# HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT
OF
COMPUTER SCIENCE AND ENGINEERING
(Data Science)

# B.TECH. PROGRAMME

Curriculum and Detailed Syllabus

Release Version 1: JULY 2023

Release Version 2: June 2024

**(Applicable from 2023 admitted batch)**

# Table of Contents


1. Preamble …… **3**
2. Institutional Vision and Mission …….. 4
3. Departmental Vision and Mission ……..... 4
4. Program Educational Objectives (PEO) of CSE(DS) Department ……..... 5
5. Program Outcomes (POs) and Program Specific Outcomes (PSOs) of CSE(DS) Department..6-**7**
6. Credit Summary ……8
7. Curriculum Structure ……9-16
8. Detailed Curriculum ……. 17–
9. APPENDIX – A ……
10. APPENDIX – B…….
11. APPENDIX – C…….

# Preamble

The discipline of data science unifies concepts and techniques from diverse fields such as computing, statistics, machine learning, and social sciences towards the extraction of knowledge from datasets that may be potentially noisy, unstructured, and large in volume. The building blocks of data science consist of data engineering, data analytics, data protection, and data ethics. A typical data science life cycle consists of defining a research question, preparing data, storing and managing data, analysing data, deployment of solutions, and dissemination of results. To meet the growing demand of data science professionals, the Department of CSE (Data Science) has been launched at the Heritage Institute of Technology. The department aims to deliver transformative education and promote high quality research and innovation in data science for meeting local and global challenges. The faculty members of this department offer a learning experience to students that endow them with engineering knowledge, problem analysis techniques, skills for the design and development of solutions and investigation of complex problems, along with familiarity with modern tools and techniques. Additionally, students are imparted the contextual knowledge to assess societal, health, safety, legal and cultural issues and the concomitant responsibilities relevant to professional engineering practice, through understanding and acting upon environment and sustainability concerns, and applying ethical principles. The curriculum also seeks to foster skills among students enabling them to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Communication skills, aptitude in project management and finance, and orientation toward life-long learning are also emphasized in the pedagogy of the Department of CSE (Data Science). Inspired by the focus on internship in NEP 2020, it is now possible to accommodate a relatively longer internship in the industry during the last semester of the B. Tech degree. Students are being motivated to select and study MOOC subjects of their choice towards attaining the degree with Honors. Apart from this, the CSE (Data Science) course code is now changed from 4 letters to 3 letters from the session 2023 – 2024 as per the suggestions came from the office of the Controller of Examinations. In accordance with this, the curriculum and syllabi are revised in a structured manner by implementing Feedback Mechanism on Curriculum from various stakeholders, including potential employers, alumni, and parents.

# Institutional Vision & Mission

**VISION:**

To prepare dynamic and caring citizens to meet the challenges of global society while retaining their traditional values.

**MISSION:**

- To prepare students with strong foundation in their disciplines and other areas of learning.
- To provide an environment for critical and innovative thinking, and to encourage life-long learning.
- To develop entrepreneurial and professional skills.
- To promote research and developmental activities and interaction with industry.
- To inculcate leadership qualities for serving the society.

# Departmental Vision & Mission

**VISION:**

To meet the challenges of 21st century and become a Centre of Excellence (CoE) in the field of Computer Science & Engineering (Data Science).

**MISSION:**

M1: To impart the best educational training and facilities to prepare the students with a strong foundation in their disciplines with a penchant for life-long learning and knowledge sharing.

M2: To inculcate a spirit of entrepreneurship and hone their professional skills through developmental activities and interaction with industry.

M3: To promote a culture of research, collaboration and innovation among students and enable them to conceptualize, analyze and solve problems and projects in their fields of interest.

M4: To help students gain perspective of their gifts, talents and interests and encourage them to learn and assess the best ways to lead a venture and respond to the needs of the society.

M5: To undertake research and development works in leading technologies by forging alliances with research organization, govt. entities, industries and alumni.

# Program Educational Objectives (PEOs)

The graduate students with the B.Tech. degree in Computer Science and Engineering (Data Science) from Heritage Institute of Technology, Kolkata are expected to achieve the following qualities after a few years of getting this degree

**PEO1.** Students will have a strong background of basic science, Mathematics & Engineering and will be receptive towards new ideas, path breaking entrepreneurial ventures, ever rising demands from the industry, and pioneering developments in academics. They will be able to use these tools to respond to associated technical and social challenges with ease.

**PEO2.** Students will have professional competence through life-long learning such as advanced degrees, professional skills and other professional activities related globally to engineering & society. They will be able to apply and share their technical knowledge for the holistic improvement of the socio-economic standards of the community. They can demonstrate technical competence in the field of computer science and engineering with specialization in data science and develop solutions to the complex problems.

**PEO3.** Students will be able to function effectively in a multi-disciplinary environment and individually, within a societal and environmental context. They will be able to organize their professional work and other priorities in their respective domains. They would be also able to relate and compare problems and solutions across industrial R&D, academics and higher education.

**PEO4.** They will be well equipped to inculcate and hone their skills in their respective professional areas and would be able to take individual responsibility and work as a part of a team towards the fulfillment of both individual and organizational goals.

**PEO5.** As and when the requirement arises, the students will be able to lead the same group and pass on their own learning to their peers and subordinates in the group.

# Program Outcomes (POs)

Engineering Graduates will be able to:

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

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

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

**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

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

**PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

# Program Specific Outcomes (PSOs)

At the end of the program, the students of Computer Science and Engineering - Data Science should be able to -

**PSO1. Reflex Action:** Understand the concepts of Data Science and apply them on real-world problems in the relevant fields. They should be able to identify the requirements to build a computational system for a given problem. The ability to categorize the different domains or areas of the sub problems associated with the computational process should come to them naturally.

**PSO2. Perceptual Action:** Analyze, comprehend, design and develop computer systems / subsystems for a variety of engineering applications of computer science, in general and data science, in particular. After analyzing the sub problems, students should be able to formulate corresponding mathematical or logical model(s) for each of them, which are suitable for that domain or area.

**PSO3. Physical Action:** Design and develop tools and algorithms for Data Curation and Data Warehousing and should also be well equipped to construct use case based models for various domains of Business Analytics and Web Mining.

**PSO4. Skilled Action:** Able to implement deep learning algorithms to solve real-world problems and should gain enough expertise to assess the prospective results, analyze the efficiency of each algorithm and choose the optimal solution.

**Credit Summary for B Tech programme in CSE (DS) with effect from 2023-2024**

| Sl. No. | Course Type | Credit CSE (DS) |
|---|---|---|
| 1. | Humanities and Social Sciences including Management Courses | 12 |
| 2. | Basic Science Courses | 27 |
| 3. | Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc. | 27.5 |
| 4. | Professional Core Courses | 51.5 |
| 5. | Professional Elective Courses relevant to chosen Specialization / Branch | 17 |
| 6. | Open Subjects – Electives from other Technical and/or Emerging Subjects | 12 |
| 7. | Project Work, Seminar and Internship in industry or elsewhere | 16 |
| 8. | Mandatory Courses (Non-credit)<br>[Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge] | (NON-CREDIT) |
| | **Total** | **163** |
| 9 | Honours Courses (MOOCS or otherwise) | 20 |
| | **Grand Total** | **183** |

**Definition of Credit (as per National Credit Framework 2022):**

- Total notional learning hours = 1200 Hours/ Year
- Minimum credits to be earned = 40/ Year
- 1 Credit = 30 notional learning hours

**Range of Credits (as per AICTE):**

- A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credit points.
- These could be acquired through MOOCs. For details kindly refer to APPENDIX – A.
- A student will be eligible to get B. Tech. degree certificate, if he/ she acquires 100 MAR points in 4 years of their study.
- Lateral entry students must acquire 75 MAR points in their 3 years of study.

For details kindly refer to APPENDIX – B.

**FIRST YEAR**
**FIRST SEMESTER**

| Sl. | Code | Subject | Contacts Periods/ Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | PHY1001 | Physics-I | 3 | 0 | 0 | 3 | 3 |
| 2 | MTH1101 | Mathematics-I | 3 | 1 | 0 | 4 | 4 |
| 3 | ECE1001 | Introduction to Electronics Devices & Circuits | 3 | 0 | 0 | 3 | 3 |
| 4 | HUM1002 | Universal Human Values and Professional Ethics | 2 | 1 | 0 | 3 | 3 |
| **Total Theory** | | | **11** | **2** | **0** | **13** | **13** |
| **B. Practical** | | | | | | | |
| 1 | PHY1051 | Physics I Lab | 0 | 0 | 2 | 2 | 1 |
| 2 | ECE1051 | Introduction to Electronics Devices & Circuits Lab | 0 | 0 | 2 | 2 | 1 |
| 3 | MEC1051 | Workshop / Manufacturing Practice | 1 | 0 | 3 | 4 | 2.5 |
| 4 | MEC1052 | Engineering Graphics and Design | 1 | 0 | 3 | 4 | 2.5 |
| **Total Practical** | | | **2** | **0** | **10** | **12** | **7** |
| **Total of Semester** | | | **13** | **2** | **10** | **25** | **20** |

**FIRST YEAR**
**SECOND SEMESTER**

| Sl. | Code | Subject | Contacts Periods/ Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | CHM1001 | Chemistry I | 3 | 0 | 0 | 3 | 3 |
| 2 | MTH1201 | Mathematics II | 3 | 1 | 0 | 4 | 4 |
| 3 | CSE1001 | Programming for Problem Solving | 4 | 0 | 0 | 4 | 4 |
| 4 | ELE1001 | Basic Electrical Engineering | 3 | 1 | 0 | 4 | 4 |
| 5 | HUM1001 | English for Technical Writing | 2 | 0 | 0 | 2 | 2 |
| **Total Theory** | | | **15** | **2** | **0** | **17** | **17** |
| **B. Practical** | | | | | | | |
| 1 | CHM1051 | Chemistry I Lab | 0 | 0 | 2 | 2 | 1 |
| 2 | CSE1051 | Programming for Problem Solving Lab | 0 | 0 | 3 | 3 | 1.5 |
| 3 | ELE1051 | Basic Electrical Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| 4 | HUM1051 | English for Technical Writing Lab | 0 | 0 | 2 | 2 | 1 |
| **Total Practical** | | | **0** | **0** | **9** | **9** | **4.5** |
| **Total of Semester** | | | **15** | **2** | **9** | **26** | **21.5** |

## SECOND YEAR
## FIRST SEMESTER

| Sl. | Code | Subject | Contacts Periods/ Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | CSE2101 | Data Structures and Algorithms | 4 | 0 | 0 | 4 | 4 |
| 2 | MTH2103 | Discrete Mathematics | 4 | 0 | 0 | 4 | 4 |
| 3 | DSC2101 | Python Programming | 3 | 0 | 0 | 3 | 3 |
| 4 | ECE2002 | Digital Circuit Design | 3 | 0 | 0 | 3 | 3 |
| 5 | EVS2016 | Environmental Sciences(Mandatory) | 2 | 0 | 0 | 2 | 0 |
| 6 | MTH2102 | Probability and Statistical Methods | 4 | 0 | 0 | 0 | 4 |
| **Total Theory** | | | **20** | **0** | **0** | **20** | **18** |
| **B. Practical** | | | | | | | |
| 1 | CSE2151 | Data Structures and Algorithms Lab | 0 | 0 | 3 | 3 | 1.5 |
| 2 | DSC2151 | Python Programming Lab | 0 | 0 | 2 | 2 | 1 |
| 3 | ECE2052 | Digital Circuit Design Laboratory | 0 | 0 | 2 | 2 | 1 |
| 4 | DSC2155 | Design Thinking and IDEA Lab | 0 | 0 | 2 | 2 | 1 |
| **Total Practical** | | | **0** | **0** | **9** | **9** | **4.5** |
| **Total of Semester** | | | **20** | **0** | **9** | **29** | **22.5** |

## SECOND YEAR
## SECOND SEMESTER

| Sl. | Code | Subject | Contacts Periods/Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | CSE2201 | Design &Analysis of Algorithms | 4 | 0 | 0 | 4 | 4 |
| 2 | CSE2202 | Computer Organization and Architecture | 4 | 0 | 0 | 4 | 4 |
| 3 | DSC2201 | Introduction to R | 3 | 0 | 0 | 3 | 3 |
| 4 | DSC2202 | Operating System with Linux | 2 | 0 | 0 | 2 | 2 |
| 5 | MTH2203 | Operations Research | 4 | 0 | 0 | 4 | 4 |
| 6 | AEI2206 | Introduction to Smart Sensing Technology for AI | 3 | 0 | 0 | 3 | 3 |
| **Total Theory** | | | **20** | **0** | **0** | **20** | **20** |
| **B. Practical** | | | | | | | |
| 1 | CSE2251 | Design & Analysis of Algorithms Lab | 0 | 0 | 3 | 3 | 1.5 |
| 2 | CSE2252 | Computer Architecture Lab | 0 | 0 | 3 | 3 | 1.5 |
| 3 | DSC2251 | R Programming Lab | 0 | 0 | 2 | 2 | 1 |
| 4 | DSC2252 | Linux Lab | 0 | 0 | 2 | 2 | 1 |
| **Total Practical** | | | **0** | **0** | **9** | **9** | **4.5** |
| **Total of Semester** | | | **20** | **0** | **9** | **29** | **24.5** |

## THIRD YEAR
## FIRST SEMESTER

| Sl. | Code | Subject | Contacts Periods/Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | CSE3101 | Database Management Systems | 4 | 0 | 0 | 4 | 4 |
| 2 | CSE3002 | Formal Language & Automata Theory | 4 | 0 | 0 | 4 | 4 |
| 3 | DSC3101 | Introduction to Data Mining | 3 | 0 | 0 | 3 | 3 |
| 4 | DSC3131-<br>DSC3140 | Professional Elective-I | 3 | 0 | 0 | 3 | 3 |
| | DSC3131<br>DSC3132<br>DSC3133 | Robotics<br>Business Analytics<br>Web Mining | | | | | |
| 5 | XXX3141-<br>XXX3150 | Professional Elective-II | 3 | 0 | 0 | 3 | 3 |
| | CSE3141<br>DSC3141 | Artificial Intelligence<br>Data Curation | | | | | |
| 6 | | Open Elective-I | 3 | 0 | 0 | 3 | 3 |
| | AEI3122 | Fundamentals of Sensors and Transducers | | | | | |
| | CHEN3121 | Water and Liquid Waste Management | | | | | |
| | CHEN3122 | Industrial Safety and Hazards | | | | | |
| | ECE3123 | Error Control Coding for Secure data Transmission | | | | | |
| | ECE3124 | Introduction to VLSI Design | | | | | |
| | MEC3121 | Additive Manufacturing | | | | | |
| | MEC3122 | Total Quality Management (TQM) | | | | | |
| | MTH3121 | Linear Algebra | | | | | |
| **Total Theory** | | | **20** | **0** | **0** | **20** | **20** |
| **B. Practical** | | | | | | | |
| 1 | CSE3151 | Database Management Systems Lab | 0 | 0 | 3 | 3 | 1.5 |
| 2 | DSC3151 | Introduction to Data Mining Lab | 0 | 0 | 2 | 2 | 1 |
| 3 | XXX3171-<br>XXX3180 | Professional Elective-II (Lab) | 0 | 0 | 2 | 2 | 1 |
| | CSE3171 | Artificial Intelligence Lab | | | | | |
| | DSC3171 | Data Curation Lab | | | | | |
| **Total Practical** | | | **0** | **0** | **7** | **7** | **3.5** |
| **Total of Semester** | | | **20** | **0** | **7** | **27** | **23.5** |

## THIRD YEAR

## SECOND SEMESTER

| Sl. | Code | Subject | Contacts Periods/Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Theory** | | | | | | | |
| 1 | DSC3201 | Object Oriented Programming Concept | 3 | 0 | 0 | 3 | 3 |
| 2 | AML3001 | Fundamentals of Machine Learning | 3 | 0 | 0 | 3 | 3 |
| 3 | HUM3201 | Economics for Engineers | 3 | 0 | 0 | 3 | 3 |
| 4 | XXX3231-XXX3240 | Professional Elective-III | 3 | 0 | 0 | 3 | 3 |
| | CSE3235<br>IOT3231<br>DSC3231 | Cloud Computing<br>BigData and IOT<br>Data Warehousing | | | | | |
| 5 | | OpenElective-II | 3 | 0 | 0 | 3 | 3 |
| | | Instrumentation and Telemetry<br>Linear Control Systems and Applications<br>Industrial Total Quality Management<br>Software Defined Radio<br>Error Control Coding for secure Data Transmission<br>Methods in Optimization | | | | | |
| 6 | INC3016 | Indian Constitution and Civil Society (Mandatory) | 2 | 0 | 0 | 2 | 0 |
| **Total Theory** | | | **17** | **0** | **0** | **17** | **15** |
| **B. Practical** | | | | | | | |
| 1 | DSC3251 | OOP Concept Lab | 0 | 0 | 3 | 3 | 1.5 |
| 2 | AML3051 | Fundamentals of Machine Learning Lab | 0 | 0 | 3 | 3 | 1.5 |
| 3 | XXX3261-XXX3270 | Professional Elective-III Lab | 0 | 0 | 2 | 2 | 1 |
| | CSE3265 | Cloud Computing Lab | | | | | |
| | IOT3261 | BigData and IOT Lab | | | | | |
| | DSC3261 | Data Warehousing Lab | | | | | |
| **Total Practical** | | | **0** | **0** | **8** | **8** | **4** |
| **C. Sessional** | | | | | | | |
| 1 | DSC3293 | Term Paper and Seminar | 0 | 0 | 4 | 4 | 2 |
| 2 | DSC3295 | Project-I | 0 | 0 | 4 | 4 | 2 |
| **Total Sessional** | | | **0** | **0** | **8** | **8** | **4** |
| **Total of Semester** | | | **17** | **0** | **16** | **33** | **23** |

## FOURTH YEAR
## FIRST SEMESTER

| Sl. | Code | Subject | Contacts Periods/Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A.Theory** | | | | | | | |
| 1 | HUM4101 | Principles of Management | 3 | 0 | 0 | 3 | 3 |
| 2 | DSC4131-<br>DSC4140 | Professional Elective-IV | 3 | 0 | 0 | 3 | 3 |
| | DSC4131<br>DSC4132<br>DSC4133<br>DSC4134<br>DSC4135 | Introduction to Soft Computing<br>Image Processing and Applications<br>Introduction to Deep Learning<br>Introduction to Computer Networks<br>Software Engineering Fundamentals | | | | | |
| 3 | XXX4141-<br>XXX4150 | Professional Elective-V | 3 | 0 | 0 | 3 | 3 |
| | CSE4141<br>CSE4143<br>CSE4145<br>CSE4146<br>DSC4141 | Natural Language Processing<br>Pattern Recognition<br>Social Network Analysis<br>Computer Vision<br>Fundamentals of Compiler Design | | | | | |
| 4 | | Open Elective-III | 3 | 0 | 0 | 3 | 3 |
| | AEI4127<br>BIO4124<br>ECE4127<br>ECE4128<br>MTH4126 | Introduction to Embedded System<br>Biosensor<br>Ad Hoc Wireless Networks<br>Introduction to VLSI Design<br>Linear Algebra | | | | | |
| 5 | | Open Elective-IV | 3 | 0 | 0 | 3 | 3 |
| | AEI4221<br>AEI4222<br>BIO4221<br>BIO4222<br>BIO4223<br>CHE4222<br>ECE4223 | Process Instrumentation<br>Medical Instrumentation<br>Computational Biology<br>Non-conventional Energy<br>Biology for Engineers<br>Introduction to Solar and Wind Technology<br>Optical Fiber Communication | | | | | |
| **Total Theory** | | | **15** | **0** | **0** | **15** | **15** |
| **B.Practical** | | | | | | | |
| | DSC4161-<br>DSC4165 | Professional Elective-IV(Lab) | 0 | 0 | 2 | 2 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | DSC4161<br>DSC4162<br>DSC4163<br>DSC4164<br>DSC4165 | Introduction to Soft Computing Lab<br>Introduction to Image Processing Lab<br>Deep Learning Lab<br>Fundamentals of Computer Networks Lab<br>Software Engineering Fundamentals Lab | | | | | |
| **Total Practical** | | | **0** | **0** | **2** | **2** | **1** |
| **C. Sessional** | | | | | | | |
| 1 | DSC4191 | Industrial Training/ Internship | - | - | - | - | 2 |
| 2 | DSC4195 | Project-II | 0 | 0 | 6 | 6 | 3 |
| **Total Sessional** | | | **0** | **0** | **6** | **6** | **5** |
| **Total of Semester** | | | **15** | **0** | **6** | **23** | **21** |

**FOURTH YEAR**

**SECOND**

**SEMESTER**

| Sl. | Code | Subject | Contacts Periods/ Week | | | | Credit Points |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | |
| **A. Sessional** | | | | | | | |
| 1 | DSC4295 | Project-III | 0 | 0 | 10 | 10 | 5 |
| 2 | DSC4297 | Comprehensive Viva-voce | - | - | - | - | 2 |
| **Total Sessional** | | | **0** | **0** | **10** | **10** | **7** |
| **Total of Semester** | | | **0** | **0** | **10** | **10** | **7** |

****Credit : 163**

**DETAILED SYLLABUS**

# 1st Year

## A. THEORY COURSES

### FIRST YEAR
### FIRST SEMESTER

| Course Title : Physics-I | | | | | |
|---|---|---|---|---|---|
| **Course Code: PHY1001** | | | | | |
| **Contact hrs per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

***Course Outcome:***

*After successfully completing this course the students will be able to:*

1. Understanding physical systems in terms of their modelling of time evolution.
2. Comprehending wave interpretation of natural phenomena and implications of allied observations.
3. Understanding theoretical backgrounds associated to some experiments based on wave phenomena.
4. Grasping an analytic view of micro and macroscopic world.
5. Accessing the knowledge of the behaviour of a particle under the influence of different potential.
6. Understanding conservative systems based on their particle and wave nature.

**DETAILED SYLLABUS:**

**Module –I [10L]**

**Mechanics:**

Plane-polar coordinate system-velocity and acceleration of a particle-trajectory under central force-conservation principle-Kepler's laws -Rotating frame of reference-Five point acceleration formula-Coriolis effect-deflection of a moving particle.

**Module – II [10L]**

**Oscillation:**

Constitutive equation of damping-nature of solutions for large, critical and weak damping-relaxation time, logarithmic decrement, energy decay (qualitative discussion) -Forced oscillation-transient and steady state-amplitude and velocity resonance---power transfer theorem-quality factor-series LCR circuit with AC source.

**Module –III [10L]**

**Optics:**

Plane Progressive Wave-phase/wave-length/frequency-qualitative description of light as an electromagnetic wave-Huygens principle-polarization (state of polarization, general equation of ellipse, transformation of polarized lights)-interference (basic theory from superposition principle)-Division of wave front (Young's double slit experiment)-Division of amplitude (thin film, wedge, Newton's ring)-Diffraction (single slit, double slit, grating, Resolving Power).

**Module – IV [10L]**

**Quantum Mechanics :**

An informal discussion from Planck to de Broglie as the historical context of quantum mechanics-Quantum Mechanics of a particle-operator-eigenvalue problem- Unitary-Hermitian frame work-position and momentum operator-Canonical Commutation Relations (CCR)- Schrodinger equation-time dependent/time independent Schrodinger equation-wave function-stationary states-probability density-probability current density-normalization-expectation value-uncertainty-Bound state problem-particle in a one dimensional box- scattering state problem-potential step-reflection and transmission coefficients- tunnelling.

**BOOKS**


1. Theoretical Mechanics : M R Spiegel (Schaum Series) McGrow-Hill Book Company
2. Classical Mechanics : N C Rana and P S Joag Tata- McGrow-Hill Publishing Company Limited.
3. Vibrations and Waves : A P French, W W Norton and Company,
4. The Physics of Waves and Oscillations : N K Bajaj, Tata- McGrow-Hill Publishing Company Limited.
5. Optics : A Ghatak, Tata McGraw-Hill Publishing Company Limited.
6. Optics : E. Hecht, Addison Wesley
7. Fundamentals of Optics : F A Jenkins and H E White, McGrow-Hill Higher Education.
8. Atomic Physics (Modern Physics): S N Ghosal, S. Chand and Company.
9. Practical Quantum Mechanics : S Flugge, Springer (Reprint of the 1994 Edition)
10. Concepts of Modern Physics : A Baiser, Tata McGraw-Hill Publishing Company Limited.

Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

| Paper Name:**MATHEMATICS-I** | | | | | |
|---|---|---|---|---|---|
| Paper Code:**MTH 1101** | | | | | |
| Contact hours per week: | L | T | P | Total | Credit Points |
| | 3 | 1 | 0 | 4 | 4 |

**After successfully completing this course the students will be able to:**

MTH1101.1 Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
MTH1101.2 Develop the concept of eigen values and eigen vectors.
MTH1101.3 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
MTH1101.4 Analyze the nature of sequence and infinite series
MTH1101.5 Choose proper method for finding solution of a specific differential equation.
MTH1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

**Detailed Syllabus:**

**Module I:[10L]**

**Matrix:** Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

**Module II:[10L]**

**Vector Calculus:** Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics.

**Infinite Series:** Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

**Module III:[10L]**

**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**Ordinary differential equations of higher orders:**General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

**Module IV:[10L]**

**Calculus of functions of several variables:** Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables.

**Multiple Integration:** Concept of line integrals, Double and triple integrals. Green's Theorem, Stoke'sTheorem and Gauss Divergence Theorem.

**References:**


1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis(Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry ( PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

| **Course Title : Introduction to Electronics Devices & Circuits** | | | | | |
|---|---|---|---|---|---|
| **Course Code : ECE 1001** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After going through this course, the students will be able to:

1. Categorize different semiconductor materials based on their energy bands and analyze the change in characteristics of those materials due to different types of doping.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode.
3. Design different application specific circuits using diodes.
4. Analyze various biasing configurations of Bipolar Junction Transistor.
5. Categorize different field-effect transistors and analyze their behavior.
6. Design and implement various practical electronic circuits.

**Module I [10 L]**
**Basic Semiconductor Physics:**
Crystalline materials, energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermienergy level, intrinsic and extrinsic semiconductors, mass action law, drift and diffusion currents insemiconductor, Einsteinrelation.
**Diodes and Diode Circuits:**
Formation of p-n junction, energy band diagram, forward & reverse biased configurations, V-I characteristics,DC load line, breakdown mechanisms - Zener and avalanche breakdown, voltage regulation using Zener diode.
Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency, rectifier output without and with filters. Light emitting diode.

**Module II [8 L]**
**Bipolar Junction Transistors (BJT):**

PNP & NPN BJT structures, different operating modes of BJT, current components in BJT, dc current gains in CE & CB configurations and their interrelation,input& output V-I characteristics of CE & CB configurations. Concept of Biasing: DC load line, Q-point, basic concept of amplification using BJT.

**Module III [9 L]**
**Field Effect Transistors (FET):**
Classification of FET, basic structure and operation of Junction Field Effect Transistor (n-channel)along with its V-I characteristics.
Metal Oxide Semiconductor Field Effect Transistor (MOSFET): Enhancement & depletion type MOSFETs (forboth n & p channel devices), drain & transfer characteristics.

**Module IV [9 L]**
**Feedback in amplifiers:**
Concept of feedback, different feedback topologies using block diagram only, effects of negative feedback(qualitative), Barkhausen criteria for sustained oscillation.
**Operational Amplifier:**
Usefulness of differential amplifier over single ended amplifier, ideal OPAMP characteristics, transfer characteristics of OPAMP, CMRR, slew rate,offset error voltages and current, concept of virtual ground
Basic circuits using OPAMP:Comparator, inverting and non-inverting amplifiers, voltage follower, adder, subtractor, integrator, differentiator.

**References:**


1. Boylestad&Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman&Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.


| **Course Title : Universal Human Values and Professional Ethics** | | | | | |
|---|---|---|---|---|---|
| **Course Code : HUM-1002** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 3 | 0 | 0 | 3 | 3 |

**COURSE OUTCOMES:**
The students will be:

**HUM1002.1** aware of the value system and the importance of following such values at workplace
**HUM1002.2** learn to apply ethical theories in the decision making process
**HUM1002.3** follow the ethical code of conduct as formulated by institutions and organizations

**HUM1002.4** Implement the principles governing work ethics
**HUM1002.5** Develop strategies to implement the principles of sustainable model of development
**HUM1002.6** Implement ecological ethics wherever relevant and also develop eco-friendly technology

**Module I (10 L)**

**Human society and the Value System**

Values: Definition, Importance and application. Formation of Values: The process of Socialization

Self and the integrated personality Morality, courage, integrity

**Types of Values:**

Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism Aesthetic Values: Perception and appreciation of beauty

Organizational Values: Employee: Employer--- rights, relationships, obligations Psychological Values: Integrated personality and mental health

Spiritual Values &their role in our everyday life

Value Spectrum for a Good Life, meaning of Good Life

**Value Crisis in Contemporary Society**

Value crisis at----

Individual Level Societal Level Cultural Level

Value Crisis management Strategies and Case Studies

**Module II [10L]**

Ethics and Ethical Values Principles and theories of ethics

Consequential and non-consequential ethics

Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives Ethics of care, justice and fairness, rights and duties

**Ethics**--

Standardization Codification Acceptance Application

Types of Ethics- Ethics of rights and Duties

Ethics of Responsibility Ethics and Moral judgment Ethics of care

Ethics of justice and fairness

Work ethics and quality of life at work

**Professional Ethics**

Ethics in Engineering Profession;

Moral issues and dilemmas, moral autonomy (types of inquiry) Kohlberg's theory, Gilligan's theory (consensus and controversy)

Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers

Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)

Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership Conflict between business demands and professional ideals

Social and ethical responsibilities of technologies.

**Whistle Blowing**: Facts, contexts, justifications and case studies

**Ethics and Industrial Law**

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

**Module III [10L]**

**Science, Technology and Engineering**

Science, Technology and Engineering as knowledge and profession

Definition, Nature, Social Function and Practical application of science Rapid Industrial Growth and its Consequences

Renewable and Non- renewable Resources: Definition and varieties Energy Crisis

Industry and Industrialization Man and Machine interaction

Impact of assembly line and automation Technology assessment and Impact analysis Industrial hazards and safety

Safety regulations and safety engineering Safety responsibilities and rights

Safety and risk, risk benefit analysis and reducing risk Technology Transfer: Definition and Types

The Indian Context

**Module IV [6L]**

**Environment and Eco- friendly Technology**

Human Development and Environment Ecological Ethics/Environment ethics

Depletion of Natural Resources: Environmental degradation Pollution and Pollution Control

Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept

Strategies for sustainable development Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development Reports of Club of Rome.

**Suggested Readings:**


1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006
2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996. 3)Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008. 4)Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008. 5)Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
3. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
4. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).


| **Course Title : Physics-I Laboratory** | | | | | |
|---|---|---|---|---|---|
| **Course Code: PHY1051** | | | | | |
| **Contact hrs per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**Course Outcomes:**

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
5. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

## Minimum of six experiments taking at least one from each of the following four groups:

**Group 1 : Experiments in General Properties of matter**

1. Determination of Young's modulus by Flexure Method
2. Determination of bending moment and shear force of a rectangular beam of uniform cross- section.
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method.
5. Determination of coefficient of viscosity by Poiseulle's capillary flow method.

**Group 2: Experiments in Optics**

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of light by Newton's ring method.
3. Determination of wavelength of light by Fresnel's biprism method.
4. Determination of the wavelength of a given laser source by diffraction method

**Group 3: Electricity & Magnetism experiments**

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of
3. logarithmic decrement with series resistance.
4. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
5. Determination of specific charge (e/m) of electron.

**Group 4: Quantum Physics Experiments**

7. Determination of Planck's constant.
8. Determination of Stefan's radiation constant.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
11. Determination of Hall co-efficient of semiconductors.
12. Determination of band gap of semiconductors.
13. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

**Books of reference:**


1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert ResnickJearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, PramodJoag, McGraw HillEducation
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

| Course Title : Introduction to Electronics Devices & Circuits Laboratory | | | | | |
|---|---|---|---|---|---|
| **Course Code : ECE 1051** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 0 | 0 | 2 | 2 | 1 |

Course Outcomes:

1. The students will correlate theory with diode behavior.
2. They will design and check rectifier operation with regulation etc.
3. Students will design different modes with BJT and FET and check the operations.
4. They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-metersetc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

| Course Name: WORKSHOP /MANUFACTURING PRACTICES | | | | | |
|---|---|---|---|---|---|
| **Course Code: MEC 1051** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **1** | **0** | **3** | **4** | **2.5** |

## Course Outcomes:

On successful completion of the course, students will be able to

CO1: **Follow** the various safety practices in workshop and personal protective elements.

CO2: **Identify** tools, work material and measuring instruments useful for fitting, carpentry and sheet metal practices.

CO3: **Operate** machine tools, components and processes to prepare jobs of specific shape and size.

CO4: **Acquire** knowledge of foundry process and casting of a product.

CO5: **Perform** welding, brazing and soldering processes.

CO6: **Assemble** a simple product.

**Syllabus:**

**(i) Lectures: (13 hours)**

**Detailed contents**

| | |
|---|---|
| 1. Introduction on Workshop and familiarization with safety norms | **(1 lecture)** |
| 2. Carpentry and Fitting | **(2 lectures)** |
| 3. Sheet metal | **(1 lecture)** |
| 4. Metal casting | **(1 lecture)** |
| **5.** Welding (arc welding & gas welding), brazing and soldering | **(2 lectures)** |
| 6. Manufacturing Methods- machining (Lathe, Shaping and Milling) | **(4 lectures)** |
| 7. Additive manufacturing | **(1 lecture)** |
| 8**.** Assembling of a product | **(1 lecture)** |

**(ii) Workshop Practice:(39 hours)**

| | |
|---|---|
| 1. Safety practices in workshop | **(3 hours)** |
| 2. Carpentry shop | **(3 hours)** |
| 3. Fitting shop | **(6 hours)** |
| 4. Foundry shop | **(3 hours)** |
| 5.Machine shop | **(9 hours)** |
| 6. Welding shop-Arc welding | **(3 hours)** |
| 7. Sheet metal shop and brazing | **(6 hours)** |
| 8. Soldering operation | **(3 hours)** |
| 9**.** Assembling of a product | **(3 hours)** |

**Suggested Text/Reference Books:**

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements ofWorkshop Technology”, Vol. I 2008 and Vol. II 2010, Media promotersandpublishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”,4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,”Manufacturing Technology – I” PearsonEducation, 2008.
4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice HallIndia, 1998.
5. 5. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House,2017.

| Course Name: ENGINEERING GRAPHICS & DESIGN | | | | | |
|---|---|---|---|---|---|
| **Course Code: MEC 1052** | | | | | |
| **Contacthours per week:** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **1** | **0** | **3** | **4** | **2.5** |

**Course Outcomes:**

After going through the course, the students will be able to

1. Visualize the basic concept of engineering drawing.
2. Use engineering drawing tools (conventional / modern tools).
3. Apply the various standards and symbols followed in engineering drawing.
4. Implement the concept of projections used in engineering graphics.
5. Relate the concept of sections to determine its true shape.
6. Execute the concept of isometric projections.

**Lecture Plan (13 L)**

1. Importance and principles of engineering drawing (1 L)
2. Lettering (1 L)
3. Concepts of Scale, dimensioning and Conic sections (3 L)
4. Introduction to concept of projection (Projections of points, lines and surfaces) (3 L)
5. Definitions of different solids and their projections (1 L)
6. Section of solids and sectional view (1 L)
7. Isometric projection (1 L)
8. Introduction to CAD (1 L)

**Detailed contents of Laboratory hours (39 hours)**

**Module 1: Introduction to Engineering Drawing covering, (3 hours)**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic sections like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

**Module 2: Orthographic Projections covering, (9 hours)**

Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

**Module 3: Projections of Regular Solidscovering, (6 hours)**

Those axes inclined to both the Planes- Auxiliary Views.

**Module 4: Sections and Sectional Views of Right Angular Solids covering, (3 hours)**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Sectional orthographic views of geometrical solids.

**Module 5: Isometric Projections covering, (6 hours)**

Principles of Isometric projection -Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

**Module 6: Overview of Computer Graphics covering, (3 hours)**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

**Module 7: Customization& CAD Drawing, (3 hours)**

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

**Module 8: Annotations, layering & other functions covering, (3 hours)**

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques;

Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

**Module 9: Demonstration of a simple team design project that illustrates (3 hours)**

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

**References:**


1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing"; CharotanPublishing House
2. Narayana, K.L. and Kannaaiah P "Engineering Graphics"; TMH
3. Lakshminarayanan, V. and VaishWanar, R.S "Engineering Graphics" Jain Brothers.
4. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Edication.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

**FIRST YEAR**
**SECOND SEMESTER**

| **Subject Name: Chemistry I** | | | | | |
|---|---|---|---|---|---|
| **Subject Code: CHM1001** | | | | | |
| **Contact Hours per week** | L | T | P | Total | Credit Points |
| | 3 | 0 | 0 | 3 | 3 |

**Course outcome for the Subject Code CHM1001**

The subject code CHM-1001 corresponds to Chemistry Theory classes (**Chemistry I**) for the first year B. Tech students, offered as Chemistry for Engineering and is common to all Branches of Engineering Disciplines. The course provides basic knowledge of theory and applications in the subjects like Thermodynamics, Quantum mechanics, Electrochemistry, & Energy conversion, Structure and reactivity of molecules. Spectroscopic techniques and their applications, Synthesis & use of Drug molecules. The Course Outcomes for the subject code **CHM1001** are furnished below:

CHM1001.1. Knowledge acquisition of bulk properties of materials and understanding of reaction processes using thermodynamic considerations.

CHM1001.2. Conception of energy conversion and its importance in clean energy scenario, the operating principles for batteries, fuel cells and the materials and reactions involved there in, their applications as sustainable energy devices, particularly in automobiles sectors to reduce environmental pollution.

CHM1001.3. Analytic view of microscopic chemistry in terms of atomic structure, molecular orbital and intermolecular forces to reinforce strong background on materials science and engineering.

CHM1001.4. Rationalize periodic trends of elements to explain various physico - chemical properties.

CHM1001.5. Understanding of the spectrum of electromagnetic radiation used for exciting different molecular energy levels in various spectroscopic techniques.

CHM1001.6. Knowledge of stereochemistry and conception of the mechanism of major chemical reactions involved in synthesis of drug molecules.

**MODULE 1**

**Thermodynamics**

The 1st and 2nd laws of thermodynamics and thermodynamic functions like free energy, work function and entropy; Carnot cycle, Joule-Thomson effect, Gibbs-Helmholtz equation; Chemical Potential, Gibbs- Duhem Equation and Clausius-Clapeyron Equation.

**5L**

**Electrochemical Cell**

Generation of electromotive force in electrochemical cells and application of Nernst equation; Electrode potentials and the redox reactions; Cell configuration and half cell reactions; Standard Hydrogen Electrode, Reference electrode, evaluation of thermodynamic functions; Electrochemical corrosion. Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

**4L**

**MODULE 2**

**Molecular Structure**

Molecular geometry, Hybridization, Ionic, dipolar and van Der Waals interactions; Molecular Orbital Theory and its application indiatomic molecule; Pi-molecular orbital of unsaturated system; Band structure of solids, intrinsic and extrinsic semiconductors and the role of doping on band structures.

**5L**

**Periodic Properties**

Effective nuclear charge, penetration of orbitals; variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes; ionization energies, electron affinity and electro-negativity, polarizability, oxidation states, coordination numbers and geometries; hard-soft acid base theory.

**4L**

**MODULE 3**

**Atomic structure and Wave Mechanics**

Brief outline of the atomic structure, wave particle duality, Heisenberg uncertainty principle; Introduction to quantum mechanics, Schrodinger wave equation for particle in one dimensional box.

**5L**

**Spectroscopic Techniques & Applications**

Electromagnetic spectrum: Interaction of EMR with matter; Principle and applications of

Fluorescence & Phosphorescence, UV-Visible, Infrared and NMRspectroscopy

**4L**

**MODULE 4**

**Stereochemistry**

Representations of 3- dimensional structures, structural isomers and stereo-isomers, configurations, symmetry and chirality; enantiomers, diastereomers, optical activity, absolute configurationsand conformational analysis.

**5L**

**Organic reactions and synthesis of drug molecules**

Introduction to reaction mechanism: substitution, addition, elimination and oxidation, reduction reactions. Synthesis of commonly used drug molecules.

**4L**

**TEXT BOOKS**


1. Atkins' Physical Chemistry, P.W. Atkins ($10^{th}$Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 ($6^{th}$Edition)
3. Engineering Chemistry, Jain & Jain,($16^{th}$Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, ($2^{nd}$Edition)
5. Engineering Chemistry -I, GourkrishnaDasmohapatra, ($3^{rd}$Edition)


**REFERENCE BOOKS**


1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, ($7^{th}$Edition)
3. Organic Chemistry, Morrison &Boyd , ($7^{th}$Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, ($4^{th}$Edition)
5. Physical Chemistry, G. W. Castellan, ($3^{rd}$Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, ($1^{st}$Edition)

| Course Title: Mathematics-II | | | | | |
|---|---|---|---|---|---|
| **Course Code: MTH1201** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 3 | 1 | 0 | 4 | 4 |

**Course Outcomes**

MTH1201. 1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MTH1201. 2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MTH1201. 3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MTH1201. 4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MTH1201. 5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MTH1201. 6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

The objective of this course is to familiarize the students with numerical techniques, integral transforms, graph theory and probability. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

**Module-I Fundamentals of Probability [10L)**

Random experiment, Sample space and events

Classical and Axiomatic definition of probability

Addition and Multiplication law of probability

Conditional probability

Bayes' Theorem

Random variables

General discussion on discrete and continuous distributions

Expectation and Variance

Examples of special distribution: Binomial and Normal Distribution

**Module-II Numerical Methods [10L]**

Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

Solution of linear system of equations: Gauss elimination method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method.

Solution of Ordinary differential equations: Euler's and Modified Euler's Method ,Runge-Kutta Method of 4th order.

**Module-III Basic Graph Theory [10L]**

Graphs: Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph

Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices

Matrix representation of a graph, Adjacency and incidence matrices of a graph

Graph isomorphism

Bipartite graph

Definition and properties of a tree

Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees

Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms

**Module-IV Laplace Transformation [10L]**

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Introduction to integral transformation

Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only)

LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT

LT of periodic and step functions

Definition and properties of inverse LT

Convolution Theorem (statement only) and its application to the evaluation of inverse LT

Solution of linear ODEs with constant coefficients (initial value problem) using LT

**Suggested Books:**

1. Advanced Engineering Mathematics , E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

| Course Title: Programming for Problem Solving | | | | | |
|---|---|---|---|---|---|
| **Course Code: CSE1001** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 4 | 0 | 0 | 4 | 4 |

**Course Outcomes:**

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

**CSE1001.1:** Remember and understand the functionalities of the different hardware and software components present in a computer system, the standard representations of various types of data in a computer system.

**CSE1001.2:**Illustrate how a computer system with one way of representation can be converted to one another equivalent representation.

**CSE1001.3:** Construct flow charts for any arithmetic or logical problems in hand.

**CSE1001.4:** Remember and understand the C programming development environment, writing, compiling, debugging, linking and executing a C program using that development environment, basic syntax and semantics of C programming language and interpret theoutcome of any given C program.

**CSE1001.5:** Use loop constructs, conditional branching, iteration, recursion to solve simpleengineering problems.

**CSE1001.6:** Apply pointers, arrays, structures, files to formulate simple engineeringproblems.

**Learning Objectives:** Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

**Module I: [10L] Fundamentals of Computer**

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX How to write algorithms & draw flow charts.

**Module II: [10L] Basic Concepts of C**

**C Fundamentals:**

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

**Module III: [10L]**

**Program Structures in C**

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes -

auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables. C preprocessor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

**Module IV: [10L]**

**Data Handling in C**

**User defined data types and files:**

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell();

**Text Books**


1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy


**Reference Books**


1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

| Course Title: Basic Electrical Engineering | | | | | |
|---|---|---|---|---|---|
| **Course Code: ELE1001** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 3 | 1 | 0 | 4 | 4 |

**Course Outcomes**

After attending the course, the students will be able to

1. Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
2. Analyse DC Machines; Starters and speed control of DC motors.
3. Analyse magnetic circuits.
4. Analyse single and three phase AC circuits.
5. Analyse the operation of single phase transformers.
6. Analyse the operation of three phase induction motors.

**Module-I: [11 L]**

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

**Module-II[10L]**

**AC single phase system:** Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

**Module-III [11 L]**

**Three phase system:** Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L]

**DC Machines:** Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.[7L]

**Module-IV [10L]**

**Transformer:** Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer.[6L]

**Three-phase induction motor:** Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.[4L]

**Text Books:**


1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle&Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand& Company


**Reference Books:**


1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, DhanpatRai
5. Basic Electrical Engineering, Nath&Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

| Course Title: English for Technical Writing | | | | | |
|---|---|---|---|---|---|
| **Course Code: HUM1001** | | | | | |
| **Contact Hours per week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | 2 | 0 | 0 | 2 | 2 |

**Course Outcome**: Students will be able to

1. Communicate effectively in an official and formal environment
2. Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment
3. Use various techniques of communication for multiple requirements of globalized workplaces
4. Learn to articulate opinions and views with clarity.
5. Write business letters and reports.
6. Apply various communication strategies to achieve specific communication goals.

**Module- I (6hrs.)**

Introduction to Phonology and Morphology

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Vocabulary Building-The concept of Word Formation

**Module- II (6hrs.)**

Communication Skills

- The Basics of Business Communication- Process, types, levels
- Barriers to Communication Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections
- Identify common audiences and design techniques for communicating with each audience

**Module- III (6hrs.)**

Organizational Communication

- Business Letters
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organizing e-mail messages, E-mail etiquette
- Techniques for writing precisely: Creating coherence, organizing principles –accuracy, clarity, brevity. Different styles of writing: descriptive, narrative, expository.

**Module- IV (6hrs.)**

Principles, techniques and skills for professional writing

- Logic in writing, thinking and problem-solving; applying deductive and inductive reasoning; Use of infographics in writing.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies. Interpreting data and writing reports
- Writing proposals and Statement of purpose

**Text Books:**


1 Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011


**Reference Books:**


1. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
2. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.


| **Subject Name: Chemistry Lab** | | | | | |
|---|---|---|---|---|---|
| **Subject Code: CHM1051** | | | | | |
| **Contact Hours per week** | L | T | P | Total | Credit Points |
| | 0 | 0 | 2 | 2 | 1 |

**Course outcome for the subject code CHM1051**

The subject code CHM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipments. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are

CHM1051.1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.

CHM1051.2. Estimation of ions like $Fe^{2+}$, $Cu^{2+}$ and $Cl^{-}$ present in water sample to know the composition of industrial water.

CHM1051.3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.

CHM1051.4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.

CHM1051.5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.

CHM1051.6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

**Experiments**

1. Estimation of iron using KMnO4self indicator.
2. Iodometric estimation of $Cu^{2+}$.
3. Determination of Viscosity.
4. Determination of surface tension.
5 Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

**Reference Books**


1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

| Course Title : Programming for Problem Solving Lab | | | | | |
|---|---|---|---|---|---|
| Course Code : CSE1051 | | | | | |
| Contact hrs per week: | L | T | P | Total | Credit points |
| | 0 | 0 | 3 | 3 | 1.5 |

**Course Outcomes:**

After completion of this course the students should be able:

1. To write simple programs relating to arithmetic and logical problems.
2. To be able to interpret, understand and debug syntax errors reported by the compiler.
3. To implement conditional branching, iteration (loops) and recursion.
4. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
5. To use arrays, pointers and structures effectively in writing programs.
6. To be able to create, read from and write into simple text files.

**Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX**

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings Topic

9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling

**Text Books**

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

| **Course Title : Basic Electrical Engineering Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code : ELE1051** | | | | | |
| **Contact hrs per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**Course Outcomes:** The students are expected to

1. Get an exposure to common electrical apparatus and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the application of common electrical measuring instruments.
4. Understand the basic characteristics of different electrical machines.

**List of Experiments:**

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's& Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

| Course Title : English for Technical Writing Laboratory | | | | | |
|---|---|---|---|---|---|
| **Course Code : HUM1051** | | | | | |
| **Contact hrs per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**Course Outcome:** Students will be able to

1 .**HUM1051.1** Communicate in an official and formal environment.
2. .**HUM1051.2** Effectively communicate in a group and engage in relevant discussion.
3. .**HUM1051.3** Engage in research and prepare presentations on selected topics.
4 **HUM1051.4** Understand the dynamics of multicultural circumstances at workplace and act accordingly.
5. **HUM1051.5** Organize content in an attempt to prepare official documents.
6. **HUM1051.6** Appreciate the use of language to create beautiful expressions

**Detailed Syllabus**

**Module- I (6hrs.)**

The Art of Speaking

- Techniques for Effective Speaking
- Voice Modulation: Developing correct tone
- Using correct stress patterns: word stress, primary stress, secondary stress. Rhythm in connected speech
- Encoding Meaning Using Nonverbal Symbols,
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Structuring content for delivery in accordance with time, platform, and audience.

**Module- II (6hrs)**

Group Discussion

- Nature and purpose and characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure

**Module- III (6hrs)**

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
- Cover Letter & CV

- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

**Module- IV (6hrs.)**

Professional Presentation Skills

- Nature and Importance of Presentation skills
- Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.
- Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides
- Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, and provide closure.
- Improving Delivery: Choosing Delivery methods, handling stage fright
- Post-Presentation discussion: Handling Questions-opportunities and challenges.

**References:**


1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A., Campus Placements, McGraw Hill Education.2015

**DETAILED SYLLABUS**

# 2nd Year

# SECOND YEAR
# FIRST SEMESTER

| Course Name: Data Structures & Algorithms | | | | | |
|---|---|---|---|---|---|
| Course Code:CSE2101 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 4 | 0 | 0 | 4 | 4 |

**Course Outcomes**
After completion of the course, students will be able to:

**CSE2101.1.** Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
**CSE2101.2.** Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)
**CSE2101.3.** Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
**CSE2101.4.**Analyse the behaviour of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)
**CSE2101.5.** Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
**CSE2101.6.** Evaluate different types of solutions (e.g. sorting) to the same problem.

**Detailed Syllabus Module I [8L]**

**Introduction:** Why do we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type; Algorithms and programs, basic idea of pseudo- code. Algorithm efficiency and analysis, time and space analysis of algorithms – Big O, Ω, Θ, notations.

**Array:** Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

**Linked List:** Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

**Module II [8L]**

**Stack and Queue:** Stack and its implementations (using array, using linked list), applications. Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.

**Recursion:** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle (Concept of Backtracking).

**Module III [13L]**

**Trees:** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non- recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

**Graphs:** Graph definitions and Basic concepts (directed/undirected graph, weighted/un- weighted edges, sub-graph, degree, cut vertex/articulation point, complete graph, simple path, simple cycle). Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

**Module IV [11L]**

**Sorting Algorithms:** Bubble sort and its optimizations, Cocktail Shaker Sort, Insertion sort, Selection sort, Quicksort (Average Case Analysis not required), Heap sort (concept of max heap, application – priority queue), Counting Sort, Radix sort.

**Searching:** Sequential search, Binary search, Interpolation search.

**Hashing:** Hashing functions, collision resolution techniques (Open and closed hashing).

**1.** Textbooks


1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.


**2.** Reference Books


Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

| Course Name: Discrete Mathematics | | | | | |
|---|---|---|---|---|---|
| Course Code: MTH2103 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 4 | 0 | 0 | 4 | 4 |

**Course Outcomes**

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

**MTH2103.1.** Interpret the problems that can be formulated in terms of graphs and trees.

**MTH2103.2.** Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.

**MTH2103.3.** Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.

**MTH2103.4.** Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.

**MTH2103.5.** Analyze the logical fundamentals of basic computational concepts.

**MTH2103.6.** Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

**Detailed Syllabus**

**Module I [10L]**

**Graph Theory:** Tree, Binary Tree, Spanning Tree. Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem. Planar Graph, Euler's Formula for Planar Graph and Related Problems. Examples of Non-Planar Graphs. Kuratowski's Theorem. Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems. Vertex Colouring, Chromatic Polynomials.

**Module II [10L]**

**Number Theory:** Well Ordering Principle, Principle of Mathematical Induction, Divisibility theory and properties of divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm for finding greatest common divisor (GCD) and some basic properties of GCD with simple examples, Congruence and its properties, Residue classes of integer modulo and its examples, Fermat's Theorem, Wilson's Theorem and Chinese Remainder Theorem.

**Module III [10L]**

**Combinatorics:** Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations, Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion, Generating Functions and Recurrence Relations: Solving Recurrence Relations using Generating Functions and other Methods.

**Module IV [10L]**

**Propositional Calculus:** Propositions, Logical Connectives, Truth Tables, Conjunction, Disjunction, Negation, Implication, Converse, Contra positive, Inverse, Biconditional Statements, Logical Equivalence, Tautology, Normal Forms, CNF and DNF, Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

**Textbooks**


1. T. Veerarajan, Discrete Mathematics, McGraw Hill Education.
2. J. L. Mott, A. Kandel and T. P. Baker, Discrete Mathematics for ComputerScientists and Mathematicians, Prentice Hall.
3. David M. Burton, Elementary Number Theory, McGraw Hill Education.
4. Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006.


**Reference Books**


1. Beginning Number Theory, Neville Robbins, Narosa Publishing House
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw- Hill
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, Tata McGraw Hill
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science, Tata McGraw Hill
5. Norman L. Biggs, Discrete Mathematics, Oxford University Press, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson
6. S.K. Mapa, Higher Algebra(Classical), Sarat Book Distributors

| Course Name: Python Programming | | | | | |
|---|---|---|---|---|---|
| Course Code: DSC2101 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 3 | 0 | 0 | 3 | 3 |

**Course Outcomes**

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

**DSC2101.1.**Understand the basics of the Python Programming Language and its data structures viz. Lists, Tuples, Dictionaries and Sets

**DSC2101.2.**Develop Python codes using iterations, recursion, function, input/output with files and using exception handling.

**DSC2101.3.**Learn how to manipulate strings, use regular expression, object-oriented features of Python and also how to write good and efficient codes in Python.

**DSC2101.4.**Apply NumPy library and develop codes using Pandas data structures (Series and Data Frames) and other features of Pandas.

**DSC2101.5.**Learn GUI programming using Tkinter, Symbolic computing using SymPy, plotting and visualization using Matplotlib and Equation Solving, Optimization, Interpolation, Integration and solving Ordinary Differential Equation using SciPy..

**DSC2101.6.**Apply Python in building solutions to basic data analysis problems

**Detailed Syllabus**

**Module I [8L]**

**Introduction to Python:** History of Python. Setting up the development environment. Variables, Expressions, Statements. Functions, Conditionals, Recursion, Iteration.

**Data Organization:** Files and Exceptions. Classes, objects, inheritances, Object Oriented Programming in Python.

**Module II [9L]**

**Manipulating Strings:** Regular Expressions in Python.

**Python Data Structures:** Lists, Tuples, Dictionaries, Sets.

**Effective Python:** Pythonic Thinking and Writing Better Pythonic Code.

**Module III [9L]**

**Processing with NumPy:** The Basics of NumPy Arrays. Array Indexing: Accessing Single Elements. Array Slicing: Accessing Subarrays. Reshaping of Arrays. Array Concatenation and Splitting. Computation on NumPy Arrays: Universal Functions. The Slowness of Loops.

Aggregations: Min, Max, Summing the Values in an Array.
Computation on Arrays: Broadcasting. Rules of Broadcasting. Comparisons, Masks, and Boolean Logic. Working with Boolean Arrays. Boolean Arrays as Masks. Fancy Indexing.

**Data Manipulation with pandas:** Introduction to pandas data structures. Series, Data frames, Index objects. Re-indexing, Selection, Filtering, Axis Indices, Summarizing, Handling missing data, Hierarchical Indexing.

**Module IV [10L]**

**GUI Programming Using Tkinter**

Getting Started with Tkinter, Processing Events, The Widget Classes, Canvas widget for displaying shapes, Geometry Managers, Displaying Images, Menus, Popup Menus, Mouse, Key Events, and Bindings, Animations, Scrollbars, Standard Dialog Boxes.
Symbolic Computing using SymPy

**Plotting and Visualization using Matplotlib**

**Using SciPy:** Equation Solving, optimization, interpolation, integration, Ordinary differential equation

**Textbooks**


1. Introduction to Programming Using Python, Y. Daniel Liang. Pearson, 2017.
2. Introduction to Python for Engineers and Scientists, Sandeep Nagar, Apress, 2018
3. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.
4. Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib Book by Robert Johansson, Apress, 2019


**Reference Books**


1. Python for Everybody, Charles Severance, 2016.
2. Effective Python, Brett Slatkin, Pearson, 2015.
3. Learn Python The Hard Way, Zed A. Shaw, Addison-Wesley, Third Edition

| Paper Name: Digital Circuit Design | | | | | |
|---|---|---|---|---|---|
| **Paper Code: ECE2002** | | | | | |
| **Contact hours per week:** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **4** | **0** | **0** | **4** | **4** |

**Course Outcomes**

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

**ECE2002.1:** Students will learn about the Binary Number system and minimization of logic expression using different methods.

**ECE2002.2:** Students will design different Arithmetic Combinational circuits like Adder, Subtractor.

**ECE2002.3:** Students will be able to design Multiplexer, De-Multiplexer, Decoder, Encoder, etc and learn about applications

**ECE2002.4:** Students will be able to design Sequential Circuits such as flip flops and perform inter conversion of them.

**ECE2002.5:** Students will design various types of Registers and Counters Circuits using Flip- Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).

**ECE2002.6:** Students will learn basic gates using CMOS logic and analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

**Module I: [8L]**

Data and number systems; Binary, Octal, and Hexadecimal representation and their conversions; BCD, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates-their truth tables and circuits; Representation in SOP and POSforms; Minimization of logic expressions by algebraic method; Karnaugh-map method, Quine-McCluskey method (3 & 4 variables).

**Module II: [12L]**

Arithmetic Circuits: Adder circuit – Ripple Carry and BCD Adder; Subtractor circuit. Combinational Circuit: Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator; Shannon's Expansion Theorem.

**Module III: [10L]**

Sequential Circuits- Sequential circuits design methodology; Basic memory element S-R, J-K, D, and T Flip Flops, Inter conversions of Flip-Flop; Finite State Machine Design using Sequential circuit design methodology; various types of Registers (with Parallel load, shift Registers), and Counters (Asynchronous ripple counters, Synchronous counters: BCD, Ring, Johnson).

**Module IV:[8L]**

Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays (PLAs and PLDs) MOS as digital switch, basic working principle of nMOS, pMOS, CMOS inverter and realization of combinational circuit using CMOS logic.

**Textbooks:**


1. S.Salivahanan, S.Arivazhagan-Digital Circuit & Design, Oxford
2. Anandkumar-Fundamental of Digital Circuits, PHI
3. Virendra Kumar-Digital technology, New Age Publication
4. R.P.Jain-Modern Digital Electronics, 2/e, Mc Graw Hill


**References:**


1. H.Taub&D.Shilling-Digital Integrated Electronics, Mc Graw Hill
2. Tocci, Widmer, Moss-Digital Systems, 9/e, Pearson
3. Leach &Malvino-Digital Principles &Application, 5/e, Mc Graw Hill
4. Floyed& Jain-Digital Fundamentals, Pearson

| Course Name: Environmental Sciences (Mandatory) | | | | | |
|---|---|---|---|---|---|
| **Course Code:EVS2016** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **2** | **0** | **0** | **2** | **0** |

**Course Outcomes**

After completion of the course, students will be able to

**EVS2016.1:** Understand the natural environment and its relationships with human activities.
**EVS2016.2:** Characterize and analyze human impacts on the environment.
**EVS2016.3:** Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
**EVS2016.4:** Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
**EVS2016.5:** Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
**EVS2016.6:** Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

**Module I: [6L]**

**Socio Environmental Impact:** Basic ideas of environment and its component
**Population growth:** exponential and logistic; resources; sustainable development.
**Concept of green chemistry**: green catalyst, green solvents
**Environmental disaster and social issue**: environmental impact assessment, environmental audit, environmental laws and protection act of India.

**Module II: [6L]**

Air Pollution: Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes, effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.

**Module III: [6L]**

Water Pollution: Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters: DO, BOD, COD. Water treatment: surface water and wastewater.

**Module IV: [6L]**

Land Pollution: Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.

Noise Pollution: Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

**Textbooks**


1. Basic Environmental Engineering and Elementary Biology, GourKrishna Das Mahapatra, Vikas Publishing House P. Ltd.
2. Environmental Chemistry, A. K. De, New Age International.
3. Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.


**Reference Books**


1. Environmental Science, S. C. Santra, New Central Book Agency P. Ltd.

Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd.

| Course Name: Probability and Statistical Methods | | | | | |
|---|---|---|---|---|---|
| **Course Code:MTH2102** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **4** | **0** | **0** | **4** | **4** |

**Course Outcomes**

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

**MTH2102.1.** Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
**MTH2102.2.** Formulate predictive models to tackle situations where deterministic algorithms are intractable.
**MTH2102.3.** Understand the application of probability and statistics in different real-world problems.
**MTH2102.4.** Summarize data visually and numerically.
**MTH2102.5.** Assess data-based models.
**MTH2102.6.** Apply tools of formal inference.

**Detailed Syllabus**

**Module I [10L]**

**Probability-I (Probability distributions):** Special type of distribution: Binomial distribution, Normal distribution, Binomial approximation to Normal distribution, Poisson distribution, Exponential distribution; Moment generating and characteristic functions, Limit theorems: Markov's inequality and Chebyshev's inequality.

**Module II [10L]**

**Joint distribution:** Joint distribution using joint probability mass/density function, finding Marginal pmf/pdf from joint distribution, Multiplicative property of joint pmf/ pdf in case of independent random variables.
**Markov Chains:** Markov Chains: Introduction, Chapman-Kolmogorov equations, Classification Of states, Some applications.

**Module III [10L]**

**Statistics-I:** Measure of central tendency: Mean, Median, Mode; Measure of dispersion: Quartile Deviation, Standard Deviation; Moments, Skewness and Kurtosis; Covariance, Correlation and Regression, Spearman's Rank Correlation coefficient; Curve fitting: Straight line and parabolas.

**Module IV [10L]**

**Statistics-II:** Population and Samples, The sampling distribution of mean (standard deviation known),The sampling distribution of mean (standard deviation unknown), Point and Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses.

**Textbooks**


1. Introduction to Probability and Statistics for Engineers and Scientists, S.M. Ross, Elsevier.
2. Groundwork of Mathematical Probability and Statistics, Amritava Gupta, Academic Publishers.
3. Probability, Statistics and Random Processes, T. Veerarajan, Tata McGraw-Hill Publishing Company Limited.


**Reference Books**


1. Probability and Statistics for Engineers, Richard A Johnson, Pearson Education
2. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons
3. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons.

| Course Name: Data Structures & Algorithms Lab | | | | | |
|---|---|---|---|---|---|
| Course Code:CSE2151 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 0 | 0 | 3 | 3 | 1.5 |

**Course Outcomes**

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

**CSE2151.1.** To understand linear and non-linear data structures.
**CSE2151.2.** To understand different types of sorting and searching techniques.
**CSE2151.3.** To know how to create an application specific data structure.
**CSE2151.4.** To solve the faults / errors that may appear due to wrong choice of data structure.
**CSE2151.5.** To analyse reliability of different data structures in solving different problems. **CSE2151.6.** To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

**Detailed Syllabus**

**Day 1: Time and Space Complexity**

**Lab Assignment**

Create three different 10; 000 10; 000 matrices matrixOne, matrixTwo and result-Matrix, using dynamic memory allocation. Initialize matrixOne and matrixTwo by using rand() or srand() function, limit the values from 0 to 9. Multiply matrixOne and matrixTwo into resultMatrix.

While execution, open another terminal and use top command to see the usage of memory by the process. Calculate the time taken for the execution of the program.

Repeat the same exercise for 100,000 x 100,000matrices.

**Home Assignment**

Write a program (WAP) to check whether a matrix is i) identity, ii) diagonal. WAP to reverse the elements of an array without using any other variable.

**Day 2: Array Lab**

**Assignment**

WAP to add two polynomials using array. Minimize the memory usage as much as you can. WAP to convert a matrix into its sparse representation (triple format). Once represented in
sparse format, do not revert back to the matrix format any-more. Manipulate the sparse representation to find the transpose of the matrix (which should also be in sparse representation).
Calculate and find out whether using triple format for your example is advantageous or not.

**Home Assignment**

WAP to multiply two polynomials. Minimize usage of memory.

WAP to add two matrices using sparse representation. Manipulation of data should be done in sparse format.

**Day 3: Singly Linked List Lab**

**Assignment**

Write a menu driven program to implement a singly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate)
iv) display the list

**Home Assignment**

Write a menu driven program to implement a singly linked list with the operations:

i) count the number of nodes
ii) reverse the list

**Day 4: Circular and Doubly Linked List Lab**

**Assignment**

Write a menu driven program to implement a circular linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate)
iv) display the list

**Home Assignment**

Write a menu driven program to implement a doubly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate)
iv) display the list

**Day 5: Stack, Queue - with array**

**Lab Assignment**

Write a menu driven program to implement stack, using array, with

i) push, ii) pop, iii) display, iv) exit operations.

WAP to evaluate a postfix expression.

Write a menu driven program to implement a queue, using array, with

i) insert, ii) delete, iii) display, iv) exit operations

Home Assignment

WAP to convert an infix expression to its corresponding postfix operation.

Write a menu driven program to implement a double-ended queue, using array, with the following operations:

i) insert (from front, from rear) ii) delete (from front, from rear)
iii) display iv) exit operations

Day 6: Stack, Queue - with linked list Lab

Assignment

Write a menu driven program to implement a stack, using linked list, with

i) push, ii) pop, iii) exit operations

Home Assignment

Write a menu driven program to implement a queue, using linked list, with

i) insert, ii) delete, iii) exit operations

Day 7: Circular Queue, Deque - with linked list Lab

Assignment

Write a menu driven program to implement a circular queue using linked list with

i) insert, ii) delete, iii) exit operations

Home Assignment

Write a menu driven program to implement a double-ended queue, using linked list, with the following operations:

i) insert (from front, rear), ii) delete (from front, rear), iii) exit operations

Day 8: Binary Search Tree (BST) Lab

Assignment

Write a program, which creates a binary search tree (BST). Also write the functions to insert, delete (all possible cases) and search elements from a BST.

Home Assignment

Write three functions to traverse a given BST in the following orders:

i) in-order, ii) pre-order, iii) post-order.

Display the elements while traversing.

**Day 9: Searching**

**Lab Assignment**

WAP to implement,

i) Linear Search, ii) Binary Search (iterative)

NB: As a pre-processing step, use bubble-sort to sort the elements in the search space.

WAP to generate integers from 1 to n (input parameter) in random order and guarantees that no number appears twice in the list. While the number sequence is being generated, store it in a text file.

Home Assignment

WAP to implement binary search recursively.

Day 10: Sorting Lab

Assignment

Write different functions for implementing,

i) Bubble sort, ii) Cocktail shaker sort, iii) Quick Sort.
Plot a graph of n vs. time taken, for n= 100, 1000, 10,000 and 100,000 to com-pare the performances of the sorting methods mentioned above. Use the second assignment of Day 9 to generate the data, using the given n values.

Home Assignment

Write different functions for implementing,

i) Insertion sort, ii) Merge sort.

Day 11: Graph Algorithms Lab

Assignment

Read a graph (consider it to be undirected) from an edge-list and store it in an adjacency list.

Use the adjacency list to run DFS algorithm on the graph and print the node labels. Detect and count the back-edges.

Home Assignment

WAP to implement BFS algorithm of a given graph (similarly as described for DFS, instead of back-edges count cross-edges)**.**

Textbooks


1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.


Reference Books


Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

| Course Name: Python Programming Lab | | | | | |
|---|---|---|---|---|---|
| Course Code:DSC2151 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 0 | 0 | 3 | 3 | 1.5 |

**Course Outcomes**

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

**DSC2151.1.** Learn how to write simple programs in Python, relating to arithmetic and logical problems.

**DSC2151.2.** Understand how to implement conditional branching, iteration (loops), recursion and function.

**DSC2151.3.** Develop python codes to do input/output with files in Python and use exception handling.

**DSC2151.4.** Learn and understand how to manipulate strings, use regular expression, and also use Python data structures viz. Lists, Tuples, Dictionaries and Sets.

**DSC2151.5.** Apply NumPy Arrays in solving problems.

**DSC2151.6.** Design and develop codes using Pandas data structures (Series, Data Frames) and other features of Pandas.

**Detailed Syllabus:**

**Topic 1:**

(a) Finding the distance between two points whose coordinates are given
(b) Finding the impedance of a series R-L-C Circuit
(c) Finding the roots of a quadratic equation
(d) Finding the maximum and minimum out of a few numbers given
(e) Finding the value of sine of a given angle from its series expansion
(f) Finding the Time period of a pendulum, whose length varies from 100 to 120 cm in steps of 5 cm.

**Topic 2:**

Implement programs using functions:

a. Largest number in a list
b. Area of different shapes
c. Circulate the values of n variables
d. Distance between two points whose coordinates are given
e. Roots of a quadratic equation
f. Factorial
g. Fibonacci series
h. GCD

**Topic 3:**

Implement programs on File I/O and exception handling:

a. Copying a file
    1. Take source file name and destination file name from the user
    2. Use exception handling to report error, if any

3. Copy thesource text file to the destination.
4. Report completion status, number of characters copied etc. to the user

b. Finding word count and longest word in a file
c. Use exception handling in nested functions
d. Write a program to show positive use of exception handling

**Topic 4:**

(a) Write programs to use various in-built functions of Python on string manipulation (reverse, palindrome, character count, replacing characters)
(b) Write programs to show the use of regular expression
(c) Write programs using Python data structures viz. Lists, Tuples, Dictionaries and Sets

**Topic 5:**

Write programs using various features provided in the NumPy

**Topic 6:**

Write programs using Pandas data structures and various features provided in Pandas

**Text Books:**

1. Allen B. Downey, Think Python: How to think like a Computer Scientist, 2nd Edition, O'Reilly, 2016
2. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2017

**Reference Books:**

1. Karl Beecher, Computational Thinking: A Beginners Guide to Problem Solving and Programming, 1st Edition, BCS Learning and Development Limited, 2017

| Course Name: Digital Circuit Design Lab | | | | | |
|---|---|---|---|---|---|
| Course Code:ECE2052 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 0 | 0 | 3 | 3 | 1.5 |

**Course Outcomes**

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

**ECE2052.1:** Define different types of logic gate ICs, verify their truth table and realize the Boolean expression using logic gates.
**ECE2052.2:** Design and developed code converters and simple arithmetic circuits like adder, subtractor etc.

**ECE2052.3:** Design and test combinational circuits.

**ECE2052.4:** Design and develop sequential circuits like flip-flops and counters.

**List of Experiments:**

1. Realization of basic gates using Universal logic gates.
2. Realization of code conversion circuits - BCD to Excess-3 and vice-versa.
3. Construction of simple arithmetic circuits - Adder, Subtractor.
4. Design of Parity Bit Generator and Checker circuits.
5. Construction of Decoder circuit using logic gates.
6. Construction of Multiplexer circuit using logic gates and realization of different combinational logic circuits using Multiplexer.
7. Design of 2-Bit Comparator Circuit.
8. Realization of RS, D and JK flip-flops using universal logic gates.
9. Realization of Asynchronous Up or Down counter.
10. Realization of Synchronous Up or Down counter.
11. Realization of Ring and Johnson's counters.

| Paper Name: Design Thinking and Idea Lab | | | | | |
|---|---|---|---|---|---|
| **Paper Code: DSC2155** | | | | | |
| **Contact hours per week:** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **2** | **2** | **1** |

Course Outcomes

**DSC2155.1:** Understand the definition, objectives, and relevance of design thinking. **AML2155.2:** Get familiarized with the stages of the design process: Empathize, Define, Ideate, Prototype, and Test.
**DSC2155.2:** Learn how to apply the design thinking process for developing innovative products.
**DSC2155.3:** Propose innovative product designs and choose appropriate frameworks, strategies, and techniques during prototype development.
**DSC 2155.4:** Perceive individual differences in user perspectives and offer appropriate interventions towards enhanced user experience.

Detailed Syllabus (in-depth discussion of these topics is available in the text book suggested below):

1. Design thinking is a way of thinking
    a. The fundamental attitude of design thinking
    b. Think flexibly
    c. Work integrally
    d. Empathize
    e. Cooperate
    f. Imagine
    g. Experiment
2. Design thinking is a way of working
    a. The cycle of design thinking
    b. The design process
    c. Discovery phase: Loving the problem
    d. Definition phase: Defining the problem
    e. Development phase: Working on solutions
    f. Implementation phase: Towards functioning solutions in practice
    g. Using design thinking as a business strategy
3. Design thinking is a project approach
    a. Discovery phase: From cause to insight
    b. Definition phase: From insight to problem definition and solution area
    c. Development phase: From solution area to solutions
    d. Implementation phase: Putting solutions into practice
    e. Other roadmaps
4. Design thinking is a tool box
    a. Assumption busting

b. Business model canvas
c. Decision matrix
d. Empathy map
e. One-hour prototype
f. Personas
g. Scenarios
h. Stakeholder map
i. Storyboard
j. User diaries
Etc.

Note: In the lab sessions, students will be working in teams to develop working prototypes using design thinking principles. A prototype can either be software or hardware based, or a combination of both. A set of slides, a document, a spreadsheet, or a user interface mock up will not qualify as a prototype. Students will need to make at least one presentation (with the idea of the prototype), and one demonstration (with the functioning prototype) during the semester. Continuous and end-semester assessment of student performance will be based on established evaluation rubrics.

Text book

Den Dekker Teun, "Design Thinking", Wolters-Noordh off B.V., Dec, 2020

Reference books

1. Prof. Karl Ulrich, U. Penn, "Design: Creation of Artifacts in Society by Change", Oct, 2012
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Kindle edition, 2009.
3. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving", Penguin Random House India Private Limited, 23 December 2020.

# SECOND YEAR
# SECOND SEMESTER

| Course Name: Design & Analysis of Algorithms | | | | | |
|---|---|---|---|---|---|
| Course Code:CSE2201 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 4 | 0 | 0 | 4 | 4 |

**Course Outcomes**
After completion of the course, students will be able to:

**CSE2201.1.** Remember time complexities of various existing algorithms in different situations.
**CSE2201.2.** Understand the basic principles of different paradigms of designing algorithms.
**CSE2201.3.** Apply mathematical principles to solve various problems.
**CSE2201.4.** Analyze the complexities of various algorithms.
**CSE2201.5.** Evaluate the performance of various algorithms in best case, worst case and average case.
**CSE2201.6.** Create/ Design a good algorithm for a new problem given to him/ her.

**Detailed Syllabus**

**Module I [10L]**

**Algorithm Analysis:** Time and space complexity. Asymptotic Notations and their significance. Asymptotic Analysis. Finding time complexity of well-known algorithms like-insertion sort, heapsort, Asymptotic solution to recurrences, Substitution Method, Recursion Tree, Master Theorem.

**Divide-and-Conquer Method:** Basic Principle, Binary Search – Worst-case and Average Case Analysis, Merge Sort – Time Complexity Analysis, quicksort – Worst-case and Average Case Analysis, Concept of Randomized Quicksort.

**Medians and Order Statistics**

**Lower Bound Theory:** Bounds on sorting and searching techniques**.**

**Module II [16L]**

**Greedy Method:** Elements of the greedy strategy. Fractional Knapsack Problem, Huffman codes.

**Dynamic Programming:** Basic method, use, Examples: 0-1 Knapsack Problem, Matrix-chain multiplication, LCS Problem.

**Graph Algorithms:** Minimum cost spanning trees: Prim's and Kruskal's algorithms (Greedy Method). Shortest Path Algorithm: Dijkstra's. (Greedy method), Bellman Ford, All pair shortest path (Floyd-Warshall Algorithm) (Dynamic Programming).

**Module III [10L]**

**Amortized Analysis:** Aggregate, Accounting and Potential methods.

**String matching algorithms:** Different techniques – Naive algorithm, string matching using finite automata, and Knuth , Morris , Pratt ( KMP ) algorithm with their complexities

**Randomized Algorithm:** Skip List.

**Module IV [10L]**

**Disjoint Set Manipulation:** UNION-FIND with union by rank, Path compression.

**Network Flow:** Ford Fulkerson algorithm, Max - Flow Min - Cut theorem (Statement and Illustration)

**NP-completeness:** P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem, Vertex Cover Problem, Independent Sets, Clique Decision Problem.

**Approximation algorithms:** Necessity of approximation scheme, performance guarantee. Approximation algorithms for 0/1 knapsack, vertex cover, TSP. Polynomial time approximation schemes: 0/1 knapsack problem.

**Textbooks**


1. Introduction to Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.


**Reference Books**


1. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

| Course Name: Computer Organization and Architecture | | | | | |
|---|---|---|---|---|---|
| Course Code:CSE2202 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 4 | 0 | 0 | 4 | 4 |

**Course Outcomes**

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

**CSE2202.1.** Understand the basic organization of computer and different instruction formats and addressing modes.
**CSE2202.2.** Analyze the concept of pipelining, segment registers and pin diagram of CPU.
**CSE2202.3.** Understand and analyze various issues related to memory hierarchy. **CSE2202.4.** Understand various modes of data transfer between CPU and I/O devices. **CSE2202.5.** Examine various inter connection structures of multi-processor.
**CSE2202.6.** Design architecture with all the required properties to solve state-of-the-art problems.

**Detailed Syllabus**

**Module I [10L]**

**Basics of Computer Organization:** Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture.

Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes.

Basics of Control Unit Design - hardwired and micro programmed control, Horizontal and Vertical micro instruction.

**Module II [11L]**

**Memory and I/O Organization:** Memory system overview, Cache memory organizations, Techniques for reducing cache misses, Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual Memory, Memory mapped IO.

Introduction to I/O interfaces. Interrupts, Interrupt hardware, Enabling and Disabling interrupts, Concept of handshaking, Polled I/O, Priorities, Daisy Chaining. Vectored interrupts; Direct memory access, DMA control.

**Module III [10L]**

**Pipelined Architecture:** Brief Introduction, Performance Measures - speed up, Efficiency, performance - cost ratio etc.

Static pipelines - reservation tables, scheduling of static pipelines, definitions - minimum average latency, minimum achievable latency, greedy strategy etc. Theoretical results on latency bounds without proof.

**Vector Processing:** Vector registers; Vector Functional Units; Vector Load / Store; Vectorization; Vector operations: gather / scatter; Masking; Vector chaining.

**Module IV [9L]**

**SIMD Architectures:** Brief introduction, various concepts illustrated by studying detailed SIMD algorithms, viz., Matrix multiplication, Sorting on Linear array.

**Interconnection Networks:** Detailed study of Interconnection Network - Boolean cube, Mesh, Shuffle-exchange, Banyan, Omega, Butterfly, Generalized Hypercube, Delta etc.

**Textbooks**


1. Computer Organization, 5th Edition, Carl Hamacher, ZvonkoVranesic, SafwatZaky, MGH.
2. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson.
3. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.
4. Advanced Computer Architecture and Parallel processing, Hwang & Briggs, MH.
5. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-Hill.


**Reference Books**


1. Onur Mutlu's lecture materials on Computer Architecture from CMU web site: https://users.ece.cmu.edu/~omutlu/.
2. NPTEL materials on Computer Organization.

| Course Name: Introduction to R | | | | | |
|---|---|---|---|---|---|
| Course Code:DSC2201 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 3 | 0 | 0 | 3 | 3 |

## 1. Course Outcomes

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

**DSC2201.1.** Learn and understand the basics of the R Programming Language.

**DSC2201.2.** Learn about basic R data structures.

**DSC2201.3.** Learn about how to develop reusable modules in R and apply them.

**DSC2201.4.** Use various libraries and packages of R Programming.

**DSC2201.5.** Learn about data exploration, querying in R.

**DSC2201.6.** Learn how to visualize data and use graphics in R.

## 2. Detailed Syllabus

### Module 1 [9L]

**Introduction :** Features of R programming, Why use R Programming, Comparison between R and Python, R Advantages and Disadvantages, Installing R and R Studio**,** RStudio Overview, How to access R Command Prompt and Help facility, Writing and executing R Script File, Installing and using R packages.

Elementary R Data Types, Keywords in R Programming ( if, else, repeat, while, for etc.) and their use, Functions (Different parts of functions, Types of function - Primitive, Infix and Replacement Functions, Different ways of passing Function arguments, Passing Functions as Arguments, examples of writing different functions),using cat() and print(),

Understanding R Programming Environment and Scope, Global and local Variable, Lexical Scoping in R, Shadowing and Variable Masking.

**Data Structures :**

Vector - Creating vector(seq(), rep()), different types of vector, various operation on vectors ( combining, adding, accessing, modifying, handling NA values, sorting, sub-setting, removing etc.)
Data Frame - Creating Data frame, Creating data frame from another data frame( cbind(), rbind()), Creating empty data frame, Various operations on data frame( naming rows, Reading a Data Frame from a File, Slice Data Frame etc.)

### Module 2 [9L]

**Data Structures:**
Factor - Creating factor for categorical variable, Various attributes of factor, Understanding difference between vector and factor, Various operations on factor (Change the levels associated with a factor, Difference between levels and label, Change Item Value, Combine factors, Order on the levels when a factor is created ), Using categorical variables in statistics, Creating frequency distribution tables using table() function, Create factors from numerical data using cut()
Matrix - Creating Matrix, Various operation on Matrix (Access Elements, Slicing, Using logical vector as index, Using character vector as index, Combine Matrices etc.)
List – Creating List, Extracting item from List (difference between '[' and '[[' operators), Addin g and deleting items, Naming elements, Loop over List.
Arrays – Creating Array, Creating Array with row column and matric names, Various operation on Array (Accessing subset of elements, Addition, Calculations on Array element (use of apply()) , Updating , Check existence of an Element)

Data Science and introduction to some important Packages, Data manipulation using dplyr package.

Descriptive statistics in R: What is Descriptive statistics, Difference between inferential and descriptive statistics, Measures of central tendency, Measures of spread, Measures of Association, Useful statistical summary functions, Use of summary() Function in R.

**Module 3 [9L]**

**Access RDBMS in R**- Role of dplyr , dbplyr and DBI packages, Common ways to query data with R, Database operation using DBI : exploring basic commands (dbConnect, dbExecute, dbGetQuery, dbSendStatement, dbBind, dbClearResult, dbWriteTable, dbSendQuery, dbFetch, dbListTables, dbDisconnect) , Examples of using some basic command of DBI for duckDB database, Running SQL query send to DBI using dbGetQuery and dbSendQuery

Database operation using dbplyr, Explore the relationship between dplyr and SQL

**R Markdown** – overview, Components of an R Markdown File, R NoteBook, Creating an R Notebook, R Markdown Vs R NoteBook, Write a SQL Statement & Execute it in RStudio using R Markdown.

**Dealing with Missing Values**- Need of handling Missing Data, Test Recode and Exclude missing values, Types of Missing Data, Imputation in R : Simple Value Imputation with Built-in Functions, Impute Missing Values with MICE, Imputation with R missForest Package.

**Module 4 [9L]**

**Data Exploration And Visualization** - Benefits/advantages, Load data file(s), Convert a variable to different data type, Data Reshaping, Melting and Casting, Sort DataFrame, Create plots (Histogram), Generate frequency tables with R, Sample Data set using sample function, Remove duplicate values of a variable, Find class level count average and sum, Recognize and Treat missing values and outliers, Merge/join data sets

Different Types of Data Visualization in Data Science, Understanding ggplot2 syntax , Aesthetic mappings, Facets, Geometric objects, geoms, Draw different charts using ggplot2, What are Density Curves, Draw density curve using ggplot2.

**Error handling in R** :Conditions and Condition system, Condition object, Signaling or throwing conditions, Handling conditions using try(), tryCatch() and withCallingHandlers(), Understanding the difference between these three handler.

3. **Textbooks**
   i. Hands on Programming in R, Garrett Grolemund, O'Reilly.

4. **Reference Books**
   i. Advanced R, Hadley Wickham. CRC Press, 2015.
   ii. R for Data Science, Hadley Wickham and Garrett Grolemund, 2017.

| Course Name: Operating Systems with Linux | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC2202** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **2** | **0** | **0** | **2** | **2** |

## 1. Course Outcomes

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

**DS 2202.1.** Develop knowledge about the importance of computer system resources and the role of Linux operating system in their management policies and algorithms.

**DS 2202.2.** Understand processes and its management policies and scheduling of processes by CPU.

**DS 2202.3.** Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.

**DS 2202.4.** Understand deadlock, prevention and avoidance algorithms.

**DS 2202.5.** Understand the structure and functions of Linux operating systemsalong with their components, types and working.

**DS 2202.6.** Gain familiarity with protection and security in Linux Operating System.

## 2. Detailed Syllabus

**Module 1 [6L]**

**Introduction:** Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S. (batch, multi-programmed, time-sharing, real-time, distributed, parallel).

**System Structure:** Computer system operation, Operating system structure (simple, layered, virtual machine), O/S services, System calls.

**Linux Operating System**: Introduction to Linux OS, Basic Commands of Linux OS.

**Module 2 [6L]**

**Processes and Threads**: 7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.

**CPU Scheduling**: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi-processor scheduling.

**Module 3 [6L]**

**Process Synchronization:** Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

**Deadlocks:** System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

**Module 4 [6L]**

**Protection & Security in Linux Operating System:** Goals of protection, Domain of protection, Access matrix and its representation, Threats and system security.

## 3. Textbooks


1. Operating System Concepts, 10E, Silberschatz A., Galvin P. B., Gagne G., Wiley Publications.
2. Operating Systems Internals and Design Principles, 9E, Stalling W., Pearson Education.


## 4. Reference Books


1. Operating System: Concept & Design, Milenkovie M., McGraw Hill.
2. Operating System Design & Implementation, Tanenbaum A.S., Printice Hall NJ.
3. Operating System Concepts, Silberschatz A., Peterson J. L., Wiley Publications.
4. Operating Systems A Concept Based Approach, Dhamdhere D.M., McGraw Hill.

| Paper Name: **Operations Research** | | | | | |
|---|---|---|---|---|---|
| Paper Code: **MTH 2203** | | | | | |
| Contact hours per week: | L | T | P | Total | Credit Points |
| | 4 | 0 | 0 | 4 | 4 |

**After successfully completing this course the students will be able to:**

**MTH2203.1** Describe the way of writing mathematical model for real-world optimization problems.

**MTH2203.2** Identify Linear Programming Problems and their solution techniques.

**MTH2203.3** Categorize and solve Transportation and Assignment problems.

**MTH2203.4** Analyze how Game theoretic models can be used to solve a variety of real-world scenarios in economics and other areas.

**MTH2203.5** Apply various optimization methods for solving realistic engineering problems and compare their accuracy and efficiency.

**MTH2203.6** Convert practical situations into non-linear programming problems and solve unconstrained and constrained programming problems using analytical and numerical techniques.

**Module- I** **10L**

**Linear Programming Problem (LPP)**

Formulation of an LPP; Graphical Method of solution of an LPP; Convex Combination and Convex Set; Basic Solution of a system of linear equations; Canonical and Standard form of an LPP; Simplex Method; Big-M Method; Concept of Duality; Mathematical formulation of duals.

**Module- II** **10L**

**Transportation and Assignment Problems**

Transportation Problems (TP); Representation of Transportation Problems as LPP; Methods of finding initial basic feasible solution of TP: North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method; Optimality test of the basic feasible solution; Assignment Problems: Hungarian Method.

**Game Theory**

Introduction; Strategies; The Minimax and Maximin Criterion; Existence of Saddle Point; Pure Strategies; Mixed Strategies; Symmetric Games; Dominance Principle; Two-Person Zero-Sum Games and their solution using by Graphical Method and Algebraic Method.

**Module- III** **10L**

**Non-Linear Programming Problems (NLPP)-I: Analytical Methods**

Single-variable Optimization; Multivariate Optimization with no constraints: Saddle Point; Multivariate Optimization with Equality Constraints: Method of Lagrange Multipliers; Multivariable Optimization with inequality constraints: Kuhn-Tucker Conditions.

**Module- IV** **10L**

**Non-Linear Programming Problem (NLPP)-II: Some Search Algorithms**

Unimodal Function; Elimination Methods: Interval Halving Method, Dichotomous Search, Fibonacci Method, Golden Section Method.

**Text Books:**

1. *Engineering Optimization* by S. S. Rao, New Age Techno Press.
2. *Operations Research* by T. Veerarajan, Universities Press
3. *Linear Programming and Game Theory* by J. G. Chakraborty and P. R. Ghosh, Moulik Library.

**Reference Books:**

1. *Operations Research* by Kanti Swarup, P. K. Gupta and Man Mohan, S. Chand and Sons.
2. *Operations Research: Theory and Applications* by J. K. Sharma, Macmillan India Ltd.
3. *Algorithms for Minimization without Derivative* by R. P. Brent, Prentice Hall.

| **Course Name: Introduction to Smart Sensing Technology** | | | | | |
|---|---|---|---|---|---|
| **Course Code: AEI2206** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

**1. Course Outcomes**

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

**AEI2206.1**. Identify the sensors for measurement of various physical parameters like displacement, pressure, force, temperature etc.

**AEI2206.2.** Interpret the operation of various sensors/transducers used for measurement of physical parameters.

**AEI2206.3**. Apply their knowledge to select right kind of sensors/transducer for application in hand.

**AEI2206.4.** Analyze the response of the sensors/transducers for fruitful information.

**AEI2206.5**. Judge the performance of the sensors.

**AEI2206.6.** Design signal conditioning unit for the sensors.

**2. Detailed Syllabus**

**MODULE I – [9L]**

Sensors/Transducers: Introduction to sensors, sensing/transduction principles, classifications, basic requirements.

Resistive type: Potentiometer, strain gauge- principle, material, signal conditioning unit (SCU), applications.

Capacitive type: Principle, SCU and applications.

**MODULE II – [9L]**

Inductive transducers: Variable reluctance type proximity pickup, LVDT.

Piezoelectric transducer: Materials, signals conditioning circuit, frequency response, ultrasonic sensors and applications, seismic accelerometer. Hall sensors.

**MODULE III – [9L]**

Temperature sensors: thermocouples, RTD, thermistors and their signal conditioning unit
Optical sensors: Photovoltaic, photoelectric, infrared sensors and their applications.

**MODULE IV – [9L]**

Intelligent devices: Intelligent instruments, smart sensors and architecture, smart sensor network, smart transmitters.

Introduction to MEMS: Accelerometer, gyroscope, magnetometer.

**3. Textbooks**


i. D. V. S. Murty, Transducer and instrumentation, PHI, second edition, 2008.
ii. A. K. Ghosh, Introduction to transducers, PHI, 2015


**4. Reference Books**


i. E. A. Doebelin, Measurement Systems: Application and Design, Mc Graw Hill, New York
ii. H. K. P. Neubert, Instrument Transducers, Oxford University Press, London and Calcutta.
iii. J. P. Bentley, Principle of Measurement Systems, Pearson Education, Third edition.
iv. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and applications, Third edition, Springer Internation-al, 2010.

| Course Name: Design & Analysis of Algorithms Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code:CSE2251** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **3** | **3** | **1.5** |

Course Outcomes

After completion of the course, students will be able to

**CSE2251.1:** Understand and Apply different types of algorithm designing paradigms like divide and conquer, greedy, dynamic programming etc.
**CSE2251.2:** Realize and Apply underlying mathematical principles of algorithms in the corresponding implemented program.
**CSE2251.3:** Analyse and Evaluate the performance of various algorithms by observing the actual running time and main memory consumption of the corresponding implemented programs for best case, worst case and average case input data.
**CSE2251.4:** Create / Design a good algorithm for solving real life computing problems, by using various design techniques and data structures, learnt in this course.

A tentative list (non-exhaustive) of the practical topics is given below:

1. **Divide and Conquer:** Implement Quick Sort and **randomized version** of quick sort using Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
2. **Divide and Conquer:** Implement Merge Sortusing Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
3. Implement Heapsort algorithm. Check the running time for each of the n! combination or input sequences of a particular set of integers to observe the best, worst and average cases.
4. **Dynamic Programming:** Find the minimum number of scalar multiplications needed for chain of Matrices.
5. **Dynamic Programming:** Implement Bellman Ford Algorithm to solve Single Source shortest Path problem of a graph.
6. **Dynamic Programming:** Implement Floyd-Warshall Algorithm to solve all pair shortest path for a graph.
7. **Dynamic Programming:** Solve 0/1 Knapsack problem using dynamic problem.
8. **Dynamic Programming:** Solve Longest Common Subsequence problem using dynamic problem.
9. **Greedy method:** Implement Dijkstra's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
10. **Greedy method:** Implement Prim's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
11. **Greedy method:** Implement Kruskal's algorithm to find Minimum Spanning Tree of a graph by implementing and using various operations of Disjoint-set Forest data structure.
12. **Greedy method:** Implement Huffman coding using greedy approach.
13. **Realization of Amortized Analysis:** Implement a Queue using Stacks.
14. Implement KMP algorithm for string matching

15. Implement Ford-Fulkerson algorithm to get maximum flow in a given flow network.
16. **Randomized Algorithm:** Implement Skip-List)**.**

**Textbooks**


1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design, Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.


Reference Books


1. Computer Algorithms: Introduction to Design and Analysis, Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

| Course Name: Computer Architecture Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code:CSE2252** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **3** | **3** | **1.5** |

**Course Outcomes**

After completion of the course, students will be able to

**CSE2252.1:** have adequate knowledge of basics of computer architecture.
**CSE2252.2:** understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
**CSE2252.3:** acquire sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
**CSE2252.4:** design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
**CSE2252.5:** understand various memory functions.
**CSE2252.6:** design a formal test bench from informal system requirements.

**Programming using VHDL**

1. All Logic Gates (Data flow and Behavioral model)
2. Half adder and half subtractor (Data flow and Behavioral Model)
3. Combinatorial Designs (Data flow and Behavioral Model)
   a. 2:1 Multiplexer
   b. 4:1 Multiplexer
   c. 3:8 Decoder
   d. Comparator
4. Full adder and full subtractor (Data flow, Behavioral and Structural Model)
5. Sequential design of flip flops (SR, JK, D, T)
6. ALU design
7. Ripple carry adder (Structural Model)
8. Adder subtractor composite unit (Structural Model)
9. 4 bit synchronous and asynchronous counters.
10. Small projects like stepper motor.

Textbooks

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw Hill.

Reference Books

1. Introduction to Logic Circuits & Logic Design with VHDL, LaMeres, Brock J, Springer.

| Course Name: R Programming Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC2251** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**1. Course Outcomes**

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

**DSC2251.1**: Understand the basics of R Programming.

**DSC2251.2**: Analyse the relative merits of R over other programming languages.

**DSC2251.3**: Evaluate basic R data structures.

**DSC2251.4**: Understand built in functions and packages in R

**DSC2251.5**: Apply R to perform scientific programming

**DSC2251.6**: Analyse data to generate insights using R

**2. Detailed Syllabus**

**Module 1 [3P]**

Introduction: What is scientific programming? And why use scripting? Introducing R, RStudio and RStudioCloud R Data Structures: Vectors, Attributes, Matrices, Arrays, Classes, Factors, Lists, Data Frames.

**Module 2 [3P]**

Conditional statements, Scoping rules. Loops: For, While, Repeat, Efficiency Issues. Working with strings, dates and times R built-in functions, user defined functions, Import/Export file

**Module 3 [3P]**

Vectorization in R. Using R Operations: Selection, Modification, Logical subsetting,Data manipulation using dplyr package, Performing CRUD operation in RDBMS using dplyr ,dbplyr and DBI packages.

**Module 4 [3P]**

Data exploration: Using the ggplot2 package to visualize data, various plots, customize charts, and build data graphics for dynamic reporting. Density plot using ggplot2, Handling missing value.

**3. Textbooks**

**i.** Hands on Programming in R, Garrett Grolemund, O'Reilly.

**4. Reference Books**

i. Advanced R, Hadley Wickham. CRC Press, 2015.

ii. R for Data Science, Hadley Wickham and Garrett Grolemund, 2017.

| Course Name: Linux Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC2252** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

## 1. Course Outcomes

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

**DSC2252.1.** Understand and implement basic services and functionalities of the operating system using system calls.

**DSC2252.2.** Will be able to describe and create user defined processes.

**DSC2252.3.** Understand the benefits of thread over process and implement them.

**DSC2252.4.** Synchronization programs using multithreading concepts.

**DSC2252.5.** Use modern operating system calls and synchronization libraries in software to implement process synchronization.

**DSC2252.6.** Implementation of Inter-process communication using PIPE.

## 2. Detailed Syllabus

1. **Shell programming:** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads:** programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

## 3. Textbooks

1. Your Unix: The Ultimate Guide, Sumitabha Das, MH

## 4. Reference Books

1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.

**DETAILED SYLLABUS**

# 3rd Year

| Paper Name: Database Management Systems | | | | | |
|---|---|---|---|---|---|
| **Paper Code: CSE3101** | | | | | |
| **Contact hours per week:** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **4** | **0** | **0** | **4** | **4** |

**Course Outcomes:**

**CSE3101.1**. Identify the basic concepts to model an application's data requirements using conceptual modeling tools like ER diagrams.

**CSE3101.2.** Formulate relational algebra expression for queries and evaluate it using the concept of query processing.

**CSE3101.3**. Create RDBMS schema mapping various business requirements and formulate queries using SQL.

**CSE3101.4.** Apply normalization and various types of dependencies for evaluating a relational database design.

**CSE3101.5**. Analyze and relate the concept of transaction, concurrency control and recovery in database.

**CSE3101.6.** Understand with basic database storage structures and access techniques, indexing methods.

---

**Module I: [12L]**

**Introduction**: An overview of database and database management system, Three-schema architecture of a database and data independence, Big data and NoSQL systems, XML systems, Cloud storage.

**Relational Database Design using ER Model**: Data modelling concepts, Notations for ER diagram, Drawing ER diagram, Concepts of Keys, Mapping Constraints, Extended E-R features, Convert ER diagrams into tables.

**Module II: [12L]**

**Relational Data Model**: Concept of Relations, Relational Algebra Operators.

**SQL:** Data definition in SQL, Integrity constraints, queries and nested sub-queries, join, aggregate functions, views, use of PL/SQL.

**Query Processing and Optimization**: Query Trees and Query Graphs, Translating SQL into relational algebra, Query Optimizer Concepts.

**Module III: [12L]**

**Dependency theory**: Relational database design, Functional dependencies, Closure, Primary Keys and Candidate Keys.

**Data Base Design & Normalization:** Different anomalies in designing a Database, Normalization and different Normal Forms (1NF, 2NF, 3NF and BCNF), Lossy and Loss-less join decompositions, Dependency preservation, Normalization using multi-valued dependencies and 4NF, Join dependency, Definition of 5NF.

**Module IV: [12L]**

**Transaction management and Concurrency control:** Transaction Fundamental, ACID properties, Conflict serializability, Concurrency control schemes, Lock-Based Concurrency Control (2PL), Schedule recoverability, Overview of Deadlock in DBMS.

**Physical database design:** Indexing Structures, B tree and B+ tree index.

**Introduction to NOSQL and Bigdata storage systems:** Document based NOSQL systems and MongoDB, Bigdata technologies based on Hadoop and MapReduce.

**Text books:**


1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", 4th Ed., McGraw Hill, Computer Science Series.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Pearson.
3. Date C. J., "Introduction to Database Management", Vol. I, II, III Pearson.
4. Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", O'REILLY
5. Ajit Singh, Sultan Ahmad, "MongoDB Simply In-Depth", 2019


**Reference books:**


1. R. Ramakrishnan, J. Gehrke, "Database Management System", McGraw-Hill.
2. A. Reuter and J. Gray, "Transaction Processing: Concepts and Techniques", Morgan Kauffman Publishers.
3. Ullman J. D., "Principles of Database Systems", Galgottia Publication.
4. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi.
5. R. Elmasri, S. B. Navathe "Fundamentals of Database Systems", Pearson.
6. A. K. Majumdar, P. Bhattacharya,"Database Management Systems", Tata McGraw Hill.
7. S. Bradshaw, E. Brazil, K. Chodorow, "Mongo DB: The Definitive Guide 3e: Powerful and Scalable Data Storage" O'REILLY

| Course Name: Formal Language & Automata Theory | | | | | |
|---|---|---|---|---|---|
| **Course Code: CSE3002** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **4** | **0** | **0** | **4** | **4** |

**1. Course Outcomes**

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

**CSE3002**.1. Recall the basic characteristics of various types of machines, languages and grammars.

**CSE3002**.2. Compare different computational models, languages and grammars based on their properties and behaviors.

**CSE3002**.3. Apply formal mathematical methods to prove properties of languages, grammars, and automata.

**CSE3002**.4. Apply the knowledge of theory of computation to an engineering application (e.g. designing the compilers).

**CSE3002**.5. Classify formal languages and Evaluate whether a language/grammar belongs to a given type or not.

**CSE3002**.6. Design automata for given languages/grammars. Generate languages/grammars for a given automaton and Construct grammars for languages and vice versa.

**2. Detailed Syllabus**

**Module 1 [11L]**

**Fundamentals**: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, Design of sequence detector (Application of concept of Automata to sequential circuit design), Introduction to finite state model.

**Finite state machine:** Definitions, capability & state equivalence, kth- equivalence concept. Minimization of FSM, Equivalence between two FSM's, Limitations of FSM; Moore & Mealy machine and their conversion.

**Finite Automata:** Deterministic finite automaton (DFA) and non-deterministic finite automaton (NFA). Transition diagrams and Language recognizers; Application of finite automata, NFA with $\epsilon$ transitions - Significance, acceptance of languages. Design of DFA/ NFA for given languages.

**Conversions and Equivalence:** Equivalence between NFA with and without $\epsilon$ transitions. NFA to DFA conversion.

**Module 2 [12L]**

**Introduction to Formal Languages and Grammars:** Chomsky Classification of grammar: unrestricted, context sensitive, context free and regular grammar. Grammar Formalism: Right linear and left linear grammars, Regular grammar, Regular Languages, Regular sets. Regular expressions, identity rules, Problems on Regular expressions. Arden's theorem statement, proof and applications. Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA. Pumping lemma of regular sets. Closure properties of regular sets (proofs not required). Equivalence between regular grammar and FA.

**Module 3 [13L]**

**Context free grammar:** Introduction to Context free grammars, Derivation/ parse trees, Sentential forms, Right most and leftmost derivation of strings, ambiguity in context free grammars, various problems on CFG. Minimization of Context Free Grammars: Removal of useless, null and unit productions. Chomsky normal form and Greibach normal form. Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications.

**Push Down Automata:** Push down automata, Definition and design of PDA. Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, conversion from one to another. (Proofs not required). Introduction to DCFL and DPDA.

**Module 4 [12L]**

**Turing Machine:** Introduction to Turing Machine, Definition, Model. Design of TM for different languages, TM as language accepter. TM as transducers. Computable functions. Languages accepted by a TM, recursively enumerable and recursive languages. Diagonalization method. Church's hypothesis, counter machine. Types of Turing machines (proofs not required). Universal Turing Machine. Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc.

**3. Textbooks**

1. Introduction to Automata Theory Language and Computation, Hopcroft H.E. and Ullman J. D., Pearson Education.
2. An Introduction to Formal Languages and Automata, Peter Linz, Jones and Bartlett Publishers.
3. Introduction to the Theory of Computation, Sipser Michael. Cengage Learning.
4. Theory of Computer Science, Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.

**4. Reference Books**

1. Switching & Finite Automata, ZVI Kohavi, 2nd Ed., Tata McGraw Hill.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. Introduction to languages and the Theory of Computation, John C Martin, TMH.
4. Elements of Theory of Computation, Lewis H.P. & Papadimitrou C.H. Pearson

| Course Name: I n t r o d u c t i o n t o Data Mining | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC3101** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

## 1. Course Outcomes

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

**DSC3101.1** Remember different terminologies in respect of data mining techniques.

**DSC3101.2** Understand and apply the various data preprocessing methods as and when required.

**DSC3101.3** Understand and apply different classification, clustering algorithms to solve various real life problems.

**DSC3101.4** Analyze various methods for mining the frequent patterns in different real life situations.

**DSC3101.5** Apply several ensemble techniques, like bagging, boosting, random forests etc. as and when required.

**DSC3101.6** Evaluate various data mining techniques to solve real-world problems.

## 2. Detailed Syllabus

**Module 1 [9L]**

Introduction: Basics of Data Mining? Why do we need data mining? Data mining Architecture, Data mining goals and techniques. Challenges in Data Mining.

Data pre-processing: Data cleaning, Data transformation and Data reduction. Applications

Rule-based Classification: How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.

**Module 2 [9L]**

Data mining algorithms: Supervised Classification Techniques: Bayesian Network: Bayes theorem, Naïve Bayes and Gaussian Naive Bayes; classifier. K-nearest neighbor . Decision Tree: Gini index, Information gain.

Support Vector Machines (SVM): Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM and kernels.

**Module 3 [9L]**

Ensemble Methods, Association Rule Mining: Ensemble Methods: Bagging, Boosting, Random Forests Association Rule Mining: Introduction, rules and item-set generation Frequent item-set generation, (Apriori principle, candidate generation and pruning), Compact representation of frequent item sets, correlation analysis,FP- growth algorithm, Sub-graph mining.

**Module 4 [9L]**

Cluster Analysis: Introduction: Motivations, objectives and applications of clustering. Different types of clustering. Partitional Clustering: K-means, K-means++. Hierarchical Clustering: Agglomerative, Divisive, MIN, MAX, dendrogram representation.

Density-based Clustering: DBSCAN. Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK.

**3. Textbooks**

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.

**4. Reference Books**

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.
2. Pattern Recognition and Machine Learning, Third Edition, C. Bishop, Springer, 2006.
3. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009

**LIST OF COURSES FOR PROFESSIONAL ELECTIVE–I**

| Paper Code | Paper Name |
|---|---|
| **DSC3131** | **Robotics** |
| **DSC3132** | **Business Analytics** |
| **DSC3133** | **Web Mining** |

| **Course Name: Robotics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC3131** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

1. **Course Outcomes:**
   On completion of this course, students will be able to:
   **DSC3131.1.** To understand the concept of Robot mechanical structure, modelling and control
   **DSC3131.2.** To understand the Kinematics of Robotic structure
   **DSC3131.3.** To realise and remember the concept of sensors, actuators and motion control
   **DSC3131.4.** To apply the knowledge of programming in developing an automated system
   **DSC3131.5.** To understand the concepts of Force Control and Visual Servoing
   **DSC3131.6.** To develop algorithms for robotic motion planning

2. Detailed Syllabus:

**Module 1:**

**Introduction**: Robot Mechanical Structure; Industrial Robotics; Advanced Robotics; Robot Modelling, Planning and Control [4L]

**Kinematics**: Pose of a Rigid Body; Rotation Matrix; Composition of Rotation Matrices; Euler Angles; Angle and Axis; Unit Quaternion; Homogeneous Transformations; Direct Kinematics; Kinematics of Typical Manipulator Structure; Joint Space and Operational Space; Kinematic Calibration; Inverse Kinematics Problem [6L]

**Module 2:**

**Trajectory Planning**: Path and Trajectory; Joint Space Trajectories; Operational Space Trajectories [2L] **Actuators and Sensors:** Joint Actuating System; Drives; Proprioceptive Sensors; Exteroceptive Sensors [2L]

**Control Architecture**: Functional Architecture; Programming Environment; Hardware Architecture [2L] **Motion Control:** The Control Problem; Joint Space Control; Decentralized Control; Computed Torque Feed forward Control; Centralized Control; Operational Space Control; Comparison Among Various Control Schemes. [4L]

**Module 3:**

**Force Control:** Manipulator Interaction with Environment; Compliance Control; Impedance Control; Force Control; Constrained Motion; Natural and Artificial Constraints; Hybrid Force/Motion Control.[4L] **Visual Servoing:** Vision for Control; Image Processing; Pose Estimation; Stereo Vision; Camera Calibration; The Visual Servoing Problem; Position-based Visual Servoing; Image-based Visual Servoing; Comparison Among Various Control Schemes; Hybrid Visual Servoing.[4L]

**Module 4:**

**Mobile Robots:** Nonholonomic Constraints; Kinematic Model; Chained Form; Dynamic Model; Planning; Path and Timing Law; Motion Control; Odometric Localization [4L]

**Motion Planning:** The Canonical Problem; Configuration Space; Planning via Retraction; Planning via Cell Decomposition; Probabilistic Planning; Planning via Artificial Potentials; The Robot Manipulator Case. [4L]

**2. References:**


i. Robotics Modelling, Planning and Control, Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, SpringerPublications.

ii. Principles of Robot Motion, Theory, Algorithms and Implementation, Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, The MIT Press, Cambridge, Massachusetts, London,England.

| Course Name: Business Analytics | | | | | |
|---|---|---|---|---|---|
| Course Code: DSC3132 | | | | | |
| Contact Hours per week: | L | T | P | Total | Credit points |
| | 3 | 0 | 0 | 3 | 3 |

## 1. Course Outcomes

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

**DSC3132.1**. Understand the need of business analytics.
**DSC3132.2**. Learn python packages for data analytics.
**DSC3132.3.** Learn how to do data visualization.
**DSC3132.4.** Learn how to store and manage large volume of data.
**DSC3132.5**. Suggest appropriate solutions forpredictive analysis.
**DSC3132.6.** Perform experiments and case studies using real-world data.

## 2. Detailed Syllabus

**Module 1 [6L]**

**Introduction:** Business value of data analytics. data-driven decision-making. Root cause analysis, Predictive Analysis, and Perspective Analysis.

**Module 2 [12L]**

**Python for analytics:**

Python basics. Solve logical problems using Python programming. Pandas package to manipulate data frames and Numpy for various matrix and vector manipulations.

**Database:**

Manage large volume of data. Derive insights from data and answer pertinent business questions.Advantages of NoSQL databases.Cleaning of data, Noise removal.

**Module 3 [9L]**

**EDA and data visualisation:**

Advanced visualization techniques using visualization tool.
Use Matplotlib & Seaborn to visualize the data in Python; Continuous and Categorical Plots: Scatter, Histogram, Heatmaps.

**Module 4 [9L]**

**Machine learning for business:**

Statistical foundation, infer insights from a population using a small sample.Formulate and validate hypotheses for a population to solve real-life business problems.Basics of Linear Regression; Best Fit Line; OLS; Metrics for Evaluation; Need of Logistic Regression, model evaluation.

Classification algorithms, application in business use cases.

K-means and Hierarchical clustering algorithms for continuous and categorical data.

3. **Textbooks**

1. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.
2. Pattern Recognition and Machine Learning, First Edition, C. Bishop, Springer, 2006.
3. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.
4. Pattern Classification, Second Edition, R. Duda, P. Hart and D. Stock, Wiley-Interscience, 2000.

| **Course Name: Web Mining** | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC3133** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

**1. Course Outcomes**

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

**DSC3133.1.** Learn and understand web mining models for Information Retrieval.

**DSC3133.2.** Understand and apply web search techniques and social network analysis.

**DSC3133.3.** Understand and apply Web crawlers, Structured data extraction and information integration.

**DSC3133.4.** Learn and understand opinion mining and sentiment analysis and web usage mining techniques.

**DSC3133.5.** Suggest appropriate solutions to web mining problems.

**DSC3133.6.** Perform experiments in Web mining, using real-world data.

**2. Detailed Syllabus**

**Module 1 (9L)**

***Introduction to Data Mining and Web Mining:*** Review of Data Mining foundations.

***Information Retrieval (IR):*** IR Models: Boolean, Vector Space, Statistical Language Model, Text and Web Page Pre-processing, Inverted Index and its compression.

***Web Search:*** Meta search, combining multiple rankings, web spamming, content spamming, link spamming, hiding techniques, Combating spam.

**Module 2 (9L)**

***Social Network Analysis:*** Co-Citation and Bibliographic Coupling, PageRank Algorithm, HITS Algorithm, Community Discovery.

***Web Crawling:*** Breadth-First Crawlers, Preferential Crawlers, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers.

**Module 3 (9L)**

***Structured Data Extraction: Wrapper Generation:*** Wrapper Induction, Instance-based Wrapper Learning, Automatic Wrapper generation, String matching and Tree matching, Multiple alignment, Extraction Based on a Single List Page:Flat Data Records, Nested Data Records.

***Information Integration:*** Schema Matching, Pre-Processing for Schema Matching, Schema-Level, Domain and Instance-Level Matching, Combining Similarities, **1:*m*** Match.

**Module 4 (9L)**

***Opinion Mining and Sentiment Analysis:*** Problem Definitions, Aspect-Based Opinion Summary, Document Sentiment Classification based on supervised and unsupervised learning, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Opinion Mining, Mining Comparative Opinions.

***Web Usage Mining:*** Data Collection and Pre-Processing, Data Modelling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender Systems and Collaborative Filtering, Query Log Mining.

**3. Textbook:**

Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, 2nd edition, Bing Liu, Springer, 2011, ISBN-10: 3642194591.

**4. References:**

(i) Introduction to Data Mining, by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Pearson/Addison Wesley, 2006, ISBN-10: 0321321367

(ii) Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011

**(i)** Zdravko Markov and Daniel T. Larose. *Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage*, Wiley, 2007, ISBN: 978-0-471-66655-4.

**LIST OF COURSES FOR PROFESSIONAL ELECTIVE–II**

| Paper Code | Paper Name |
|---|---|
| **CSE3141** | **Artificial Intelligence** |
| **DSC3141** | **Data Curation** |

| **Course Name: Artificial Intelligence** | | | | | |
|---|---|---|---|---|---|
| **Course Code: CSE3141** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | 3 | 0 | 0 | 3 | 3 |

**1.** Course Outcomes

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

**CSE3141**.1. Remember and understand the basic principles of state-space representation of any given problem, various searching and learning algorithms, game playing techniques, logic theorem proving etc.

**CSE3141**.2. Comprehend the importance of knowledge as far as intelligence is concerned and the fundamentals of knowledge representation and inference techniques.

**CSE3141**.3. Apply this knowledge so that it can be used to infer new knowledge in both certain and uncertain environment

**CSE3141**.4. Apply various AI searching algorithms, like state-space search algorithm, adversarial search algorithm, constraint satisfaction search algorithm as and when required.

**CSE3141**.5. Understand the working knowledge of Prolog/ Lisp in order to write simple Prolog/ Lisp programs and explore more sophisticated Prolog/ Lisp code on their own.

**CSE3141**.6. Design and evaluate the performance of a heuristic applied to a real-world situation.

**2. Detailed Syllabus**

Module1 [9L]

Introduction: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI. Introduction to Intelligent Agents: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.

Knowledge Representation & Propositional Logic: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Resolution for propositions, Limitation of Propositional Logic.

Problem Solving using Single Agent Search: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit vs. Implicit State space.

Uninformed Search Techniques: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

**Module 2 [9L]**

Informed Search Methods: Basic Principles, Heuristics, A* Search and its properties, Admissible & Consistent heuristic, Iterative deepening A* (IDA*) and AO* search, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods

Problem Solving using Two Agent Search: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.

Constraint Satisfaction Problem: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

**Module 3 [9L]**

Knowledge Representation & Predicate Logic: Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

Knowledge Representation using Rules: Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.

Probabilistic reasoning: Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks –representation & syntax, semantics of Bayesian net, Brief discussion on Fuzzy sets & fuzzy logic.

Other Representational Formalism: Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

**Module 4 [9L]**

Planning: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Learning: Overview, Taxonomy of learning system, various learning models, learning rules, Naïve Bayes classifier and Decision tree based learning, Brief idea about learning using Neural Network & Genetic Algorithm.

Natural Language Processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

**3. Textbooks**


1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education.
2. Artificial Intelligence, Rich & Knight, TMH.


**4. Reference Books**


1. Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
2. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.
3. Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.
4. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

| Course Name: Data Curation | | | | | |
|---|---|---|---|---|---|
| **Course Code:DSC3141** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **3** | **0** | **0** | **3** | **3** |

## 1. Course Outcomes:

After completion of course, students would be able to:

**DSC3141.1.**Define and distinguish digital Curation, data Curation and related terminology.

**DSC3141.2.** Understand the characteristics of various data types generated and used by a variety of fields, research communities, and government organizations.

**DSC3141.3.** Understand the data curation lifecycle and identify the activities associated with each stage.

**DSC3141.4.** Understand the importance of dataset identifiers, citation and data repository.

**DSC3141.5.** Identify standards and technologies for managing and maintaining digital content.

**DSC3141.6.** Apply theoretical understanding to practical issues in data Curation.

## 2. Detailed Syllabus

**Module I: (9L)**

Basics, What are data? Research data, Data Catalog, Need of Data catalog, Managed Data Sharing, Need of Data Curation, Data lifecycle; research data lifecycle, Impact on our society, data sharing and reuse.

**Module II: (9L)**

Distinguish between analogue and digital materials, Different data types and formats, Disciplinary data, Curation action associated with stages of data, Data Curation lifecycle, Curation approaches for big and small data.

**Module III: (9L)**

Data preservation and its importance , Approaches for research data storage, backup, access control and security, Types of available repositories/archives, Data ingest and manipulation in repository context (repository perspective), Understand process issues for depositing data in repository (sharer perspective), Distinguish between back-up and preservation.

**Module IV: (9L)**

OAIS Reference Model, Persistent identification, Unique identification of digital objects, Digital Object Identifiers, CrossRef Open Archives Initiative protocols OAI-PMH and OAI-ORE , Open data for data --Namespaces, URLs, and versions of record.

## 3. Textbooks

1. Data Curation A Complete Guide - 2020 Edition by Gerardus Blokdyk.
2. Digital Curation Fundamentals by Jody L Deridder.

## 4. Reference Books


1. International Journal of Digital Curation: http://www.ijdc.net/
2. The Practice of Data Curation from Archive Journal: http://www.archivejournal.net/roundtable/data-curation-curating-the-digital-curatingthe-analog/
3. Journal of e-Science Librarianship: https://escholarship.umassmed.edu/jeslib/
4. Data Science Journal: https://datascience.codata.org/

# OPEN ELECTIVE

| Paper Name: Database Management Systems Lab | | | | | |
|---|---|---|---|---|---|
| **Paper Code: CSE3151** | | | | | |
| **Contact hours per week:** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **1.5** |

Course Outcomes:

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

**CSE3151.1.** Learn to use Entity Relationship Diagram (ERD) model as a blueprint to develop the corresponding relational model in a RDBMS system like Oracle DBMS.
**CSE3151.2.** Apply DDL component of Structured query language (SQL) to create a relational database from scratch through implementation of various constraints in Oracle RDBMS system. **CSE3151.3.** Apply DML component of Structured query language (SQL) for storing and modification of data in Oracle RDBMS system.
**CSE3151.4.** Apply DQL component of Structured query language (SQL) to construct complex queries for efficient retrieval of data from existing database as per the user requirement specifications.
**CSE3151.5.** Conceptualize and apply various P/L SQL concepts like cursor, trigger in creating database programs.
**CSE3151.6.** Develop a fully-fledged database backend system using SQL and P/L SQL programming to establish overall integrity of the database system.

Creation of a database using a given ERD Model as blueprint:

SQL Data Definition Language - Create (and Alter) table structure, Apply (and Alter) constraints on columns/tables viz., primary key, foreign key, unique, not null, check. Verify/ Review the table structure (along with applied constraints) using appropriate data dictionary tables like user_constraints, user_cons_columns, etc. Create view, materialized view using one or more table.

SQL Data Manipulation Language - Insert into rows (once at a time/ and in bulk) from a table, Update existing rows of a table, Delete rows (a few or all rows) from a table.

Data Query Language (DQL):

Basic select-from-where structure - Usage of Top, Distinct, Null keywords in query, Using String and Arithmetic Expressions, Exploring Where Clause with various Operators and logical combination of various conditions, Sorting data using Order By clause. Usage of IN, LIKE, ALL keywords.

Introduction to Joins -Natural Joins, equi-join, non-equi-join, Self-Join, Inner Join, Outer (left, right) Join.

Set operations- Unions, Intersect, minus set operations on table data using SQL.

Using single row functions in Queries - NVL function (to handle ambiguity of null data), upper, lower, to_date, to_char functions, etc.

Using group/multiple row functions in Queries like Count, Sum, Min, Max, Avg, etc, using Group By and Having Clause, using Group By with Rollup and Cube.

Sub-query - Working with various nested structure of Sub Queries - use in from or where clause with more than one level of nesting, correlated sub-query- Ranking table data using correlated sub-query.

P/L SQL:

Stored Procedures and Functions- Basic programming constructs of PL / SQL like if, else, else- if, loop, while, for structure. Populate stored procedure variables with the data fetched from table using SQL command.

Working with Cursors - Creating Cursors, parameterized cursor, Locks on cursors, Exploring advantages of cursors.

Introduction to triggers - Constraints vs Triggers, Creating, Altering, Dropping triggers, use of for/ after/ instead of triggers, using trigger to validate/ rollback a Transaction, Automatically populate integer data based primary key columns (e.g., Id.) using trigger**.**

Textbooks


1. Database System Concepts, Henry F. Korth and Silberschatz Abraham, Mc.Graw Hill.
2. Fundamentals of Database Systems, ElmasriRamez and Novathe Shamkant, Benjamin Cummings Publishing Company.


Reference Books


SQL, PL/SQL: The Programming Language of Oracle (With CD-ROM) (English) 4th Revised Edition, Ivan Bayross, BPB Publications.

| Course Name: Introduction to Data Mining Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC3151** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**1. Course Outcomes**

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

**DSC3151**.1 Understand the errors and noises present in data and apply various techniques to clean them.

**DSC3151**.2 Learn, implement and compare various classification algorithms

**DSC3151**.3 Learn, implement and compare various clustering algorithms

**DSC3151**.4 Understand and implement a-priori and FP-tree algorithms for association rule mining

**DSC3151**.5 Analyze the problem (data) and use appropriate algorithm to data mining problems

**DSC3151**.6 Apply data mining algorithms on real-world data

**2. Detailed Syllabus**

1. Preprocessing of Data
   (i) Data set generation
   (ii) Identification and cleaning of data
   (iii) Noise removal from data
2. Familiarization with
   (i) Python
   (ii) TensorFlow
3. Classifiers
   (i) K-NN
   (ii) Naïve Bayes Classifier
   (iii) Decision Tree
   (iv) Support Vector Machine
4. Clustering Algorithms
   (i) K-Means
   (ii) DB-Scan
   (iii) Hierarchical Clustering
5. Association Rule Mining – Frequent item set and Rule generation
   (i) A-priori Algorithm
   (ii) FP-Tree
   (iii) Rule Generation

**3. Textbooks**

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.

2. Py hon for Data Analy sis, Wes McKinney , O'Reilly , 2017.

**4. Reference Books**

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.

| **Course Name: Artificial Intelligence Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: CSE3171** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**1. Course Outcomes**

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

**CSE3171.1**. Remember and understand the working principles of PROLOG/ LISP
**CSEN171.2**. Apply LIST structure of PROLOG as and when required
**CSE3171.3.** Make use of CUT to the programs as and when required
**CSE3171.4.** Solve the problems by using accumulator
**CSE3171.5.** Apply the principles of reasoning and inference to real world problems
**CSE3171.6**. Design programs to solve various puzzles.

**2. Detailed Syllabus**

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline is given below:

1. Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; somesimple queries on the family tree
2. Formation of recursive definition; how PROLOG executes the goals; simple assignments
3. How PROLOG deals with problems with numbers – integers, real; with some examples
4. Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
5. Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
6. Introduction to CUT with simple assignments; implementation of Sorting algorithms
7. PROLOG clauses for file operation – with simple assignments
8. Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
9. Implementation of some well-known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries &Cannibals problem etc.
10. Introduction to LISP
11. Some simple assignments on LISP.

**3. Textbooks**

1. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

**4. Reference Books**

1. Logic and Prolog Programming, Saroj Kaushik, New Age International Publishers.

| Course Name: Data Curation Lab | | | | | |
|---|---|---|---|---|---|
| **Course Code: DSC3171** | | | | | |
| **Contact Hours per week:** | **L** | **T** | **P** | **Total** | **Credit points** |
| | **0** | **0** | **2** | **2** | **1** |

**1. Course Outcomes**

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

**DSC3171**.1 Understand the errors and noises present in data and apply various techniques to clean them.

**DSC3171**.2 Analyze data using different machine learning algorithms to perform exploratory analysis.

**DSC3171**.3 Implementing Linear Regression in Python.

**DSC3171**.4 Visualize the data set and the regression line.

**2. List of Experiments**

1. Perform exploratory data analysis - data cleaning and processing.
2. Implement and analyze Linear regression with scikit-learn in python (Single variable & Multivariable).
3. Implement and analyze Logistic regression in python.
4. Visualize the data set and the regression line.
5. Implement and analyze Decision tree algorithm in python.
6. Implement and analyze Random Forest algorithm in python.

**3. Textbooks**

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.

2. Python for Data Analysis, Wes McKinney , O'Reilly , 2017.

**4. Reference Books**

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.

# APPENDIX – A

OFFICE OF THE CONTROLLER OF EXAMINATIONS

## HERITAGE INSTITUTE OF TECHNOLOGY, KOLKATA

### MANDATORY ADDITIONAL REQUIREMENTS (MAR)

Activity List w.e.f. 2023-2024 Academic Year

| | Activity | Points per Activity | Permissible Points (max) |
|---|---|---|---|
| 1. | MOOCS (SWAYAM / NPTEL / SPOKEN TUTORIAL / ANY TECHNICAL, NON-TECHNICAL COURSE) (PER COURSE) | | |
| a) | For 12 weeks duration/40 Hours | 20 | 40 |
| b) | For 8 weeks duration/30 Hours | 15 | |
| c) | For 4 weeks duration/20 Hours | 10 | |
| d) | For 2 weeks duration/10 Hours | 5 | |
| 2. | TECH FEST / FEST / TEACHERS DAY / FRESHER'S WELCOME | | |
| a) | Organizer | 5 | 10 |
| b) | Participant | 3 | 6 |
| 3. | RURAL REPORTING | 5 | 10 |
| 4. | TREE PLANTATION AND UP-KEEPING (PER TREE) | 1 | 10 |
| 5. | RELIEF / CHARITABLE ACTIVITIES | | |
| a) | Collection of fund / materials for the Relief Camp or Charitable Trusts | 5 | 40 |
| b) | To be a part of the Relief Work Team | 20 | |
| 6. | PARTICIPATION IN DEBATE / GROUP DISCUSSION / WORKSHOP / TECH QUIZ / MUSIC / DANCE / DRAMA / ELOCUTION / QUIZ / SEMINAR / PAINTING / ANY PERFORMING ARTS / PHOTOGRAPHY / FILM MAKING / LIFE SKILLS | 10 | 20 |
| 7. | PUBLICATION IN NEWS PAPER, MAGAZINE, WALL MAGAZINE & BLOGS | 10 | 20 |
| 8. | RESEARCH PUBLICATION (PER PUBLICATION) | 15 | 30 |
| 9. | INNOVATIVE PROJECTS (OTHER THAN COURSE CURRICULUM) | 30 | 60 |
| 10. | BLOOD DONATION | | |
| a) | Individual Blood donation | 8 | 16 |
| b) | Blood Donation Camp Organization | 10 | 20 |
| 11. | SPORTS / GAMES / ADVENTURE SPORTS / TREKKING / YOGA CAMP | | |
| a) | Personal Level | 10 | 20 |
| b) | College level | 5 | 10 |
| c) | University Level | 10 | 20 |
| c) | District Level | 12 | 24 |
| e) | State Level | 15 | 30 |
| f) | National / International Level | 20 | 20 |
| 12. | ACTIVITIES IN A PROFESSIONAL SOCIETY / STUDENT CHAPTER | 10 | 20 |
| 13. | RELEVANT INDUSTRY VISIT & REPORT / HOTEL-EVENT MANAGEMENT TRAINING & REPORT (MINIMUM 3 DAYS WITH SUBMITTED REPORT) | 10 | 20 |
| 14. | COMMUNITY SERVICE & ALLIED ACTIVITIES LIKE: CARING FOR THE SENIOR CITIZENS, UNDER-PRIVILEGED / STREET CHILDREN / ANIMAL CARE ETC. / TRAINING TO DIFFERENTLY ABLE | 10 | 20 |
| 15. | SELF-ENTREPRENEURSHIP PROGRAMME | | |
| a) | To organise entrepreneurship programmes and workshops | 10 | 20 |
| b) | To take part in entrepreneurship workshop and get certificate | 5 | 10 |
| c) | Video film making on entrepreneurship | 10 | 20 |
| d) | Submit business plan on any project | 10 | 20 |
| e) | To work for start-up/as entrepreneur | 20 | 40 |

## Format for Report Submission

Name :

Department :

Year/Semester :

Title of the Activity :

Date :

Name of the organization :

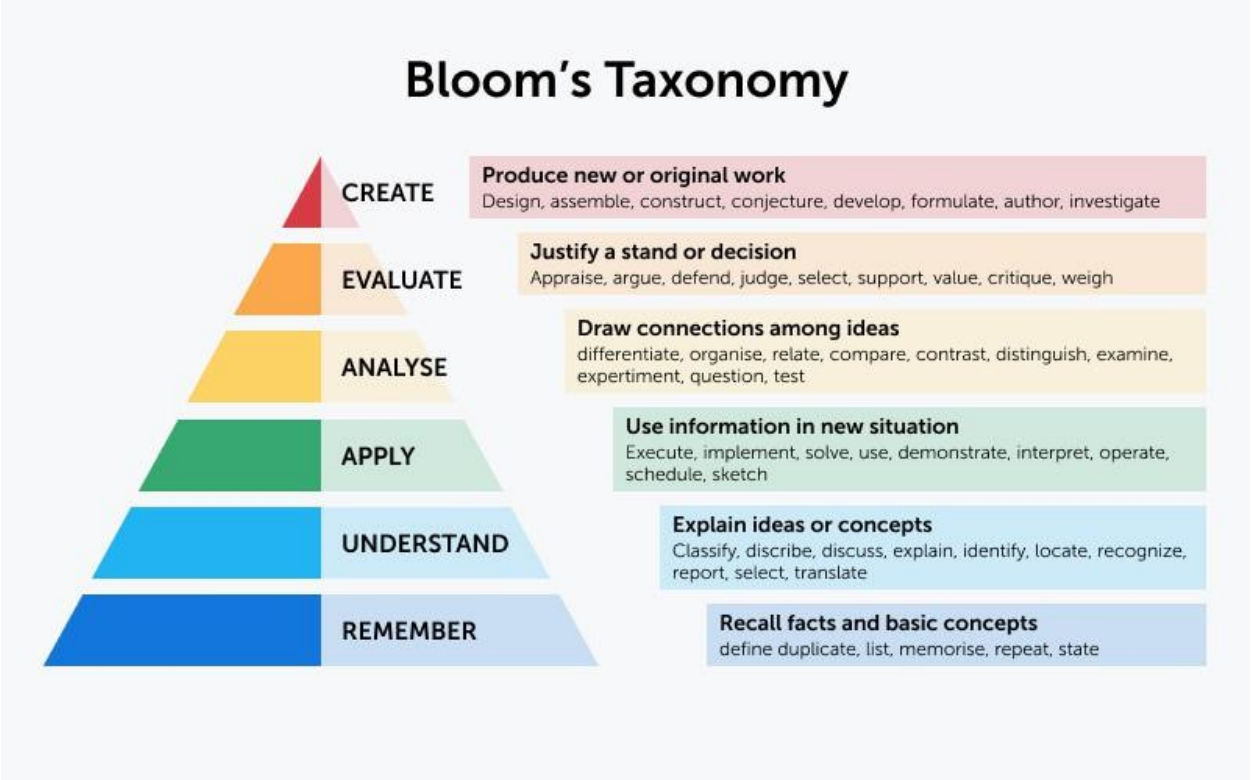
Report :

Signature
(Coordinator / Competent Authority)

Points earned:

Signature of the Mentor

# APPENDIX – B


Bloom's Taxonomy
CREATE
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate
EVALUATE
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh
ANALYSE
Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, expertiment, question, test
APPLY
Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch
UNDERSTAND
Explain ideas or concepts
Classify, discribe, discuss, explain, identify, locate, recognize, report, select, translate
REMEMBER
Recall facts and basic concepts
define duplicate, list, memorise, repeat, state