# B.E. (Computer Science and Engineering Engineering)

# 2022 Regulations, Curriculum & Syllabi

## (Candidates admitted during Academic Year 2022-2023)

Stay Ahead

**BANNARI AMMAN INSTITUTE OF TECHNOLOGY**

An Autonomous Institution Affiliated to Anna University – Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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## VISION OF THE DEPARTMENT

To excel in the field of Computer Science and Engineering, to meet the emerging needs of the industry, society, and beyond.

## MISSION OF THE DEPARTMENT

1. To impart need based education to meet the requirements of the industry and society.
2. To equip students for emerging technologies with global standards and ethics that aid in societal sustainability.
3. To build technologically competent individuals for industry and entrepreneurial ventures by providing infrastructure and human resources.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Graduates will apply computer science and engineering principles and practices to solve real-world problems with their technical competence.

II. Graduates will have the domain knowledge to pursue higher education and apply cutting edge research to develop solutions for socially relevant problems.

III. Graduates will communicate effectively and practice their profession with ethics, integrity, leadership, teamwork, and social responsibility, and pursue lifelong learning throughout their careers.

## PROGRAM OUTCOMES (POs)

a) Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c) 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 public health and safety, and the cultural, societal, and environmental considerations.

d) 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.

e) 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.

f) 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

g) 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.

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

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

j) 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.

k) 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.

l) 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.

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

**m)** Apply suitable algorithmic thinking and data management practices to design develop, and evaluate effective solutions for real-life and research problems.

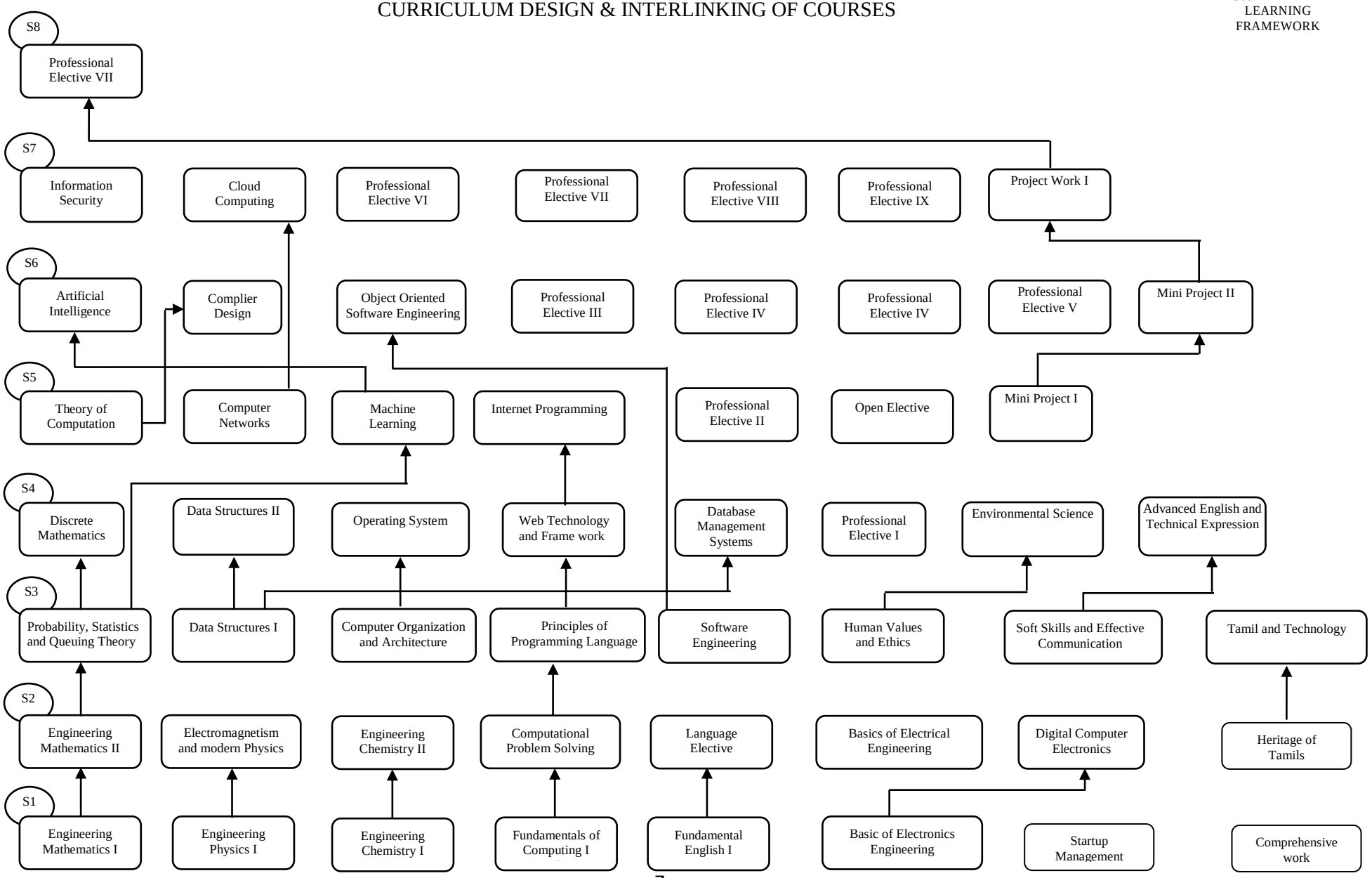
**n)** Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

## MAPPING OF PEOs AND POs

| PEOs | Program Outcomes(s) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** | **m** | **n** |
| **I** | X | X | X | X | X | X | X | | | | | | X | X |
| **II** | X | X | X | X | X | X | X | | | | | X | | |
| **III** | | | | | | | | X | X | X | X | X | X | X |

# CONNECTIVITY CHART
## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CURRICULUM DESIGN & INTERLINKING OF COURSES

360° FLEXIBLE LEARNING FRAMEWORK



| DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING<br>Minimum Credits to be Earned: 163 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **I SEMESTER** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/ Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22MA101 | Engineering Mathematics I | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | BS |
| 22PH102 | Engineering Physics | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 22CH103 | Engineering Chemistry I | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 22GE001 | Fundamentals of Computing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | ES |
| 22HS001 | Foundational English | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 22GE004 | Basics of Electronics Engineering | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | ES |
| 22HS002 | Startup Management | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | EEC |
| 22CS108 | Comprehensive Work | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **14** | **1** | **12** | **21** | **27** | **-** | **-** | **-** | **-** |
| **II SEMESTER** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/ Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22MA201 | Engineering Mathematics II | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | BS |
| 22PH202 | Electromagnetism and Modern Physics | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 22CH203 | Engineering Chemistry II | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | BS |
| 22GE002 | Computational Problem Solving | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | ES |
| 22GE003 | Basics of Electrical Engineering | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | ES |
| 22CS206 | Digital Computer Electronics | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | ES |
| | Language Elective | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| *22HS003 | தமிழர் மரபு/ Heritage of Tamils | 1 | 0 | 0 | 1 | 1 | 100 | 0 | 100 | HSS |
| **Total** | | **17** | **1** | **10** | **23** | **28** | **-** | **-** | **-** | **-** |

* The Lateral entry students have to study this course during IV semester

| III SEMESTER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/ Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS301 | Probability, Statistics and Queuing Theory | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | BS |
| 22CS302 | Data Structures I | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS303 | Computer Organization and Architecture | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | ES |
| 22CS304 | Principles of Programming Languages | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS305 | Software Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 22HS004 | Human Values and Ethics | 2 | 0 | 0 | 2 | 2 | 100 | 0 | 100 | HSS |
| 22HS005 | Soft Skills and Effective Communication | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | HSS |
| 22HS006 | தமிழரும் தொழில்நுட்பமும் / Tamils and Technology | 1 | 0 | 0 | 1 | 1 | 100 | 0 | 100 | HSS |
| **Total** | | **18** | **1** | **8** | **22** | **25** | **-** | **-** | **-** | **-** |
| **IV SEMESTER** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/ Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS401 | Discrete Mathematics | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | ES |
| 22CS402 | Data Structures II | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS403 | Operating Systems | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | PC |
| 22CS404 | Web Technology and Frameworks | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PC |
| 22CS405 | Database Management System | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| | Professional Elective I | - | - | - | 3 | - | - | - | 100 | PE |
| 22HS007 | Environmental Science | 2 | 0 | 0 | - | 2 | 100 | 0 | 100 | HSS |
| 22HS008 | Advanced English and Technical Expression | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **16** | **2** | **8** | **23** | **26** | **-** | **-** | **-** | **-** |

| V SEMESTER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours/ Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS501 | Theory of Computation | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | ES |
| 22CS502 | Computer Networks | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS503 | Machine Learning | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS504 | Internet Programming | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PC |
| | Professional Elective II | - | - | - | 3 | - | - | - | 100 | PE |
| | Open Elective | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS507 | Mini Project I | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **14** | **1** | **8** | **22** | **23** | **-** | **-** | **-** | **-** |
| **VI SEMESTER** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours /Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS601 | Artificial Intelligence | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| 22CS602 | Compiler Design | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 | PC |
| 22CS603 | Object Oriented Software Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| | Professional Elective III | - | - | - | 3 | - | - | - | 100 | PE |
| | Professional Elective IV | - | - | - | 3 | - | - | - | 100 | PE |
| | Professional Elective V | - | - | - | 3 | - | - | - | 100 | PE |
| 22CS607 | Mini Project II | 0 | 0 | 2 | 1 | 2 | 100 | 0 | 100 | EEC |
| **Total** | | **9** | **1** | **4** | **21** | **14** | **-** | **-** | **-** | **-** |

| VII SEMESTER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours /Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS701 | Information Security | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 22CS702 | Cloud Computing | 3 | 0 | 2 | 4 | 5 | 50 | 50 | 100 | PC |
| | Professional Elective VI | - | - | - | 3 | - | - | - | 100 | PE |
| | Professional Elective VII | - | - | - | 3 | - | - | - | 100 | PE |
| | Professional Elective VIII | - | - | - | 3 | - | - | - | 100 | PE |
| | Professional Elective IX | - | - | - | 3 | - | - | - | 100 | PE |
| 22CS707 | Project Work I | 0 | 0 | 4 | 2 | 4 | 60 | 40 | 100 | EEC |
| **Total** | | **6** | **0** | **6** | **21** | **12** | **-** | **-** | **-** | **-** |
| **VIII SEMESTER** | | | | | | | | | | |
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours /Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22CS801 | Project Work II | 0 | 0 | 20 | 10 | 20 | 60 | 40 | 100 | EEC |
| **Total** | | **0** | **0** | **20** | **10** | **20** | **-** | **-** | **-** | **-** |

| ELECTIVES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **L** | **T** | **P** | **C** | **Hours /Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| 22HS201 | Communicative English II | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 22HSH01 | Hindi | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 22HSG01 | German | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 22HSJ01 | Japanese | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| 22HSF01 | French | 1 | 0 | 2 | 2 | 3 | 100 | 0 | 100 | HSS |
| **VERTICAL 1 - DATA SCIENCE** | | | | | | | | | | |
| 22CS001 | Exploratory Data Analysis | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS002 | Recommender Systems | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS003 | Big Data Analytics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS004 | Neural Networks and Deep Learning | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS005 | Natural Language Processing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS006 | Computer Vision | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **VERTICAL II - FULL STACK DEVELOPMENT** | | | | | | | | | | |
| 22CS007 | Agile Software Development | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS008 | UI and UX Design | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS009 | Web Frameworks | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS010 | App Development | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS011 | Software Testing and Automation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS012 | DevOps | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **VERTICAL III - CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES** | | | | | | | | | | |
| 22CS013 | Virtualization in Cloud Computing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS014 | Cloud Services and Data Management | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS015 | Cloud Storage Technologies | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS016 | Cloud Automation Tools and Applications | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS017 | Software Defined Networks | 2 | 0 | 2 | 3 | 3 | 50 | 50 | 100 | PE |
| 22CS018 | Security and Privacy in Cloud | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |

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|---|---|---|---|---|---|---|---|---|---|---|
| **VERTICAL IV - CYBER SECURITY AND DATA PRIVACY** | | | | | | | | | | |
| 22CS019 | Cyber Security | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS020 | Modern Cryptography | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS021 | Cyber Forensics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS022 | Ethical Hacking | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS023 | Crypto currency and Block chain Technologies | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS024 | Malware Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **VERTICAL V - CREATIVE MEDIA** | | | | | | | | | | |
| 22CS025 | Multimedia and Animation | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS008 | UI and UX Design | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS026 | Augmented Reality and Virtual Reality | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS027 | Game Development | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS028 | Video Creation and Editing | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS029 | Digital Marketing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **VERTICAL VI- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** | | | | | | | | | | |
| 22CS030 | Knowledge Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS031 | Soft Computing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS004 | Neural Networks and Deep Learning | 2 | 0 | 2 | 3 | 4 | 50 | 50 | 100 | PE |
| 22CS032 | Text and Speech Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS033 | Optimization Techniques | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS034 | Ethics and AI | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **VERTICAL VII- DIVERSE COURSES** | | | | | | | | | | |
| 22CS035 | Software Quality Assurance | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS036 | XML and Web Services | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS037 | Information Storage Management | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS038 | Mobile Application Development | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS039 | Internet of Things | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 22CS040 | Business Analytics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| **OPEN ELECTIVE COURSES** | | | | | | | | | | |
| 22OCS01 | Object Oriented Programming | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCS02 | JAVA Fundamentals | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCS03 | Knowledge Discovery in Databases | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |

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|---|---|---|---|---|---|---|---|---|---|---|
| 22OCS04 | E-Learning Techniques | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCS05 | Social Text and Media Analytics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCE01 | Energy Conservation and management | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEC01 | Basics of Analog and Digital Electronics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEC02 | Microcontroller Programming | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEC03 | Principles of Communication Systems | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEC04 | Principles of Computer Communication and Networks | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEI01 | Programmable Logic Controller | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEI02 | Sensor Technology | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEI03 | Fundamentals of Virtual Instrumentation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OEI04 | Optoelectronics and Laser Instrumentation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OME01 | Digital Manufacturing | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OME02 | Industrial Process Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OME03 | Maintenance Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OME04 | Safety Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OBT01 | Biofuels | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFD01 | Traditional Foods | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFD02 | Food Laws and Regulations | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFD03 | Post-Harvest Technology of Fruits and Vegetables | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFD04 | Cereal, Pulses and Oil Seed Technology | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFT01 | Fashion Craftsmanship | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFT02 | Interior Design in Fashion | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OFT03 | Surface Ornamentation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OPH01 | Nanomaterials Science | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OPH02 | Semiconductor Physics and Devices | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OPH03 | Applied Laser Science | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OPH04 | Bio-photonics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OPH05 | Physics of Soft Matter | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCH01 | Corrosion Science and Engineering | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCH02 | Polymer Science | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OCH03 | Energy Storing Devices | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OMA01 | Graph Theory and Combinatorics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 22OGE01 | Principles of Management | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OGE02 | Entrepreneurship Development I | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OGE03 | Entrepreneurship Development II | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| 22OGE04 | Nation building: Leadership and Social Responsibility | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | OE |
| **ONE CREDIT COURSES** | | | | | | | | | | |
| 22CS0XA | Angular Java | - | - | - | 1 | - | 100 | 0 | 100 | EEC |
| 22CS0XB | GO Programming | - | - | - | 1 | - | 100 | 0 | 100 | EEC |
| 22CS0XC | React JS | - | - | - | 1 | - | 100 | 0 | 100 | EEC |
| 22CS0XD | Node JS | - | - | - | 1 | - | 100 | 0 | 100 | EEC |
| 22CS0XE | POSTGRESQL | - | - | - | 1 | - | 100 | 0 | 100 | EEC |
| 22CS0XF | Embedded IoT | - | - | - | 1 | - | 100 | 0 | 100 | EEC |

CS – Department Code

## SUMMARY OF CREDIT DISTRIBUTION

| S.No | Category | Credit per semester | | | | | | | | Total Credit | Credits in % | Range of total credits | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | | | Min | Max |
| 1 | BS | 10 | 10 | 4 | | | | | | 24 | 15 | 15% | 20% |
| 2 | ES | 6 | 10 | 3 | 4 | 4 | | | | 27 | 17 | 15% | 20% |
| 3 | HSS | 2 | 3 | 4 | | | | | | 9 | 6 | 5% | 10% |
| 4 | PC | | | 11 | 15 | 11 | 11 | 7 | | 55 | 34 | 30% | 40% |
| 5 | PE | | | | 3 | 6 | 9 | 12 | | 30 | 18 | 15% | 20% |
| 6 | EEC | 3 | | | 1 | 1 | 1 | 2 | 10 | 18 | 11 | 5% | 10% |
| **Total** | | 21 | 23 | 22 | 23 | 22 | 21 | 21 | 10 | 163 | 100 | - | - |

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

## 22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

**Course Objectives**

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Course Outcomes (COs)**

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 2 | 3 | | | | | | | | | | | | |
| 4 | 3 | 3 | | | | | | | | | | | | |
| 5 | 1 | 3 | | | | | | | | | | | | |

**UNIT I** **9 Hours**

**MATHEMATICS MODELING OF LINEAR FUNCTIONS**

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

**UNIT II** **9 Hours**

**MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS**

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orthogonality - Canonical form and its nature

**UNIT III** **9 Hours**

**MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS**

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and

polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

**UNIT IV** **9 Hours**

**MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS**

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y = abx through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

**UNIT V** **9 Hours**

**MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS**

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

**Total: 60 Hours**

**Reference(s)**


1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

## 22PH102 ENGINEERING PHYSICS 2 0 2 3

**Course Objectives**

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | | | | | | 2 | | | | | | |
| 2 | 2 | 1 | | | | | | 2 | | | | | | |
| 3 | 2 | 1 | | | | | | 2 | 2 | | | | | |
| 4 | 2 | 1 | | | | | | 2 | | | | | | |
| 5 | 2 | 1 | | | | | | 2 | | | | | | |

**UNIT I** **6 Hours**

**CONSERVATION OF ENERGY**

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

**UNIT II** **5 Hours**

**VIBRATIONAL ENERGY**

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency - resonance

**UNIT III** **6 Hours**

**PROPAGATION OF ENERGY**

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voicere - reflection - refraction - beats

**UNIT IV** **7 Hours**

**EXCHANGE OF ENERGY**

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

**UNIT V** **6 Hours**

**ENERGY IN MATERIALS**

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

**1** **5 Hours**

**EXPERIMENT 1**

Determination of resultant of system of concurrent coplanar forces - Parallelogram law of forces

**2** **5 Hours**

**EXPERIMENT 2**

Determination of moment of inertia - Torsional pendulum

**3** **5 Hours**

**EXPERIMENT 3**

Determination of thickness of a thin wire using interference of light - Air wedge method

**4** **4 Hours**

**EXPERIMENT 4**

Determination of AC frequency using Meldes apparatus

**5** **3 Hours**

**EXPERIMENT 5**

Determination of thermal conductivity of a bad conductor using Lees disc method

**6** **4 Hours**

**EXPERIMENT 6**

Wavelength of ultrasonics in a liquid medium
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer

**7** **4 Hours**

**EXPERIMENT 7**

Determination of Youngs modulus of a given material- Non uniform bending method

**Total: 60 Hours**

**Reference(s)**

1. 1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. 2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. 3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. 4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. 5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

## 22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

**Course Objectives**

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

**Programme Outcomes (POs)**

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

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

**Course Outcomes (COs)**

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | | | | | | | | | | | | |
| 2 | 2 | 1 | | | | | | | | | | | | |
| 3 | 2 | 1 | | | | | | | | | | | | |
| 4 | 2 | 1 | | | | | | | | | | | | |
| 5 | 2 | 1 | | | | | | | | | | | | |

**UNIT I** **5 Hours**

**ORIGIN OF ELEMENTS**

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

**UNIT II** **7 Hours**

**ATOMIC STRUCTURE AND PERIODICITY**

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

**UNIT III** **6 Hours**

**CHEMICAL BONDING**

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

**UNIT IV** **6 Hours**

**REACTION THERMODYNAMICS**

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

**UNIT V** **6 Hours**

**STATES OF MATTER**

Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

**1** **2 Hours**

**EXPERIMENT 1**

Lab safety rules and guidelines for students - OSHA Guidelines

**2** **3 Hours**

**EXPERIMENT 2**

Estimation of dissolved oxygen content in water sample(s) by Winkler's method

**3** **4 Hours**

**EXPERIMENT 3**

Determination of Fe(II) in a sample using spectrophotometer

**4** **3 Hours**

**EXPERIMENT 4**

Estimation of chromium content in water sample by volumetric analysis

**5** **3 Hours**

**EXPERIMENT 5**

Estimation of chloride present in the given water sample by argentometric method

**6** **3 Hours**

**EXPERIMENT 6**

Conductometric titration of mixture of acids

**7** **4 Hours**

**EXPERIMENT 7**

Estimation of magnesium ions in given solution by EDTA method

**8** **4 Hours**

**EXPERIMENT 8**

Preparation of salt of fatty acid by saponification process

**9** **4 Hours**

**EXPERIMENT 9**

Recrystallization of aspirin from water/ethanol

**Total: 60 Hours**

**Reference(s)**


1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

## 22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

**Course Objectives**

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.

**Course Outcomes (COs)**

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 2 | 3 | 3 | 3 | 1 | | | | | | | | | | |
| 3 | 2 | 2 | 2 | 1 | | | | | | | | | | |
| 4 | 2 | 2 | 2 | 1 | | | | | | | | | | |
| 5 | 2 | 2 | 2 | 1 | | | | | | | | | | |

**UNIT I** **8 Hours**

**CODES AND COMBINATIONS**

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

**UNIT II** **9 Hours**

**COMPUTATION USING COMPUTER**

Communication to computing devices through various input sources - Computational operation - flow, functions and controls - communication to output devices - Basic communication protocol.

**UNIT III** **11 Hours**

**ASSEMBLY LANGUAGE PROGRAMMING**

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simple programs.

**UNIT IV** **9 Hours**

**OPERATING SYSTEM AND APPLICATION GENERATION**

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

**UNIT V** **8 Hours**

**SOFTWARE DEVELOPMENT**

Phases of application life cycle management - Software Development Methodologies - Web Page development.

**Total: 45 Hours**

**Reference(s)**


1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed From The Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner""s Approach", McGraw Hill International edition, Seventh edition, 2010

## 22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

**Course Objectives**

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

**Programme Outcomes (POs)**

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

j. 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.

l. 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.

**Course Outcomes (COs)**

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | | | | | | | | | 2 | 3 | | 2 | | |
| 4 | | | | | | | | | 2 | 3 | | 2 | | |
| 5 | | | | | | | | | 2 | 3 | | 2 | | |

**UNIT I** **15 Hours**

**SELF-EXPRESSION**

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs Self-Introduction-Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions- Paralinguistic / Vocalic- Body Language- Appearance-Eye Contact-Artefacts Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH- questions- Prepositions-Listening to Ted talks-Listening for specific information

**UNIT II** **15 Hours**

**CREATIVE EXPRESSION**

Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One-word substitution-Adjectives-Similes, Metaphors, Imagery & Idioms -Link words - Inclusive language Narrative Expression- Travelogue and Minutes of Meeting -Verbal Analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph Completion-Past tense -Using quotation marks

**UNIT III** **15 Hours**

**FORMAL EXPRESSION**

Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail- Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs Precision in comprehension, Summary writing, Selective summary-Reading: Active reading- short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis- Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarizing information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context Paraphrasing- Sentence Transformation - simple, compound, complex. Sentence Substitution-Sentence completion- Interpreting paragraphs

**Total: 45 Hours**

**Reference(s)**


1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

## 22GE004 BASICS OF ELECTRONICS ENGINEERING

**2 0 2 3**

**Course Objectives**

- To Understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To Analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 2 |
| 2 | 3 | 3 | 3 | 2 | | | | | | | | | 3 | 2 |
| 3 | 3 | 3 | 3 | 2 | | | | | | | | | 2 | 2 |
| 4 | 3 | 3 | 3 | 2 | | | | | | | | | 2 | 2 |
| 5 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 2 |

**UNIT I** **6 Hours**

**ENERGY TRANSFER AND SIGNALS**

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

**UNIT II** **8 Hours**

**SIGNAL CONDITIONING USING DIODE**

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

**UNIT III** **6 Hours**

**SIGNAL CONDITIONING USING TRANSISTOR**

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

**UNIT IV** **6 Hours**

**LOGIC SYNTHESIS USING DIODE AND TRANSISTORS**

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

**UNIT V** **4 Hours**

**DEVICES FOR SPECIAL REQUIREMENTS**

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

**1** **4 Hours**

## EXPERIMENT 1

Design and Implement a simple device to communicate basic information between two different small distance points
using wired and wireless methods.

**2** **6 Hours**

## EXPERIMENT 2

Design and Implement different wave shaping Circuits using PN Junction Diodes.

**3** **4 Hours**

## EXPERIMENT 3

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

**4** **4 Hours**

## EXPERIMENT 4

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

**5** **4 Hours**

**EXPERIMENT 5**

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

**6** **4 Hours**

**EXPERIMENT 6**

Design and Implement Basic Logic Gates using PN Junction Diodes.

**7** **4 Hours**

**EXPERIMENT 7**

Design and Implement Basic Logic Gates using BJTs.

**Total: 60 Hours**

**Reference(s)**


1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

## 22HS002 STARTUP MANAGEMENT 1 0 2 2

**Course Objectives**

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering support in developing marketing strategies and financial outlay enable to scale up the porotypes to commercial market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

**Programme Outcomes (POs)**

g. 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.

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

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

j. 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.

k. Project Management and Finance: Demonstrate the 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.

**Course Outcomes (COs)**

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 1 | 2 | 1 | | 1 | | | |
| 2 | | | | | | | 2 | 2 | 1 | 1 | 2 | | | |
| 3 | | | | | | | 3 | 3 | 1 | 2 | 2 | | | |
| 4 | | | | | | | 1 | 3 | 1 | 2 | 2 | | | |
| 5 | | | | | | | | 2 | 3 | 2 | 2 | | | |

**UNIT I** **3 Hours**

**BUSINESS MODELS AND IDEATION**

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking

**UNIT II** **3 Hours**

**UNDERSTANDING CUSTOMERS**

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

**UNIT III** **3 Hours**

**DEVELOPING PROTOTYPES**

Prototyping: Methods - Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

**UNIT IV** **3 Hours**

**BUSINESS STRATEGIES AND PITCHING**

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

**UNIT V** **3 Hours**

**COMMERCIALIZATION**

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

**1** **1 Hours**

**EXPERIMENT 1**

Analysis of various business sectors

**2** **2 Hours**

**EXPERIMENT 2**

Developing a Design Thinking Output Chart

**3** **1 Hours**

**EXPERIMENT 3**

Creating Buyer Personas

**4** **3 Hours**

**EXPERIMENT 4**

Undertake Market Study to understand market needs and assess market potential

**5** **2 Hours**

**EXPERIMENT 5**

Preparation of Business Model Canvas

**6** **15 Hours**

**EXPERIMENT 6**

Developing Prototypes

**7** **2 Hours**

**EXPERIMENT 7**

Organizing Product Design Sprints

**8** **2 Hours**

**EXPERIMENT 8**

Preparation of Business Plans

**9** **2 Hours**

**EXPERIMENT 9**

Preparation of Pitch Decks

**Total: 45 Hours**

**Reference(s)**


1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

## 22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

**Course Objectives**

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**Course Outcomes (COs)**

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 3 | 3 | | | | | | | | | | | | |

**UNIT I** **9 Hours**

**FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS**

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables - Cooling/Heating of an object - A falling object - Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model

**UNIT II** **9 Hours**

**SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS**

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits

**UNIT III** **9 Hours**

**VECTOR DIFFERENTIAL CALCULUS**

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion

**UNIT IV** **9 Hours**

**VECTOR INTEGRAL CALCULUS**

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

**UNIT V** **9 Hours**

**COMPLEX FUNCTIONS**

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

**Total: 60 Hours**

**Reference(s)**


1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

## 22PH202 ELECTROMAGNETISM AND MODERN PHYSICS

**2 0 2 3**

**Course Objectives**

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**Course Outcomes (COs)**

1. Understand the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 2 | 1 | | | | | | | 2 | | | | | |

**UNIT I** **6 Hours**

**ELECTRICITY**

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy- Capacitor- Conductors and Insulators - Electric dipole and polarization - Electric current - Voltage sources - Resistance

**UNIT II** **6 Hours**

**MAGNETISM**

Sources of magnetism - Monopoles - Magnetic field and force - magnetic field and current distribution - Magnetic dipole - Magnetic potential energy - Inductor - Electric and magnetic field comparison

**UNIT III** **6 Hours**

**ELECTROMAGNETIC WAVES AND LIGHT**

Electromagnetism: Basic laws - Electromagnetic energy - radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical optics-Human eye - Diffraction - Interference - Polarization - LASER

**UNIT IV** **6 Hours**

**MODERN PHYSICS**

Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation. Matter waves - De-Broglie hypothesis - Wave nature of particles

**UNIT V** **6 Hours**

**ENERGY BANDS IN SOLIDS**

Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy - Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity

**1** **5 Hours**

**EXPERIMENT 1**

Determination of V-I characteristics of a solar cell

**2** **5 Hours**

**EXPERIMENT 2**

Determination of Hall voltage of a given specimen by Hall Effect method

**3** **5 Hours**

**EXPERIMENT 3**

Determination of wavelength of a given laser source - Grating method

**4** **4 Hours**

**EXPERIMENT 4**

Determination of particle size using diode laser

**5** **3 Hours**

**EXPERIMENT 5**

Determination of refractive index of a given solid medium and liquid medium

**6** **4 Hours**

**EXPERIMENT 6**

Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

**7** **4 Hours**

**EXPERIMENT 7**

Determination of band gap energy of a given semiconducting material

**Total: 60 Hours**

**Reference(s)**


1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019

4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

## 22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

**Course Objectives**

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Course Outcomes (COs)**

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Understand the mechanism of corrosion and suggest a method to control the corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 5 | 2 | 1 | | | | | | | | | | | | |

**UNIT I** **6 Hours**

**ELECTROCHEMISTRY**

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials

**UNIT II** **6 Hours**

**ENERGY STORING DEVICES**

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies

**UNIT III** **6 Hours**

**METAL CORROSION AND ITS PREVENTION**

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

**UNIT IV** **6 Hours**

**CATALYSIS**

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

**UNIT V** **6 Hours**

**NUCLEAR REACTIONS**

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - Radiocarbon dating

**1** **4 Hours**

**EXPERIMENT 1**

Determination of strength of hydrochloric acid in a given solution using pH meter

**2** **4 Hours**

**EXPERIMENT 2**

Application of calomel electrode to determine the redox potential of Fe(II) solution

**3** **4 Hours**

**EXPERIMENT 3**

Construct an electrochemical cell exhibiting valid output and compare its potential with the given standard cell

**4** **5 Hours**

**EXPERIMENT 4**

Determination of corrosion percentage of iron/steel by weight loss method

**5** **4 Hours**

**EXPERIMENT 5**

Determination of percentage of corrosion inhibition in iron/mild steel using a natural inhibitor

**6** **4 Hours**

**EXPERIMENT 6**

Electroplate copper on the given target object and estimate the amount of copper deposited at cathode

**7** **5 Hours**

**EXPERIMENT 7**

Determination of rate constant of acid catalyzed hydrolysis of ester

**Total: 60 Hours**

**Reference(s)**


1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E. McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley & Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011

6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017

## 22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

**Course Objectives**

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.

**Course Outcomes (COs)**

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 2 | 2 | 2 | 2 | | | | | | | | | | |

**UNIT I** **6 Hours**

**VISUAL PROCESS MODELING**

Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

**UNIT II** **12 Hours**

**ALGORITHMIC DESIGN THINKING**

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

**UNIT III** **12 Hours**

**DATA ORGANIZATION**

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

**UNIT IV** **7 Hours**

**DATA STORAGE**

Flat File and Relational database - Data Read & Write in Local Storage, Server Storage and Cloud storage - Database Query Methods.

**UNIT V** **8 Hours**

**NETWORKING ESSENTIALS**

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

**Total: 45 Hours**

**Reference(s)**


1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

## 22GE003 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

**Course Objectives**

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.

**Course Outcomes (COs)**

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **5 Hours**

**ELECTRIC CHARGE**

Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

**UNIT II** **7 Hours**

**ELECTRIC FIELD**

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

**UNIT III** **7 Hours**

**MAGNETIC FIELDS**

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

**UNIT IV** **6 Hours**

**FORCE ON CHARGES**

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

**UNIT V** **5 Hours**

**ELECTRO MECHANICAL ENERGY CONVERSION**

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

**1** **15 Hours**

## EXPERIMENT 1

Analyze and design of Electromechanical energy conversion system.

**2** **15 Hours**

## EXPERIMENT 2

Develop an electrical machine and analyze its performance with supplied input of AC from 0 V to 230 V.

**Total: 60 Hours**

**Reference(s)**


1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

## 22CS206 DIGITAL COMPUTER ELECTRONICS 3 0 2 4

**Course Objectives**

- Understand the operation of Arithmetic Logic unit in Microprocessors
- Interpret Data retrieval from Memory by Microprocessors
- Analyze the role of Control Unit in Microprocessors
- Analyze Instruction execution in Microprocessors

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.

**Course Outcomes (COs)**

1. Analyze the Design of Arithmetic and Logic Unit in Microprocessors.
2. Analyze the Data Storage and Retrieval from Random Access Memory
3. Analyze the working mechanism of Control Unit in Microprocessors
4. Analyze the execution of Arithmetic and Logical Instructions
5. Analyze the execution of Jump and Memory related Instructions

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 2 | 2 | | | | | | | | | | | | |

**UNIT I** **9 Hours**

**BINARY SYSTEM AND DESIGN OF ALU**

Conversion of Decimal, Hexadecimal, Octal and Binary Numbers - Representation of Negative Numbers in Binary - Design of Binary Arithmetic Logic Modules - Magnitude Comparator - Encoder - Decoder - Multiplexer - Demultiplexer - Design of Arithmetic and Logic Unit (ALU)

**UNIT II** **9 Hours**

**SYNCHRONOUS CIRCUIT AND DESIGN OF RAM**

Latches and Flip Flops - Clock - Registers - Counters - Shift Registers - Storage and Retrieval of Binary Numbers from Registers - Design of Random Access Memory (RAM) - Encoding and Decoding of Memory address locations

**UNIT III** **9 Hours**

**DESIGN OF CONTROL UNIT**

Design of Control Unit - Mechanism of Instruction Read, Data Read, Instruction Decode, Instruction Execute and Data Write

**UNIT IV** **9 Hours**

**BASIC INSTRUCTION EXECUTION**

Arithmetic Instructions - Increments, Decrements and Rotate Instructions - Logic Instructions - Arithmetic and Logic instructions

**UNIT V** **9 Hours**

**ADVANCED INSTRUCTION EXECUTION**

Memory Reference instructions - Register Instructions - Jump and Call Instructions - Concept of Flag - Extended Register Instructions - Indirect Instructions - Stack instructions

**1** **2 Hours**

**EXPERIMENT 1**

Design and Simulation of Fundamental Gates using Universal Gates (NAND and NOR)

**2** **3 Hours**

**EXPERIMENT 2**

Design and Simulation of Half Adder, Full Adder, Half Subtractor, Full Subtractor

**3** **3 Hours**

**EXPERIMENT 3**

Design and Simulation of 4-bit Ripple Carry Adder

**4** **4 Hours**

**EXPERIMENT 4**

Design and Simulation of a 4-bit Arithmetic and Logic Unit

**5** **4 Hours**

**EXPERIMENT 5**

Design and Simulation of D Flip Flop and J K Flip Flop

**6** **4 Hours**

**EXPERIMENT 6**

Design and Simulation of 8-bit Register

**7** **4 Hours**

**EXPERIMENT 7**

Design and Simulation of an 8 bit SISO, SIPO, PISO, PIPO Shift Registers

**8** **3 Hours**

**EXPERIMENT 8**

Simulation of Data Read and Data Write from a RAM

**9** **3 Hours**

**EXPERIMENT 9**

Simulation of Control Unit Functionality

**Total: 75 Hours**

**Reference(s)**


1. Morris Mano, "Digital Logic & Computer Design", Pearson Education India, 2019.
2. Albert Paul Malvino and Jerald A Brown, "Digital Computer Electronics,(3rd Edition)", McGraw Hill Education India, 2001.
3. David Money Harris and Sarah L Harris, "Digital Design and Computer Architecture", Elsevier, 2007
4. John C Schott, "But How do it Know? The Basic Principles of Computers for Everyone", John C Scott Publishers, 2009.
5. Petzold Charles, "Code: The Hidden Language of Computer Hardware and Software (2nd Edition)", Microsoft Press, 2022.
6. Thomas C Bartee, "Digital Computer Fundamentals (6th Edition)",Tata Mcgraw Hill Education, 2011.

## 22HS003 HERITAGE OF TAMILS 1 0 0 1

**Course Objectives**

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures
- Examine the role of sports and games in promoting cultural values and community bonding
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | | | | | | | | | 2 | 3 | | | | |

**UNIT I** **3 Hours**

**UNIT I LANGUAGE AND LITERATURE**

Language Families in India - Dravidian Languages - Tamil as aClassical Language- Classical Literature in Tamil- Secular Nature of Sangam Literature- Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II** **3 Hours**

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III** **3 Hours**

**UNIT III FOLK AND MARTIAL ARTS**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV** **3 Hours**

**UNIT IV THINAI CONCEPT OF TAMILS**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V** **3 Hours**

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India - Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine - Inscriptions & Manuscripts - Print History of Tamil Books.

**Total: 15 Hours**

**Reference(s)**


1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

## 22CS301 PROBABILITY, STATISTICS AND QUEUING THEORY

**3 1 0 4**

**Course Objectives**

- The students will be able to understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables
- Summarize and apply the methodologies of the statistics and queuing theory.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Course Outcomes (COs)**

1. Demonstrate and apply the basic probability axioms and concepts in the core areas.
2. Apply the concepts of probability distributions in an appropriate place of computers and Engineering.
3. Implement basic statistical inference techniques engineering problems.
4. Design an experiment using ANOVA technique and summarize the measurements for statistical quality control.
5. Identify and apply the queuing methodologies to optimize the result of the waiting line.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 2 | | | | | | | | | | | | |
| 4 | 1 | 2 | | | | | | | | | | | | |
| 5 | 1 | 2 | | | | | | | | | | | | |

**UNIT I** **9 Hours**

**PROBABILITY AND RANDOM VARIABLE**

Axioms of probability-Conditional probability-Total probability-Bayes theorem-Random variable-Probability mass function-Probability density functions-Properties-Moments - Moment generating functions and their properties.

**UNIT II** **9 Hours**

**STANDARD DISTRIBUTIONS**

Discrete distributions: Binomial - Poisson - Negative Binomial - Continuous distributions: Uniform - Exponential - Gamma - Normal distributions and their properties.

**UNIT III** **9 Hours**

**TESTING OF HYPOTHESIS**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on normal distribution for single mean and difference of means -Small sample tests: t-test for mean -F-test - Chi-square test for Goodness of fit and Independence of attributes.

**UNIT IV** **9 Hours**

**DESIGN OF EXPERIMENTS AND CONTROL CHART**

One way and two way classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - Control charts for measurements (X and R charts) - Control charts for attributes (p, c and np charts).

**UNIT V** **9 Hours**

**QUEUING THEORY**

Pure Birth and Death Process -Characteristics of Queuing models- Kendalls notation- Single and multi server Markovian queuing models- M/M/1 and M/M/C (Finite and infinite capacity)- Pollaczek-Khinchine formula.

**Total: 60 Hours**

**Reference(s)**


1. Richard A Johnson, Miller & Freund's Probability and Statistics for Engineers, PHL Publisher, 1996.
2. Kishore S Trivedi, Probability and Statistics with Reliability Queuing and Computer Science Applications, John Wiley and Sons, Second Edition, 2012.
3. Arnold O Allen, Probability Statistics and Queuing Theory with Computer Applications, New Age International, 2003.
4. Jay L Devore, Probability and Statistics for Engineering and The Sciences, Thomson Learning, Seventh Edition, 2002.
5. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists,

## 22CS302 DATA STRUCTURES I 3 0 2 4

**Course Objectives**

- Implement array and hash data structure for real world applications.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the performance of various data structures using asymptotic notations.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Implement the array data structure and its types for searching and sorting operations.
2. Outline the algorithm efficiency with different asymptotic notations for optimizing the code.
3. Implement the linear node-based data structure for real world applications.
4. Evaluate the performance of Hash over arrays and list in memory access.
5. Analyze the tree traversal algorithms for various non-linear data structures.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 2 | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | 1 | |
| 3 | 2 | 3 | 3 | 2 | 2 | | | | | | 2 | 2 | 2 | 1 |
| 4 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | 3 | |
| 5 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 | 2 | 2 |

**UNIT I** **10 Hours**

**FOUNDATIONAL DATA STRUCTURES**

Algorithms and Data Structures - Data Structures hierarchy -Types of Data- Singular Data and Plural Data - Position indexing : Array - Sets - Ordered Arrays - Searching over Arrays and Ordered Arrays.

**UNIT II** **7 Hours**

**ALGORITHM EFFICIENCY**

Algorithm efficiency using Asymptotic Notations - Optimizing code with and without Big O Notation - Optimizing for optimistic scenarios - Trade- offs between Time and Space.

**UNIT III** **10 Hours**

**ADT AND NODE BASED DATA STRUCTURES**

ADT : Stacks - Queues - Recursion - Recursive Algorithms for Speed - Node Based Data Structures : Linked list - Need of Linked List - Arrays vs Linked List - Types of Linked List and its operations - Skip Lists.

**UNIT IV** **8 Hours**

**FAST LOOKUP WITH HASH**

Hash Table - Hash functions - Internal implementation of Hash - Iteration over Hash - Hash operations - Hash of Hash - Array of Hash - Hash of Array.

**UNIT V** **10 Hours**

**TREES**

Tree - Binary Tree - Binary Search Tree - Tree traversal - AVL Tree - Red Black Tree - B Tree - B+ Tree - Heap.

**1** **2 Hours**

**EXPERIMENT 1**

Implementing Array operations

**2** **6 Hours**

**EXPERIMENT 2**

Implementing stack and queue data structures:
i. Stack applications (expression evaluation, stack-based algorithms)
ii. Queue applications (implementing a circular queue, queue-based algorithms)

**3** **4 Hours**

**EXPERIMENT 3**

Implementing Singly linked list and its operations like insertion, deletion, searching, and traversal

**4** **4 Hours**

**EXPERIMENT 4**

Implementing hashing techniques (linear probing, quadratic probing, chaining)

**5** **2 Hours**

**EXPERIMENT 5**

Implementing Binary tree traversal algorithms (pre-order, in-order, post-order)

**6** **2 Hours**

**EXPERIMENT 6**

Implementing various searching algorithms:
i. Linear search
ii. Binary search

**7** **10 Hours**

**EXPERIMENT 7**

Implementing and analyzing various sorting algorithms:
i. Bubble sort
ii. Selection sort
iii. Insertion sort
iv. Merge sort
v. Quick sort
vi. Heap sort

**Total: 75 Hours**

**Reference(s)**


1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures & Algorithms in Python, Wiley, 2013.
2. Larry Wall, Tom Christiansen & Randal L. Schwartz, Progrmaming Perl, O"Reilly, 3rd edition, 2000.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2016.
4. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
5. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011.
6. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009.

## 22CS303 COMPUTER ORGANIZATION AND ARCHITECTURE

**3 0 0 3**

**Course Objectives**

- Understand the computer architecture concepts related to design of processors, memory management and I/O system.
- Explore the GPU computing architecture and develop an environment for creating high performance GPU-accelerated applications using CUDA programming.
- Gain knowledge on modern processor architecture to design the best processor/computing system.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Analyze the processor architecture and instruction sets of x86/x64 and ARM architecture.
2. Design a data path for a simple processor and compare the various techniques related to simultaneous execution of multiple instructions from a program.
3. Organize the computer memory to speed up the performance and facilitate the transfer of data between the computer's central processing unit and the external devices.
4. Analyze the GPU computing architecture and develop applications to run on NVIDIA GPUs using the CUDA programming environment.
5. Analyze the modern processor architectures and instruction sets and implement a RISC-V processor in a low-cost FPGA board.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 2 | 2 | 2 | 2 | | | | | | | | 2 | | 2 |

**UNIT I** **9 Hours**

**UNDERSTANDING PROCESSOR ARCHITECTURE AND INSTRUCTION SETS**

Basic Computer Organization and Design - Instruction Set principles - x86 and x64 architecture & instruction sets - 32 bit and 64 bit ARM architecture & instruction sets.

**UNIT II** **9 Hours**

**PROCESSOR DESIGN**

Designing a Data path for a Simple Processor - DLX Pipeline - Super Pipelining - Super scalar processor - Instruction level parallelism (ILP) - Speculative Execution - Side channel attack (Spectre and Meltdown)

**UNIT III** **9 Hours**

**MEMORY UNIT AND I/O ORGANIZATION**

Memory Hierarchy - Cache Architectures - Levels in Cache - Improving Cache Performance - Memory Prefetch - Tera MTA - Connecting I/O Devices to the Processor.

**UNIT IV** **8 Hours**

**EXPLORING GPU ARCHITECTURE**

GPU Vs CPU architecture - GPU Architecture Basics - NVIDIA"s CUDA Toolkit - CUDA Programming

**UNIT V** **10 Hours**

**MODERN COMPUTER ARCHITECTURE**

Domain-Specific Computer Architectures - Sony PlayStation design PS3/PS5, MAC M1 chip, Xbox, Cerebas - Wafer Scale Computing, Accelerators (FPGA, ASIC) - RISC-V Architecture and Instruction Set - Implementing RISC-V in a field-programmable gate array (FPGA).

**Total: 45 Hours**

**Reference(s)**


1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill,Third Reprint, 2015.
2. David A, Patterson and John L, Hennessy, Computer Organization and Design: The hardware/ software interface, MorganKaufmann,4th edition, 2014.
3. Jim Ledin, Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-V architectures and the design of smartphones, PCs, and cloud servers - Second Edition,2022.

## 22CS304 PRINCIPLES OF PROGRAMMING LANGUAGES

**3 0 2 4**

**Course Objectives**

- Understand the history and evolution of programming language.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the subprograms, functions, debugging and error handling mechanisms.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Outline the programming paradigms and the basic structure of programming language.
2. Assess the implementation of different types of data, variable and types system.
3. Analyze suitable conditional statements and control structures for real world applications.
4. Develop programs using subprograms and explore their types for problem solving.
5. Determine the tools for error handling and event handling in Programming.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 3 | 1 | 2 | 3 | 1 | 3 | | | | | | 2 | 2 | 2 | |
| 4 | 1 | 2 | 3 | 1 | 3 | | | | | | 2 | 2 | | 2 |
| 5 | 1 | 2 | 3 | 1 | 3 | | | | | | 2 | 2 | | 2 |

**UNIT I** **8 Hours**

**UNDERSTANDING PROGRAMMING PARADIGMS**

Natural Vs Artificial language - Common Programming Paradigms - Syntax and semantics - Language Evaluation Criteria - Programming Language Grammar.

**UNIT II** **10 Hours**

**VARIABLES AND DATA TYPES**

Variable Declarations - Guidelines for Initializing Variables - Power of Variable names - Fundamental Data types - Type Systems - Type Inference and Polymorphism.

**UNIT III** **10 Hours**

**STATEMENTS**

Expressions and Assignment statements - Organizing straight-line code - Using conditionals - Controlling loops - Unusual control structures - General control issues.

**UNIT IV** **9 Hours**

**SUBPROGRAMS**

Fundamentals of Subprograms - Design issues - Parameter passing methods - Overloaded subprograms -Generic subprograms - Implementing subprograms.

**UNIT V** **8 Hours**

**DEBUGGING AND ERROR HANDLING**

Debugging - Debugging Strategies - Debugging Tools - Error Messages - Documentation - Test cases - Debugging with print statements - Debugging with comments and questions - Exception handling and Event handling

**1** **3 Hours**

## EXPERIMENT 1

Write a Python program to Experiment with different variable scopes (global, local)

**2** **3 Hours**

## EXPERIMENT 2

Create a program for using the built-in data structures (lists, sets, tuples, dictionary etc.)

**3** **3 Hours**

## EXPERIMENT 3

Generate a n x n table and implement the following,

a. Fill the odd rows with '1'

b. Fill the even rows and odd columns with '1'

c. Fill the odd rows with 1 and odd columns with '0'

d. Fill the diagonal cells with '9'

e. Fill all the cells with number from 1 to n^2 from the middle cell in a spiral order

f. Fill all the cells with number from 1 to n^2 from the last cell to the middle cell in a spiral order

**4** **3 Hours**

## EXPERIMENT 4

Implement a program that uses conditional statements to simulate a decision-making process.

**5** **3 Hours**

**EXPERIMENT 5**
Create a program to implement looping statements.

**6** **3 Hours**

**EXPERIMENT 6**
Create a program that demonstrates the concept of short-circuit evaluation in logical expressions.

**7** **6 Hours**

**EXPERIMENT 7**
Develop a program for implementation of subprograms and nested subprograms and investigate the differences between pass-by-value and pass-by-reference parameter passing mechanisms

**8** **3 Hours**

**EXPERIMENT 8**
Develop a program to implement the concept of Recursion.

**9** **3 Hours**

**EXPERIMENT 9**
Create a program to demonstrate the Exception Handling mechanisms

**Total: 75 Hours**

**Reference(s)**


1. Code Complete, Steve McConnell, Microsoft Press, 2004.
2. Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.
3. Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007.
4. Programming Languages, 2nd Edition, A.B. Tucker, R. E. Noonan, TMH.
5. Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003

## 22CS305 SOFTWARE ENGINEERING 3 0 0 3

**Course Objectives**

- Understand the systematic approach related to the design, development and maintenance of a software system
- Analyze the limitations of manual testing process and provide a succinct summary of those limitations with the help of automated testing tools.
- Understand the Enterprise Architecture (EA) framework that provides the building blocks for successful digital business transformation.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Apply the software development methodologies to various real life scenarios.
2. Apply modern tools and techniques to develop scalable, maintainable, and reliable software systems.
3. Analyze the coding strategies and techniques to write well-structured, efficient, and error-free code.
4. Apply specific modern testing tools to ensure the quality and reliability of software products.
5. Analyze the elements, structure, and positioning of an Enterprise Architecture framework used for successful digital business transformation.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 3 | 2 | 2 | | | 2 | | 2 | | 2 | 2 | 1 | |
| 2 | 3 | 3 | 2 | 2 | 3 | | 2 | | 2 | | | 2 | | 2 |
| 3 | 2 | 2 | 2 | | | | 2 | | 2 | | | 2 | 1 | |
| 4 | 2 | 2 | 2 | | 3 | | 2 | | 2 | | | 2 | | 2 |
| 5 | 2 | 2 | 2 | | | | | | 2 | | | | 1 | |

**UNIT I** **9 Hours**

**SOFTWARE DEVELOPMENT PROCESS**

Phases in Software Development - Traditional Software Development Models - Agile Methodologies - Agile Scaling Frameworks - Lean Software Development - Software Requirements Specification(SRS) - Project Scheduling and Estimation.

**UNIT II** **10 Hours**

**TOOLS AND TECHNIQUES FOR SOFTWARE DEVELOPMENT**

DevOps - Version control with Git - Containerization Using Docker and Kubernetes- Application Performance Monitoring (APM) - Continuous Integration Continuous deployment (CICD) - Clean Room build.

**UNIT III** **9 Hours**

**CODE QUALITY**

Software Metaphors - Upstream Prerequisites - Key Construction Decisions - Defensive Programming - Code Tuning Strategies and Techniques.

**UNIT IV** **9 Hours**

**TESTING**

Writing good test cases - Test driven development - Test Automation - Testing using Selenium tool - Continuous Testing - Exploratory Testing - Testing in Agile and DevOps Environments.

**UNIT V** **8 Hours**

**ENTERPRISE ARCHITECTURE AND MODELING**

Enterprise Architecture (EA) in Digital Transformation - Agility in Digital Business - Measuring EA: Metrics, KPIs and Risks.

**Total: 45 Hours**

**Reference(s)**


1. Charles Petzold, Code: The Hidden Language of Computer Hardware and Software, Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, Computational thinking for the modern problem Solver, CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, Little Man Computer Programming: For The Perplexed From The Ground Up, The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S.Pressman, Software Engineering: A Practitioner""s Approach, McGraw Hill International edition, Seventh edition, 2010.

## 22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION

**0 0 2 1**

**Course Objectives**

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT 1** **10 Hours**

### SELF-EXPRESSION

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives Discourse markers – Interjections Decision making - Synthesis - Higher order thinking - Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

**UNIT II** **10 Hours**

## CREATIVE EXPRESSION

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

**UNIT III** **10 Hours**

## FORMAL EXPRESSION

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

**Total: 30 Hours**

**Reference(s)**


1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011

## 22HS006 TAMILS AND TECHNOLOGY 1 0 0 1

**Course Objectives**

- Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | | | | | | | | | 2 | 3 | | | | |

**UNIT I** **3 Hours**

**WEAVING AND CERAMIC TECHNOLOGY**

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

**UNIT II** **3 Hours**

**DESIGN AND CONSTRUCTION TECHNOLOGY**

Designing and Structural construction House and designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

**UNIT III** **3 Hours**

**MANUFACTURING TECHNOLOGY**

Art of Ship Building-Metallurgical studies-Iron industry-Iron smelting,steel-Copper and gold-Coins as source of history-Minting of Coins-Beads making-industries Stone beads -Glass beads-Terracotta beads-Shell beads-bone beats-Archeological evidences-Gem stone types described in Silappathikaram.

**UNIT IV** **3 Hours**

**AGRICULTURE AND IRRIGATION TECHNOLOGY**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry-Wells designed for cattle use- Agriculture and Agro Processing-Knowledge of Sea-Fisheries-Pearl-Conche diving-Ancient Knowledge of Ocean-Knowledge Specific Society.

**UNIT V** **3 Hours**

**SCIENTIFIC TAMIL**

Development of Scientific Tamil-Tamil computing-Digitalization of Tamil Books-Development of Tamil Software-Tamil Virtual Academy-Tamil Digital Library-Online Tamil Dictionaries-Sorkuvai Project.

**Total: 15 Hours**

**Reference(s)**


1. Dr. K. K. Pillay , Social Life of Tamils, A joint publication of TNTB & ESC and RMRL
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian , Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies
5. Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

## 22CS401 DISCRETE MATHEMATICS 3 1 0 4

**Course Objectives**

- Implement the definitions of relevant vocabulary from graph theory and combinatorics and be able to perform related calculations.
- Understand and use the terms Cardinality, finite, countably infinite and uncountably infinite, and determine which of these characteristics is associated with a given set.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**Course Outcomes (COs)**

1. Understand and apply the concepts of Boolean algebra and characteristics in computers.
2. Apply formalized arguments to classify and assess real-world arguments.
3. Represent the characteristics of predicate logic in computer engineering.
4. Apply different properties of injection, surjection, bijection, composition and inverse functions in software engineering.
5. Interpret the concepts of Permutations, Combinations and Mathematical induction in the phenomena of real world.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 2 | | | | | | | | | | | | |
| 4 | 2 | 2 | | | | | | | | | | | | |
| 5 | 1 | 2 | | | | | | | | | | | | |

**UNIT I** **9 Hours**

**BOOLEAN ALGEBRA**

Introduction of Boolean algebra - Truth table - Basic logic gate - Basic postulates of Boolean algebra - Principle of duality- Canonical form - Karnaugh map.

**UNIT II** **9 Hours**

**PROPOSITIONAL CALCULUS**

Propositions- Logical connectives-Compound propositions-Conditional and biconditional propositions- Truth tables - Tautologies and Contradictions - Logical and equivalences and implications-DeMorgans Laws-Normal forms-Principal conjunctive and disjunctive normal forms - Rules of inference-Arguments-Validity of arguments.

**UNIT III** **9 Hours**

**PREDICATE CALCULUS**

Predicates-Statement Function - Variables-free and bound variables- Quantifiers-Universe of discourse-Logical equivalences and implications for quantified statements- Theory of inference- The rules of universal specification and generalization-Validity of arguments.

**UNIT IV** **9 Hours**

**SET THEORY AND FUNCTIONS**

Set Operations-properties-Power set-Relations-Graph and matrix of a relation- Partial Ordering-Equivalence relations-Partitions- Functions -Types of Functions- composition of relation and functions- inverse functions.

**UNIT V** **9 Hours**

**COMBINATORICS**

Basics of Counting - Counting arguments- Pigeonhole Principle- Permutations and Combinations-Recursion and recurrence relations-Generating Functions- Mathematical Induction- Inclusion - Exclusion

**Total: 60 Hours**

**Reference(s)**


1. Trembly J P and Manohar R, Discrete Mathematical Structures with Applications to computer Science, Tata McGraw Hill Publications Co. Ltd., New Delhi 30th Re-print 2007.
2. Alan Doerr and Kenneth Levasseur, Applied Discrete Structures for Computer Science, Galgotia Publications Pvt. Ltd. Delhi. 2010.
3. Ralph P Girmaldi and Ramana B.V. Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education Asia, Delhi, 2007.
4. Kolman Busby Ross, Discrete Mathematical Structures , Prentice-Hall India, New Delhi, Fifth Edition, 2007.
5. Rosen K.H Discrete Mathematics and its Applications, Tata McGraw Hill Publications, New Delhi. 7th Edition, 2011.

## 22CS402 DATA STRUCTURES II 3 0 2 4

**Course Objectives**

- Understand and use the various major modern data structures like Trie, Rope, Segment tree and Octree.
- Apply the graph data structure and tree traversal algorithms for solving real time problems.
- Analyze the performance of algorithm design techniques with different data structures.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.

**Course Outcomes (COs)**

1. Implement the Trie data structure and its basic search operations.
2. Outline the traversal algorithm and its types with graph data structure.
3. Implement Minimum Spanning tree algorithms and analyze their performance.
4. Design and implement different problems using the backtracking and branch and bound techniques and analyze the time complexities of them.
5. Implement modern data structures like Segment tree, Quadtree and Octree for real world applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 5 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 | | |

**UNIT I** **9 Hours**

**TRIE DATA STRUCTURES**

Trie Structure-Types-Prefix-Based Search-Space Efficiency-Time Complexity-Compact Tries-Applications-Suffix Array and Suffix Tree-Rope.

**UNIT II** **9 Hours**

**GRAPH**

Graph representation-Breadth-first traversal-Depth-first traversal-Shortest Path Algorithms: Unweighted Shortest Paths-Dijkstras Algorithm-Travelling Salesman Problem-Analysis of shortest path algorithms.

**UNIT III** **9 Hours**

**GRAPH MST**

Minimum Spanning Tree: Prims Algorithm-Kruskals Algorithm-Disjoint-Set Union (Union-Find)-A* algorithm-Flood filling algorithm-Analysis of MST algorithms.

**UNIT IV** **9 Hours**

**ALGORITHM DESIGN TECHNIQUES**

NP Complete problems- Backtracking: N-Queens Problem and Subset-Sum problem - Branch and bound: Knapsack problem-Approximation algorithms for NP hard problems: Traveling salesman-P, NP, NP-Complete and NP-Hard Problems.

**UNIT V** **9 Hours**

**MODERN DATA STRUCTURES**

Segment Tree-Interval Tree-Fenwick Tree-K-D Tree-Quadtree and Octree-Circular Buffer (Ring Buffer)-Marshaling/Unmarshalling-JSON-benefits-Schema-limitations-Protobuf.

**1** **4 Hours**

## EXPERIMENT 1

Implement a Trie data structure and perform prefix based search.

**2** **4 Hours**

## EXPERIMENT 2

For a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra s algorithm.

**3** **4 Hours**

## EXPERIMENT 3

Find Minimum Cost Spanning Tree of a given undirected graph using Kruskals algorithm.

**4** **6 Hours**

## EXPERIMENT 4

Implement the Flood fill algorithm for replacing the color from the source row to source column in 2D array.

**5** **4 Hours**

## EXPERIMENT 5

Implement N Queens problem using Backtracking.

**6** **4 Hours**

## EXPERIMENT 6

Construct a segment tree for computing sum of the elements in a given range.

**7** **4 Hours**

**EXPERIMENT 7**

Implement a Quad tree for locating a node in the given quad.

**Total: 75 Hours**

**Reference(s)**


1. Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley publications,2013.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C,2nd Edition,Pearson Education,2016.
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures-A Pseudocode Approach with C, Thomson 2011.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Reema Thareja, Data Structures Using C, Second Edition , Oxford University Press, 2011

## 22CS403 OPERATING SYSTEMS 3 1 0 4

**Course Objectives**

- Establish a solid foundation in the introductory concepts of operating systems and gain insights into the structures, services, and roles of operating systems in computing environments.
- To apply process scheduling algorithms in a multi-programming environment and implement the various deadlock strategies effectively to prevent each other from accessing the computer resources
- To gain knowledge on the operations of memory management and File management.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate the 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.
l. 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.

**Course Outcomes (COs)**

1. Analyze the basic structure and architectural components of the operating system and interpret how application programs interact with the operating system through APIs.
2. Apply the various scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Analyze memory allocation and deallocation mechanisms involved in memory management for a specific system.
4. Apply the various file handling strategies to manage files on a secondary storage structure and in a distributed environment.
5. Analyze the virtualization technologies and their types to simulate hardware functionality and create a virtual computer system.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 3 | 2 | 2 | | | 2 | | 2 | | 2 | 2 | | |
| 2 | 3 | 3 | 2 | 2 | 3 | | 2 | | 2 | | | 2 | | |
| 3 | 2 | 2 | 2 | | | | 2 | | 2 | | | 2 | | |
| 4 | 2 | 2 | 2 | | 3 | | 2 | | 2 | | | 2 | | |
| 5 | 2 | 2 | 2 | | | | | | 2 | | | | | |

**UNIT I** **8 Hours**

**INTRODUCTION TO OPERATING SYSTEMS**

Basic Operating System Concepts-Operating System Structure and Components-Operating System Services and Interfaces-Role of the Kernel and User Space-System calls and System Programs-Open Source and Closed source operating systems.

**UNIT II** **12 Hours**

**PROCESS MANAGEMENT**

Processes and Threads-Process Scheduling and CPU Scheduling Algorithms-Process Synchronization and Concurrency Control-Deadlocks and Handling Strategies-Inter-Process Communication (IPC)-Multi-Core and Multi-Processor Management

**UNIT III** **9 Hours**

**MEMORY MANAGEMENT**

Memory Hierarchy-Address Spaces and Memory Allocation-Paging and Segmentation-Page Replacement Algorithms-NUMA (Non-Uniform Memory Access)-Memory Compression-Memory Tiering.

**UNIT IV** **8 Hours**

**FILE SYSTEM DESIGN AND AND IMPROVEMENTS**

File System Structures-Storage Technologies-SSD and Flash Storage Optimization-Copy-on-Write (CoW) File Systems-File System Journaling-Distributed File Systems and Cloud Storage-File System Monitoring and Analytics

**UNIT V** **8 Hours**

**VIRTUALIZATION AND RECENT DEVELOPMENTS**

Virtualization Principles and Types (Hardware, Software, Network, Storage)-Hypervisors and Virtual Machine Monitors-Microkernels and Exokernels-Security and Integrity in Virtualized Environments-Security in Operating Systems-Operating Systems for Quantum Computers-Cross-Platform Compatibility.

**Total: 60 Hours**

**Reference(s)**


1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015
2. Andrew S. Tanenbaum, Modern Operating Systems, Fourth Edition, Prentice Hall of India Pvt. Ltd, 2014
3. William Stallings, Operating System, Seventh Edition Prentice Hall of India, 2012
4. Harvey M. DeitelM, Operating Systems, Pearson Education Pvt. Ltd, 2007.
5. Distributed file system for cloud: A Clear and Concise Reference Kindle Edition by Gerardus Blokdyk
6. https://www.redhat.com/en/topics/virtualization

## 22CS404 WEB TECHNOLOGY AND FRAMEWORKS 2 0 2 3

**Course Objectives**

- Understand the Web Application Architectures and trace the evolution of the web and introduce concepts like Web 3.0 and Decentralized Web.
- Familiar with the different Web development Frameworks and Full stack development.
- Explore the emerging web technologies and implement best practices for making web applications accessible to all users

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.

**Course Outcomes (COs)**

1. Analyze the architecture of various web applications and develop simple use cases for the real time web applications
2. Implement web applications using client-side scripting language and server-side scripting languages.
3. Integrate the web applications with databases using Web frameworks.
4. Develop a complete, functional web application that incorporates both front-end and back-end components.
5. Implement the emerging web technologies in web application development projects.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | | |
| 2 | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | | |
| 3 | 2 | 3 | 3 | 2 | 2 | | | | | | 2 | 2 | | |
| 4 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | | |
| 5 | 3 | 2 | 3 | 3 | 3 | | | | | | 3 | 3 | | |

**UNIT I** **5 Hours**

**INTRODUCTION TO WEB APPLICATION**

Evolution of the web-Understanding Web Application Architectures:Server Side Rendered Applications-Single Page Application SPA-Mobile Application Development-Comparison of Monolithic and Microservice architectures-Serverless computing-HTTP Protocol and Methods-Web Browsers and Rendering Engines-Use cases of various web applications, including Flipkart, BIT Discourse, BIP, Wiki and Moodle.

**UNIT II** **7 Hours**

**SCRIPTING LANGUAGES**

SCRIPTING LANGUAGES

Client-side Scripting vs Server-Side Scripting-Client-side Scripting: Execution Location-Languages: JavaScript Fundamentals-Document Object Model DOM.

Server-Side Scripting: Execution Location-Languages-PHP Programming fundamentals

**UNIT III** **6 Hours**

**WEB DEVELOPMENT FRAMEWORKS**

Introduction to Web Development Frameworks -MVC Architecture - Building APIs with a Framework - RESTful APIs and API Design - Building a RESTful API - Database Integration with ORM/ODM -Building a Basic Front-End Application.

**UNIT IV** **6 Hours**

**FULL STACK DEVELOPMENT**

Full-Stack Development - Combining Front-End and Back-End Technologies - Building a Full-Stack Web Application- 12 factor application model - Deployment and Hosting Options - Continuous Integration and Continuous Deployment CI/CD - Performance Optimization and Scalability.

**UNIT V** **6 Hours**

**EMERGING WEB TECHNOLOGIES**

Emerging Web Technologies-Progressive Web Apps PWAs-WebAssembly and WebRTC-Web Security Best Practices-Open Web Application Security Project OWASP-Web Accessibility and Inclusive Design-Web Performance Optimization.

**1** **3 Hours**

## EXPERIMENT 1

Create a simple HTML page and use the browsers developer tools to inspect and manipulate elements.

**2** **3 Hours**

## EXPERIMENT 2

Write JavaScript to validate the following fields of the Registration page.

a)First Name (Name should contains alphabets and the length should not be less than 6 characters).

b)Password (Password should not be less than 6 characters length).

c)E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)

d)Mobile Number (Phone number should contain 10 digits only).

e)Last Name and Address (should not be Empty).

**3** **3 Hours**

## EXPERIMENT 3

Develop a multi-page website using HTML and CSS and apply responsive design techniques to make the site mobile-friendly.

**4** **3 Hours**

**EXPERIMENT 4**

Develop a QR code generator using PHP and connect to a database to store and retrieve data

**5** **3 Hours**

**EXPERIMENT 5**

Developing a Simple Web Application using a server-side framework (e.g., Flask, Django, or Ruby on Rails) and apply security measures to protect against common web vulnerabilities

**6** **4 Hours**

**EXPERIMENT 6**

Create a single-page application (SPA) using the front-end framework (e.g., React, Angular, or Vue.js) and implement routing and state management.

**7** **3 Hours**

**EXPERIMENT 7**

Develop a RESTful API using a back-end framework (e.g., Node.js or Express), perform the CRUD operations and Test the API using tools like Postman

**8** **4 Hours**

**EXPERIMENT 8**

Create a full-stack web application to implement user authentication and authorization connected to a database to store and retrieve data for the application

**9** **4 Hours**

**EXPERIMENT 9**

Deploy a web application in a hosting platform (e.g., Heroku, AWS, or Azure) and set up a continuous integration and continuous deployment (CI/CD) pipeline to monitor the deployed application for performance and errors.

**Total: 60 Hours**

**Reference(s)**


1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education,2009.
2. James Gillies and Robert Cailliau, How the Web Was Born: The Story of the World Wide Web, 2000
3. D Crockford , The Good Parts, O Reilly , 2009
4. Mark Masse , REST API Design Book,O Reilly,2011
5. Matti Luukkainen and Jarkko Moilanen , Fullstack Open: Deep Dive Into Modern Web Development
6. Michal Zalewski , The Tangled Web: A Guide to Securing Modern Web Applications 2011

## 22CS405 DATABASE MANAGEMENT SYSTEM 3 0 2 4

**Course Objectives**

- Analyze the data models, conceptualize and Design a database system using E-R diagrams.
- Gain knowledge on the design principles of relational and modern database systems like SQL, NoSQL and NewSQL.
- Impart knowledge in transaction processing, concurrency control and recovery techniques.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.

**Course Outcomes (COs)**

1. Analyze the data models and the types of data used in databases.
2. Implement SQL queries for creating databases and performing the relational operations.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes.
5. Analyze the performance of NoSQL and NewSQL databases related to design.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | | |
| 2 | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | | |
| 3 | 2 | 3 | 3 | 2 | 2 | | | | | | 2 | 2 | | |
| 4 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | | |
| 5 | 3 | 2 | 2 | 3 | 3 | | | | | | 3 | 3 | | |

**UNIT I** **8 Hours**

**INTRODUCTION TO DATABASES AND DBMS**

Understanding Data and Information - Database vs DBMS - Modern Databases - DBMS Architecture and Components - Data Models - Relational Model - Codd"s 12 Rules - Object-Relational Mapping (ORM).

**UNIT II** **10 Hours**

**STRUCTURED QUERY LANGUAGE (SQL)**

SQL Basic Commands - Constraints - Database Objects - SQL Functions - Subqueries- Correlated Subqueries- Nested subqueries - Recursive queries - Common Table Expressions (CTEs) - Triggers and Stored procedures.

**UNIT III** **9 Hours**

**DATABASE DESIGN AND NORMALIZATION**

Database Design fundamentals - Entity-Relationship Diagrams (ERD) - ERD to tables - Functional Dependencies and Normal Forms: 1NF, 2 NF, 3 NF, BCNF, 4 NF, 5NF and 6 NF - Domain-Key Normal Form (DKNF) - Nested Normal Form (NNF) - Denormalization and Trade-offs - Emerging trends in Database Design - Dealing with real-world complexities in Database Design- CASE Tools for Database Design.

**UNIT IV** **9 Hours**

**QUERY OPTIMIZATION AND TRANSACTION MANAGEMENT**

Query Optimization and Execution Plans -Optimization Visualization Tool - DB Sharding - Vitess - Vitess vs MySQL- Table partitioning - Transaction Management and ACID Properties - Concurrency Control: Lock based protocols -Deadlock handling - Multi version concurrency control (MVCC) - Transaction isolation.

**UNIT V** **9 Hours**

**NOSQL AND NEWSQL DATABASES**

NoSQL Vs NewSQL- NoSQLDatabases: MongoDB and Cassandra - NewSQL databases: Redis and NuoDB -Selection of NoSQL or NewSQL over RDBMS - CAP Theorem and BASE Properties - HeidiSQL - In-Memory Databases and Caching - Database Security and Encryption - Database Performance Tuning

**1** **4 Hours**

## EXPERIMENT 1

Create a simple relational database with tables and write SQL queries for basic CRUD operations (Create, Read, Update, Delete).

**2** **3 Hours**

## EXPERIMENT 2

Create multiple tables and perform Database Querying - Simple queries, Nested queries, Sub queries, Joins and views.

**3** **3 Hours**

## EXPERIMENT 3

Create a database with multiple tables. Add constraints (e.g., primary key, foreign key, check constraints) to database tables. Create indexes for performance optimization. Implement triggers to automate actions based on data changes.

**4** **3 Hours**

## EXPERIMENT 4

Design an ERD for a simple database schema. Normalize the schema to eliminate redundancy and improve data integrity.

**5** **3 Hours**

**EXPERIMENT 5**

Implement the normalized schema in the RDBMS and populate it with sample data.

**6** **3 Hours**

**EXPERIMENT 6**

Install and set up a NoSQL database (e.g., MongoDB). Write queries to insert, update, and query data in MongoDB.

**7** **4 Hours**

**EXPERIMENT 7**

Set up a distributed database cluster using open-source tools (e.g: Apache Cassandra). Store and retrieve data in a distributed environment.

**8** **4 Hours**

**EXPERIMENT 8**

Implement in-memory caching using technologies (Redis) and measure the performance improvements achieved through caching.

**9** **3 Hours**

**EXPERIMENT 9**

Implement access control and user authentication in an RDBMS. Encrypt sensitive data at rest and in transit

**Total: 75 Hours**

**Reference(s)**


1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw -Hill, Sixth Edition, 2018
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, Seventh Edition, 2016
3. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, Ninth edition, 2011
4. Guy Harrison , Next Generation Databases: NoSQLand Big Data, Apress.

## 22HS007 ENVIRONMENTAL SCIENCE 2 0 0 0

**Course Objectives**

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

**Programme Outcomes (POs)**
**Course Outcomes (COs)**

1. Show the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Demonstrate the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Assess the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Compare the impacts of population and human activities on environment

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **6 Hours**

**NATURAL RESOURCES**

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer - pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources - renewable (solar, wind, and hydro).

**UNIT II** **6 Hours**

**ECOSYSTEMS AND BIODIVERSITY**

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

**UNIT III** **6 Hours**

**ENVIRONMENTAL POLLUTION**

Pollution: Definition - causes - effects - control measures of air pollution - Water pollution - Sewage water treatment by activated sludge and trickling filter process - Noise pollution - Thermal pollution. Disaster management - causes - effects - control measures of floods - Earthquake

**UNIT IV** **7 Hours**

**SOCIAL ISSUES AND ENVIRONMENT**

Sustainable development - Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles - landfills, incineration, composting. Water conservation - rain water harvesting - watershed management. Climate change - Global warming - acid rain - Ozone layer depletion. E-waste

**UNIT V** **5 Hours**

**HUMAN POPULATION AND ENVIRONMENT**

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

**Total: 30 Hours**

**Reference(s)**


1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P. H. Hassenzahl, D.M. & Berg, L.R. 2012. Environment, 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I. L, Gerba, C. P. & Brusseau, M. L. 2011, Environmental and Pollution Science, Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014


Communication englich

## 22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION

**0 0 2 1**

**Course Objectives**

- To enable students to achieve proficiency in academic writing
- effectively use the language to persuade others
- appreciate the nuances of the language and engage an audience
- use advanced tools of language to improve communicative competence
- prepare for professional demands at the workplace
- give concrete expression to the plans and goals

**Programme Outcomes (POs)**

**Course Outcomes (COs)**

1. Understand the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 4 | | | | | | | | | 2 | 3 | | | | |
| 5 | | | | | | | | | 2 | 3 | | | | |

**UNIT I** **15 Hours**

**CREATIVE EXPRESSION**

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: 'Why should we hire you?' Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

**UNIT II** **15 Hours**

**FORMAL EXPRESSION**

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning - SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions -

Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs.

**Total: 30 Hours**

**Reference(s)**


1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace & L.Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N. K. Agrawal & F. T. Wood, Macmillan India Ltd., New Delhi

## 22CS501 THEORY OF COMPUTATION 3 1 0 4

**Course Objectives**

- Understand the mathematical models of computation and formal language
- Understand the capability of Turing machines and to design TM for a given language.
- Understand the decidability and intractability of computational problems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Design the Finite Automata for computable problems
2. Formulate / Design regular expression for pattern recognition
3. Develop pushdown automata for language recognition
4. Analyse the Turing machine for language acceptance.
5. Analyse the undecidability of languages

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 2 | | | | | | | | | | - | |
| 2 | 2 | 3 | 2 | | | | | | | | | | - | |
| 3 | 3 | 2 | 3 | | | | | | | | | | - | |
| 4 | 3 | 2 | 3 | | | | | | | | | | - | |
| 5 | 1 | 1 | 1 | | | | | | | | | | - | |

**UNIT I** **9 Hours**

**FINITE AUTOMATA**

Introduction- Basic Mathematical Notation and techniques - Finite State systems - Basic Definitions - Finite Automaton - DFA & NFA - Regular Languages - Regular Expression - Equivalence of NFA and DFA - Equivalence of finite Automaton and regular expressions - Minimization of DFA - Pumping Lemma for Regular sets.

**UNIT II** **9 Hours**

**CONTEXT FREE GRAMMAR**

Grammar Introduction - Types of Grammar - Context Free Grammars (CFG) and Languages - Derivations and Languages - Ambiguity - Relationship between derivation and derivation trees - Simplification of CFG - Greibach Normal form - Chomsky normal form.

**UNIT III** **9 Hours**

**PUSHDOWN AUTOMATA**

Pushdown Automata - Definitions - Moves - Instantaneous descriptions - Deterministic pushdown automata - Equivalence of Pushdown automata and CFL - pumping lemma for CFL

**UNIT IV** **9 Hours**

**TURING MACHINES**

Definitions of Turing machines - Models - Computable languages and functions - Techniques for Turing machine construction - Multi head and Multi tape Turing Machines - The Halting problem.

**UNIT V** **9 Hours**

**UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS**

Unsolvable Problems and Computable Functions - Recursive and recursively enumerable languages - Universal Turing machine. Measuring and Classifying Complexity: - P and NP completeness - Polynomial time reductions

**Total: 60 Hours**

**Reference(s)**


1. Hopcroft J.E, Motwani R, and Ullman J D, Introduction to Automata Theory, Language and Computations, 3rd Edition, Pearson Education (ISBN 1292039051), 2014.
2. Martin J, Introduction to Languages and the Theory of Computation, 3rd Edition, TMH, 2007.
3. Kamala Krithivasan and Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson Education 2009.
4. Peter Linz , An Introduction to Formal Languages and Automata, Fifth edition, 2012.
5. Harry R Lewis and Christos H Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2003
6. Mishra K L P and Chandrasekaran N, Theory of Computer Science Automata, Languages and Computation, Third Edition, Prentice Hall of India, 2004.

## 22CS502 COMPUTER NETWORKS 3 0 2 4

**Course Objectives**

- To understand the division of network functionality into layers and to familiarize the functions and protocols of each layer of TCP/IP protocol suite.
- To understand the components required to build different types of network and to learn concepts related to network addressing.
- To understand the flow of information from one node to another node in the network and to learn the application layer utilities

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Compare OSI model with TCP/IP protocol suite and design a network based on four different topologies.
2. Design and analyze error and flow control algorithms for communication between adjacent nodes in a network.
3. Identify and apply the suitable routing algorithms for the given network.
4. Develop a client/server application using TCP/UDP and design algorithms for end-end communication
5. Analyze the capabilities of application layer utilities and replicate the same for new applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 1 | 3 | | | | | | | | | | 2 | |
| 2 | 1 | 2 | 3 | 1 | 1 | | | | | | | | 2 | |
| 3 | 3 | 2 | 2 | | | | | | | | | | 2 | |
| 4 | 1 | 3 | 2 | | | | | | | | | | 2 | |
| 5 | 3 | 2 | | | | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**DATA COMMUNICATIONS**

Introduction: Data Communications, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, OSI Model - Physical Layer: Introduction to Physical Layer - Transmission Media: Guided Media, Unguided Media.

**UNIT II** **9 Hours**

**DATA LINK LAYER**

Introduction to Data Link Layer: Link Layer Addressing - Error Detection and Correction: Block Coding, Cyclic Codes, Checksum, Forward Error Correction - Data Link Control: DLC services, Data-Link Layer Protocols, HDLC, Point-to-Point Protocol - Media Access Control: Random Access and Controlled Access

**UNIT III** **9 Hours**

**NETWORK LAYER**

Network Layer Services - Packet Switching - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMPv4 - Routing Algorithms- Unicast Routing Protocols - Next Generation IP: IPv6 Addressing, IPv6 Protocol.

**UNIT IV** **9 Hours**

**TRANSPORT LAYER**

Introduction to Transport Layer: Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol, Selective Repeat Protocol, Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control

**UNIT V** **9 Hours**

**APPLICATION LAYER**

Client Server Programming - WWW - HTTP - FTP - DNS - SNMP-DHCP

**1** **5 Hours**

**EXPERIMENT 1**

Experiment on configuring network topology using packet tracer.

**2** **5 Hours**

**EXPERIMENT 2**

Experiment on error correction code like CRC and Checksum.

**3** **5 Hours**

**EXPERIMENT 3**

Experiment on configuring router and switch.

**4** **5 Hours**

**EXPERIMENT 4**

Experiment on ARP and RARP in live network.

**5** **5 Hours**

**EXPERIMENT 5**

Experiment on routing algorithms like Distance Vector and Link State Routing.

**6** **5 Hours**

**EXPERIMENT 6**

Experiment on chat programming using TCP and UDP sockets.

**Total: 75 Hours**

**Reference(s)**


1. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, 2017.
2. Andrew S Tanenbaum and David J Wetherall, Computer Networks, Fifth Edition, Pearson Education, 2011.
3. William Stallings, Data and Computer Communications, Tenth Edition, Prentice Hall, 2013.
4. Larry L Peterson and Bruce S Davie, Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
5. James F Kurose and Keith W Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Sixth Edition, Addison-Wesley, 2013.

## 22CS503 MACHINE LEARNING 3 0 2 4

**Course Objectives**

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Apply neural networks, Bayes classifier and k nearest neighbor algorithms in machine learning.
- Perform statistical analysis of machine learning techniques.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the need for Machine learning and apply concept learning to find maximally consistent hypothesis.
2. Apply supervised learning algorithms to solve classification and regression problems.
3. Analyze unsupervised and reinforcement learning algorithms with real time applications.
4. Analyze the representation and algorithms involved in Neural Networks.
5. Apply the advanced machine learning algorithms to design predictive

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 2 | | | | | | | | | | |
| 2 | 1 | 2 | 2 | 2 | 1 | 1 | | | | | | | | |
| 3 | 1 | | 2 | 1 | 1 | 1 | | | | | | | 2 | |
| 4 | 1 | 2 | 2 | 2 | | | | | | | | | | |
| 5 | 1 | 2 | 2 | 2 | | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Need for Machine Learning- Machine Learning Process - Types of Machine Learning - Concept Learning: Find - S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias

**UNIT II** **9 Hours**

**SUPERVISED LEARNING**

Classification Algorithms: Support Vector Machines - Logistic Regression - K-Nearest Neighbors - Naive Bayes Classifier - Decision Trees - Random Forests - Regression Algorithms: Simple Linear Regression - Multiple Linear Regression

**UNIT III** **9 Hours**

**UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING**

Clustering algorithm: k-means clustering - Fuzzy c-means clustering - Hierarchical clustering - Gaussian (EM) clustering - Density-based clustering - Reinforcement Learning: Examples - Challenges - Q - Learning Algorithm

**UNIT IV** **9 Hours**

**NEURAL NETWORKS**

Neural Network Basics: Multilayer Perceptron - Feed Forward Neural Networks - Back Propagation - Hyperparameter Tuning. Convolutional Neural Networks: Image Classification. Recurrent Neural Networks: Long Short - Term Memory

**UNIT V** **9 Hours**

**ADVANCED MODELS**

Generative Models - Autoencoders - Recommendation System: Collaborative Filtering Recommendation System - Content Based Recommendation System - Hybrid Recommendation System

**1** **5 Hours**

## EXPERIMENT 1

Consider a set of training data examples and implement algorithms to find the most specific hypothesis and set of all hypotheses that are consistent with the training examples.

**2** **5 Hours**

## EXPERIMENT 2

Apply suitable classification algorithm to classify the iris data set.

**3** **5 Hours**

## EXPERIMENT 3

Apply EM algorithm and k-Means algorithm to cluster a set of data. Compare the results of these two algorithms and comment on the quality of clustering.

**4** **5 Hours**

## EXPERIMENT 4

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

**5** **5 Hours**

**EXPERIMENT 5**

Apply CNN to build computational models consisting of several processing elements to receive inputs and deliver outputs based on activation functions. learning to get the desired output.

**6** **5 Hours**

**EXPERIMENT 6**

Build a Simple and Content-Based Book Recommendation System.

**Total: 75 Hours**

**Reference(s)**


1. 1Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, Springer Series in Statistics.
3. Ethem Alpaydin, Introduction to Machine Learning, Second edition, MIT press.

## 22CS504 INTERNET PROGRAMMING 2 0 2 3

**Course Objectives**

- Impart the knowledge of web application development platforms.
- Develop the front end user interface using HTML, CSS.
- Analyze the user experience design methodologies like Java script, JSON and JQuery for responsive web design.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Identify working model and learn basic web concepts to develop Static and Dynamic web pages.
2. Create web pages that demonstrate proficiency in the use of HTML.
3. Present a professional document using Cascaded Style Sheets.
4. Implement the knowledge of HTML and CSS code to create personal and/or business websites following current professional and/or industry standards.
5. Apply static and dynamic web page design techniques to construct an interactive web page using Client side technologies.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | | | 3 | | | | | | | | 1 | |
| 2 | 1 | 3 | 2 | | 3 | | | | | | | | 1 | |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | |
| 4 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | |
| 5 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | |

**UNIT I** **6 Hours**

**INTRODUCTION TO HTML**

Basic Web Concepts - Web based Client/Server model - Web Protocols - Working of web browser - Browser & Server Communication - Basics of HTML - Elements and Attributes of HTML. HTML Layouts - HTML forms - HTML Lists and Tables - HTML frames - HTML Media - Getting started with HTML5 - HTML Graphics.

**UNIT II** **8 Hours**

**CASCADING STYLE SHEETS**

Basics of CSS - HTML Style attributes - CSS Syntax - CSS Selectors - Three ways to insert CSS - Element based CSS - CSS Layouts - CSS Image Gallery - Gradients and Shadows - 2D and 3D transforms with CSS - CSS Pagination and Columns - Basics of Responsive UI Design - Basics of CSS frameworks.

**UNIT III** **6 Hours**

**JAVA SCRIPT**

An introduction to JavaScript - Data Types - Conditionals and Loops - Functions - Classes and Objects - Inbuilt Methods - Arrays - Regular Expressions.

**UNIT IV** **5 Hours**

**AJAX AND JQUERY**

Introduction to AJAX - JS vs jQuery - jQuery Load - jQuery Get/Post.

**UNIT V** **5 Hours**

**ANGULAR**

Introduction to AngularJS - Expressions - Modules - Data binding - Controllers - Scope - Services.

**1** **6 Hours**

**EXPERIMENT 1**

Develop a Event page for Conference using HTML.

**2** **6 Hours**

**EXPERIMENT 2**

Build a Restaurant website using HTML and CSS.

**3** **6 Hours**

**EXPERIMENT 3**

Develop a Random Quote Generator using JavaScript.

**4** **6 Hours**

**EXPERIMENT 4**

Design a snake game using Jquery.

**5** **6 Hours**

**EXPERIMENT 5**

Design an online voting system using angularJS.

**Total: 60 Hours**

**Reference(s)**


1. Thomas a Powell, HTML & CSS: The Complete Reference, 5th Edition, Tata McGraw Hill Education Private Limited, 2010.
2. Russ Ferguson, Beginning The Ultimate Guide to Modern JavaScript Development, Apress Publishers, 3rd Edition, 2019.
3. Jon Duckett, HTML and CSS: Design and build websites, John Wiley & Sons, 2011.
4. David Flanagan, JavaScript The Definitive Guide, 5th Edition, O Reilly, 2011
5. Deitel Deitel Goldberg, Internet and World Wide Web - How to program, 5th Edition, Prentice Hall Publishers, 2012.

6. Robert W Sebesta, Programming the World Wide Web, 7th Edition, Pearson Education Inc., 2014.

**22CS507 MINI PROJECT I** **0 0 2 1**

**Course Objectives**

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | 2 | - | | 2 | 2 | 2 | - | | | 1 | 1 |
| 2 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | | | 1 | 1 |
| 3 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | 2 | | 1 | 1 |
| 4 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | 2 | | 1 | 1 |
| 5 | 1 | 2 | | | 2 | | | 2 | 2 | 2 | | | 1 | 1 |

**Total: 0 Hours**

## 22CS601 ARTIFICIAL INTELLIGENCE 3 0 2 4

**Course Objectives**

- To impart artificial intelligence principles, techniques and its history
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
- To develop intelligent systems by assembling solutions to concrete computational problems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
4. Analyze and illustrate how learning algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | | | | | | | | | | | 1 | |
| 2 | 2 | 3 | 3 | | | | | | | | | | 2 | |
| 3 | 2 | 3 | 3 | | | | | | | | | | 2 | |
| 4 | 2 | 3 | 3 | 3 | | | | | | | | | 3 | |
| 5 | 2 | 2 | 3 | 3 | | | | | | | | | 3 | |

**UNIT I** **9 Hours**

**ARTIFICIAL INTELLIGENCE AND ITS ISSUES**

Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.

**UNIT II** **9 Hours**

**OVERVIEW TO PROBLEM SOLVING AND HEURISTIC APPROACH**

Problem solving by Search, Problem space - State space, Performance Measurement-Game playing mini-max algorithm, Alpha-Beta Pruning, Search Algorithms, Breadth-first search, Depth-first search, A* search, The effect of heuristic accuracy on performance, Generating heuristics from relaxed problems. Local Search and Optimization Problem, Hill-climbing search, Constraint Satisfaction Problem, Variations on the CSP formalism.

**UNIT III** **9 Hours**

**KNOWLEDGE REPRESENTATION, UNCERTAINTY AND KNOWLEDGE REASONING**

Logical systems Knowledge Based systems, Propositional Logic Constraints, Predicate Logic First Order Logic, Inference in First Order Logic, Ontological Representations and applications-Overview Definition of uncertainty, Bayes Rule Inference, Belief Network-Decision Network.

**UNIT IV** **9 Hours**

**LEARNING SYSTEMS**

Knowledge in learning: Explanation based learning-Forms of Learning Types - Supervised, Unsupervised, Learning Decision Trees-Statistical learning methods: Instance based learning-Neural Network-Reinforcement learning: Passive and active communication: Formal grammar- Augmented Grammars-Future of AI.

**UNIT V** **9 Hours**

**EXPERT SYSTEMS AND GAMES**

Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems- Game theory, classification of games, game playing strategies, prisoner s Dilemma, Game playing techniques

**1** **5 Hours**

**EXPERIMENT 1**

Data pre-processing, annotation and creation of datasets using various AI tools

**2** **5 Hours**

**EXPERIMENT 2**

Implementation of Breadth First and Depth First searching techniques

**3** **5 Hours**

**EXPERIMENT 3**

Implementation of Hill Climbing algorithm and A* algorithm

**4** **5 Hours**

**EXPERIMENT 4**

Designing a chat-bot application

**5** **5 Hours**

**EXPERIMENT 5**

Implementation of Inference system

**6** **5 Hours**

**EXPERIMENT 6**

Implementation of n-Queens problem where n>=1 to n<=9

**Total: 75 Hours**

**Reference(s)**


1. Russell, S. and Norvig, P, Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall,2015.
2. Poole, D. and Mackworth, A, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press,2010
3. Ric, E., Knight, K and Shankar, B, Artificial Intelligence, 3rd edition, Tata McGraw Hill,2009
4. Luger, G.F, Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson,2008.
5. Padhy, N.P, Artificial Intelligence and Intelligent Systems, Oxford University Press,2009.
6. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010

## 22CS602 COMPILER DESIGN 3 1 0 4

**Course Objectives**

- Understand the principles, algorithms, and data structures involved in the design and construction of compilers
- Acquire knowledge in construction of scanners, parsers and in intermediate code generation
- Familiar with the code generation schemes and optimization methods.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Examine the role of each phase of a compiler and the compiler construction tools.
2. Construct Finite automata to recognize regular language.
3. Construct Parser to recognize Context Free Grammar.
4. Generate intermediate code for programming constructs.
5. Apply optimization techniques in code generation and analyze the issues in code generation.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | | | | | | | | | | |
| 2 | 1 | 2 | 2 | | 1 | | | | | | | | 2 | |
| 3 | | 3 | 3 | | 1 | | | | | | | | 2 | |
| 4 | | 2 | 2 | | | | | | | | | | 1 | |
| 5 | | 2 | 2 | | | | | | | | | | 1 | |

**UNIT I** **8 Hours**

**INTRODUCTION TO FORMAL LANGUAGES AND COMPILERS**

Formal Language - Elements of Language - Formal Grammar - Chomsky Classification. Compilers: Language Processors - Structure of a Compiler - Grouping of Phases into Passes - Compiler Construction Tools.

**UNIT II** **9 Hours**

**LEXICAL ANALYSIS**

Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Specification of tokens - Recognition of Tokens. Finite automata - Regular expression to finite automata- Optimization of DFA based Pattern Matches-Lexical Analyzer Generator Lex.

**UNIT III** **11 Hours**

**SYNTAX ANALYSIS**

Introduction-Role of the parser - Context-Free Grammars -Writing a Grammar-Top Down parsing - LL(1) Grammars- Non-recursive Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing-LR Parsers: Simple LR Parser - Canonical LR Parser - LALR Parser - Parser Generator YACC

**UNIT IV** **8 Hours**

**INTERMEDIATE CODE GENERATION**

Variants of Syntax Trees- Three-Address Code - Types and Declarations - Translation of Expressions - Control Flow - Switch-Statements - Backpatching

**UNIT V** **9 Hours**

**CODE GENERATION**

Issues in the Design of a Code Generator - The Target Language - Basic Blocks and Flow Graphs- Optimization of Basic Blocks - A Simple Code Generator- Principal Sources of Optimization.

**Total: 60 Hours**

**Reference(s)**


1. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2012.
2. Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.
3. Charles N, Ron K Cytron, Richard J LeBlanc Jr., Crafting a Complier, Pearson Education, 2010
4. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008
5. Kennath C. Louden, Compiler Construction Principles and Practice. New Delhi: Vikas publishing House, 2006.
6. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2007.

## 22CS603 OBJECT ORIENTED SOFTWARE ENGINEERING

**3 0 0 3**

**Course Objectives**

- Understand the concept of Software Engineering and Object-Oriented System
- Acquire knowledge in construction of various Unified Modeling Language and to model the project
- Analyze and develop the model based on the requirement and under different testing

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the concepts of System Design, Software Engineering and Object-Oriented Design.
2. Infer the process during requirement and analysis steps in system design
3. Design an object model by understanding the concepts of pattern solution and interface
4. Design various UML models using the appropriate notation for different applications
5. Implement the Model and apply various testing techniques.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | | | | | | | | | | | 2 | |
| 2 | 2 | 2 | | | | | | | | | | | 2 | |
| 3 | 3 | 3 | 3 | | 3 | | | | | | | | 2 | |
| 4 | 3 | 3 | 2 | | 2 | | | | | | | | 2 | |
| 5 | 3 | 3 | 3 | | 3 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**SOFTWARE ENGINEERING ASPECTS**

Software Engineering Concepts - Characteristics of software- software engineering development activities - Managing software development - SDLC Process Models - Waterfall, RAD, Agile Software Development - Project communication concepts - Organizational activities

**UNIT II** **9 Hours**

**REQUIREMENT ELICITATION AND ANALYSIS**

Overview of requirements elicitation -Requirements elicitation concepts -Requirements elicitation activities - Managing requirements elicitation - Concepts of analysis - Activities from use cases to objects- Managing analysis.

**UNIT III** **9 Hours**

**OBJECT ORIENTATION WITH OBJECT AND SYSTEM DESIGN**

Preface to object orientation - Classes and Objects - Decomposing the system - System Design: System design concepts and activities - From objects to subsystems - Addressing design goals - Managing system design - Object Design: Reusing pattern solutions - Overview of reuse concepts - Design patterns - Mapping models to code: Mapping concepts.

**UNIT IV** **9 Hours**

**UNIFIED MODELING LANGAUAGE AND DIAGRAMS**

Introduction to UML - UML Structured Diagrams: Class diagram - Use Case diagram - Component and Deployment diagram - User Centered design, UML Behavioral Diagrams: Modelling interactions and behavior: Activity diagram - State diagram -Sequence diagram - Implementing classes based on interaction and state diagrams.

**UNIT V** **9 Hours**

**TESTING AND CONFIGURATION MANAGEMENT**

Testing: Testing concepts activities and managing testing - Rationale management - Rationale concepts and activities, Configuration Management: Configuration management activities and concepts - Configuration management concepts and activities - Managing configuration management.

**Total: 45 Hours**

**Reference(s)**


1. Sommerville, Software Engineering, Pearson Education,2009
2. Roger S. Pressman. Software Engineering - A Practitioners Approach, McGraw-Hill International Edition, 2010.
3. Bernd Bruegge, Allen H., Object-Oriented Software Engineering: Using UML, Patternsand Java, Pearson Education, 2011.
4. Timothy C. Lethbridge and Robert Laganiere, Object -Oriented Software Engineering: Practical software development using UML and Java, McGraw-Hill Higher Education, 2013.

## 22CS607 MINI PROJECT II 0 0 2 1

**Course Objectives**

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | | | 1 | 1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | | | 1 | 1 |
| 3 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | 2 | | 1 | 1 |
| 4 | 1 | 2 | 1 | 1 | 2 | | | 2 | 2 | 2 | 2 | | 1 | 1 |
| 5 | 1 | 2 | | | 2 | | | 2 | 2 | 2 | | | 1 | 1 |

**Total: 0 Hours**

## 22CS701 INFORMATION SECURITY 3 0 0 3

**Course Objectives**

- Understand information security"s importance in our data-driven digital world.
- Acquire the knowledge of key concepts of information security and how they work.
- Develop a Security mindset learn how to critically analyze situations of computer and network usage from a security perspective, identifying the salient issues, technologies, policies, laws, standards, and practices.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Examines the business drivers behind the information security analysis design process.
2. Illustrate the major components, scope, and target audience for each of the levels of security policy
3. Apply the suitable security technologies to segregate the organizations systems from the insecure Internet.
4. Identify the underlying foundations of modern cryptosystems and analyze the traditional symmetric encryption systems with more modern asymmetric encryption systems.
5. Interpret the several key laws, policies, standards and practices that shape the field of information security.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | | | | | | | | | | | 2 | |
| 2 | 2 | 1 | | | | | | | | | | | 2 | |
| 3 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | |
| 4 | 1 | 2 | 2 | | 2 | | | | | | | | 2 | |
| 5 | 2 | 1 | 3 | | 3 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION TO INFORMATION SECURITY**

The History of Information Security-Key Information Security Concepts-The Security Systems Development Life Cycle- Security Professionals and the Organization- Need for Security.

**UNIT II** **9 Hours**

**INFORMATION SECURITY POLICY, STANDARDS AND PRACTICES**

Information Security Planning and Governance - Information Security Policy, Standards, and Practices - The Information Security Blueprint - Security Education, Training, and Awareness Program - Continuity Strategies.

**UNIT III** **9 Hours**

**SECURITY TECHNOLOGIES**

Introduction-Access Control, Identification, Authentication, Authorization and Accountability-Firewalls Virtual Private Networks (VPNs)- Intrusion Detection and Prevention Systems - Scanning and Analysis Tools- Biometric Access Controls.

**UNIT IV** **9 Hours**

**CRYPTOGRAPHY**

Foundations of Cryptology-Cipher Methods-Cryptographic Algorithms-Cryptographic Tools-Protocols for Secure Communications-Attacks on Cryptosystems.

**UNIT V** **9 Hours**

**LEGAL, ETHICAL, AND PROFESSIONAL ISSUES IN INFORMATION SECURITY**

Law and Ethics in Information Security - General Computer Crime Laws - International Laws and Legal Bodies - Agreement on Trade-Related Aspects of Intellectual Property Rights - Digital Millennium Copyright Act (DMCA) - Ethics and Information Security-Codes of Ethics and Professional Organizations.

**Total: 45 Hours**

**Reference(s)**


1. Michael E Whitman, Herbert J Mattord, Principles of Information Security, Sixth Edition, Cengage Learning,2017.
2. Mark Stamp, Information Security: Principles and Practices, Wiley, Second edition,2011
3. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall of India/Pearson Education, New Delhi, 2007.
4. Charles B.fleeger and Shari Lawrence Pfleeger, Security in Computing, Pearson Education, 2014.
5. Dieter Gollmann, Computer Security, John Wiley & Sons Ltd., 2011.
6. SunitBelapure and Nina Godbole , Cyber Security, Wiley, 2011.

## 22CS702 CLOUD COMPUTING` 3 0 2 4

**Course Objectives**

- To provide the ideal solution to manage enterprise resources effectively and efficiently by cloud computing.
- Identify the security and privacy issues in cloud computing.
- To develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Outline the concept of virtualization in Cloud Computing.
2. Deploy applications over different Cloud computing infrastructures
3. Implement Cloud Dockers to automate the deployment of applications.
4. Identify the security and privacy issues in cloud computing.
5. Implement the cloud applications to solve real time problems.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | | | | | | | | | | | 2 | |
| 2 | 2 | 2 | | | | | | | | | | | 2 | |
| 3 | 3 | 3 | 3 | | 3 | | | | | | | | 2 | |
| 4 | 3 | 3 | 2 | | 3 | | | | | | | | 2 | |
| 5 | 3 | 3 | 3 | | 3 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Introduction to Cloud Computing -Characteristics and Benefits of Cloud Computing- Hardware and software - Evolution of cloud computing - Server virtualization: parallel and vector processing.

**UNIT II** **9 Hours**

**CLOUD SERVICE MODELS**

Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS) - Cloud Data Center - Service Oriented Architecture (SoA) - Basic approach to a Data center Based SoA.

**UNIT III** **9 Hours**

**CLOUD DOCKER**

Introduction - Docker Architecture -Docker Engine - Docker Containers - Docker Objects - Docker Run - Pipeline - Automation Scripts.

**UNIT IV** **9 Hours**

**CLOUD SECURITY**

Securing cloud boundary - Service boundary - Security mapping - Brokered cloud storage access - Storage location and tenancy - Encryption - Establishing the Identity and Presence.

**UNIT V** **9 Hours**

**CLOUD APPLICATIONS**

Applications in the cloud - Functionality mapping - Applications attributes - Cloud APIs-Cloud storage definition - Managed and Unmanaged cloud storage - Exploring cloud backup solutions - Cloud storage interoperability.

**1** **4 Hours**

**EXPERIMENT 1**

Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows

**2** **4 Hours**

**EXPERIMENT 2**

Install a C compiler in the virtual machine created using virtual box and execute Simple Programs

**3** **4 Hours**

**EXPERIMENT 3**

Implement the procedure to transfer the files from one virtual machine to another virtual machine for reliable data access with the help of any open stack virtual machine.

**4** **4 Hours**

**EXPERIMENT 4**

Install the single node private cloud environment to resource allocation

**5** **4 Hours**

**EXPERIMENT 5**

Implement the procedure to create and deploy a simple web application in public cloud environment

**6** **4 Hours**

**EXPERIMENT 6**

Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

**7** **3 Hours**

**EXPERIMENT 7**

Create and Deploy applications on Microsoft Windows Azure

**8** **3 Hours**

**EXPERIMENT 8**

Install Hadoop single node cluster and run simple applications like word count.

**Total: 75 Hours**

**Reference(s)**


1. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
3. Adrian Mouat - Using Docker: Developing and Deploying software with containers, O Reilly Media, 2016.
4. George Reese, Cloud Application Architectures Building Applications and Infrastructure in the Cloud Transactional Systems for EC2 and Beyond (Theory in Practice), O Reilly, 2009., CRC Press, 2017
5. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, - Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
6. IBM Cloud Computing http://www.ibm.com/cloud-computing/us/en/

## 22CS707 PROJECT WORK I 0 0 4 2

**Course Objectives**

- To develop knowledge to formulate a real world problem and projects goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | | 2 | 3 | 3 |
| 2 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | | 2 | 3 | 3 |
| 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| 5 | 2 | 2 | | | 2 | 3 | | 3 | 3 | 3 | | 2 | 3 | 3 |

**Total: 0 Hours**

## 22CS801 PROJECT WORK II 0 0 20 10

**Course Objectives**

- To develop knowledge to formulate a real world problem and project"s goals
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Formulate a real-world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | | 2 | 3 | 3 |
| 2 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | | 2 | 3 | 3 |
| 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| 5 | 2 | 2 | | | 2 | 3 | | 3 | 3 | 3 | | 2 | 3 | 3 |

**Total: 0 Hours**

## 22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

**Course Objectives**

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Increase ability to comprehend complex content
- Enhance confidence in expressing with clarity and elegance
- Enthusiastic and reflective use of the language through sufficient and focused practice
- Articulate fluently and confidently in challenging situations

**Programme Outcomes (POs)**

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

j. 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.

l. 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.

**Course Outcomes (COs)**

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **15 Hours**

**SELF-EXPRESSIONRESSION**

Personal Goals and Values - Being a Team Player-Expressing strengths and weaknesses-Abstract nouns -Adjectives-Active Listening skills-Note making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional ethics-Reported Speech-Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses- Hypothetical questions and answers-Sentence Structure-Simple Present Tense-Perfect tense

**UNIT II** **15 Hours**

**CREATIVE EXPRESSION**

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept explanation-Reported speech-Voice Sentence equivalence-Proofreading

**UNIT III** **15 Hours**

**FORMAL EXPRESSION**

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and articles-Spelling-Reading: Analyzing and interpreting notices and circulars-Understanding the gist of short real-world notices, and messages.Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speechWriting: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

**Total: 45 Hours**

**Reference(s)**


1. Sasikumar, V, et.al. A Course in Listening & Speaking FoundationBooks, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

**22HSH01 HINDI** **1 0 2 2**

**Course Objectives**

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **9 Hours**

**VOWELS AND CONSONANTS**

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

**UNIT II** **9 Hours**

**NOUNS**

Nouns: Genders -Masculine & Feminine -Reading Exercises

**UNIT III** **9 Hours**

**PRONOUNS AND TENSES**

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

**UNIT IV** **9 Hours**

**CLASSIFIED VOCABULARY**

Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes -Directions -Seasons Professions.

**UNIT V** **9 Hours**

**CONVERSATIONS**

Speaking -Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

**Total: 45 Hours**

**Reference(s)**


1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

**22HSG01 GERMAN** **1 0 2 2**

**Course Objectives**

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Listen and identify individual sounds of German
2. use basic phonemes and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand basic grammar and appropriate vocabulary in completing language tasks

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 3 | 3 | | | | |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

**UNIT II** **9 Hours**

**LANGUAGE AND ITS COMMON USE**

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation

**UNIT III** **9 Hours**

**TECHNICAL DEUTSCHE**

Regular &Irregular verbs -Personal pronouns-family-Introduction to types of sentences

**UNIT IV** **9 Hours**

**INTERROGATION**

Question words -Types of Questions -Nominative case-Verb Conjugation -country -nationalities

**UNIT V** **9 Hours**

**IMPLEMENTATION**

Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

**Total: 45 Hours**

**Reference(s)**


1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

## 22HSJ01 JAPANESE 1 0 2 2

**Course Objectives**

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 3 | 3 | | | | |
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| 4 | | | | | | | | | 3 | 3 | | | | |
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**UNIT I** **9 Hours**

**SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS**

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions -Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time

**UNIT II** **9 Hours**

**TIME EXPRESSION / VERBS - PAST**

Introduction to time -Introduction of verbs -Listening to specific information

**UNIT III** **9 Hours**

**- ADJECTIVES - II ADJECTIVE**

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation Listening to Japanese Alphabet Pronunciation -Simple Conversation

**UNIT IV** **9 Hours**

**CONJUGATION OF II ADJECTIVE**

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

**UNIT V** **9 Hours**

**CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM**

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives

**Total: 45 Hours**

**Reference(s)**


1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

**22HSF01 FRENCH** **1 0 2 2**

**Course Objectives**

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

**Programme Outcomes (POs)**

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

j. 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.

**Course Outcomes (COs)**

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 3 | 3 | | | | |
| 2 | | | | | | | | | 3 | 3 | | | | |
| 3 | | | | | | | | | 3 | 3 | | | | |
| 4 | | | | | | | | | 3 | 3 | | | | |
| 5 | | | | | | | | | 3 | 3 | | | | |

**UNIT I** **9 Hours**

**ENTRER EN CONTACT**

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

**UNIT II** **9 Hours**

**PARTAGER SON LIEU DE VIE**

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, les pieces, l equipement, la description physique

**UNIT III** **9 Hours**

**VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES**

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie -

Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

**UNIT IV** **9 Hours**

**COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE**

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait Communication Propose a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires

**UNIT V** **9 Hours**

**GOUTER A LA CAMPAGNE**

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, l argent

**Total: 45 Hours**

**Reference(s)**


1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

## 22CS001 EXPLORATORY DATA ANALYSIS 2 0 2 3

**Course Objectives**

- To outline an overview of exploratory data analysis.
- To implement data cleaning and preparation techniques.
- To perform descriptive statistics and data visualization techniques to present insights from the data.
- To apply univariate, bivariate, multivariate, correlation, and time series data exploration and analysis techniques
- To use dimensionality reduction techniques for simplifying complex datasets and visualize high-dimensional data.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the fundamentals of exploratory data analysis.
2. Implement the data cleaning and preparation techniques.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data.
4. Analyze and interpret relationships between variables using EDA analysis techniques to gain insights into complex data patterns.
5. Apply dimensionality reduction techniques, such as Principal Component Analysis (PCA), to simplify complex datasets and extract essential features.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 2 | 3 | 3 | 3 | | | | | | | | 1 | |
| 2 | 2 | 2 | 2 | 3 | 3 | | | | | | | | 2 | |
| 3 | 2 | 3 | 3 | 2 | 3 | | | | | | | | 2 | |
| 4 | 2 | 2 | 2 | 2 | 3 | | | | | | | | 2 | |
| 5 | 2 | 2 | 3 | 2 | 1 | | | | | | | | 2 | |

**UNIT I** **6 Hours**

**EXPLORATORY DATA ANALYSIS**

Overview of Exploratory Data Analysis- importance of EDA - data analysis process: data collection, data cleaning, and data exploration- Introduction to common data types and formats - Introduction to Python - data analysis libraries.

**UNIT II** **6 Hours**

**DATA CLEANING AND PREPARATION**

Introduction to data quality issues and common data cleaning techniques - Handling missing data and outliers - Data transformation techniques - Feature engineering and variable creation.

**UNIT III** **6 Hours**

**DESCRIPTIVE STATISTICS AND DATA VISUALIZATION**

Descriptive statistics: measures of central tendency, dispersion, and shape - Data visualization principles and best practices - Exploratory data visualization using Matplotlib and Seaborn

**UNIT IV** **6 Hours**

**EXPLORATORY DATA ANALYSIS TECHNIQUES**

Univariate analysis: exploring single variables - Bivariate analysis: exploring relationships between variables - Multivariate analysis: analyzing relationships among multiple variables - Exploring time series data.

**UNIT V** **6 Hours**

**DIMENSIONALITY REDUCTION TECHNIQUES**

Introduction to dimensionality reduction - Principal Component Analysis (PCA) and its applications - Distributed Stochastic Neighbor Embedding (t-SNE) for visualization

**1** **5 Hours**

## EXPERIMENT 1

Explore the Titanic dataset using descriptive statistics and data visualization.

1. Load the Titanic dataset.
2. Calculate the descriptive statistics for each variable.
3. Create a variety of data visualizations to explore the relationships between variables.
4. Interpret the results of the descriptive statistics and data visualizations.

**2** **5 Hours**

## EXPERIMENT 2

Clean and prepare the California housing dataset for analysis.

1. Identify and handle missing data.
2. Identify and remove outliers.
3. Convert categorical variables to numerical variables.
4. Explore the distribution of the data after cleaning and preparing it.

**3** **5 Hours**

## EXPERIMENT 3

Perform univariate analysis on the Iris dataset.

1. Calculate the descriptive statistics for each variable.
2. Create a variety of data visualizations to explore the distribution of each variable.
3. Interpret the results of the descriptive statistics and data visualizations.

**4** **5 Hours**

**EXPERIMENT 4**

Perform bivariate analysis on the Boston housing dataset.

1. Explore the relationship between housing prices and different features of the houses, such as the number of rooms, the lot size, and the crime rate.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the bivariate analysis.

**5** **5 Hours**

**EXPERIMENT 5**

Perform multivariate analysis on the Wine dataset.

1. Explore the relationships between different features of the wine, such as the color, the acidity, and the
alcohol content.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the multivariate analysis.

**6** **5 Hours**

**EXPERIMENT 6**

Apply dimensionality reduction techniques to the MNIST dataset.

1. Use PCA to reduce the dimensionality of the dataset from 784 dimensions to 2 dimensions.
2. Visualize the reduced data using a scatter plot.
3. Interpret the results of the dimensionality reduction.

**Total: 60 Hours**

**Reference(s)**


1. Provost, Foster, and Tom Fawcett.Data Science for Business: What you need to know about data mining and data-analytic thinking Reilly Media, 2013. (Unit 1)
2. McKinney, Wes.Python for Data Analysis.Reilly Media,2022. (Unit 1, 3, 5)
3. Knaflic, Cole Nussbaumer. Storytelling with data A data visualization guide for business professionals.John Wiley Sons, 2015. (Unit 2)
4. Kazil, Jacqueline, and Katharine Jarmul.Data wrangling with python tips and tools to make your life easier. Reilly Media, Inc.2016. (Unit 3)
5. Wickham, Hadley, and Garrett Grolemund. R for data science import, tidy, transform, visualize, and model data.Reilly Media, Inc.2016. (Unit 4, 5)
6. Matthew O. Ward, Georges Grinstein, Daniel Keim, Interactive Data Visualization Foundations, Techniques, and Applications, 2nd Edition, CRC press, 2015.

## 22CS002 RECOMMENDER SYSTEMS 3 0 0 3

**Course Objectives**

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the basic concepts of recommender systems.
2. Implement machine-learning and data-mining algorithms in recommender systems data sets.
3. Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
4. Implement a simple recommender system.
5. Learn about Evaluating Paradigms of recommender systems and its applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 1 | 2 | 1 | | | | | | | | | 1 |
| 2 | 1 | 2 | 1 | 1 | 1 | | | | | | | | | 1 |
| 3 | 2 | 3 | 1 | 1 | 1 | | | | | | | | | 2 |
| 4 | 3 | 2 | 2 | 2 | 1 | | | | | | | | | 2 |
| 5 | 2 | 2 | 1 | 2 | 1 | | | | | | | | | 1 |

**UNIT I** **9 Hours**

**INTRODUCTION**

Introduction and basic taxonomy of recommender systems Traditional and non-personalized Recommender Systems Overview of data mining methods for recommender systems similarity measures Dimensionality reduction Singular Value Decomposition (SVD)

**UNIT II** **9 Hours**

**CONTENT-BASED RECOMMENDATION SYSTEMS**

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

**UNIT III** **9 Hours**

**COLLABORATIVE FILTERING**

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

**UNIT IV** **9 Hours**

**ATTACK-RESISTANT RECOMMENDER SYSTEMS**

Introduction Types of Attacks Detecting attacks on recommender systems Individual attack Group attack Strategies for robust recommender design - Robust recommendation algorithms.

**UNIT V** **9 Hours**

**EVALUATING RECOMMENDER SYSTEMS**

Evaluating Paradigms User Studies Online and Offline evaluation Goals of evaluation design Design Issues Accuracy metrics Limitations of Evaluation measures

**Total: 45 Hours**

**Reference(s)**


1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Systems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition,Cambridge University Press, 2020.

## 22CS003 BIG DATA ANALYTICS 3 0 0 3

**Course Objectives**

- Acquire a deep understanding of big data and NoSQL.
- Develop expertise in map reduce analytics using Hadoop and related tools
- Explore the Hadoop related tools for Big Data Analytics.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the big data and use cases from selected business domains.
2. Understand NoSQL big data management.
3. Utilize map reduce analytics and related tools.
4. Understand the basics of Hadoop.
5. Apply the usage of Hadoop related tools for Big Data Analytics.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | | 1 | | | | | | | | 2 | 1 |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | 2 |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | 2 |
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**UNIT I** **9 Hours**

**UNDERSTANDING BIG DATA**

Introduction to big data Convergence of key trends Unstructured data Industry examples of big data Web analytics Big data applications Big data technologies Introduction to Hadoop Open source technologies Cloud and big data Mobile business intelligence Crowd sourcing analytics Inter and trans firewall analytics.

**UNIT II** **9 Hours**

**NOSQL DATA MANAGEMENT**

Introduction to NoSQL Aggregate data models Key-value and document data models Relationships Graph databases Schema less databases Materialized views Distribution models Master slave replication Consistency Cassandra Cassandra data model Cassandra examples Cassandra clients

**UNIT III** **10 Hours**

**MAP REDUCE APPLICATIONS**

MapReduce workflows Unit tests with MRUnit Test data and local tests Anatomy of MapReduce job run Classic Map reduce YARN Failures in classic Map reduce and YARN Job scheduling Shuffle and sort Task execution MapReduce types Input formats Output formats.

**UNIT IV** **9 Hours**

**BASICS OF HADOOP**

Data format Analyzing data with Hadoop Scaling out Hadoop streaming Hadoop pipes Design of Hadoop distributed file system (HDFS) HDFS concepts Java interface Data flow Hadoop I/O Data integrity Compression Serialization Avro File based data structures Cassandra Hadoop integration.

**UNIT V** **9 Hours**

**HADOOP RELATED TOOLS**

Hbase Data model and implementations Hbase clients Hbase examples Praxis. Pig Grunt Pig data model Pig Latin Developing and testing Pig Latin scripts. Hive Data types and file formats HiveQL data definition HiveQL data manipulation HiveQL queries.

**Total: 46 Hours**

**Reference(s)**


1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, Big Data, Big Analytics Emerging Business Intelligence and Analytic Trends for Todays Businesses", Wiley,2013.
2. Eric Sammer, Hadoop Operations,Reilley, 2012.
3. Sadalage, Pramod J. NoSQL distilled, 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, Reilley, 2012.
5. Lars George, HBase: The Definitive Guide, Reilley, 2011.
6. Eben Hewitt,Cassandra The Definitive Guide,Reilley, 2010.

## 22CS004 NEURAL NETWORKS AND DEEP LEARNING

**2 0 2 3**

**Course Objectives**

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications
- To analyze the key computations underlying deep learning to build and train deep neural networks for various tasks.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Apply Convolution Neural Network for any suitable applications.
2. Analyze the various categories of associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for any suitable applications.
4. Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
5. Apply auto encoders and generative models for suitable applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **6 Hours**

**UNDERSTANDING NEURAL NETWORKS**

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

**UNIT II** **6 Hours**

**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

**UNIT III** **6 Hours**

**THIRD-GENERATION NEURAL NETWORKS**

Spiking Neural Networks Convolutional Neural Networks Deep Learning Neural Networks Extreme Learning Machine Model Convolutional Neural Networks The Convolution Operation Motivation Pooling Variants of the basic Convolution Function Structured Outputs Data Types Efficient Convolution Algorithms Neuroscientific Basis Applications Computer Vision, Image Generation, Image Compression.

**UNIT IV** **6 Hours**

**DEEP FEEDFORWARD NETWORKS**

History of Deep Learning A Probabilistic Theory of Deep Learning Gradient Learning Chain Rule and Backpropagation Regularization Dataset Augmentation Noise Robustness Early Stopping, Bagging and Dropout batch normalization VC Dimension and Neural Nets.

**UNIT V** **6 Hours**

**RECURRENT NEURAL NETWORKS**

Recurrent Neural Networks Introduction Recursive Neural Networks Bidirectional RNNs Deep Recurrent Networks Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

**1** **3 Hours**

## EXPERIMENT 1

Implement simple vector addition in TensorFlow.

**2** **3 Hours**

## EXPERIMENT 2

Implement a regression model in Keras.

**3** **3 Hours**

## EXPERIMENT 3

Implement a perceptron in TensorFlow/Keras Environment.

**4** **3 Hours**

## EXPERIMENT 4

Implement a Feed-Forward Network in TensorFlow/Keras.

**5** **3 Hours**

## EXPERIMENT 5

Implement an Image Classifier using CNN in TensorFlow/Keras.

**6** **3 Hours**

## EXPERIMENT 6

Improve the Deep learning model by fine tuning hyper parameters.

**7** **3 Hours**

**EXPERIMENT 7**

Implement a Transfer Learning concept in Image Classification.

**8** **3 Hours**

**EXPERIMENT 8**

Using a pre trained model on Keras for Transfer Learning

**9** **3 Hours**

**EXPERIMENT 9**

Perform Sentiment Analysis using RNN

**10** **3 Hours**

**EXPERIMENT 10**

Implement an LSTM based Autoencoder in TensorFlow/Keras.

**Total: 60 Hours**

**Reference(s)**


1. S Rajasekaran, G A Vijayalakshmi Pai, Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and pplications, PHI Learning, 2017
2. Charu C. Aggarwal, Neural Networks and Deep Learning A Textbook, Springer International Publishing, 1st Edition, 2018.
3. James A Freeman, David M S Kapura, Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
5. Francois Chollet,Deep Learning with Python, Second Edition, Manning Publications, 2021.
6. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

## 22CS005 NATURAL LANGUAGE PROCESSING 3 0 0 3

**Course Objectives**

- To understand basics of linguistics, probability and statistics.
- To study statistical approaches to NLP and understand sequence labeling.
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences.
- To understand discourse analysis, question answering and chatbots.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand basics of linguistics, probability and statistics associated with NLP
2. Implement a Part-of-Speech Tagger
3. Design and implement a sequence labeling problem for a given domain
4. Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
5. Implement a simple chatbot using dialogue system concepts

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Natural Language Processing Components Basics of Linguistics and Probability and Statistics Words TokenizationMorphologyFinite State Automata.

**UNIT II** **9 Hours**

**STATISTICAL NLP AND SEQUENCE LABELING**

N grams and Language models Smoothing Text classification NaÃƒÂ¯ve Bayes classifier Evaluation Vector Semantics TF IDF Word2Vec Evaluating Vector Models Sequence Labeling Part of Speech Part of Speech Tagging Named Entities Named Entity Tagging.

**UNIT III** **9 Hours**

**CONTEXTUAL EMBEDDING**

Constituency Context Free Grammar Lexicalized Grammars CKY Parsing Earleys algorithm Evaluating Parsers Partial Parsing Dependency Relations Dependency Parsing Transition Based Graph Based.

**UNIT IV** **9 Hours**

**COMPUTATIONAL SEMANTICS**

Word Senses and WordNet Word Sense Disambiguation Semantic Role Labeling Proposition Bank FrameNet Selectional Restrictions Information Extraction Template Filling.

**UNIT V** **9 Hours**

**DISCOURSE ANALYSIS AND SPEECH PROCESSING**

Discourse Coherence Discourse Structure Parsing Centering and Entity Based Coherence Question Answering Factoid Question Answering Classical QA Models Chatbots and Dialogue systems Frame-based Dialogue Systems Dialogue State Architecture.

**Total: 45 Hours**

**Reference(s)**


1. Daniel Jurafsky and James H.Martin, Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition (Prentice Hall Series in Artificial Intelligence), 2020.
2. Jacob Eisenstein. Natural Language Processing , MIT Press, 2019.
3. Samuel Burns Natural Language Processing A Quick Introduction to NLP with Python and NLTK, 2019.
4. Christopher Manning, Foundations of Statistical Natural Language Processing, MIT Press,2009.
5. Nitin Indurkhya,Fred J. Damerau, Handbook of Natural Language Processing, Second edition, Chapman Hall/CRC Machine Learning Pattern Recognition, Hardcover,2010.

## 22CS006 COMPUTER VISION 3 0 0 3

**Course Objectives**

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. To understand basic knowledge, theories and methods in image processing and computer vision.
2. To implement basic and some advanced image processing techniques in OpenCV.
3. To apply 2D a feature-based based image alignment, segmentation and motion estimations.
4. To apply 3D image reconstruction techniques
5. To design and develop innovative image processing and computer vision applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 3 | 3 | 2 | 2 | 3 | | | | 1 | 1 | 2 | 2 | 3 | |
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| 5 | 2 | 3 | 3 | 2 | 2 | 2 | | | 2 | 1 | 2 | 3 | 3 | |

**UNIT I** **9 Hours**

**INTRODUCTION TO IMAGE FORMATION AND PROCESSING**

Computer Vision Geometric primitives and transformations Photometric image formation The digital camera Point operators Linear filtering More neighborhood operators Fourier transforms Pyramids and wavelets Geometric transformations Global optimization.

**UNIT II** **8 Hours**

**FEATURE DETECTION, MATCHING AND SEGMENTATION**

Points and patches Edges Lines Segmentation Active contours Split and merge Mean shift and mode finding Normalized cuts Graph cuts and energy-based methods.

**UNIT III** **10 Hours**

**FEATURE-BASED ALIGNMENT**

2D and 3D feature-based alignment Pose estimation Geometric intrinsic calibration Triangulation Two frame structure from motion Factorization Bundle adjustment Constrained structure and motion Translational alignment Parametric motion Spline-based motion Optical flow Layered motion.

**UNIT IV** **9 Hours**

**3D RECONSTRUCTION**

Shape from X Active range finding Surface representations Point based representations Volumetric representations Model based reconstruction Recovering texture maps and albedosos.

**UNIT V** **9 Hours**

**IMAGE-BASED RENDERING AND RECOGNITION**

View interpolation Layered depth images Light fields and Lumigraphs Environment mattes Video based Rendering Object detection Face recognition Instance recognition Category recognition Context and scene understanding Recognition databases and test sets.

**Total: 45 Hours**

**Reference(s)**


1. Richard Szeliski, Computer Vision Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006.
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

## 22CS007 AGILE SOFTWARE DEVELOPMENT 3 0 0 3

**Course Objectives**

- To provide students with a theoretical as well as practical understanding of agile software development practices.
- To understand the Agile Scrum framework and development practices.
- To apply software design principles and refactoring techniques to achieve agility.
- To understand Agile requirements and perform testing activities within an agile project.
- To understand the benefits and pitfalls of working in an Agile team in terms of quality assurance.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand genesis of Agile and driving forces for choosing Agile techniques.
2. Apply the Agile Scrum framework and development practices.
3. Apply iterative software development processes by planning and executing them.
4. Analyze the impact of the success of social aspects behind the software testing.
5. Analyze techniques and tools for improving team collaboration and management.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**AGILE METHODOLOGY**

Theories for Agile management agile software development traditional model vs. agile model classification of agile methods agile manifesto and principles agile project management agile team

interactions ethics in agile teams agility in design, testing agile documentations agile drivers, capabilities and values.

**UNIT II** **9 Hours**

**AGILE PROCESSES**

Extreme Programming: Method overview lifecycle work products, roles and practices Lean production SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Kanban model.

**UNIT III** **9 Hours**

**AGILITY AND KNOWLEDGE MANAGEMENT**

Agile information systems agile decision making Earls schools of KM institutional knowledge evolution cycle development, acquisition, refinement, distribution, deployment, leveraging KM in software engineering managing software knowledge challenges of migrating to agile methodologies agile knowledge sharing role of story cards Story card Maturity Model SMM.

**UNIT IV** **9 Hours**

**AGILITY AND REQUIREMENTS ENGINEERING**

Impact of agile processes in RE current agile practices variance overview of RE using agile managing unstable requirements requirements elicitation agile requirements abstraction model requirements management in agile environment, agile requirements prioritization agile requirements modeling and generation concurrency in agile requirements generation

**UNIT V** **9 Hours**

**AGILITY AND QUALITY ASSURANCE**

Agile Interaction Design Agile product development Agile Metrics Feature Driven Development FDD Financial and Production Metrics in FDD Agile approach to Quality Assurance Test Driven Development Pair programming: Issues and Challenges Agile approach to Global Software Development.

**Total: 45 Hours**

**Reference(s)**


1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede Eds. Agile Software Development, Current Research and Future Directions, Springer Verlag Berlin Heidelberg, 2010
2. David J. Anderson Eli Schragenheim, Agile Management for Software Engineering Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza Dubinsky, Agile Software Engineering, Series Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, Agile and Iterative Development: A managers Guide, Addison-Wesley, 2004
5. Kevin C. Desouza, Agile information systems conceptualization, construction, and management, Butterworth-Heinemann, 2007.

## 22CS008 UI AND UX DESIGN 3 0 0 3

**Course Objectives**

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests Learning steps for digital products.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**USER-CENTERED DESIGN PROCESS**

Scripting Languages HTML, CSS Fundamentals of graphics design, principles of visual design Overview of UI UX Design Overview of the UX Design Process Difference between User Interface (UI) vs User Experience (UX) Defining problem and vision statement Persona creation Primary and Secondary persona Requirement definition Creative ideation brainstorming and ideation

techniques Scenarios and functionality extraction Information Architecture Task flows Wireframe design

**UNIT II** **9 Hours**

**FUNDAMENTALS OF UI, HEURISTICS, AND INTERACTION DESIGN**

Design Principles for UX and UI Design UI Elements-Patterns Material Design (Google) and Human Interface Design (Apple) guidelines Interaction Principles Interaction Behaviour Master the Brand Platforms Style Guides comments and current UI patterns Understand problems and design solutions for e commerce, social media, message, data, and dashboard design

**UNIT III** **9 Hours**

**ELEMENTARY SKETCHING**

Principles of Sketching Core Responsive Design Wireframing vs Wireflows Click through Wireframing Prototyping Wireflow Creation Work with different tools Figma Low High Fidelity Design Inclusive Design and Designing for Accessibility Building High Fidelity Mockups Designing Efficiently with Tools Interaction Patterns Designing animations and interactions

**UNIT IV** **9 Hours**

**UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING**

Building a Design System Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration Use of grids in UI design Design animations and interaction patterns for key UI elements

**UNIT V** **9 Hours**

**USABILITY EVALUATION AND PRODUCT DESIGN**

Type of usability evaluation Qualitative Quantitative evaluation Guerilla testing , A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud Think aloud Introduction and advantages Designing evaluation protocol Conducting usability evaluation study Conduct Usability Test explicit Synthesize Test Findings practices in corporate World

**Total: 45 Hours**

**Reference(s)**


1. Norman, Donald A. The Design of Everyday Things. Basic Books, 2002. ISBN: 9780465067107.
2. Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.
3. Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces Communication Oriented Techniques. Prentice Hall, 1994. ISBN 9780133033892.
4. Wilbent. O. Galitz ,The Essential Guide To User Interface Design, John Wiley Sons, 2001.
5. Ben Sheiderman, Design The User Interface, Pearson Education, 1998.
6. Alan Cooper, The Essential Of User Interface Design, Wiley Dream Tech Ltd.,2002.

## 22CS009 WEB FRAMEWORKS 3 0 0 3

**Course Objectives**

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
e. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Apply modules and components and Animations for creating Forms and developing web pages
2. Create web applications by performing CRUD operations in database using web frameworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Designing single page applications with reusable UI components using React CSS and SaaS
5. Use Node Package Manager and Node packages for Server Side programming.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 4 | 1 | | 1 | | 3 | | | | 2 | 2 | | | 2 | |
| 5 | 1 | | 1 | | 3 | | | | 1 | 1 | | | 2 | |

**UNIT I** **9 Hours**

**ANGULAR FRONT-END FRAMEWORK**

Introduction Setup Architecture Modules, Components, Services and DI fundamentals Components and Templates Configuration Forms Observables RxJS Boot Strapping Ng Modules Dependency Injection Http Client Routing and Navigation Animations

**UNIT II** **9 Hours**

**FRAMEWORKS WITH DATABASES**

MongoDB MongoDB Basics Documents Collections Query Language Installation The mongo Shell Schema Initialization MongoDB Node.js Driver Reading from MongoDB Writing to MongoDB CRUD operations projections Indexing Aggregation Replication Sharding Creating backup Deployment

**UNIT III** **9 Hours**

**ANGULAR TECHNIQUES**

Service workers PWA Server side rendering Angular Libraries Schematics CLI Builders Angular Ivy Web Workers

**UNIT IV** **9 Hours**

**REACT**

React Introduction React ES6 React Render HTML React JSX Components React Classes Composing Components Passing Data Dynamic Composition React state setting State Async State Initialization Event Handling Communicating from Child to Parent Stateless Components Designing components React Forms React CSS React SaaS

**UNIT V** **9 Hours**

**NODE JS BACK-END FRAMEWORK**

Node.js basics Local and Export Modules - Node Package Manager Node.js web server Node.js File system Node Inspector Node.js EventEmitter Frameworks for Node.js Express.js Web App Serving static Resource Node.js Data Access

**Total: 45 Hours**

**Reference(s)**


1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.
2. Christoffer Noring, Pablo Deeleman,Learning Angular, Packt Publishing Limited, 2nd Revised edition edition, 2017.
3. Caleb Dayley Brad Dayley,Brendan Dayley ,Node.js, MongoDB and Angular Web Development, 2nd Edition,Pearson, 2018.
4. Shyam Seshadri, Angular: Up and Running- Learning Angular, Step by Step ,Reilly; First edition, 2018

## 22CS010 APP DEVELOPMENT 2 0 2 3

**Course Objectives**

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development
- To inculcate working knowledge of Android Studio development tool

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SqLite Database
5. Design the flutter applications on the Android marketplace for distribution.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 4 | 1 | 1 | 2 | | 3 | | | | | | | | 3 | |
| 5 | 1 | 2 | 2 | | 3 | | | | | | | | 3 | |

**UNIT I** **6 Hours**

**INTRODUCTION TO ANDROID**

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

**UNIT II** **6 Hours**

**ANDROID APPLICATION DESIGN ESSENTIALS**

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

**UNIT III** **6 Hours**

**COMMON ANDROID APIS**

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

**UNIT IV** **6 Hours**

**IOS USER INTERFACE DESIGN ESSENTIALS**

Ios features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, integrating calendar and address book with social media application, Using Wifi, iPhone marketplace.

**UNIT V** **6 Hours**

**APP DEVELOPMENT WITH FLUTTER**

Flutter Introduction, Create First Flutter Application, Exploring commonly used flutter widgets Container, Margin, Padding and Box Constraints, Custom Fonts, Column and Expanded Widgets, Image Asset, Raised Button, and Alert Dialog.

**1** **4 Hours**

## EXPERIMENT 1

Develop a simple application with one EditText so that the user can write some text in it. Create a button called Convert Text to Speech that converts the user input text into voice.

**2** **4 Hours**

## EXPERIMENT 2

Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

**3** **4 Hours**

## EXPERIMENT 3

Create a SIGNUp activity with Username and Password. Validation of password should happen based on the following rules

Password should contain uppercase and lowercase letters.

Password should contain letters and numbers.

Password should contain special characters.

Minimum length of the password the default value is 8

On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying Successful Login or else display a toast message saying Login Failed. The user is given only two attempts and after that display a toast message saying Failed Login Attempts and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

**4** **4 Hours**

## EXPERIMENT 4

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

**5** **5 Hours**

**EXPERIMENT 5**

Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.

**6** **5 Hours**

**EXPERIMENT 6**

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

**7** **4 Hours**

**EXPERIMENT 7**

Implement UI elements like TextFields, Label, Toolbar, Statusbar, Tabbar.

**Total: 60 Hours**

**Reference(s)**


1. Reto Meier, Professional Android 2 Application Development, Wiley India Pvt Ltd.
2. Mark L Murphy, Beginning Android, Wiley India Pvt Ltd 3. R3. Android Application Development All in one for Dummies by Barry Burd.
3. Alberto Miola, Flutter Complete Reference Create beautiful, fast and native apps for any device ISBN-13 9780141044804.
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, Beginning iOS 6Development Exploring the iOS SDK, Apress, 2013.55.

## 22CS011 SOFTWARE TESTING AND AUTOMATION

**3 0 0 3**

**Course Objectives**

- Understand the importance of software testing in the software development process
- Analyze different testing methodologies and techniques to create test plans, test cases, and test scripts
- Apply automation testing tools and frameworks to design and implement automated test suites

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the importance of testing in the software development process
2. Compare the different test case design strategies
3. Analyze the different levels of testing and their importance
4. Apply test management techniques and the role of a test specialist
5. Analyze the software test automation and its requirements

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 2 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | |
| 3 | 2 | 2 | 2 | | 2 | | | | | | | | 1 | |
| 4 | 2 | 3 | 2 | | 3 | | | | | | | | 1 | |
| 5 | 3 | 2 | 1 | | 3 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Basic definitions Software Testing Principles The Testers Role in a Software Development Organization Origins of Defects Cost of Defects Defect Classes The Defect Repository and Test Design Defect Examples Developer Tester Support of Developing a Defect Repository.

**UNIT II** **9 Hours**

**TEST CASE DESIGN STRATEGIES**

Test Scenarios Test Cases Test case Design Strategies Black Box Approach to Test Case Design Using White Box Approach to Test design Test Adequacy Criteria Static testing vs. Structural testing Code functional testing Coverage and Control Flow Graphs Covering Code Logic Paths Code complexity testing Additional White box testing approaches Test Coverage

**UNIT III** **9 Hours**

**LEVELS OF TESTING**

Types of testing manual and automation Introduction to testing methods White-box, Black box and Grey box Functional testing Non functional testing Introduction to levels of testing Unit Testing, Integration Testing, System Testing, User Acceptance Testing Introduction to types of testing Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing

**UNIT IV** **9 Hours**

**TEST MANAGEMENT**

People and organizational issues in testing Organization structures for testing teams testing services Test Planning Test Plan Components Test Plan Attachments Locating Test Items test management test process Reporting Test Results Introducing the test specialist Skills needed by a test specialist Building a Testing Group The Structure of Testing Group The Technical Training Program.

**UNIT V** **9 Hours**

**TEST AUTOMATION**

Software test automation Design and Architecture for Automation Automation testing Automation Tools Selenium Web Driver Create Selenese Commands TestNG TestNG Annotations Jmeter Assertions in JMeter Junit

**UNIT VI** **45 Hours**

**TEXT BOOKS**

1.Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing Principles and Practices, Pearson Education, 2006.
2.Ron Patton, Software Testing, Second Edition, Sams Publishing, Pearson Education, 2007.

**Total: 90 Hours**

**Reference(s)**

1. Ilene Burnstein, Practical Software Testing, Springer International Edition, 2003.
2. Edward Kit, Software Testing in the Real World Improving the Process, Pearson Education, 1995.
3. Boris Beizer, Software Testing Techniques 2nd Edition, Van Nostrand Reinhold, New York,1990.
4. Aditya P. Mathur, Foundations of Software Testing Fundamental Algorithms and Techniques, Dorling Kindersley India Pvt. Ltd., Pearson Education, 2008.

**22CS012 DEVOPS** **3 0 0 3**

**Course Objectives**

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real-world problems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**UNIT I** **7 Hours**

**INTRODUCTION TO DEVOPS**

Devops Essentials Introduction to AWS, GCP, Azure Version control systems Git and GitHub.

**UNIT II** **10 Hours**

**COMPILE AND BUILD USING MAVEN**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases compile build, test, package Maven Profiles Maven repositories local, central, global Maven plugins Maven create and build Artifacts Dependency Management Installation of Gradle- understanding build using Gradle.

**UNIT III** **12 Hours**

**CONTINUOUS INTEGRATION USING JENKINS**

Install Configure Jenkins Jenkins Architecture Overview creating a Jenkins Job Configuring a Jenkins job Introduction to Plugins Adding Plugins to Jenkins commonly used plugins Git Plugin, Parameter Plugin HTML Publisher Copy Artifact, and Extended choice parameters. Configuring Jenkins to work with Java Git and Maven Creating a Jenkins Build and Jenkins workspace.

**UNIT IV** **9 Hours**

**CONFIGURATION MANAGEMENT USING ANSIBLE**

Ansible Introduction Installation-Ansible master slave configuration YAML basics Ansible Modules Ansible Inventory files Ansible playbooks Ansible Roles and ad hoc commands in Ansible

**UNIT V** **7 Hours**

**BUILDING DEVOPS PIPELINES USING AZURE**

Create GitHub Account, Create Repository Create Azure Organization Create a new pipeline Build a sample code Modify azure pipelines- yaml file

**Total: 45 Hours**

**Reference(s)**


1. Roberto Vormittag, A Practical Guide to Git and GitHub for Windows Users From Beginner to Expert in Easy Step By Step Exercises, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, Linux for Beginners An Introduction to the Linux Operating System and Command Line, Kindle Edition, 2014.
3. Hands-On Azure DevOps Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure DevOps And Microsoft Azure CICD Implementation for . DevOps and Microsoft Azure
4. English Edition Paperback 1 January 2020 by Mitesh Soni.
5. Jeff Geerling, Ansible for DevOps Server and configuration management for humans, First Edition, 2015.
6. David Johnson, Ansible for DevOps Everything You Need to Know to Use Ansible for DevOps, Second Edition, 2016.

## 22CS013 VIRTUALIZATION IN CLOUD COMPUTING

**3 0 0 3**

**Course Objectives**

- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud-based applications.
- Create an application by utilizing cloud platforms such as Amazon Web Services and Windows Azure.
- Identify major security and privacy problems in cloud computing environment.
- Apply the ability to use the architecture of cloud, service and delivery models.
- Implement the key enabling technologies that help in the development of cloud.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Analyze the concept of virtualization and its properties.
2. Apply different forms of virtualization.
3. Implement various architectures for implementing virtualization methods.
4. Create virtual machines and installing various operating systems.
5. Evaluate the performance of the virtual machines and deployed applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**UNDERSTANDING VIRTUALIZATION**

Describing Virtualization-Microsoft Windows Drives Server Growth -Explaining Moore s Law-Understanding the Importance of Virtualization -Examining Todays Trends -Virtualization and Cloud Computing -Understanding Virtualization Software Operation -Virtualizing Servers -Virtualizing Desktops -Virtualizing Applications

**UNIT II** **9 Hours**

**HYPERVISORS**

Describing a Hypervisor -Exploring the History of Hypervisors -Understanding Type 1 Hypervisors - Type 2 Hypervisors - Role of a Hypervisor -Holodecks and Traffic Cops -Resource Allocation - Comparing Todays Hypervisors -VMware ESX -Citrix Xen -Microsoft Hyper-V -Other Solutions.

**UNIT III** **9 Hours**

**VIRTUAL MACHINES**

Introduction to Virtual Machine - CPUs in a Virtual Machine -Memory in a Virtual Machine - Network Resources in a Virtual Machine - Storage in a Virtual Machine -Understanding How a Virtual Machine Works -Working with Virtual Machines -Virtual Machine Clones -Templates - Snapshots -OVF - Containers

**UNIT IV** **9 Hours**

**CREATION OF VIRTUAL MACHINES**

Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine-Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

**UNIT V** **9 Hours**

**AVAILABILITY**

Increasing Availability-Protecting a Virtual Machine-Protecting Multiple Virtual Machines-Protecting Data Centers - Examining Virtual Infrastructure Performance Capabilities -Deploying Applications in a Virtual Environment-Understanding Virtual Appliances and vApps -Open Stack and Containers.

**Total: 45 Hours**

**Reference(s)**


1. Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016.
2. Kailash Jayaswal, Jagannath Kallakurchi,Donald J.Houde,Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015.
3. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S,Mastering in Cloud Computing, McGraw Hill Education, (India) Private Limited, 2013.
4. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013.
5. http//www.microsoft.com/learning/default.mspx.
6. https://www.oreilly.com/library/view/cloud- security-and/9780596806453/ch04.html.

## 22CS014 CLOUD SERVICES AND DATA MANAGEMENT

**3 0 0 3**

**Course Objectives**

- Analyze the basic concepts of Cloud and capabilities across the various Cloud service models.
- Analyze virtualization technology to derive the best practice model for deploying cloud-based applications.
- Create an application by utilizing cloud platforms such as Google App Engine, Microsoft Azure and Open Stack.
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011.
2. Analyze the different forms of cloud service models
3. Apply the characteristics and architecture of IaaS using various real-world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Analyze, and synthesize concepts related to the SaaS delivery model.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)**

Introduction to Cloud Computing Reference Architecture (CCRA), Benefits of CCRA, Architecture Overview, Versions and Application of CCRA for Developing Clouds

**UNIT II** **9 Hours**

**INTRODUCTION OF DELIVERY MODELS IN CLOUD COMPUTING**

Introduction to Cloud Delivery Models, List Various Cloud Delivery Models, Advantages of Delivery Models in Cloud, Trade-off in Cost to Install Versus Flexibility, Cloud Service Model Architecture.

**UNIT III** **9 Hours**

**INFRASTRUCTURE AS A SERVICE (IAAS)**

Introduction to Infrastructure as a Service Delivery Model, Characteristics of IaaS, Architecture, Examples of IaaS, Applicability of IaaS in the Industry.

**UNIT IV** **9 Hours**

**PLATFORM AS A SERVICE (PAAS)**

Introduction to Platform as a Service Delivery Model, Characteristics of PaaS, Patterns, Architecture and Examples of PaaS, Applicability of PaaS in the Industry.

**UNIT V** **9 Hours**

**SOFTWARE AS A SERVICE (SAAS)**

Introduction to Software as a Service Delivery Model, Characteristics of SaaS, Architecture, Examples of SaaS, Applicability of SaaS in the Industry.

**Total: 45 Hours**

**Reference(s)**


1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011.
2. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013.
3. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, 2011.
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
5. Cloud Application Architectures Building Applications and Infrastructure in the Cloud,George Reese, Oreilly, SPD, 2011.

## 22CS015 CLOUD STORAGE TECHNOLOGIES 3 0 0 3

**Course Objectives**

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Analyze the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2. Apply the usage of advanced intelligent storage systems and RAID.
3. Evaluate various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Execute the different roles in providing disaster recovery and remote replication technologies.
5. Implement the security needs and security measures to be employed in information storage management.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 1 | 3 | 2 | 2 | | | | | | | | | 2 |
| 4 | 3 | 2 | 1 | 2 | 2 | | | | | | | | | 1 |
| 5 | 1 | 3 | 2 | 1 | 2 | | | | | | | | | 2 |

**UNIT I** **9 Hours**

**STORAGE SYSTEMS**

Cloud Storage Fundamentals and Architecture - Cloud Storage Providers and Services - Access methods(RESTful APIs, SDKs) for cloud object storage - Block storage technologies in cloud environments - File Storage in the Cloud: Network File System (NFS) and Server Message Block (SMB) protocols -Hybrid Cloud Storage - Data Migration - Data Lifecycle Management in the Cloud

**UNIT II** **9 Hours**

**INTELLIGENT STORAGE SYSTEMS AND RAID**

Storage Tiering and Caching - Automated Data Placement and Load Balancing: Intelligent Algorithms for Data Placement, Load Balancing Strategies for Distributed Storage Systems, Dynamic Resource Allocation - RAID Technologies in Cloud Storage: RAID Levels - Data Striping, Mirroring, and Parity for Fault Tolerance - RAID Configuration and Performance Optimization

**UNIT III** **9 Hours**

**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**

Storage Networking in Cloud Environments - Understanding storage protocols - Network-attached storage (NAS) vs. storage area network (SAN) - Storage virtualization techniques and technologies - Network-Attached Storage (NAS) - Storage Area Network (SAN) - iSCSI and Fiber Channel over IP (FCIP) in Cloud Storage - Network Virtualization and Overlay Networks - Storage Virtualization and Abstraction - Network Performance Optimization - Network Security in Cloud Storage

**UNIT IV** **9 Hours**

**BACKUP, ARCHIVE AND REPLICATION**

Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine-Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

**UNIT V** **9 Hours**

**SECURING STORAGE INFRASTRUCTURE**

Storage Security Fundamentals: Key Security Principles, Threats and Vulnerabilities in Storage Infrastructure, Access Control and Authentication: Role-based Access Control (RBAC) and Permissions Management, Multi-factor authentication (MFA) for Storage Systems - Storage-level Encryption and Application-level Encryption - Storage infrastructure Management Functions and Processes.

**Total: 45 Hours**

**Reference(s)**


1. George Reese, " Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice),O"Reilly, 2009.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, " Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Rittinghouse, John W., and James F. Ransome,CloudComputing Implementation, Management and Security, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, quotCloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.

## 22CS016 CLOUD AUTOMATION TOOLS AND APPLICATIONS

**3 0 0 3**

**Course Objectives**

- To learn the options for running automation tools, and load balancers in the cloud-native applications.
- To learn the configuration management in the cloud.
- To know why cloud automation is important.
- To learn what types of cloud automation tools can be used.
- To learn load balancing and auto scaling in the cloud

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Implement cloud native applications on AWS, Terraform etc.
2. Apply VM provisioning and migration in the cloud.
3. Analyze cloud automation and configuration.
4. Apply balance load and auto scaling in the cloud.
5. Analyze the AWS cloud formation use-case.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**UNDERSTANDING THE CLOUD**

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs CloudFormation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

**UNIT II** **9 Hours**

**ABSTRACTION AND VIRTUALIZATION**

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

**UNIT III** **9 Hours**

**AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD**

Cloud automation at scale Cloud Configuration Management unmanaged and managed configuration management Modification of the capacity of the service horizontal and vertical scaling and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments Balancers.

**UNIT IV** **9 Hours**

**LOAD BALANCING AND AUTO SCALING IN CLOUD**

Managed instance groups, Auto scaling and health check Overview of HTTP(S) load balancing Example HTTP load balancer HTTP(S) load balancing Configuring an HTTP Load Balancer with Auto scaling SSL proxy load balancing TCP proxy load balancing Network load balancing Internal load balancing Configuring an Internal Load Balancer Choosing a load balancer.

**UNIT V** **9 Hours**

**AWS CLOUDFORMATION USE-CASE**

Introduction to AWS Cloud Formation, AWS CloudFormation Features and Components, Working of AWS CloudFormation setting up AWS CloudFormation, building a Pipeline for Test and Production Stacks AWS CloudFormation Artifacts Parameter Override Functions with Code Pipeline Using AWS CLI. AWS CloudFormation, Terraform VMware vs Center Configuration Manager (VCM) and Puppet.

**Total: 45 Hours**

**Reference(s)**


1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures, O'Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

## 22CS017 SOFTWARE DEFINED NETWORKS 2 0 2 3

**Course Objectives**

- To understand the need for SDN and its data plane operations.
- To understand the functions of control plane.
- To comprehend the migration of networking functions to SDN environment.
- To explore various techniques of network function virtualization.
- To comprehend the concepts behind network virtualization.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Apply the motivation behind SDN
2. Analyze the functions of the data plane and control plane
3. Evaluate and develop network applications using SDN
4. Execute network services using NFV
5. Implement various use cases of SDN and NFV

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 3 | | 2 | 1 | 3 | | | | | | | | | | 2 |
| 4 | 1 | 2 | 1 | 2 | | | | | | | | | | 2 |
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**UNIT I** **6 Hours**

**SDN DATA PLANE AND CONTROL PLANE**

History of Software Defined Networking (SDN) Modern Data Center Traditional Switch Architecture Why SDN Evolution of SDN How SDN Works Centralized and Distributed Control and Date Planes.

**UNIT II** **6 Hours**

**SDN DATA PLANE AND CONTROL PLANE**

Data Plane functions and protocols OpenFlow Protocol Packet Processing and Performance Optimization Flow Table Control Plane Functions Southbound Interface Northbound Interface SDN Controllers Ryu Open Daylight ONOS Distributed Controllers.

**UNIT III** **6 Hours**

**VIRTUALMACHINES SDN APPLICATIONS**

SDN Application Plane Architecture Network Services Abstraction Layer Traffic Engineering Measurement and Monitoring Security Data Center Networking Wide Area Networks WAN Service Provider Networks Internet Service Providers ISPs.

**UNIT IV** **6 Hours**

**NETWORK FUNCTION VIRTUALIZATION**

Network Virtualization NFV Architecture Virtual LANs OpenFlow VLAN Support NFV Standards and Frameworks NFV Concepts Benefits and Requirements Reference Architecture.

**UNIT V** **6 Hours**

**NFV FUNCTIONALITY**

NFV Infrastructure Virtualized Network Functions NFV Management and Orchestration NFV Use Cases Virtual Customer Premises Equipment, Virtual Evolved Packet Core, Virtualized Network Monitoring and Traffic Analysis, Network Slicing, Edge Computing and NFV.

**1** **6 Hours**

## EXPERIMENT 1

Setup your own virtual SDN lab
i) Virtual box/Mininet Environment for SDN - http://mininet.org
ii) https://www.kathara.org
iii) GNS3

**2** **6 Hours**

## EXPERIMENT 2

Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

**3** **6 Hours**

## EXPERIMENT 3

Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

**4** **6 Hours**

## EXPERIMENT 4

Create a simple end-to-end network service with two VNFs using vim-emu.
Https://github.com/containernet/vim-emu

**5** **6 Hours**

## EXPERIMENT 5

Install OSM and onboard and orchestrate network service.

**Total: 60 Hours**

**Reference(s)**

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1 st Edition, CRC Press, 2014.

2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow,2 nd Edition, OReilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks A Comprehensive Approach, 2 nd Edition, Morgan Kaufmann Press, 2016.
5. Thomas D Nadeau, Ken Gray, SDN Software Defined Networks, O Reilly Media, 2013.
6. William Stallings, Foundations of Modern Networking SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1 st Edition, 2015.

## 22CS018 SECURITY AND PRIVACY IN CLOUD 3 0 0 3

**Course Objectives**

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the cloud security concepts and fundamentals.
2. Explain the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Delivers various risks, audit and monitoring mechanisms in the cloud.
5. Applying the various architectural and design considerations for security in the cloud.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 3 | 2 | 2 | 3 | 2 | | | | | | | | 2 | |
| 4 | 2 | 1 | 2 | 3 | 3 | | | | | | | | | 2 |
| 5 | 1 | 3 | 3 | 1 | 1 | | | | | | | | | 2 |

**UNIT I** **8 Hours**

**FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**

Overview of Cloud Security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of Cryptography - Conventional and Public-key cryptography, Hash Functions, Authentication and Digital Signatures.

**UNIT II** **11 Hours**

**SECURITY DESIGN AND ARCHITECTURE FOR CLOUD**

Security Design Principles for Cloud Computing - Comprehensive Data Protection - End-to-end access control - Common Attack Vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data Redaction, Tokenization, Obfuscation, PKI and Key

**UNIT III** **9 Hours**

**ACCESS CONTROL AND IDENTITY MANAGEMENT**

Access Control Requirements for Cloud infrastructure User Identification Authentication and Authorization Roles based Access Control Multifactor authentication Single Sign-on Identity Federation Identity providers and service consumers Storage and network access control options OS Hardening and minimization Verified and measured boot Intruder Detection

**UNIT IV** **8 Hours**

**CLOUD SECURITY DESIGN PATTERNS**

Introduction to Design Patterns, Cloud Bursting, Geo tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

**UNIT V** **9 Hours**

**MONITORING, AUDITING AND MANAGEMENT**

Proactive Activity Monitoring Incident Response, Monitoring for Unauthorized Access Malicious Traffic Abuse of System Privileges Events and Alerts Auditing Record generation Reporting and Management Tamper Proofing Audit logs Quality of Services Secure Management, User Management Identity Management Security Information and Event Management

**Total: 45 Hours**

**Reference(s)**


1. Dave Shackleford, Virtualization Security, SYBEX a Wiley Brand, 2013
2. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

## 22CS019 CYBER SECURITY 3 0 0 3

**Course Objectives**

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the basics of cyber security, cybercrime and cyber law.
2. Classify various types of attacks and learn the tools to launch the attacks.
3. Apply various tools to perform information gathering for data security and integrity.
4. Apply intrusion techniques to detect intrusion and to observe network traffic for malicious transactions in the network.
5. Apply intrusion prevention techniques to prevent intrusion and to protect against known and unknown threats.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 2 | 1 | 3 | 1 | 3 | 3 | | | | | | | | 2 | |
| 3 | 2 | 1 | 1 | 1 | 2 | | | | | | | | 2 | |
| 4 | 3 | 3 | 2 | 2 | 1 | | | | | | | | 3 | |
| 5 | 3 | 2 | 2 | 2 | 3 | | | | | | | | 3 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Cyber Security History of Internet Impact of Internet CIA Triad Reason for Cyber Crime Need for Cyber Security History of Cyber Crime Cybercriminals A Global Perspective on Cyber Crimes Classification of Cybercrimes

**UNIT II** **9 Hours**

**ATTACKS AND COUNTER MEASURES**

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber Attacks Security Breach Types of Malicious Attacks Malicious Software Common Attack Vectors Social engineering Attack Wireless Network Attack Web Application Attack Attack Tools Countermeasures.

**UNIT III** **9 Hours**

**RECONNAISSANCE**

Harvester Who is Netcraft Host Extracting Information from DNS Extracting Information from E-mail Servers Social Engineering Reconnaissance Scanning Port Scanning Network Scanning and Vulnerability Scanning Scanning Methodology Ping Sweer Techniques Nmap Command Switches SYN Stealth XMAS NULL IDLE FIN Scans Banner Grabbing and OS Fingerprinting Techniques.

**UNIT IV** **9 Hours**

**INTRUSION DETECTION**

Host Based Intrusion Detection Network Based Intrusion Detection Distributed or Hybrid Intrusion Detection Intrusion Detection Exchange Format Honeypots Example System Snort Cyber Laws The Indian IT Act Cyber Crime and Punishment.

**UNIT V** **9 Hours**

**INTRUSION PREVENTION**

Firewalls and Intrusion Prevention Systems Need for Firewalls Firewall Characteristics and Access Policy Types of Firewalls Firewall Basing Firewall Location and Configurations Intrusion Prevention Systems Example Unified Threat Management Products.

**Total: 45 Hours**

**Reference(s)**


1. Anand Shinde, Introduction to Cyber Security Guide to the World of Cyber Security, Notion Press, 2021
2. Nina Godbole, Sunit Belapure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publishers, 2011
3. https://owasp.org/www-project-top-ten/David Kim, Michael G. Solomon, Fundamentals of Information Systems Security, Jones & Bartlett Learning Publishers, 2013.
4. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made easy, Elsevier, 2011.
5. Kimberly Graves, CEH Official Certified Ethical hacker Review Guide, Wiley Publishers, 2007.

## 22CS020 MODERN CRYPTOGRAPHY 3 0 0 3

**Course Objectives**

- To learn about the basics of modern cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudorandom permutation.
- To construct the basics of cryptanalytic techniques for ensuring data integrity.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Interpret the basic principles of cryptography and general cryptanalysis.
2. Determine the concepts of symmetric encryption and authentication.
3. Identify the use of public key encryption, digital signatures, and key establishment.
4. Apply the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
5. Demonstrate the use of Message Authentication Codes to authenticate information transmitted between the users.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 3 | 1 | 1 | 2 | 3 | 2 | | | | | | | 3 | 1 | |
| 4 | 3 | 1 | 2 | 1 | 3 | | | | | | | 2 | 3 | |
| 5 | 2 | 3 | 3 | 3 | 3 | | | | | | | 1 | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

**UNIT II** **9 Hours**

**FORMAL NOTIONS OF ATTACKS**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model

**UNIT III** **9 Hours**

**RANDOM ORACLES**

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF).

**UNIT IV** **9 Hours**

**BUILDING A PSEUDORANDOM PERMUTATION**

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

**UNIT V** **9 Hours**

**MESSAGE AUTHENTICATION CODES**

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

**Total: 45 Hours**

**Reference(s)**


1. William Stallings, "Cryptography and Network Security: Principles and Practice quot, PHI 7th Edition, 2017.
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), 2009.
3. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, 2007.
4. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition), 2004.

## 22CS021 CYBER FORENSICS 3 0 0 3

**Course Objectives**

- To understand the principles and concepts of computer forensics.
- To learn to utilize forensic tools for network-based attacks.
- To identify and apply appropriate methodologies for forensics data.
- To identify and analyze the vulnerabilities in the network.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. To understand the basics of computer forensics, legal and ethical considerations, and the importance of maintaining the integrity of digital evidence.
2. Apply different types of computer forensic tools to preserve the integrity of data in the network.
3. Analyze and validate forensics data from the communicating devices to detect intruders.
4. Apply the various firewall techniques to detect the vulnerabilities in the networks.
5. Implement real-world hacking techniques to test system security and to ensure the system safety from hackers.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 2 | 2 | 2 | 3 | 2 | 3 | | | 2 | | | | | 2 | |
| 3 | 2 | 1 | 3 | 2 | 2 | | | 3 | | | | | 2 | |
| 4 | 2 | 1 | 2 | 3 | 3 | | | 3 | | | | | 3 | |
| 5 | 2 | 2 | 2 | 2 | 3 | | | 3 | | | | | 3 | |

**UNIT I** **9 Hours**

**INTRODUCTION TO COMPUTER FORENSICS**

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft amp Identity Fraud. Types of CF techniques Incident and incident response methodology Forensic duplication and investigation. Preparation for IR Creating response tool kit and IR team Forensics Technology and Systems Understanding Computer Investigation Data Acquisition.

**UNIT II** **9 Hours**

**EVIDENCE COLLECTION AND FORENSICS TOOLS**

Processing Crime and Incident Scenes Working with Windows and DOS Systems. Current Computer Forensics Tools Software/ Hardware Tools.

**UNIT III** **9 Hours**

**ANALYSIS AND VALIDATION**

Validating Forensics Data Data Hiding Techniques Performing Remote Acquisition Network Forensics Email Investigations Cell Phone and Mobile Devices Forensics.

**UNIT IV** **9 Hours**

**E-MAIL SECURITY**

PGP S/MIME Internet Firewalls for Trusted System Roles of Firewalls Firewall related terminology Types of Firewalls Firewall designs SET for E-Commerce Transactions.

**UNIT V** **9 Hours**

**ETHICAL HACKING IN WEB**

Social Engineering Denial of Service Session Hijacking Hacking Web servers Hacking Web Applications SQL Injection Hacking Wireless Networks Hacking Mobile Platforms.

**Total: 45 Hours**

**Reference(s)**


1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, Computer Forensics and Investigations, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.
3. MarjieT.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd Edition, Prentice Hall, 2013.
4. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning, 2nd Edition, 2005.
5. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003.

## 22CS022 ETHICAL HACKING 3 0 0 3

**Course Objectives**

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To understand the different phases in penetration testing

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Enumerate the numerous assaults carried out during ethical hacking and penetration testing.
2. Apply the hacking techniques and understand the tools to be used for hacking.
3. Understand the various vulnerabilities of Windows and Linux OS.
4. Apply the techniques to hack web servers and tools for it.
5. Determine the characteristics of the firewall, the intruder detection mechanisms, and the malicious software to protect the system.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 4 | 1 | 2 | 2 | 3 | 3 | | | | | | | | 2 | |
| 5 | 1 | 2 | 1 | 2 | 2 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Ethical Hacking Overview Role of Security and Penetration Testers Penetration Testing Methodologies Laws of the Land Overview of TCP/IP- The Application Layer The Transport Layer

The Internet Layer IP Addressing Network and Computer Attacks Malware Protecting Against Malware Attacks- Intruder Attacks Addressing Physical Security

**UNIT II** **9 Hours**

**SCANNING AND ENUMERATION**

Introduction to Scanning Objectives Scanning Methodology Tools Introduction to Enumeration Enumeration Techniques Enumeration Procedure Tools

**UNIT III** **9 Hours**

**SYSTEM HACKING**

Introduction Cracking Passwords Password Cracking Websites Password Guessing Password Cracking Tools Password Cracking Countermeasures Escalating Privileges Executing Applications Keyloggers and Spyware

**UNIT IV** **9 Hours**

**PROGRAMMING FOR SECURITY PROFESSIONALS**

Programming Fundamentals C language HTML Perl Windows OS Vulnerabilities Tools for Identifying Vulnerabilities Countermeasures Linux OS Vulnerabilities Tools for Identifying Vulnerabilities Countermeasures

**UNIT V** **9 Hours**

**NETWORK PROTECTION SYSTEMS**

Access Control Lists Cisco Adaptive Security Appliance Firewall Configuration and Risk Analysis Tools for Firewalls and Routers Intrusion Detection and Prevention Systems Network-Based and Host Based IDSs and IPSs Web Filtering Security Incident Response Teams Honeypots.

**Total: 45 Hours**

**Reference(s)**


1. EC-Council, Ethical Hacking and Countermeasures: Attack Phases, Cengage Learning, 2010.
2. Jon Erickson, Hacking, 2nd Edition: The Art of Exploitation, No Starch Press Inc., 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 2013.
4. Patrick Engebretson,The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy Second Edition0 Elsevier2013.
5. RafayBoloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2014.

## 22CS023 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES

**2 0 2 3**

**Course Objectives**

- To understand the basics of Blockchain Technology.
- To learn Different protocols and consensus algorithms in Blockchain.
- To learn the Blockchain implementation frameworks.
- To experiment the Hyperledger Fabric, Ethereum networks.
- To understand the Blockchain Applications.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand emerging abstract models for Blockchain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Analyze the real life applications of Blockchain Technologies.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 2 | 2 | 1 | | | | | | | | 1 | |
| 2 | 3 | 3 | 3 | 1 | 2 | | | | | | | | 2 | |
| 3 | 2 | 2 | 1 | 1 | | | | | | | | | | |
| 4 | | 2 | 2 | | 3 | | | | | | | | 2 | |
| 5 | 1 | 2 | 3 | 1 | 2 | | | | | | | | 1 | |

**UNIT I** **7 Hours**

**INTRODUCTION TO BLOCKCHAIN**

Blockchain Public Ledgers Blockchain as Public Ledgers Block in a Blockchain Transactions The Chain and the Longest Chain Permissioned Model of Blockchain Cryptographic Hash Function Properties of a hash function Hash pointer and Merkle tree.

**UNIT II** **6 Hours**

**BITCOIN AND CRYPTOCURRENCY**

A basic crypto currency Creation of coins Payments and double spending FORTH the precursor for Bitcoin scripting Bitcoin Scripts Bitcoin P2P Network Transaction in Bitcoin Network Block Mining Block propagation and block relay.

**UNIT III** **6 Hours**

**BITCOIN CONSENSUS**

Bitcoin Consensus Proof of Work (PoW) Hashcash PoW Bitcoin PoW Attacks on PoW monopoly problem Proof of Stake Proof of Burn Proof of Elapsed Time Bitcoin Miner Mining Difficulty Mining Pool Permissioned model and use cases.

**UNIT IV** **5 Hours**

**HYPERLEDGER FABRIC**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

**UNIT V** **6 Hours**

**BLOCKCHAIN APPLICATIONS**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities Finance and Banking, Insurance, etc-Case Study.

**1** **5 Hours**

## EXPERIMENT 1

Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.

**2** **5 Hours**

## EXPERIMENT 2

Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

**3** **5 Hours**

## EXPERIMENT 3

Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.

**4** **5 Hours**

## EXPERIMENT 4

Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

**5** **5 Hours**

## EXPERIMENT 5

Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

**6** **5 Hours**

**EXPERIMENT 6**

Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.

**Total: 60 Hours**

**Reference(s)**


1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, Mastering Bitcoin Unlocking Digital Cryptocurrencies, OReilly, 2014.
3. Daniel Drescher, Blockchain Basics, First Edition, Apress, 2017.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies a comprehensive introduction. Princeton University Press, 2016.
5. Melanie Swan, Blockchain Blueprint for a New Economy, OReilly, 2015
6. Ritesh Modi, Solidity Programming Essentials A Beginners Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publishing

## 22CS024 MALWARE ANALYSIS 3 0 0 3

**Course Objectives**

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the various concepts of malware analysis and their technologies used.
2. Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
3. Understand the methods and techniques used by professional malware analysts.
4. To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.
5. Understand the concept of Android malware analysis their architecture, and App development.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 2 | |
| 2 | 3 | 3 | 2 | 3 | 2 | | | | | | | | 2 | |
| 3 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| 4 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| 5 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |

**UNIT I** **9 Hours**

**INTRODUCTION AND BASIC ANALYSIS**

Introduction to Malware Malware threats Malware types Viruses, Worms, Rootkits, Trojans, Bots,Spyware, Adware, Logic Bombs Goals of Malware Analysis AV ScanningHashing Finding Strings Packing and Obfuscation PE file formatStatic Linked Libraries and Functions Static Analysis

tools Virtual Machines and their usage in Malware analysisSandboxing Basic dynamic analysis Malware execution Process Monitoring -Viewing processes Registry snapshots

**UNIT II** **10 Hours**

**ADVANCED STATIC ANALYSIS**

The Stack Conditionals Branching Rep Instructions Disassembly Global and local variables Arithmetic operations Loops Function Call Conventions C Main Method and Offsets. Portable Executable File Format The PE File Headers and Sections IDA Pro Function analysis Graphing The Structure of a Virtual Machine Analyzing Windows programs Anti-static analysis techniques obfuscation packing metamorphism polymorphism.

**UNIT III** **10 Hours**

**ADVANCED DYNAMIC ANALYSIS**

Live malware analysis dead malware analysis analyzing traces of malware system calls api calls registries network activities. Anti-dynamic analysis techniques VM detection techniques Evasion techniques Malware Sandbox Monitoring with Process Monitor Packet Sniffing with Wireshark Kernel vs. User-Mode Debugging OllyDbg Breakpoints Tracing Exception Handling Patching

**UNIT IV** **8 Hours**

**MALWARE FUNCTIONALITY**

Downloaders and Launchers Backdoors Credential Stealers Persistence Mechanisms Handles Mutexes Privilege Escalation Covert malware launching Launchers Process Injection Process Replacement Hook Injection Detours APC injection

**UNIT V** **8 Hours**

**ANDROID MALWARE ANALYSIS**

Android Malware Analysis Android architecture App development cycle APKTool APK Inspector Dex2JarJD GUI Static and Dynamic AnalysisCase Study Smartphone Apps Security

**Total: 45 Hours**

**Reference(s)**


1. Michael Sikorski and Andrew Honig, Practical Malware Analysis by No Starch Press, 2012, ISBN 9781593272906
2. Bill Blunden, The Rootkit Arsenal Escape and Evasion in the Dark Corners of the System, Second Edition, Jones amp Bartlett Publishers, 2009.
3. Jamie Butler and Greg Hoglund, Rootkits Subverting the Windows Kernel by 2005, Addison-Wesley Professional.
4. Bruce Dang, Alexandre Gazet, Elias Bachaalany, bastienJosse, " Practical Reverse Engineering x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
5. Victor Marak, quot Windows Malware Analysis Essentials quot Packt Publishing, O Reilly, 2015.

## 22CS025 MULTIMEDIA AND ANIMATION 2 0 2 3

**Course Objectives**

- Understand the basic knowledge of multimedia Systems and related technologies.
- To learn about multimedia elements in a comprehensive way.
- Understand the basics of digital 2D animation to create story and multimedia production
- Design the technical and artistic skills to produce 3D animations.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Apply the multimedia elements, image processing and animation.
2. Analyze the encode and decode the multimedia elements
3. Apply the author 2D and 3D creative and interactive presentations for different target multimedia applications.
4. Apply the author 2D and 3D creative and interactive presentations for different target multimedia applications.
5. Create and animate the 3D models using software tools.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | | - | | | | | | | | | |
| 2 | - | - | - | - | - | | | | | | | | - | |
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| 5 | - | - | - | | | | | | | | | | | - |

**UNIT I** **6 Hours**

**INTRODUCTION TO MULTIMEDIA ELEMENTS**

Multimedia Medium Properties of a Multimedia System Traditional Data Stream Characteristics Text Basic Sound Concepts Speech. Image Computer Image Processing

**UNIT II** **6 Hours**

**MULTIMEDIA COMPRESSION**

Storage Space Coding Requirements Hybrid Coding JPEG Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode H.261 MPEG: Video Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21.

**UNIT III** **6 Hours**

**MULTIMEDIA AUTHORING**

Authoring metaphors, Tools Features and Types Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.

**UNIT IV** **6 Hours**

**2D ANIMATION**

Introduction to 2D Animation, Colour theory& amp basics, Layout & Designing Basic of sketching, Composition of basic elements, Graphics and advertising Creating Digital Layout, Professional image editing, Story Boarding, stop motion animation, Production / Post-Production Background composition, 2D animation and techniques.

**UNIT V** **6 Hours**

**3D ANIMATION**

3D Modeling Modeling Techniques, Types of Modeling 3D Shading Use of Material, Shader and Texture editing, Introduction to 3D Animation -3D Animation and Rigging, Setting up controllers for joints, Simple Skeleton structure with proper joint orientation, 3D Lighting and Rendering.

**1** **3 Hours**

**EXPERIMENT 1**

Image Editing and Manipulation.

**2** **3 Hours**

**EXPERIMENT 2**

Implementation of audio and Video Editing techniques

**3** **3 Hours**

**EXPERIMENT 3**

Sketching of cartoon characters

**4** **3 Hours**

**EXPERIMENT 4**

Design 2D Logo using the image editing tool.

**5** **3 Hours**

**EXPERIMENT 5**

Creating gif animated images in 2D Animation

**6** **3 Hours**

**EXPERIMENT 6**

Exploring the Interface of 3D application

**7** **3 Hours**

**EXPERIMENT 7**

Create different types of Materials and Shading

**8** **3 Hours**

**EXPERIMENT 8**

Create a simple walk cycle using the character Rigs

**9** **3 Hours**

**EXPERIMENT 9**

Create a 3-point Light Setup

**10** **3 Hours**

**EXPERIMENT 10**

Create particle Simulation

**Total: 60 Hours**

**Reference(s)**


1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia, Third Edition, Springer Texts in Computer Science, 2021.
2. Andleigh, P. K and Kiran Thakrar, Multimedia Systems and Design, PHI, 2003.
3. Multimedia: Making It Work, Tay Vaughan, 9th Edition,
4. The Illusion of Life Disney Animation Frank Thomas and Ollie Johnston
5. Maraffi, Chris, Maya Character Creation Modeling and Animation Controls. New Riders, 2008.
6. John M Blain, The Complete Guide to Blender Graphics Computer Modeling & Animation, CRC press, 3rd Edition, 2016.

## 22CS026 AUGMENTED REALITY AND VIRTUAL REALITY

**2 0 2 3**

**Course Objectives**

- To impart the fundamental aspects and principles of AR/VR technologies.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To gain knowledge about AR/VR application development.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Analyze the tools and technologies related to AR/VR.
2. Design various models using modeling techniques.
3. Apply programming concepts and techniques specific to VR development, including 3D graphics.
4. Develop AR/VR applications in different domains.
5. Apply the technologies related to AR to build AR-enabled devices.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | | | - | - | - | | - | - | - |

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| 2 | - | - | - | - | - | | | - | - | - | | - | - | - |
| 3 | - | - | - | - | - | | | - | - | - | | - | - | - |
| 4 | - | - | - | - | - | | | - | - | - | | - | - | - |
| 5 | - | - | - | - | - | | | - | - | - | | - | - | - |

**UNIT I** **6 Hours**

**INTRODUCTION**

Introduction to Virtual Reality and Augmented Reality Definition Introduction to Trajectories and Hybrid Space-Three Is of Virtual Reality Virtual Reality Vs 3D Computer Graphics Benefits of Virtual Reality Components of VR System Introduction to AR-AR Technologies Input Devices Types of Trackers Human Visual System Personal Graphics Displays Human Auditory System.

**UNIT II** **6 Hours**

**VR MODELING**

Modelling Geometric Modelling Virtual Object Shape Object Visual Appearance Kinematics Modelling Transformation Matrices Object Position Transformation Invariants Object Hierarchies Physical Modelling Behavior Modelling Model Management.

**UNIT III** **6 Hours**

**VR PROGRAMMING**

VR Programming Toolkits and Scene Graphs World ToolKit Java 3D Comparison of World ToolKit and Java 3D.

**UNIT IV** **6 Hours**

**APPLICATIONS**

Human Factors in VR Methodology and Terminology VR Health and Safety Issues VR and Society Medical Applications of VR Education, Arts and Entertainment Military VR Applications Emerging Applications of VR.

**UNIT V** **6 Hours**

**AUGMENTED REALITY**

Introduction to Augmented Reality Computer vision for AR Interaction Modelling and Annotation Navigation Wearable devices.

**1** **10 Hours**

## EXPERIMENT 1

Develop an AR business card application using Marker based AR.

**2** **10 Hours**

## EXPERIMENT 2

Develop an mobile VR application that allows users to explore and interact with buildings.

**3** **10 Hours**

## EXPERIMENT 3

Create a Markerless augmented reality museum application.

**Total: 60 Hours**

**Reference(s)**


1. 1. Charles Palmer, John Williamson, Virtual Reality Blueprints Create compelling VR experiences for mobile, Packt Publisher, 2018.
2. 2. Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles & Practice, Addison Wesley, 2016.
3. 3. John Vince, Introduction to Virtual Reality, Springer-Verlag, 2004.
4. 4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality Interface, Application, Design, Morgan Kaufmann, 2003.

## 22CS027 GAME DEVELOPMENT 2 0 2 3

**Course Objectives**

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the foundations of 2D and 3d Graphics
2. Design game design documents
3. Implementation of gaming engines.
4. Survey gaming environments and frameworks.
5. Develop and construct a simple game in Pygame.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | | 1 | | | | | | | | 2 | 1 |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 1 | 1 |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | 2 |
| 4 | 2 | 2 | 2 | | 3 | | | | | | | | 1 | 2 |
| 5 | 2 | 2 | 1 | | 3 | | | | | | | | 2 | 3 |

**UNIT I** **6 Hours**

**3D GRAPHICS FOR GAME DESIGN**

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components - 2D and 3D Transformations - Projections - Color Models - Illumination and Shader Models - Animation - Controller Based Animation.

**UNIT II** **6 Hours**

**GAME DESIGN PRINCIPLES**

Character Development, Storyboard Development for Gaming - Script Design - Script Narration, Game Balancing, Core Mechanics, Principles of Level Design - Proposals - Writing for Preproduction, Production and Post - Production.

**UNIT III** **6 Hours**

**GAME ENGINE DESIGN**

Rendering Concept - Software Rendering - Hardware Rendering - Spatial Sorting Algorithms - Algorithms for Game Engine- Collision Detection - Game Logic - Game AI - Pathfinding.

**UNIT IV** **6 Hours**

**OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS**

Pygame Game development - Unity - Unity Scripts - Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

**UNIT V** **6 Hours**

**GAME DEVELOPMENT USING PYGAME**

Developing 2D and 3D interactive games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating music and sound - Asset Creations - Game Physics Algorithms Development - Device Handling in Pygame - Overview of Isometric and Tile Based Arcade Games - Puzzle Games.

**1** **3 Hours**

## EXPERIMENT 1

Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game

**2** **3 Hours**

## EXPERIMENT 2

Character design, sprites, movement and character control

**3** **3 Hours**

## EXPERIMENT 3

Level design: design of the world in the form of tiles along with interactive and collectible objects

**4** **4 Hours**

## EXPERIMENT 4

Design of interaction between the player and the world, optionally using the physics engine.

**5** **4 Hours**

## EXPERIMENT 5

Developing a 2D interactive using Pygame

**6** **4 Hours**

## EXPERIMENT 6

Developing a Puzzle game

**7** **3 Hours**

**EXPERIMENT 7**
Design of menus and user interaction in mobile platforms.

**8** **3 Hours**

**EXPERIMENT 8**
Developing a 3D Game using Unreal

**9** **3 Hours**

**EXPERIMENT 9**
Developing a Multiplayer game using unity

**Total: 60 Hours**

**Reference(s)**


1. Sanjay Madhav, Game Programming Algorithms and Techniques: A Platform Agnostic Approach, Addison Wesley,2013.
2. Will McGugan, Beginning Game Development with Python and Pygame: From Novice to Professional, Apress,2007.
3. Paul Craven, Python Arcade games, Apress Publishers,2016.
4. David H. Eberly, 3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics, Second Edition, CRC Press,2006.
5. Jung Hyun Han, 3D Graphics for Game Programming, Chapman and Hall/CRC, 2011.

## 22CS028 VIDEO CREATION AND EDITING 2 0 2 3

**Course Objectives**

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Project Management and Finance: Demonstrate the 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Compare the strengths and limitations of Nonlinear editing.
2. Identify the infrastructure and significance of storytelling.
3. Apply suitable methods for recording to CDs and VCDs.
4. Address the core issues of advanced editing and training techniques
5. Design and develop projects using AVID XPRESS DV 4.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 1 | 2 | 1 | 1 | | | | 1 | 2 | 3 | 2 | 3 | 1 |
| 2 | 2 | 3 | 3 | 3 | 1 | | | | 1 | 2 | 2 | 1 | 1 | 1 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 2 | 3 | 3 | 1 | | | | 3 | 1 | 1 | 1 | 2 | 1 |
| 4 | 2 | 2 | 2 | 2 | 1 | | | | 3 | 1 | 1 | 1 | 2 | 2 |
| 5 | 2 | 1 | 3 | 3 | 1 | | | | 3 | 2 | 1 | 2 | 2 | 2 |

**UNIT I** **6 Hours**

**FUNDAMENTALS**

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

**UNIT II** **6 Hours**

**STORYTELLING**

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits Consumer and pro NLE systems - digitizing images - managing resolutions - Understanding video color Color Correcting Basics - Color Enhancement Effects mechanics of digital editing - pointer files - media management.

**UNIT III** **6 Hours**

**USING AUDIO AND VIDEO**

Audio: Timeline Audio Tracks - Editing Audio- Gaining, Fading and Balancing Audio- Video: Capturing digital and analog video - importing audio on putting video - exporting digital video to tape - recording to CDs and VCDs.

**UNIT IV** **6 Hours**

**WORKING WITH FINAL CUT PRO**

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio Using Media Tools - Viewing and Setting Preferences.

**UNIT V** **6 Hours**

**WORKING WITH AVID XPRESS DV 4**

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

**1** **3 Hours**

**EXPERIMENT 1**

Write a Movie Synopsis (Individual/Team Writing)

**2** **3 Hours**

**EXPERIMENT 2**

Present team stories in class

**3** **4 Hours**

**EXPERIMENT 3**

Script/Storyboard Writing(Individual Assignment)

**4** **4 Hours**

**EXPERIMENT 4**

Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts

**5** **4 Hours**

**EXPERIMENT 5**

Production: Single camera production personnel

**6** **3 Hours**

**EXPERIMENT 6**

Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching

**7** **4 Hours**

**EXPERIMENT 7**

Write Documentary

**8** **5 Hours**

**EXPERIMENT 8**

Post-production: Editing, Sound design, Finishing

**Total: 60 Hours**

**Reference(s)**


1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.
3. Keith Underdahl, Digital Video for Dummies, Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, Editing Digital Video: The Complete Creative and Technical Guide, Digital Video and Audio, McGraw - Hill 2003.

## 22CS029 DIGITAL MARKETING 3 0 0 3

**Course Objectives**

- Understand the overview of Digital Marketing.
- Examine the role and importance of digital marketing in the business environment.
- Determine the focuses on digital marketing and its measure

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Identify some of the latest digital marketing trends and skills sets needed for today"s Marketer.
2. Compare the strengths and limitations of search engine optimization.
3. Apply the suitable techniques for E-Mail Marketing.
4. Discover the hottest techniques to help to successfully plan, predict, and manage your digital Marketing campaigns.
5. Evaluate the importance of your digital marketing assets, which ones actually matter the most to your business.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | | 1 | | | | | | | | 1 | 1 |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | 3 |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | 2 |
| 4 | 2 | 2 | 2 | | 3 | | | | | | | | 1 | 2 |
| 5 | 2 | 2 | 1 | | 3 | | | | | | | | 2 | 3 |

**UNIT I** **9 Hours**

**INTRODUCTION TO ONLINE MARKET**

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

**UNIT II** **9 Hours**

**SEARCH ENGINE OPTIMISATION**

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.

**UNIT III** **9 Hours**

**E- MAIL MARKETING**

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.

**UNIT IV** **9 Hours**

**SOCIAL MEDIA MARKETING**

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing

**UNIT V** **9 Hours**

**DIGITAL TRANSFORMATION**

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, social media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

**Total: 45 Hours**

**Reference(s)**


1. Fundamentals of Digital Marketing by Puneet Singh Bhatia; Publisher: Pearson Education; First Edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
2. Digital Marketing by Vandana Ahuja; Publisher: Oxford University Press ( April 2015). ISBN-10: 0199455449
3. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; first edition(April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4. Michael Millerth, B2B Digital Marketing: Using the Web to Market Directly to Businesses, first edition, Que Biz-Tech series2012.
5. Dave Chaffey, Fiona Ellis Chadwick, Digital Marketing: Strategy, Implementation & Practice, Paperback - Import, 2012.

## 22CS030 KNOWLEDGE ENGINEERING 3 0 0 3

**Course Objectives**

- To understand the basics of Knowledge Engineering.
- To discuss the knowledge representation and reasoning methods.
- To apply reasoning and uncertainty for intelligent systems.
- To design and develop ontologies.
- To understand learning and rule learning.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the basics of Knowledge Engineering.
2. Interpret the knowledge representation and reasoning methods.
3. Apply reasoning and uncertainty for intelligent systems.
4. Design and develop ontologies.
5. Understand learning and rule learning.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 2 | 3 | 3 | 3 | | | | | | | | 2 | |
| 2 | 2 | 2 | 2 | 3 | 3 | | | | | | | | 2 | |
| 3 | 2 | 3 | 2 | 2 | 3 | | | | | | | | 2 | |
| 4 | 2 | 2 | 2 | 2 | 3 | | | | | | | | 2 | |
| 5 | 2 | 2 | 3 | 2 | 1 | | | | | | | | 2 | |

**UNIT I** **9 Hours**

**INTRODUCTION TO KNOWLEDGE ENGINEERING**

Introduction Data, Information and Knowledge Skills of Knowledge Engineer Knowledge based systems Types of Knowledge based systems Expert Systems Neural Networks Case Based Reasoning Genetic Algorithms Intelligent Systems Data Mining

**UNIT II** **9 Hours**

**KNOWLEDGE REPRESENTATION AND REASONING**

Knowledge Acquisition Knowledge Representation and Reasoning Using Knowledge Logic, Rules and Representation Developing Rule based Systems Semantic Networks Frames

**UNIT III** **9 Hours**

**REASONING UNDER UNCERTAINTY**

Introduction Abductive reasoning Probabilistic reasoning Enumerative Probabilities Subjective Bayesian view Belief Functions Baconian Probability Fuzzy Probability Uncertainty methods Evidence based reasoning Intelligent Agent Mixed Initiative Reasoning Knowledge Engineering.

**UNIT IV** **9 Hours**

**ONTOLOGIES DESIGN AND DEVELOPMENT**

Concepts and Instances Generalization Hierarchies Object Features Defining Features Representation Transitivity Inheritance Concepts as Feature Values Ontology Matching Design and Development Methodologies Steps in Ontology Development

**UNIT V** **9 Hours**

**LEARNING AND RULE LEARNING**

Machine Learning Concepts Generalization and Specialization Rules Types of Generalization and Specialization Formal definition of Generalization. Modelling, Learning and Problem Solving

**Total: 45 Hours**

**Reference(s)**


1. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
2. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.
3. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
4. John F. Sowa: Knowledge Representation Logical, Philosophical, and Computational Foundations, Brooks Cole, Thomson Learning, 2000.
5. King, Knowledge Management and Organizational Learning, Springer, 2009.
6. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001.

**22CS031 SOFT COMPUTING 3 0 0 3**

**Course Objectives**

- Apply suitable soft computing techniques for various applications
- Integrate various soft computing techniques for complex problems

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
f. 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.
g. 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.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the basic concepts of soft computing
2. Classify the architecture and working principles of specialized neural networks
3. Apply the concept of fuzzification and defuzzification in fuzzy systems
4. Analyze the fundamental concepts of genetic algorithm and classify its types
5. Apply hybrid soft computing techniques to solve real time problem

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 2 | 2 | 2 | | 2 | 2 | | | | | 3 | 3 | |
| 2 | 2 | 2 | 3 | 2 | | 2 | 2 | | | | | 3 | 3 | |
| 3 | 2 | 3 | 3 | 2 | | 2 | 2 | | | | | 3 | 3 | |
| 4 | 3 | 3 | 3 | 3 | | 3 | 2 | | | | | 3 | 3 | |
| 5 | 3 | 3 | 3 | 3 | | 3 | 2 | | - | - | | 3 | 3 | |

**UNIT I** **10 Hours**

**INTRODUCTION TO SOFT COMPUTING**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

**UNIT II** **10 Hours**

**ARTIFICIAL NEURAL NETWORKS**

Back propagation Neural Networks- Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

**UNIT III** **9 Hours**

**FUZZY SYSTEMS**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification- Fuzzy Arithmetic and Fuzzy Measures -Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making

**UNIT IV** **8 Hours**

**GENETIC ALGORITHMS**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction -Inheritance Operators- Cross Over - Inversion and Deletion -Mutation Operator- Bit-wise Operators - Convergence of Genetic Algorithm.

**UNIT V** **8 Hours**

**HYBRID OF SYSTEMS**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron- Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

**Total: 45 Hours**

**Reference(s)**


1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 3rd Edition, 2018.
3. Kwang H.Lee, "First course on Fuzzy Theory and Applications, Springer, 2005.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and programming Techniques, Addison Wesley, 2003.

## 22CS032 TEXT AND SPEECH ANALYSIS 3 0 0 3

**Course Objectives**

- Acquire a deep understanding of natural language processing (NLP) techniques.
- Develop expertise in text analysis through practical implementation of advanced techniques
- Explore the fundamentals of speech processing.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the foundations of natural language processing and speech analysis
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop speech recognition and speech synthesis systems
5. Develop and construct a robust text classification model by exploring advanced techniques in text and speech analysis

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | | 1 | | | | | | | | 1 | |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | 2 | |
| 4 | 2 | 2 | 2 | | 3 | | | | | | | | 2 | |
| 5 | 2 | 2 | 1 | | 3 | | | | | | | | 2 | |

**UNIT I** **6 Hours**

**NATURAL LANGUAGE PROCESSING BASICS**

Introduction to natural language processing-Language syntax and structure-Text pre-processing and wrangling-Text tokenization-Stemming and lemmatization-Stop-word removal-Feature engineering for text representation-Bag-of-Words model-Bag-of-N-Grams model-TF-IDF model.

**UNIT II** **9 Hours**

**TEXT CLASSIFICATION AND SENTIMENT ANALYSIS**

Vector semantics and word embeddings-Word2Vec model-GloVe model-FastText model-Deep learning models for text classification-Recurrent Neural -Networks (RNN)-Transformers-Text summarization techniques-Topic modelling.

**UNIT III** **9 Hours**

**QUESTION ANSWERING AND DIALOGUE SYSTEMS**

Information retrieval techniques-IR-based question Answering-Knowledge-based question Answering- Language models for question Answering-Classic -question answering Models-Introduction to Chabots and dialogue Systems-Designing Dialogue Systems-Evaluating dialogue systems.

**UNIT IV** **9 Hours**

**SPEECH RECOGNITION AND SYNTHESIS**

Introduction to speech Processing-Speech signal analysis and pre-Processing-Acoustic modelling for speech Recognition-Hidden Markov Models (HMM)-Deep learning-based speech Recognition-Automatic Speech Recognition (ASR) Systems-Text normalization and letter-to-sound Conversion-Speech Synthesis Techniques-Concatenative and parametric Approaches-Wave Net and other neural TTS systems.

**UNIT V** **12 Hours**

**TEXT AND SPEECH ANALYSIS MODELLING**

Named Entity Recognition (NER)-Coreference resolution-Text coherence and cohesion-Advanced sentiment analysis-Advanced language modelling-Machine translation-Multi-modal analysis (text and speech)-Ethical considerations in text and speech analysis.

**Total: 45 Hours**

**Reference(s)**


1. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit" by Steven Bird, Ewan Klein, and Edward Loper.
2. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin.
3. Text Mining: Classification, Clustering, and Applications" by Ashok N. Srivastava and Mehran Sahami.
4. Deep Learning for Natural Language Processing: Creating Neural Networks with Python" by Palash Goyal, Sumit Pandey, and Karan Jain.
5. Speech and Language Processing for Human-Machine Communications" by Joseph Mariani, rard Chollet, and Jacques.
6. Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data" by Dipanjan Sarkar

## 22CS033 OPTIMIZATION TECHNIQUES 3 0 0 3

**Course Objectives**

- Formulate and solve linear programming problems (LPP), Integer Programming Problems and Transportation Problems
- Solve the dynamic programming and its simulation and obtain a solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints and solve problems under Markovian queuing models.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Formulate and solve linear programming problems (LPP).
2. Evaluate Integer Programming Problems and Transportation Problems.
3. Solve dynamic programming and its simulation.
4. Obtain a solution to network problems using CPM and PERT techniques.
5. Optimize the function subject to the constraints and solve problems under Markovian queuing models.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 3 | 3 | | | | | | | | | | | 1 |
| 2 | 3 | 2 | 2 | | | | | | | | | | | 2 |
| 3 | 3 | 3 | 2 | | | | | | | | | | | 2 |
| 4 | 2 | 2 | 2 | | 2 | | | | | | | | | 3 |
| 5 | 3 | 3 | 3 | | | | | | | | | | | 1 |

**UNIT I** **9 Hours**

**LINEAR MODELS**

Introduction of Operations Research: Development, definition, characteristics and phases, types of operation research models, applications; Linear Programming: mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Two-Phase method

**UNIT II** **9 Hours**

**INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS**

Integer programming: Integer Programming Formulations- the Cutting-plane Algorithm - Branch and bound method - Zero-One Implicit Enumeration Algorithm - Transportation problem - Types of Transportation Problem - Methods to Solve Transportation Problem - Transshipment Model - Modelling the Transportation Problem with Quantity Discounts.

**UNIT III** **9 Hours**

**DYNAMIC PROGRAMMING AND SIMULATION**

Dynamic Programming: Introduction, Terminology, Bellmans Principle of optimality, Applications of dynamic programming, shortest path problem, linear programming problem. Simulation: Introduction, Definition, types of simulation models, steps involved in the simulation process - Advantages and Disadvantages, Application of Simulation to queuing and inventory.

**UNIT IV** **9 Hours**

**PROJECT SCHEDULING**

Introduction - Phases of project management - Guidelines for network construction - Critical path method (CPM) - Gantt Chart - PERT- Crashing of project network - Project Scheduling with Constrained Resources -Cost considerations in PERT and CPM.

**UNIT V** **9 Hours**

**CLASSICAL OPTIMIZATION THEORY**

Unconstrained problems - necessary and sufficient conditions - Newton-Raphson method, Constrained problems - equality constraints - inequality constraints - Kuhn-Tucker conditions.

**Total: 45 Hours**

**Reference(s)**


1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.
2. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
3. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
4. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
5. Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
6. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.

## 22CS034 ETHICS AND AI 3 0 0 3

**Course Objectives**

- Understand the fundamental concepts of morality and ethics in AI.
- Explore the AI standards and Regulations in the field of AI.
- Determine the problems to solve societal issues using ethics and artificial intelligence.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Understand the morality and ethics in AI
2. Acquire knowledge in application ethics, issues, and its challenges
3. Design Autonomous and semi-Autonomous System based on AI standards and Regulations.
4. Develop the concepts of Robo ethics and Morality with professional responsibilities.
5. Construct the applications related to societal issues in AI with National and International Strategies on AI.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | 1 | | 1 | | | 1 | | | | | 1 | |
| 2 | 2 | 2 | 3 | | 3 | | | 2 | | | | | 2 | |
| 3 | 1 | 3 | 3 | | 3 | | | 2 | | | | | 2 | |
| 4 | 2 | 2 | 2 | | 3 | | | 2 | | | | | 2 | |
| 5 | 2 | 2 | 1 | | 3 | | | 2 | | | | | 1 | |

**UNIT I** **9 Hours**

**INTRODUCTION**

Definition of morality and ethics in AI-Impact on Society-Impact on human Psychology-Impact on the legal System-Impact on the environment and the Planet-Impact on trust.

**UNIT II** **9 Hours**

**ETHICAL INITIATIVES IN AI**

International ethical Initiatives-Ethical harms and Concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

**UNIT III** **9 Hours**

**AI STANDARDS AND REGULATION**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

**UNIT IV** **9 Hours**

**ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS**

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility Roboethics Taxonomy

**UNIT V** **9 Hours**

**AI AND ETHICS- CHALLENGES AND OPPORTUNITIES**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in Industries-National and International Strategies on AI.

**Total: 45 Hours**

**Reference(s)**


1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge series, April.
3. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, The ethics of artificial intelligence Issues and initiatives, EPRS European 189 Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 - March 2020.
4. Patrick Lin, Keith Abney, George A Bekey, Robot Ethics: The Ethical and Social Implications of Robotics, The MIT Press- January 2014.

## 22CS035 SOFTWARE QUALITY ASSURANCE 3 0 0 3

**Course Objectives**

- Understand the standards and components of software quality assurance.
- Understand software quality assurance activities with tools and techniques
- Study the metrics for software quality assurance.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Illustrate the components of software quality assurance system and its challenges
2. Identify the SQA components and the quality activities in the project life cycle
3. Analyze the procedures required to ensure software quality
4. Illustrate the project process control and its metrics in software quality assurance
5. Examine the standards and certifications of software quality assurance

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | | 2 | | 2 | 2 | 2 | | | | | 2 | |
| 2 | 2 | 3 | | 2 | | 2 | 2 | | | | | | 2 | |
| 3 | 2 | 3 | | 2 | | 2 | 2 | 2 | | | | | 1 | |
| 4 | 2 | 3 | | 2 | | 2 | 2 | 2 | | | | | 2 | |
| 5 | 2 | 3 | | 2 | | 2 | 2 | 2 | | | | | 2 | |

**UNIT I** **7 Hours**

**INTRODUCTION**

Software Quality Challenge - Software Quality Factors - Components of the Software Quality Assurance System. Pre-Project Software Quality Components - Contract Review - Development and Quality Plans

**UNIT II** **10 Hours**

**SQA COMPONENTS IN THE PROJECT LIFE CYCLE**

Integrating Quality Activities in the Project Life Cycle - Reviews - Software Testing - Strategies - Software Testing -Implementation - Assuring the Quality of Software Maintenance - Assuring The Quality of External Participants" Parts - Case Tools and their effect on Software Quality.

**UNIT III** **9 Hours**

**SOFTWARE QUALITY INFRASTRUCTURE COMPONENTS**

Procedures and Work Instructions - Supporting Quality Devices - Staff Training Instructing and Certification - Preventive and Corrective Actions - Configuration Management - Documentation and Quality Records Controls.

**UNIT IV** **10 Hours**

**SOFTWARE QUALITY MANAGEMENT COMPONENTS**

Project Progress Control - components of project progress control- Progress control of internal projects and external participants- Implementation of project progress control. Software Quality Metrics - Objectives of quality measurement- Process metrics- Product metrics. Software Quality Costs - Objectives of cost of software quality metrics- classic model of cost of software quality.

**UNIT V** **9 Hours**

**STANDARDS- CERTIFICATION AND ASSESSMENT**

SQA Standards - ISO 9001 Certification - Software Process Assessment. Organizing for Quality Assurance -Management and its Role in Quality Assurance - The Software Quality Assurance Unit - SQA Trustees and Committees

**Total: 45 Hours**

**Reference(s)**


1. Daniel Galin - Software Quality Assurance: From Theory to Implementation - Pearson Addison-Wesley, 2012.
2. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
3. Y.Langsam, M.J.Augenstein and A.M.Tenenbaum, Data Structures using C, PHI, 2007.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2009.

## 22CS036 XML AND WEB SERVICES 3 0 0 3

**Course Objectives**

- Construct the web page using XML and service-oriented architecture
- Implement the real time applications using XML technologies
- Analyze the design principles and applications of SOAP based Web Services
- Use the key technologies in web services.
- Evaluate the security issues in XML.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Construct the web page using XML and service oriented architecture.
2. Apply DTD and Schema for structuring XML page and use presentation techniques and transformation in web page creation
3. Analyze the design principles and applications of SOAP based Web Services.
4. Analyze the paradigms needed for designing the standards of web services.
5. Apply XML security standards in web pages.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 5 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | | | | 2 | - |

**UNIT I** **9 Hours**

**INTRODUCTION**

Role of XML - XML and the Web - XML Language Basics - SOAP - Web Services - Revolutions of XML - Service Oriented Architecture (SOA)

**UNIT II** **9 Hours**

**XML TECHNOLOGY**

XML - Name Spaces - Structuring with Schemas and DTD - Presentation Techniques - Transformation.

**UNIT III** **9 Hours**

**SOAP SERVICES**

Overview of SOAP - HTTP - XML - RPC - SOAP: Protocol - Message Structure - Intermediaries - Actors - Design Patterns and Faults - SOAP with Attachments.

**UNIT IV** **9 Hours**

**WEB SERVICES**

Overview - Architecture - Key Technologies - UDDI - WSDL - ebXML - SOAP and Web Services in ECom - Overview of .NET and J2EE.

**UNIT V** **9 Hours**

**XML SECURITY**

Security Overview - Canonicalization - XML Security Framework - XML Encryption - XML Digital Signature - XKMS Structure - Guidelines for Signing XML Documents - XML in Practice.

**Total: 45 Hours**

**Reference(s)**


1. Frank. P. Coyle, XML, Web Services and the Data Revolution, Pearson Education, 2007.
2. David Hunter, Jeff Rafter, Joe Fawcett, Eric Van der Vlist, Danny Ayers, Jon Duckett, Andrew Watt, Linda McKinnon, Begining XML , Fourth Edition, Wrox publication.
3. Deitel H M, Deitel P J, Nirto T R, Lin T M, XML How to Program, Pearson Edition, 2011.

## 22CS037 INFORMATION STORAGE MANAGEMENT

**3 0 0 3**

**Course Objectives**

- Understand the challenges in information storage and management.
- Describe the core elements in a data center.
- Understand RAID and its various levels for data backup.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Illustrate physical and logical components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems
2. Describe storage networking technologies such as FC-SAN, IP-SAN, FCoE, NAS and object-based and unified storage
3. Illustrate and articulate business continuity solutions, backup and replications, along with archive for managing fixed content
4. Identify key characteristics, services, deployment models, and infrastructure components for a cloud computing
5. Implement the concept of security storage infrastructure management

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**STORAGE SYSTEM**

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

**UNIT II** **9 Hours**

**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**

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

**UNIT III** **9 Hours**

**BACKUP, ARCHIVE AND REPLICATION**

Business continuity terminologies, planning and solutions, Clustering and multipathing to avoid single points of failure, Backup and recovery methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection.

**UNIT IV** **9 Hours**

**CLOUD COMPUTING CHARACTERISTICS AND BENEFITS**

Cloud Enabling Technologies - Characteristics of Cloud Computing- Benefits of Cloud Computing- Cloud Service Models Cloud deployment models- Cloud Computing Infrastructure-Cloud Challenges, Cloud migration considerations.

**UNIT V** **9 Hours**

**SECURING AND MANAGING STORAGE INFRASTRUCTURE**

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

**Total: 45 Hours**

**Reference(s)**


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

## 22CS038 MOBILE APPLICATION DEVELOPMENT 3 0 0 3

**Course Objectives**

- Understand the basics of mobile application development.
- Work with mobile app development platforms

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Understand the basics of mobile application development.
2. Design the architecture of android application development.
3. Develop software using android.
4. Develop applications using components of android framework.
5. Develop android applications including files and databases.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| 4 | 2 | 3 | 3 | 2 | | | 3 | | | | | | | 2 |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Introduction to Android, Android versions and its feature set The various Android devices on the market , The Android Market application store, Android Development Environment - System Requirements, Android SDK, Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE), Creating Android Virtual Devices (AVDs).

**UNIT II** **9 Hours**

**ANDROID ARCHITECTURE OVERVIEW AND CREATING AN EXAMPLE ANDROID APPLICATION**

The Android Software Stack, The Linux Kernel, Android Runtime - Dalvik Virtual Machine, Android Runtime Core Libraries, Dalvik VM Specific Libraries, Java Interoperability Libraries, Android Libraries, Application Framework, Creating a New Android Project ,Defining the Project Name and SDK Settings, Project Configuration Settings, Configuring the Launcher Icon, Creating an Activity, Running the Application in the AVD, Stopping a Running Application, Modifying the Example Application, Reviewing the Layout and Resource Files.

**UNIT III** **9 Hours**

**ANDROID SOFTWARE DEVELOPMENT PLATFORM**

Understanding Java SE and the Dalvik Virtual Machine , The Directory Structure of an Android Project , Common Default Resources Folders , The Values Folder , Leveraging Android XML, Screen Sizes , Launching Your Application: The AndroidManifest.xml File ,Creating Your First Android Application.

**UNIT IV** **9 Hours**

**ANDROID FRAMEWORK OVERVIEW**

Android Application Components, Android Activities: Defining the UI, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool.

**UNIT V** **9 Hours**

**FILES, CONTENT PROVIDERS, AND DATABASES**

Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers.

**Total: 45 Hours**

**Reference(s)**


1. Code Complete: A Practical Handbook of Software Construction, 2nd Edition by Steve McConnell.
2. Mobile Apps Made Simple: The Ultimate Guide to Quickly Creating, Designing and Utilizing Mobile Apps for Your Business, 2nd Edition by Jonathan McCallister.
3. Android Application Development Cookbook- Second Edition by Rick Boyer and Kyle Mew.

## 22CS039 INTERNET OF THINGS 3 0 0 3

**Course Objectives**

- Understand the components and protocols used in IOT.
- To Understand the IoT Reference Architecture and Real World Design Constraints
- Ability to understand the Security requirements in IoT.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Identify physical design, communication and Technologies used in IOT.
2. Illustrate the IoT reference models and IoT protocols.
3. Examine the components, interfacing devices and communication models of IoT
4. Analyze the cloud storage models and web service and data analytics for IoT
5. Analyse the security requirements and threats in IOT.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**INTRODUCTION TO INTERNET OF THINGS**

IOT Fundamentals - Characteristics of IoT - Physical Design of IoT - IoT Protocols - IoT communication models - IOT Communication APIs -IOT enabled Technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, and Communication protocols, Embedded Systems, IOT Levels and Templates.

**UNIT II** **10 Hours**

**IOT REFERENCE ARCHITECTURE**

Introduction- State of the art - Architecture Reference Model- IOT reference Model-IOT Protocols: Zigbee, RFID, BLE, NFC, BACnet, 6LowPAN, RPL, XMPP, CoAP, and MQTT.

**UNIT III** **9 Hours**

**IOT DEVICES AND INTERFACING**

IOT components - Sensors - Actuators - Hardware Platforms - Interfacing with devices: Setting up the board -Programming for IOT - Reading from Sensors, Communication: Connecting microcontroller with mobile devices - communication through Bluetooth, wifi, Ethernet

**UNIT IV** **9 Hours**

**IOT CLOUD, WEB SERVICES AND DATA ANALYTICS**

Introduction to Cloud Storage models - Cloud services and IOT - communication APIs -Cloud for IOT -Web server: Web server for IOT - Amazon Web services for IOT- Data analytics for IOT.

**UNIT V** **9 Hours**

**IOT SECURITY**

Security Requirements in IOT - Security Concerns in IOT Applications - Security Architecture in the Internet of Things - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IOT. Vulnerabilities - Secrecy and Secret- Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption.

**Total: 45 Hours**

**Reference(s)**


1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012
4. Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) [Kindle Edition] by CunoPfister,2011 Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren.

## 22CS040 BUSINESS ANALYTICS 3 0 0 3

**Course Objectives**

- Understand data analytics.
- Understand and apply open source modelling.
- Analyzing and develop techniques to solve data analytics problems.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Illustrate the fundamental Concepts of Data Science and its related theories
2. Implement R programming for Bayes model for real-time applications
3. Implement R program for discriminate and factor analysis for problem solving
4. Apply clustering and classification techniques in real-time scenario
5. Analyse the techniques involved in growth of Big Data and its future inventions.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **8 Hours**

**THE ART OF DATA SCIENCE**

Volume, Velocity, Variety - Machine Learning -Supervised and Unsupervised Learning - Predictions and Forecasts -Innovation and Experimentation - The Dark Side - Big Errors -Privacy - Theories, Models, Intuition, Causality, Prediction, Correlation -Normal Distribution - Poisson Distribution- Statistical Regression.

**UNIT II** **10 Hours**

**OPEN SOURCE MODELLING**

Introducing to R - R Data Structures - Help functions in R - Vectors - Scalars - Declarations - recycling -Common Vector operations - Learning from Experience: Bayes Theorem -Introduction - Bayes and Joint Probability Distributions- Bayes Nets - Bayes Rule in Marketing - Bayes Models in Credit Rating Transitions Accounting Fraud.

**UNIT III** **9 Hours**

**DISCRIMINANT AND FACTOR ANALYSIS**

Discriminant Analysis - Notation and assumptions -Discriminant Function - Implementation using R - Confusion Matrix -Multiple groups - Eigen Systems - Factor Analysis.

**UNIT IV** **9 Hours**

**CLUSTER ANALYSIS AND PREDICTION TREES**

Introduction -Clustering using k-means -Example: Randomly generated data in kmeans- Hierarchical Clustering - Prediction Trees- Classification Trees - The C4.5 Classifier - Regression Trees.

**UNIT V** **9 Hours**

**BIG DATA ANALYTICS: INTRODUCTION**

Big Data Ecosystem-Future trends in Big Data Analytics: Growth of social medium, Creation of Data Lakes, Visualization tools at the hands of business users , Prescriptive Analytics, IoT, Artificial Intelligence, Whole data processing, Vertical and Horizontal Applications, Real-time Analytics, Putting the Analytics in the hands of business users, Migration of solutions from one tool to another, Cloud cloud Everywhere the cloud, In-Database Analytics, In-memory Analytics, Autonomous services for machine Learning, Addressing Security & compliance, Healthcare.

**Total: 45 Hours**

**Reference(s)**


1. Data science for Business, Foster Provost & Tom Fowcett ,O Reilly,2013.
2. Mark Gardener, Beginning R- The Statistical Programming Language, Wiley, 2013.
3. Robert Knell, "Introductory R: A Beginners Guide to Data Visualization, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.
4. Umesha Nayak, Umesh R Hodeghatta, Business Analytics using R, A Press.

## 22OCS01 OBJECT ORIENTED PROGRAMMING 3 0 0 3

**Course Objectives**

- Understand the concepts of Object Oriented Programming
- Study the concepts of objects and classes.
- Familiarize in the types of constructors.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Identify the characteristics and data types of C++ language.
2. Develop programs using objects and classes for real world applications
3. Construct programs to implement operator overloading and inheritance techniques
4. Apply Polymorphism and File streams concepts to develop C++ program
5. Design applications using templates and apply exception handling mechanisms

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Need for object oriented programming - Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using cout - Input with cin - Data types- Variables and Constants - Operators - Control Statements-Manipulators - Type conversion. Function Prototyping- call by reference, return by reference- Inline function- Default arguments - Function overloading.(sona)

**UNIT II** **8 Hours**

**OBJECTS AND CLASSES**

Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types- CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors(PSG) - Structures and Classes - Arrays and Strings

**UNIT III** **10 Hours**

**OPERATOR OVERLOADING AND INHERITANCE**

Operator Overloading and Inheritance Need of operator overloading- Overloading Unary Operators- Overloading binary Operators - Overloading Special Operators - Data Conversion Inheritance: Derived Class and Base Class - Derived Class Constructors-Overriding Member Functions-Class Hierarchies- Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

**UNIT IV** **10 Hours**

**POLYMORPHISM AND FILE STREAMS**

Polymorphism and File Streams Virtual Function - Friend Function - Static Function-Assignment and Copy Initialization- Memory Management: new and delete Pointers to Objects, this Pointer- Streams - String I/O - Character I/O - Object I/O - I/O with Multiple Objects - File Pointers - Disk I/O with Member Functions- Error Handling in File I/O.

**UNIT V** **10 Hours**

**TEMPLATES AND EXCEPTION HANDLING**

Templates: Introduction - Function Templates - Overloading Function Templates-, user defined template arguments(sona) - Class Templates - Exception Handling - Syntax, multiple exceptions, exceptions with arguments.

**Total: 47 Hours**

**Reference(s)**


1. Deitel & Deitel, C++ How to program, Prentice Hall,2005
2. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication.
3. D.S.Malik, C++ Programming, Thomson, 2007.
4. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
5. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing,New.

## 22OCS02 JAVA FUNDAMENTALS 3 0 0 3

**Course Objectives**

- Implement applications based on core Java Concepts with examples
- Construct application using inheritance, packages and exception handling for real time problems.
- Integrate the Java I/O concepts to handle input and output operations.
- Develop programs to perform string manipulation in java.
- Design GUI with Java for event handling and database applications.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Demonstrate applications based on core Java Concepts with examples
2. Construct application using inheritance, packages and exception handling for real time problem
3. Explain the Java I/O concepts to handle input and output operations
4. Develop programs to perform string manipulation in Java.
5. Design GUI with Java for event handling and database applications.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**BASICS OF JAVA**

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators - Control Statements - Introducing Classes - Methods and Classes.

**UNIT II** **9 Hours**

**INHERITANCE, PACKAGES AND EXCEPTIONS**

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages- Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw.

**UNIT III** **9 Hours**

**EXPLORING JAVA I/O**

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization.

**UNIT IV** **9 Hours**

**JAVA STRINGS**

String Handling: Special String operations and Methods - String Buffer - Exploring java.lang: Simple type Wrappers - System - Math - Collections Framework: Collections Interfaces and Classes - Utility Classes: String Tokenizer - Date and Time.

**UNIT V** **9 Hours**

**GUI WITH JAVA**

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts AWT Controls - Layout Managers and Menus - JDBC

**Total: 45 Hours**

**Reference(s)**


1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015.
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
3. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.

## 22OCS03 KNOWLEDGE DISCOVERY IN DATABASES

**3 0 0 3**

**Course Objectives**

- Introduce the basic concepts of data warehousing.
- Impart knowledge about the data mining functionalities.
- Assess the strengths and weaknesses of association mining and cluster analysis.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Explain the concepts of Data Warehousing architecture and business analysis process.
2. Illustrate the process of Data Mining and preprocessing techniques for data cleansing.
3. Apply the association rules for mining the various kinds of data
4. Analyze Classification and Clustering algorithms for various problems with high dimensional data.
5. Illustrate the various data mining techniques on complex data objects.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **10 Hours**

**DATA WAREHOUSING AND BUSINESS ANALYSIS**

Data warehousing Components -Building a Data warehouse -Data Warehouse and DBMS- Metadata- Multidimensional data model - Data Extraction, Cleanup and Transformation Tools -Reporting, Query tools and Applications - OLAP vs OLTP - OLAP operations - Data Warehouse Schemas: Stars, Snowflakes and Fact constellations.

**UNIT II** **8 Hours**

**INTRODUCTION TO DATA MINING**

Introduction - Steps in knowledge discovery from databases process - Architecture of a Typical Data Mining Systems - Data Mining Functionalities - Classification of Data Mining Systems - Data mining on different kinds of data - Different kinds of pattern - Task Primitives - Integration of a Data Mining System with a Data Warehouse - Major issues in Data mining.

**UNIT III** **9 Hours**

**ASSOCIATION RULE MINING**

Market Basket Analysis- Frequent Item Set Mining methods: Apriori algorithm - Generating Association Rules - A Pattern Growth Approach- Pattern mining in multilevel and multidimensional space - Mining Various Kinds Of Association Rules - Association Analysis to Correlation Analysis - Constraint Based Association Mining.

**UNIT IV** **10 Hours**

**CLASSIFICATION AND CLUSTERING**

Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Back propagation - Support Vector Machines - Clustering: Types of data - Partitioning methods: k-means, k- medoid - Hierarchical Methods: distance based agglomerative and divisible clustering, BIRCH - Density Based Method: DBSCAN - Grid Based Method: STING.

**UNIT V** **10 Hours**

**DATA MINING APPLICATIONS**

Mining complex data objects - Text Mining - Graph mining - Web mining - Spatial Data mining - Application and trends in data mining - Social impacts of Data mining.

**Total: 47 Hours**

**Reference(s)**


1. Jiawei Han, Micheline Kamber and Jian Pai , Data Mining: Concepts and Techniques, Morgan Kauffman, 3rd Edition, 2013.
2. Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw- Hill, 1997.
3. David Hand, Heikki Manila, Padhraic Symth, Principles of Data Mining, MIT Press, 2001.
4. Margaret H.Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education 2003.

## 22OCS04 E-LEARNING TECHNIQUES 3 0 0 3

**Course Objectives**

- Understand the technologies involved in e-learning.
- Gain the fundamentals of e-learning techniques
- Determine the characteristics of Teaching-Learning Process

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
n. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

**Course Outcomes (COs)**

1. Acquire knowledge about the basic concepts of e-learning.
2. Explain the technology mediated communication in e-learning.
3. Exemplify of e-learning and content the process management.
4. Analyze the teaching and learning processes in e-learning environment.
5. Assess the various applications of e-learning.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **9 Hours**

**INTRODUCTION**

Evolution of Education - Generations of Distance Educational Technology - Role of E-Learning - Components of e-learning: CBT, WBT, Virtual Classroom - Barriers to e-Learning Roles and Responsibilities: Subject Matter Expert - Instructional Designer - Graphic Designer - Multimedia Author - Programmer - System Administrator - Web Master

**UNIT II** **9 Hours**

**TECHNOLOGIES**

Satellite Broadcasting - Interactive Television - Call Centers - Whiteboard Environment - Teleconferencing: Audio Conferencing - Video Conferencing -Computer Conferencing. Internet: E-mail, Instant Messaging, Chat, Discussion Forums, Bulletin Boards, Voice Mail, File Sharing, Streaming Audio and Video.

**UNIT III** **9 Hours**

**MANAGEMENT**

Content: E-Content, Dynamic Content, Trends - Technology: Authoring, Delivery, Collaboration - Services: Expert Service, Information Search Service, Knowledge Creation Service - Learning Objects and E-Learning Standards. Process of E-Learning: Knowledge acquisition and creation, Sharing of knowledge, Utilization of knowledge - Knowledge Management in E-Learning.

**UNIT IV** **9 Hours**

**TEACHING-LEARNING PROCESS**

Interactions: Teacher-Student - Student-Student - Student-Content - Teacher- Content - Teacher-Teacher - Content-Content Role of Teachers in E-Learning - Blended Learning -Cooperative Learning - Collaborative Learning - Multi Channel learning -Virtual University - Virtual Library.

**UNIT V** **9 Hours**

**APPLICATIONS**

Customer service training - Sales training - Customer training - Safety training - IT training - Product training - Healthcare training.

**Total: 45 Hours**

**Reference(s)**


1. E-Learning: An Expression of the Knowledge Economy, Gaurav Chadha, S.M. Nafay Kumail, Tata McGraw-Hill Publication, 2002.
2. E-Learning: New Trends and Innovations, P.P. Singh, Sandhir Sharma, Deep & Deep Publications, 2005. 4. 4. Michael Allen"s Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002
3. E-Learning: Concepts, Trends and Applications, Epignosis LLC, LLC publications, 2014.
4. Michael Allen"s Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.

## 22OCS05 SOCIAL TEXT AND MEDIA ANALYTICS 3 0 0 3

**Course Objectives**

- Understand the basic ideas of Text mining.
- Analyze the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. 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.

**Course Outcomes (COs)**

1. Demonstrate the concepts and applications of text mining
2. Explain Content analysis and Sentiment analysis
3. Illustrate web analytics with a suitable model
4. Illustrate social network and media analytics with suitable example.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **7 Hours**

**TEXT MINING**

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

**UNIT II** **9 Hours**

**METHODS**

Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modeling-Sentiment Analysis; Sentiment Prediction.

**UNIT III** **9 Hours**

**WEB ANALYTICS**

Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

**UNIT IV** **10 Hours**

**SOCIAL NETWORK ANALYTICS**

Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks

**UNIT V** **10 Hours**

**SOCIAL MEDIA ANALYTICS**

Information visualization - Making connections: Link analysis - Random graphs and network evolution.

**Total: 45 Hours**

**Reference(s)**


1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
3. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
4. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003

## 22CS0XA EDGE AI FOR DATA SCIENCE 1 0 0 1

**Course Objectives**

- To understand the fundamental concepts of AI and their applications
- To Understand the intuition behind the fundamental components of AI.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Build a comprehensive knowledge base and gain hands-on experience in EDGE AI.
2. Explore and implement hardware technologies for AI

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**IT PERSPECTIVE FOR AI**

The IT perspective for AI - The hardware technologies for AI - Technological evolution and AI revolution The IT architecture for AI on Cloud - Machine- and deep-learning-as-a-service - Hardware accelerators fueling AI - Computing anywhere: IoT and Edge for AI - AI for IoT - Edge AI - Motivation behind Edge AI -Edge AI applications- Implementation process of Algorithms Inferences deployment on Edge

**Total: 15 Hours**

**Reference(s)**


1. Serverless Edge Computing Vision and Challenges M.S. Aslanpour and A.N. Toosi,2021
2. Edge-centric computing: vision and challenges", P. Garcia Lopez, 2015.
3. Edge AI: Convergence of Edge Computing and Artificial Intelligence , X. Wang, and Y. Han, 2020.
4. Towards a Serverless Platform for Edge Ai , V. Muthusamy, 2019.

## 22CS0XB GENERATIVE ADVERSARIAL NETWORKS FOR DATA SCIENCE

**1 0 0 1**

**Course Objectives**

- To understand the fundamental concepts of GANs and their applications
- To Understand the intuition behind the fundamental components of GANs.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Develop the ability to conceptualize and build conditional GANs capable of generating examples from determined categories
2. Explore and implement multiple GAN architectures

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**GENERATIVE MODELS**

Generative Models - Real Life GANs - Intuition Behind GANs - Discriminator - Generator - BCE Activations (Basic Properties) - Mode Collapse and Problems with BCE Loss- Common Activation Functions Batch Normalization - Review of Pytorch-Convolutions - Padding and Stride - Pooling and

Upsampling - Transposed Convolutions- Earth Movers Distance (Wasserstein Distance)- Wasserstein-Loss

**Total: 15 Hours**

**Reference(s)**


1. GANs in Action Jakub Langr and Vladimir Bok,2019.
2. Generative Deep Learning, David Foster,2019.
3. Learning Generative Adversarial Networks, Kuntal Ganguly, 2017.
4. Generative Adversarial Networks Projects, Kailash Ahirwar, 2019.

## 22CS0XC AUTOML FOR DATA SCIENCE 1 0 0 1

**Course Objectives**

- Understand the fundamental concepts and techniques of exploratory data analysis.
- Develop skills in analyzing and visualizing data to gain insights and make informed decisions.
- Apply exploratory data analysis techniques to real-world datasets.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. Demonstrate knowledge of the principles and techniques of exploratory data analysis
2. Apply appropriate statistical and visual methods to analyze and interpret data.
3. Communicate insights and findings effectively through data visualization and reporting

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**EXPLORATORY DATA ANALYSIS**

Introduction to Exploratory Data Analysis (EDA) and its importance in data analysis- Data types and data structures -Descriptive statistics- summary statistics -Data visualization techniques -Data cleaning and preprocessing-Exploring relationships between-analyzing individual variables and relationships between variables-Introduction to statistical inference and hypothesis testing-Case studies and hands-on exercises: applying EDA techniques to real-world datasets.

**Total: 15 Hours**

**Reference(s)**


1. Exploratory Data Analysis with Python by Pratap Dangeti
2. Python for Data Analysis by Wes McKinney.
3. The Visual Display of Quantitative Information by Edward R. Tufte.
4. Data Visualization: A Practical Introduction by Kieran Healy.
5. Online resources and tutorials from data science communities and platforms (e.g., Kaggle, Towards Data Science).

## 22CS0XD FULL STACK WEB DEVELOPMENT 1 0 0 1

**Course Objectives**

- To understand the responsive UI components, implementing user authentication and setting up backend communication through APIs
- To develop robust web applications using React for dynamic front-end interfaces and Java for creating APIs, ensuring seamless communication and functionality between the two layers.

**Programme Outcomes (POs)**

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
f. 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.
g. 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.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.
m. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

**Course Outcomes (COs)**

1. To develop web applications using React for the front end and Java for backend.
2. To integrate the web application APIs using deployment strategies.

**Articulation Matrix**

| CO No | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**UNIT I** **15 Hours**

**WEB APPLICATION INTEGRATION AND DEPLOYMENT**

Overview of React in Web Applications-Setting Up the development environment-Creating React component for Community web application-Designing Responsive UI- Hands-on to work on development for overview page - Creating API for backend communication in java - Implementing

User Authentication and Access Control - Enhancing the UI with additional Features - Deployment strategies and future scalability considerations.

**Total: 15 Hours**

**Reference(s)**


1. https://www.linkedin.com/pulse/ultimate-guide-web3-community-management-tips-tricks-building-martin
2. https://core.ac.uk/download/pdf/161432422.pdf
3. https://www.ijraset.com/research-paper/developing-an-e-commerce-web-application-with-react-js-and-firebase
4. http://irjaes.com/wp-content/uploads/2022/02/IRJAES-V7N1P162Y22.pdf