and reinforcement learning. (K2)

CO2 **:** Estimate the bellman optimality and explore the concepts of dynamic programming and Monte Carlo methods. (K3)

CO3 : Explore the concepts of eligibility traces and function approximation. (K3)

CO4 : Acquire the concepts of policy gradient approaches. (K3)

CO5 : Examine the applications of RL in various real life examples. (K3)

## Text Books:


1. Sutton R. S. and Barto A.G., "*Reinforcement learning: An introduction"*, Second Edition, MIT Press, 2019.
2. Platt, Aske, "*Reinforcement learning: An introduction"*, Springer, 2020.


## Reference Books:


1. Platt, Aske, "*Deep reinforcement learning"*, Springer, 2022.
2. Sugiyama, Masashi. "*Statistical reinforcement learning: modern machine learning approaches*', CRC Press, 2015.


## CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO2** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO3** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO4** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **CO5** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| **Score** | 15 | 15 | 13 | - | - | - | - | - | - | - | - | - | 15 | - | 10 |
| **COM** | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |

# MANAGEMENT ELECTIVE

| | |
|---|---|
| **Course Code** | **HME731** |
| **Course Title** | **Organizational Behaviour** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **GIR** |

## COURSE OBJECTIVES:

- Understand organizational behavior which can foster job satisfaction leading towards higher productivity.
- Develop skills like command and control mentality, leadership and conflict resolution.

## COURSE CONTENTS:

### UNIT I: FOCUS AND PURPOSE

Definition, need and importance of organizational behavior, Nature and scope, Frame work, Organizational behavior models. **8**

### UNIT II: INDIVIDUAL BEHAVIOUR

Personality, types, Factors influencing personality, Theories, Learning, Types of learners, The learning process, Learning theories, Organizational behavior modification. Misbehavior, Types, Management Intervention. Emotions, Emotional Labor, Emotional Intelligence, Theories, Attitudes, Characteristics, Components, Formation, Measurement, Values. Perceptions, Importance, Factors influencing perception, Interpersonal perception, Impression Management, Motivation, importance, Types, Effects on work behavior. **8**

### UNIT III: GROUP BEHAVIOUR

Organization structure, Formation, Groups in organizations, Influence, Group dynamics, Emergence of informal leaders and working norms, Group decision making techniques, Team building**:** Interpersonal relations, Communication Control. **8**

### UNIT IV: LEADERSHIP AND POWER

Meaning, Importance, Leadership styles, Theories, Leaders versus Managers, Sources of power, Power centers, Power and Politics. **8**

### UNIT V: DYNAMICS OF ORGANIZATIONAL BEHAVIOUR

Organizational culture and climate, Factors affecting organizational climate, Importance. Job satisfaction, Determinants, Measurements, Influence on behavior Organizational change, Importance, Stability versus Change,

Proactive versus Reaction change, the change process, Resistance to change, Managing change, Stress, Work Stressors, Prevention and Management of stress, Balancing work and Life, Organizational development, Organizational effectiveness. **8**

**Total Hours: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to

| | | |
|---|---|---|
| CO1 | Define organizational behavior and explain various organizational behavior models. | (K2) |
| CO2 | Explain and interpret various components of individual behavior and development of learning attitude by understanding the learning theories. | (K2) |
| CO3 | Develop effective communication and interpersonal skills and apply the concepts related to group behavior required significantly for the working in team in the organization. | (K3) |
| CO4 | Evaluate various leadership styles to inspire and get the things done from others. | (K5) |
| CO5 | Analyze various dynamics of organizational behavior to apply healthy working style in competitive environment and manage the stress in personal and professional life. | (K4) |

## Text Books:

1. Luthans, F., *"Organizational Behavior: An Evidence-Based Approach",* 12th edition, McGraw Hill, 2017.
2. Robins, S. P., Judge, T. A., and Vohra, N., *"Organizational Behavior",* 16th edition, Pearson Education, 2016.

## Reference Book:

1. Pareek, U. and Khanna, S., *"Understanding Organizational Behavior",* 4th edition, Oxford, 2016.

**CO to PO/PSO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | 2 | - | - | 2 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | 3 | 3 | - | - | - | - | - |
| **CO4** | - | - | - | - | - | - | 2 | - | 2 | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 3 |
| **Score** | - | - | - | - | - | - | 4 | - | 9 | 3 | - | 2 | - | - | 3 |
| **COM** | - | - | - | - | - | - | 2 | - | 3 | 3 | - | 2 | - | - | 3 |

| | |
|---|---|
| **Course Code** | **HME732** |
| **Course Title** | **Entrepreneurship Development** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **GIR** |

## COURSE OBJECTIVES:

- To develop and strengthen entrepreneurial quality in students.
- To impart basic entrepreneurial skills to run a business efficiently and effectively.

## COURSE CONTENTS:

**UNIT I: ENTREPRENEUR AND ENTREPRENEURSHIP**

Entrepreneur, Types of Entrepreneurs, Difference between Entrepreneur and Intrapreneur, Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. **8**

**UNIT II: MOTIVATION**

Major Motives Influencing an Entrepreneur, Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test, Stress Management, Entrepreneurship Development Programs: Need, Objective. **8**

**UNIT III: BUSINESS**

Small Enterprises: Definition, Classification, Characteristics, Ownership Structures, Project Formulation, Steps involved in setting up a Business: identifying, selecting a Good Business opportunity, Market Survey and Research, Techno-Economic Feasibility Assessment; Preparation of Preliminary Project Reports, Project Appraisal, Sources of Information, Classification of Needs and Agencies**.** **8**

**UNIT IV: FINANCING AND ACCOUNTING**

Need, Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation, Income Tax, Excise Duty, Sales Tax. **8**

**UNIT V: SUPPORT TO ENTREPRENEURS**

Sickness in small Business, Concept, Magnitude, Causes and Consequences, Corrective Measures, Business Incubators, Government Policy for Small Scale Enterprises, Growth Strategies in small industry, Expansion,

Diversification, Joint Venture, Merger and Sub Contracting. **8**

**Total Hours: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able

| | | |
|---|---|---|
| CO1 | Understand the entrepreneurial mind-set and what it takes to create value. | (K2) |
| CO2 | Develop essential knowledge of how to start one's own business. | (K3) |
| CO3 | Analyse the business environment in order to identify business opportunities. | (K4) |
| CO4 | Learn to secure financial backing and coordinate business growth. | (K1) |
| CO5 | Evaluates the effectiveness of different entrepreneurial strategies. | (K5) |

## Text Books:


1. Khanka. S.S., "*Entrepreneurial Development*" S.Chand and Co. Ltd., 2013.
2. Donald F Kuratko, "*Entreprenuership – Theory, Process and Practice*", 9th Edition, Cengage Learning 2014.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | 3 | - | - | 3 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | 3 | - | - | - | 3 | - | - | 2 |
| **CO3** | - | - | - | - | - | - | 2 | - | - | - | - | 3 | - | - | 3 |
| **CO4** | - | - | - | - | - | - | - | - | - | - | 3 | 3 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | 3 | 3 | - | - | - |
| **Score** | - | - | - | - | - | - | 2 | 3 | 3 | - | 6 | 15 | - | - | 5 |
| **COM** | - | - | - | - | - | - | 2 | 3 | 3 | - | 3 | 3 | - | - | 3 |

| | |
|---|---|
| **Course Code** | **HME733** |
| **Course Title** | **E-Commerce and Digital Marketing** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **GIR** |

## COURSE OBJECTIVES:

- To identify several factors and web store requirements needed to succeed in e-commerce.
- To understand the main technologies behind e-commerce systems and how these technologies interact.
- To define various electronic payment types and associated security risks and the ways to protect against them.

### COURSE CONTENTS:

**UNIT I: ELECTRONIC COMMERCE**

Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications, Consumer Oriented Electronic commerce, Mercantile Process models. **8**

**UNIT II: ELECTRONIC PAYMENT SYSTEMS:**

Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems, Inter Organizational Commerce EDI, EDI Implementation, Value added networks. **8**

**UNIT III: INTRA ORGANIZATIONAL COMMERCE:**

Work Flow, Automation Customization and internal Commerce, Supply chain Management. **8**

**UNIT IV: DIGITAL MARKETING:**

Introduction, email marketing, social media marketing Facebook, Twitter, LinkedIn, mobile marketing, web analytics. **8**

**UNIT V: SEARCH ENGINE OPTIMIZATION:**

Introduction, SEO white hat, black hat, tools for SEO, Pay per click. **8**

**Total Hours: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | |
|---|---|---|
| CO1 | Explain various E-commerce applications related to organization and the consumer usability. | (K2) |
| CO2 | Explain various electronic payment systems and inter-organizational commerce for various commercial applications. | (K2) |
| CO3 | Explain intra-organizational commerce for workflow through automation customization and supply chain management. | (K2) |
| CO4 | Create and evaluate various digital marketing solutions for various commercial applications. | (K6) |
| CO5 | Develop solutions for promotional and e-commercial activities through search engine optimization keeping in view the ethical practices. | (K6) |

## Text Books:

1. Schneider, G. P., "*Electronic Commerce",* 10th edition, Cencage learning publishers, 2012.
2. Chan, H., Lee, R., Dillon, T., and Chang, E., "*E-Commerce Fundamentals and Applications",* 1st edition, Wiley, 2007.

## Reference Books:

1. Dodson I., "The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns", 1st edition, Wiley, 2016.
2. Kalakata, "*Frontiers of electronic commerce",* 1st edition, Pearson, 2002.

### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | 1 | - | - | 3 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | 3 | - | - | 3 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | - | - | - | - | - | - | - | 3 | 3 | - | - | 3 | - | - | 2 |
| **Score** | - | - | - | - | - | - | - | 3 | 7 | - | - | 12 | - | - | 2 |
| **COM** | - | - | - | - | - | - | - | 3 | 3 | - | - | 3 | - | - | 2 |

| | |
|---|---|
| **Course Code** | **HME734** |
| **Course Title** | **Usability Analysis** |
| **Number of Credits** | **3-0-0-3** |
| **Type of Course** | **GIR** |

## COURSE OBJECTIVES:

- To understand the concept of usability analysis.
- To analyze the usability requirements to succeed in e-commerce.
- To introduce students to the techniques being used for web usability.

## COURSE CONTENTS:

**UNIT I: USABILITY ANALYSIS**

Concept of usability analysis, Advantages of usability analysis, Framework of usability analysis, Models of usability evaluation, System quality, Information quality, Service quality, Application of usability analysis in E-commerce, and web design. **8**

**UNIT II: USABILITY AND CUSTOMER RETENTION IN E-COMMERCE**

Usability measures in E-commerce, User interface architecture, Customer conversion, Customer satisfaction, and retention in business-to-business E-commerce and business to consumer E-commerce. **8**

**UNIT III: WEB USABILITY**

Introduction, Dimensions of web usability, Web usability criteria, Principles and evaluation methods, Serviceability, Learnability, Simplicity, Efficiency, Control, Customer relationship management. **8**

**UNIT IV: WEB DESIGN OPTIMIZATION**

Web analytics, Web design errors, Web design conventions, Design features to promote usability, Search engine optimization. **8**

**UNIT V: USABILITY TESTING**

Process of usability testing, Elements and techniques of usability testing, Comparative and explorative usability testing, Qualitative and quantitative usability testing, System usability scale (SUS), Heuristic evaluations. **8**

**Total Hours: 40**

## COURSE OUTCOMES:

After the completion of this course, students will be able to:

| | | |
|---|---|---|
| CO1 | Understand the advantages and be able to distinguish between good and poor human computer interaction design. | (K2) |
| CO2 | Understand the way of retaining customers with their changing attitudes and behaviors. | (K1) |
| CO3 | Understand the different internet and social media uses on today's society in context to e-commerce. | (K2) |
| CO4 | Analyse web interaction design activities to integrate into the wider product development lifecycle. | (K4) |
| CO5 | Evaluates the effectiveness of usability testing and basics of experimental design. | (K5) |

## Text Books:


1. Travis D., "*E-Commerce Usability: Tools and Techniques to Perfect the On-Line Experience*", 2nd edition, Taylor and Francis, 2017.
2. Steve K., "*Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability*", 3rd edition, Pearson Education, 2014.


### CO to PO/PSO Mapping

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | 3 | - | - | - | 3 | - | - | 2 |
| **CO3** | - | - | - | - | - | - | - | 3 | - | - | - | 3 | - | - | 3 |
| **CO4** | - | - | - | - | - | - | - | 3 | - | 2 | - | 3 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| **Score** | - | - | - | - | - | - | - | 9 | - | 2 | - | 15 | - | - | 5 |
| **COM** | - | - | - | - | - | - | - | 3 | - | 2 | - | 3 | - | - | 3 |

# COURSE OUTCOME SURVEY FORM

**Date: __/__/__**

**Course Code:**

**Course Name:**

**Year/Semester:**

**Faculty:**

| S. No. | Your satisfaction on the following statements | Very Satisfied | Generally Satisfied | Generally Dissatisfied | Very Dissatisfied |
|---|---|---|---|---|---|
| **1.** | Faculty has made the subject interesting | | | | |
| **2.** | Faculty is enthusiastic about what is taught | | | | |
| **3.** | Faculty is good at explaining things | | | | |
| **4.** | The course is well organized | | | | |
| **5.** | The course is intellectually simulating | | | | |
| **6.** | Any changes in the course or teaching have been communicated effectively | | | | |
| **7.** | The criteria used in assessment have been clearly stated in advance | | | | |
| **8.** | Assessment and marking have been fair | | | | |
| **9.** | I have been able to contact faculty when I needed to | | | | |
| **10.** | I have received detailed comments on my work | | | | |
| **11.** | I have received sufficient advice and support from the faculty | | | | |
| **12.** | I have been able to access general IT resources when I needed to | | | | |
| **13.** | My communication skills have improved | | | | |
| **14.** | Feedback on my work has been prompt | | | | |
| **15.** | Feedback on my work has helped me clarify things I did not understand | | | | |
| **16.** | As a result of the course, I feel confident in tackling problems related to this course | | | | |
| **17.** | Overall I am satisfied with the quality of the course | | | | |

**Signature of Student**

# PROGRAM SURVEY FORM

**(By Final Year B. Tech. Students)**

**Date: __/__/__**

## 1. Course Outcomes

| Overall, Your satisfaction on the following statements: | Very Satisfied | Generally Satisfied | Generally dissatisfied | Very dissatisfied |
|---|---|---|---|---|
| How current the content is in most subjects in your courses? | | | | |
| How interesting the teaching is in most subjects in your courses? | | | | |
| The variety of courses offered in your programme. | | | | |
| How helpful and accurate the academic advising is in your course? | | | | |
| How helpful and accurate the career counselling is in your programme? | | | | |
| How challenging the work is intellectually in most courses in your programme? | | | | |
| The overall educational experience in your programme. | | | | |

## 2. About Faculty

| To what extent do you agree or disagree with the following statements: | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| Faculties are good at explaining things | | | | |
| Faculties are good at motivating me to do my best work | | | | |
| Faculties normally give me helpful feedback on how I am doing | | | | |
| Faculties give feedback promptly | | | | |
| Faculties work hard to make the subjects interesting | | | | |
| Faculties grading method are fair | | | | |
| Faculties treat students with respect | | | | |
| Faculties are available when I need them | | | | |
| Course objectives are clear in most courses | | | | |
| Course objectives are met in most courses | | | | |

### 3. Teaching and Learning Environment

| What extent are you satisfied with the following aspects of the teaching and learning environment? | Very Satisfied | Generally Satisfied | Generally dissatisfied | Very dissatisfied |
|---|---|---|---|---|
| Intellectual stimulation of most courses | | | | |
| Amount of work required in most courses | | | | |
| Relevance of lab/practical classes | | | | |
| Group work for assignments | | | | |
| Level of class interactions in most courses | | | | |
| Course content in most courses | | | | |
| Assistance from most faculty outside of class | | | | |
| Library access to reading materials | | | | |
| Opportunities to be involved with other students outside of class | | | | |
| Being informed about things in the department | | | | |

### 4. Skill Development

| What extent does your coursework in your major improve the following skills? | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| Communication skills | | | | |
| Writing skills | | | | |
| Interpersonal relationship skills | | | | |
| Self-reliance skills | | | | |
| Decision-making skills | | | | |
| Ability to execute plans | | | | |
| Ability to work in groups on projects | | | | |
| Leadership skills | | | | |
| Analytical skills | | | | |
| Research skills | | | | |
| Making logical judgements | | | | |
| Producing independent work | | | | |
| Understanding my strengths and weaknesses | | | | |
| Achieving personal goals | | | | |
| Achieving career goals | | | | |
| My education from IIITU is important to me | | | | |

## 5. Professional Ethics

| What extent do you agree or disagree with the following statements. | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| I show respectful behaviour toward faculty and other students in most of my classes | | | | |
| I actively participate in most class discussions | | | | |
| I usually attend my classes | | | | |
| I usually read the text or other readings prior to class | | | | |
| I study extensively for exams and quizzes | | | | |
| I study a few days before the cycle tests/ end semester exam | | | | |
| I complete all course assignments as explained in syllabus | | | | |
| I ask for help from most of my faculty when I need it | | | | |
| I am motivated to learn course materials | | | | |
| I care about what grade I will receive in most courses | | | | |

**Signature of Student**

# ALUMNI SURVEY FORM

**(Assessment of Outcomes - B. Tech. (IT))**

**Date: __/__/__**

**Name:**

**Year of Graduation:**

**Organization:**

**Address:**

**Phone:**

**E-mail:**

| Overall, are you satisfied with: | Very Satisfied | Generally Satisfied | Generally dissatisfied | Very dissatisfied |
|---|---|---|---|---|
| Demonstrate basic knowledge in mathematics, science, engineering, and humanities. | | | | |
| Define the problems and provide solutions by designing and conducting experiments, interpreting and analyzing data, and reporting the results. | | | | |
| Demonstrate the ability to design Computer Science and Engineering systems | | | | |
| Ability to participate as members of multidisciplinary design teams along with mechanical, electrical, and other engineers | | | | |
| Understand quantitative modelling and analysis of a broad array of systems-level techniques to identify, formulate and solve IT problems | | | | |
| Broadly educated and will have an understanding of ethical responsibilities | | | | |
| Proficient in English language in both communicative and technical forms | | | | |
| Awareness to apply engineering solutions in global, national, and societal contexts. | | | | |
| Capable of self-education and clearly understand the value of updating their professional knowledge to engage in life-long learning | | | | |
| Demonstrate the ability to apply advanced technologies to solve contemporary and new problems | | | | |
| Demonstrate the ability to choose and apply appropriate resource management techniques. | | | | |

**Signature of Alumnus**

# EMPLOYER/SCHOLAR SURVEY FORM

## B. Tech. (IT) IIITU Alumni

**Date: __/__/__**

**Name of the Company Institute:**

**Name of the B.Tech. (IT) IIITU Alumni:**

**Batch: 20__ to 20__**

**Designation of Alumni:**

**Job Specification of Alumni:**

**Name of the Assessor:**

| **How do you rate the current potential of IIITU IT alumni working in your organization on the following criteria:** | **Very Satisfied** | **Generally Satisfied** | **Generally Dissatisfied** | **Very Dissatisfied** |
|---|---|---|---|---|
| Application of mathematical foundations | | | | |
| Application of computer science theory and algorithmic principles | | | | |
| Applications of modelling and design of computer based systems | | | | |
| Application of engineering knowledge in their domain<br>Domain: Health care/ Banking/ Finance/ Medical/ Law/ Others.<br>Others, specify: | | | | |
| Design and conduct of experiments and to analyse and interpret data | | | | |
| Analyze the problem, subdivide into smaller tasks with well-defined interface for interaction among components | | | | |
| Complete the project (given task) within the specified time frame and financial constraints | | | | |
| Proposal of original ideas and solutions | | | | |
| Design, implement, and evaluation of hardware/software systems with security features | | | | |
| Design, implement, and evaluation of hardware/software systems with assured quality and efficiency | | | | |
| Effective communication of engineering solution to peers and leads | | | | |
| Effective communication of engineering solution to customer and users | | | | |
| Understanding of contemporary issues | | | | |
| Engagement of lifelong learning | | | | |

**Signature of Assessor**

# COURSE REGISTRATION FORM

This form has to be submitted, on the day of Registration of Courses, First working day of the odd/even semester, attaching the proof for fee payment.

| | |
|---|---|
| | **INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, UNA [HP]**<br>(An Institute of National Importance under MoE)<br>**Saloh, Una (HP) - 177209**<br>**Website:** www.iiitu.ac.in |

**Date:**

**Student Name:** **Roll No.:**

**Program: B.Tech.** **Branch: CSE/ ECE/ IT**

**AY:** **Semester:**

| S. No. | Subject Code and Title | Credit |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

**Fees Payment Details**

| Date of Payment | Bank | Transaction / DD Number | Amount | Is proof of payment attached |
|---|---|---|---|---|
| | | | | |

Encl.: Proof of Payment details

**Signature of Student** **Faculty In-charge**

# TIME TABLE

| Day | | Mon | Tue | Wed | Thur | Fri |
|---|---|---|---|---|---|---|
| 8:30-9:20 | | | | | | |
| 9:20-10:10 | | | | | | |
| 10:10-10:30 | B R E A K | | | | | |
| 10:30-11:20 | | | | | | |
| 11:20-12:10 | | | | | | |
| 12:10-13:30 | L U N C H | | | | | |
| 13:30-14:20 | | | | | | |
| 14:20-15:10 | | | | | | |
| 15:10-16:00 | | | | | | |
| 16:00-16:50 | | | | | | |


भारतीय सूचना प्रौद्योगिकी संस्थान, ऊना
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, UNA
विद्या सर्वज्ञ गौरवः