**M.E. COMPUTER SCIENCE AND ENGINEERING**
**REGULATION – 2021**
**CHOICE BASED CREDIT SYSTEM**
**I - IV SEMESTERS CURRICULA AND SYLLABI**

## PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

**Profession:** Graduates excel in computer technology in order to pursue higher education and research, or have a successful career in industries or as entrepreneurs.

**Technophile:** Graduates will have the ability and attitude to adapt emerging technological changes in the field of Computer Science and Engineering.

**Team Player:** Possess an ability to collaborate as a team member and team leader to affect technical solutions for computing systems, providing improved function and outcomes.

## PROGRAM OUTCOMES POs:

**Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **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.
4. **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.
5. **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.
6. **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.

7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OBJECTIVES (PSOs):

**Efficacy:** Ability to apply mathematical methodologies and foundational concepts of Computer Science and Engineering to solve computational tasks, model the real world problem using appropriate data structure and algorithm with suitable programming languages.

**Potentiality to design:** Analyze, design and evaluate a computer based system by applying software engineering principles and practices for developing quality software for scientific and business applications.

**Technical expertise:** Adapt to modern engineering technologies and thereby build robust, reliable, maintainable, scalable, innovative and efficient computing systems by considering social, environmental, economic, and security constraints

**MAPPING OF PROGRAM OUTCOMES (POs) WITH**
**PROGRAM EDUCATIONAL OBJECTIVES (PEOs) and PROGRAM SPECIFIC OUTCOMES (PSOs)**

| Program Outcomes (POs) | Program Educational Objectives (PEOs) | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|
| | Profession | Technophile | Team Player | Efficacy | Potentiality to design | Technical expertise |
| **Engineering knowledge** | 3 | 3 | 1 | 3 | 3 | 3 |
| **Problem analysis** | 3 | 3 | 2 | 3 | 3 | 2 |
| **Design/development of solutions** | 3 | 3 | 2 | 3 | 3 | 3 |
| **Conduct investigations of complex problems** | 3 | 3 | 3 | 3 | 3 | 2 |
| **Modern tool usage** | 2 | 3 | 1 | 3 | 3 | 3 |
| **The engineer and society** | 2 | 2 | 2 | 2 | 2 | 3 |
| **Environment and sustainability** | 2 | 2 | 2 | 2 | 2 | 3 |
| **Ethics** | 3 | 2 | 3 | 2 | 2 | 2 |
| **Individual and team work** | 3 | 2 | 3 | 2 | 2 | 2 |
| **Communication** | 3 | 2 | 3 | 2 | 2 | 3 |
| **Project management and finance** | 2 | 2 | 2 | 3 | 3 | 2 |
| **Life-long learning** | 3 | 3 | 2 | 3 | 2 | 3 |

**Correlation Level 1, 2 or 3 as defined below:**

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)

**MAPPING OF COURSE OUTCOMES (Cos)**

**WITH PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs)**

**A broad relation between the Course Outcomes and Program Outcomes is given in the following table**

| Sem | Course Title | Program Outcomes (POs) | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| I | Advanced Mathematics for Scientific Computing | √ | √ | √ | | | | | √ | √ | √ | | √ | √ | √ | √ |
| | Algorithm Design and Implementation (Lab Integrated) | √ | √ | √ | | | | | | √ | | | | √ | √ | √ |
| | Advanced Computer Architecture | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Advanced Network Principles and Protocols | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Machine Learning Techniques | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Research Methodology and IPR | | | | | √ | √ | √ | √ | √ | √ | | √ | √ | √ | √ |
| | Machine Learning Lab | √ | √ | √ | | √ | √ | | √ | √ | √ | | √ | √ | √ | √ |
| II | Information Storage Management | √ | √ | √ | | | | | √ | √ | √ | | √ | √ | √ | √ |
| | Compiler Optimization Techniques | √ | √ | √ | | | | | | √ | | | | √ | √ | √ |
| | Soft Computing Techniques | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Big Data Analytics | √ | √ | √ | | | | √ | √ | √ | √ | | √ | √ | √ | √ |
| | Data Analytics Lab | √ | √ | √ | √ | √ | √ | | √ | √ | √ | | √ | √ | √ | √ |
| II | Design and Analysis of Parallel Algorithms | √ | √ | √ | | √ | | | √ | | | | √ | √ | √ | √ |
| | Open Source Programming | √ | √ | √ | | √ | | | √ | | | | √ | √ | √ | √ |
| | Principles of Cryptography | √ | √ | √ | | √ | | | √ | | | | | √ | √ | √ |
| | Computer Graphics and Image Processing | √ | √ | √ | | √ | | | | √ | | | | √ | √ | √ |
| | Internet of Things | √ | √ | √ | | √ | | | √ | | | | √ | √ | √ | √ |

| Sem | Course Title | Program Outcomes (POs) | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| III | Human Computer Interaction | √ | √ | √ | | | | | | √ | √ | | √ | √ | √ | √ |
| | Imaging and Multimedia Systems | √ | √ | √ | | | | | √ | | | | | √ | √ | √ |
| | Agent Based Intelligent Systems | √ | √ | √ | | √ | | | | | | | √ | √ | √ | √ |
| | Deep Learning | √ | √ | √ | | √ | | | | | | | √ | √ | √ | √ |
| | Information Retrieval Techniques | √ | √ | √ | | | | | | √ | | | √ | √ | √ | √ |
| | Blockchain Technologies | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Speech Processing and Synthesis | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Advanced Software Engineering | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Mobile Network Systems | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Cyber Security | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Cloud Computing | √ | √ | √ | | | | | | | | | | √ | √ | √ |
| | Software Design Patterns | | | | √ | | | | √ | √ | √ | | | √ | √ | √ |
| | Big Data Mining and Analytics | √ | √ | √ | | √ | | | | | | | | √ | √ | √ |
| | Social Network Analysis | √ | √ | √ | | √ | | | √ | | | | | √ | √ | √ |
| | Cognitive Science | √ | √ | √ | | √ | | | √ | | √ | √ | | √ | √ | √ |

**SEMESTER I**

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | MA1151 | Advanced Mathematics for Scientific Computing | FC | 4 | 4 | 0 | 0 | 4 |
| 2 | CP1101 | Algorithm Design and Implementation (Lab Integrated) | PCC | 5 | 3 | 0 | 2 | 4 |
| 3 | CP1102 | Advanced Computer Architecture | PCC | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1103 | Advanced Network Principles and Protocols | PCC | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1104 | Machine Learning Techniques | PCC | 3 | 3 | 0 | 0 | 3 |
| 6 | RM1101 | Research Methodology and IPR | RMC | 2 | 2 | 0 | 0 | 2 |
| **PRACTICAL** | | | | | | | | |
| 7 | CP1107 | Machine Learning Laboratory | PCC | 4 | 0 | 0 | 4 | 2 |
| **Total** | | | | **24** | **18** | **0** | **6** | **21** |

**SEMESTER II**

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | CP1201 | Information Storage Management | PCC | 3 | 3 | 0 | 0 | 3 |
| 2 | CP1202 | Compiler Optimization Techniques | PCC | 4 | 4 | 0 | 0 | 4 |
| 3 | CP1203 | Soft Computing Techniques | PCC | 4 | 4 | 0 | 0 | 4 |
| 4 | CP1204 | Big Data Analytics | PCC | 3 | 3 | 0 | 0 | 3 |
| 5 | | Open Elective - I | OEC | 3 | 3 | 0 | 0 | 3 |
| 6 | | Professional Elective - I | PEC | 3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | |
| 7 | CP1207 | Data Analytics Laboratory | PCC | 4 | 0 | 0 | 4 | 2 |
| **Total** | | | | **24** | **20** | **0** | **4** | **22** |
| 8 | | Audit Course (Optional) | AC | | | | | |

## SEMESTER III

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | | Professional Elective - II | PEC | 3 | 3 | 0 | 0 | 3 |
| 2 | | Professional Elective - III | PEC | 3 | 3 | 0 | 0 | 3 |
| 3 | | Professional Elective - IV | PEC | 3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | |
| 4 | CP1307 | Project Work - Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| **Total** | | | | **21** | **9** | **0** | **12** | **15** |
| 5 | | Value Added Course / Internship | Audit Course | Two Weeks | | | | 1 |

## SEMESTER IV

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICAL** | | | | | | | | |
| 1 | CP1407 | Project Work - Phase II | EEC | 24 | 0 | 0 | 24 | 12 |
| **Total** | | | | **24** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS: 70**

## FOUNDATION COURSES (FC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | MA1151 | Advanced Mathematics for Scientific Computing | 4 | 4 | 0 | 0 | 4 |

## PROFESSIONAL CORE COURSES (PCC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1101 | Algorithm Design and Implementation (Lab Integrated) | 4 | 3 | 0 | 2 | 4 |
| 2 | CP1102 | Advanced Computer Architecture | 3 | 3 | 0 | 0 | 3 |
| 3 | CP1103 | Advanced Network Principles and Protocols | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1104 | Machine Learning Techniques | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1107 | Machine Learning Lab | 4 | 0 | 0 | 4 | 2 |
| 6 | CP1201 | Information Storage Management | 3 | 3 | 0 | 0 | 3 |
| 7 | CP1202 | Compiler Optimization Techniques | 4 | 4 | 0 | 0 | 4 |
| 8 | CP1203 | Soft Computing Techniques | 4 | 4 | 0 | 0 | 4 |
| 9 | CP1204 | Big Data Analytics | 3 | 3 | 0 | 0 | 3 |
| 10 | CP1207 | Data Analytics Lab | 4 | 0 | 0 | 4 | 2 |

## RESEARCH METHODOLOGY COURSE (RMC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | RM1101 | Research Methodology and IPR | 2 | 2 | 0 | 0 | 2 |

## PROFESSIONAL ELECTIVE COURSES (PEC)
## SEMESTER II
## PROFESSIONAL ELECTIVE – I

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1211 | Design and Analysis of Parallel Algorithms | 3 | 3 | 0 | 0 | 3 |
| 2 | CP1212 | Open Source Programming | 3 | 3 | 0 | 0 | 3 |
| 3 | CP1213 | Principles of Cryptography | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1214 | Computer Graphics and Image Processing | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1215 | Internet of Things | 3 | 3 | 0 | 0 | 3 |

**SEMESTER III**
**PROFESSIONAL ELECTIVE – II**

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1311 | Human Computer Interaction | 3 | 3 | 0 | 0 | 3 |
| 2 | CP1312 | Imaging and Multimedia Systems | 3 | 3 | 0 | 0 | 3 |
| 3 | CP1313 | Agent Based Intelligent Systems | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1314 | Deep Learning | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1315 | Information Retrieval Techniques | 3 | 3 | 0 | 0 | 3 |

**SEMESTER III**
**PROFESSIONAL ELECTIVE – III**

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1321 | Block chain Technologies | 3 | 3 | 0 | 0 | 3 |
| 2 | CP1322 | Speech Processing and Synthesis | 3 | 3 | 0 | 0 | 3 |
| 3 | CP1323 | Advanced Software Engineering | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1324 | Mobile Network Systems | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1325 | Cyber Security | 3 | 3 | 0 | 0 | 3 |

**SEMESTER III**
**PROFESSIONAL ELECTIVE – IV**

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1331 | Cloud Computing | 3 | 3 | 0 | 0 | 3 |
| 2 | CP1332 | Software Architecture and Design Patterns | 3 | 3 | 0 | 0 | 3 |
| 3 | CP1333 | Big Data Mining and Analytics | 3 | 3 | 0 | 0 | 3 |
| 4 | CP1334 | Social Network Analysis | 3 | 3 | 0 | 0 | 3 |
| 5 | CP1335 | Cognitive Science | 3 | 3 | 0 | 0 | 3 |

## OPEN ELECTIVE COURSES (OEC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | OBY101 | Essentials Of Hazardous Waste Management | 3 | 3 | 0 | 0 | 3 |
| 2 | OCP101 | Business Data Analytics | 3 | 3 | 0 | 0 | 3 |
| 3 | OEC101 | Next Generation Wireless Networks | 3 | 3 | 0 | 0 | 3 |
| 4 | OMF103 | Optimization Techniques | 3 | 3 | 0 | 0 | 3 |
| 5 | OPE101 | Renewable sources of Electrical Energy | 3 | 3 | 0 | 0 | 3 |

## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | CP1307 | Project Work - Phase I | 12 | 0 | 0 | 12 | 6 |
| 2 | CP1407 | Project Work - Phase II | 24 | 0 | 0 | 24 | 12 |

## AUDIT COURSE (AC)

| S.No. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | AD1001 | Constitution of India | 2 | 2 | 0 | 0 | 0 |
| 2 | AD1002 | Value Education | 2 | 2 | 0 | 0 | 0 |
| 3 | AD1003 | Pedagogy Studies | 2 | 2 | 0 | 0 | 0 |
| 4 | AD1004 | Stress Management by Yoga | 2 | 2 | 0 | 0 | 0 |
| 5 | AD1005 | Personality Development Through Life EnlightenmentSkills | 2 | 2 | 0 | 0 | 0 |
| 6 | AD1006 | Unnat Bharat Abhiyan | 2 | 2 | 0 | 0 | 0 |
| 7 | AD1007 | Essence of Indian Knowledge Tradition | 2 | 2 | 0 | 0 | 0 |
| 8 | AD1008 | Sanga Tamil Literature Appreciation | 2 | 2 | 0 | 0 | 0 |

**CREDIT SUMMARY**

| S. No. | SUBJECT AREA | I | II | III | IV | CREDITS TOTAL | PERCENTAGE |
|---|---|---|---|---|---|---|---|
| **1** | **FC** | 4 | | | | **4** | **5.71** |
| **2** | **PCC** | 15 | 16 | | | **31** | **44.29** |
| **3** | **PEC** | | 3 | 9 | | **12** | **17.14** |
| **4** | **RMC** | 2 | | | | **2** | **2.86** |
| **4** | **OEC** | | 3 | | | **3** | **4.29** |
| **5** | **EEC** | | | 6 | 12 | **18** | **25.71** |
| **Total** | | **21** | **22** | **15** | **12** | **70** | **100** |

| MA1151 | ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |

**OBJECTIVES**

- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queuing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems.

| UNIT I | RANDOM VARIABLES | 12 |
|---|---|---|
| Random variables – Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions – Function of a Random variable - Moments, Moment generating function. | | CO1 |
| **UNIT II** | **QUEUING MODELS** | **12** |
| Poisson Process – Markovian Queues – Single and Multi-server Models – Model 1: (M/M/1): FIFO/∞/∞)-Model 2: (M/M/1): FIFO/N/∞)- Model 3: (M/M/C): FIFO/∞/∞)- Model 4: (M/M/C): FIFO/N/∞)- Little"s formula –Machine Interference Model – Steady State analysis – Self Service Queue | | CO2 |
| **UNIT III** | **SIMULATION** | **12** |
| Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing systems. | | CO3 |
| **UNIT IV** | **TESTING OF HYPOTHESIS** | **12** |
| Sampling distributions – Estimation of parameters - Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion. | | CO4 |
| **UNIT V** | **LINEAR PROGRAMMING** | **12** |
| Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems. | | CO5 |
| | | **TOTAL : 60 PERIODS** |

**REFERENCE BOOKS**


1. Johnson, R.A. Miller and Freund"s," Probability and Statistical for Engineers, Prentice Hall of India Pvt., Ltd., New Delhi, Seventh Edition, 2005.
2. Hamdy A. Taha, "Operations Research: An Introduction", Prentice Hall of India Pvt, Ltd. New Delhi, Eighth Edition, 2007.
3. Jay L. Devore," Probability and Statistics for Engineering and the Sciences", Cengage Learning, Seventh Edition, 2009.
4. J.Medhi," Stochastic models of Queuing Theory", Academic Press, Elsevier, Amsterdam, 2003
5. Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, 2003.
6. Gross D. and Harris C.M., "Fundamentals of Queuing Theory", John Wiley and Sons, New York, 1998.
7. Ross. S.M., "Probability Models for Computer Science", Academic Press, 2002.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Identify the type of random variable and distribution for a given operational conditions /scene |
| CO2 | The course gives ideas on Queuing models modelling through Monrovian Queues through which students will be able to Design appropriate queuing model for a given problem / system situation. |
| CO3 | Handle the real-life situation through discrete event simulation and do the analysis. |
| CO4 | Gain the knowledge on testing of hypotheses on data from biological, economic and social experiments and all kinds of generalizations based on information from samples. |
| CO5 | Learn an optimization technique by learning the solution procedures of linear programming, the same can be applied to Formulate and find optimal solution in the real life optimizing /allocation /assignment problems involving conditions and resource constraints |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | 1 | 1 | 2 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | 2 | 2 | 1 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 2 | 1 | - | - | - | 2 | 2 | 2 | 2 | 1 |
| **CO4** | 3 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | 1 | 2 | 2 | 2 | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 2 | 1 | 2 | 2 | 1 |

| CP1101 | ALGORITHM DESIGN AND IMPLEMENTATION (Lab Integrated) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES**

- ❖ To understand the usage of algorithms in computing.
- ❖ To learn and use hierarchical data structures and its operations
- ❖ To learn the usage of graphs and its applications.
- ❖ To select and design data structures and algorithms that is appropriate for problems.
- ❖ To study about NP Completeness of problems.

| UNIT I | ALGORITHM DESIGN INTRODUCTION | 9+6 |
|---|---|---|

Review off Data Structures-Program Performance- Time and space complexity, average and worst-case analysis, asymptotic notation, recurrence equations- Search techniques (backtracking and bounding), Sorting algorithms - lower bound, sorting in linear time, Greedy algorithms (Huffman coding, knapsack), Divide and conquer - Master theorem, Dynamic programming (0/1 knapsack, Traveling salesman problem, matrix multiplication, all-pairs shortest paths)

**Lab Component**

- Implement nth Fibonacci using recursive and non-recursive function. Compare the time complexities of both.
- Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.

**CO1**

| UNIT II | ADVANCED STRUCTURES | 9+6 |
|---|---|---|

Binary search trees, B trees, AVL trees, Red black trees, splay trees. Van Emde Boas trees. Randomly built binary search trees. Heaps, Binomial heaps, Fibonacci heaps. Minimum spanning trees, BFS, DFS, strongly connected components, Biconnected components.

**Lab Component**

- Implement B trees and Red black trees
- Implement Binomial Heaps and Fibonacci heaps

**CO2**

| UNIT III | NETWORK FLOW AND STRING MATCHING | 9+6 |
|---|---|---|

Flow networks, The Ford-Fulkerson method, Maximum bipartite matching. String Matching: Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.

**Lab Component**

- Analyse the flow of network using Ford-Fulkerson method
- Implement Knuth-Morris-Pratt algorithm

**CO3**

| UNIT IV | APPROXIMATION ALGORITHMS | 9+6 |
|---|---|---|

NP completeness, Reductions, coping with NP completeness, Approximation algorithms: The vertex cover problem, - the travelling salesman problem, The set covering problem, The Subset-sum problem. Graph colouring.

**Lab Component**

- Use approximation algorithms and implement the technique in the travelling salesman problem.
- Design and implement in Java to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution. 12. Design and implement in Java to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

**CO4**

| UNIT V | RANDOMIZED ALGORITHMS | 9+6 |
|---|---|---|
| Las Vegas and Monte Carlo algorithm, Random variables and their expectations. Probabilistic analysis and uses of indicator random variables: Birthday paradox, coupon collector's problem, The online hiring problem. Randomized version of quick sort, Miller Rabin randomized primality Test.<br>**Lab Component**<br>• Implement Las Vegas using randomized algorithm<br>• Simulate the Miller Rabin randomized primality Test. | | CO5 |

| PRACTICAL :30 PERIODS | THEORY:45 PERIODS | TOTAL : 75 PERIODS |
|---|---|---|

**TEXT BOOKS**

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein. "Introduction to Algorithms," Third edition ,Prentice Hall India, 2011

**REFERENCE BOOKS**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++," Third edition, Pearson 2007.
2. Michael Sipser, "Introduction to theory of computation", Thomson Course technology, 2006
3. R. Motwani and P. Raghavan, "Randomized Algorithms," Cambridge University Press, 1995

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Demonstrate the following capabilities: to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in programming context. |
| CO2 | Choose the appropriate data structure for modelling a given problem and Compare and contrast the costs and benefits of different data structure implementations. |
| CO3 | Choose the appropriate string matching and network flow algorithms |
| CO4 | Explain the significance of NP-completeness and importance of approximation algorithms. |
| CO5 | Explain the use of randomization in the design of an algorithm for a problem where a deterministic algorithm is unknown or much more difficult |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |

| CP1102 | ADVANCED COMPUTER ARCHITECTURE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

| UNIT I | FUNDAMENTALS OF COMPUTER DESIGN AND ILP | 9 |
|---|---|---|
| Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading | | CO1 |
| **UNIT II** | **MEMORY HIERARCHY DESIGN** | **9** |
| Introduction – Optimizations of Cache - Performance– Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies. | | CO2 |
| **UNIT III** | **MULTIPROCESSOR ISSUES** | **9** |
| Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks | | CO3 |
| **UNIT IV** | **MULTICORE ARCHITECTURES** | **9** |
| Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers-Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer | | CO4 |
| **UNIT V** | **VECTOR, SIMD AND GPU ARCHITECTURES** | **9** |
| Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Darryl Gove, ―Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, ―Programming Massively Parallel Processors‖, Morgan Kauffman, 2010


**REFERENCE BOOKS**


1. David E. Culler, Jaswinder Pal Singh, ―Parallel computing architecture : A hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999
2. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Identify the limitations of ILP. |
| CO2 | Discuss the issues related to multiprocessing and suggest solutions |
| CO3 | Discuss the various techniques used for optimising the cache performance |
| CO4 | Point out the salient features of different multicore architectures and how they exploit parallelism. |
| CO5 | Point out how data level parallelism is exploited in architectures |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |

| CP1103 | ADVANCED NETWORK PRINCIPLES AND PROTOCOLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks
- To understand the paradigm of Software defined networks

| UNIT I | NETWORK PRINCIPLES | 9 |
|---|---|---|
| Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks. | | CO1 |
| **UNIT II** | **WIRELESS NETWORKS** | **9** |
| IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles | | CO2 |
| **UNIT III** | **CELLULAR NETWORKS** | **9** |
| GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security | | CO3 |
| **UNIT IV** | **4G NETWORKS** | **9** |
| LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G | | CO4 |
| **UNIT V** | **SOFTWARE DEFINED NETWORKS** | **9** |
| Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Erik Dahlman, Stefan Parkvall, Johan Skold, —4G: LTE/LTE-Advanced for Mobile Broadband‖, Academic Press, 2013.
2. Jonathan Rodriguez, —Fundamentals of 5G Mobile Networks‖, Wiley, 2015.

**REFERENCE BOOKS**


1. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
2. Martin Sauter, ―Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0‖, Wiley, 2009.
3. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, ―Next-Generation Wireless Technologies‖, Springer, 2013.
4. Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Morgan Kauffman, 2014.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Identify the components required for designing a network |
| CO2 | Design a network at a high-level using different networking technologies |
| CO3 | Analyze the various protocols of wireless and cellular networks |
| CO4 | Discuss the features of 4G and 5G networks |
| CO5 | Experiment with software defined networks |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |

| CP1104 | MACHINE LEARNING TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques
- To understand graphical models of machine learning algorithms

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression. | | CO1 |
| **UNIT II** | **LINEAR MODELS** | **9** |
| Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines. | | CO2 |
| **UNIT III** | **TREE AND PROBABILISTIC MODELS** | **9** |
| Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map | | CO3 |
| **UNIT IV** | **DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS** | **9** |
| Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process | | CO4 |
| **UNIT V** | **GRAPHICAL MODELS** | **9** |
| Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1 Stephen Marsland ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

2 Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014

**REFERENCE BOOKS**


1. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014
3. Tom M Mitchell, —Machine Learning‖, First Edition, McGraw Hill Education, 2013.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Distinguish between, supervised, unsupervised and semi-supervised learning |
| CO2 | Apply the appropriate machine learning strategy for any given problem |
| CO3 | Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem |
| CO4 | Design systems that use the appropriate graph models of machine learning |
| CO5 | Modify existing machine learning algorithms to improve classification efficiency |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |

| RM1101 | RESEARCH METHODOLOGY AND IPR | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 |

**OBJECTIVES**

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

| UNIT I | RESEARCH PROBLEM FORMULATION | 6 |
|---|---|---|
| Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations | | CO1 |
| **UNIT II** | **LITERATURE REVIEW** | **6** |
| Effective literature studies approaches, analysis, plagiarism, and research ethics. | | **CO2** |
| **UNIT III** | **TECHNICALWRITING /PRESENTATION** | **6** |
| Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee. | | **CO3** |
| **UNIT IV** | **INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)** | **6** |
| Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. | | **CO4** |
| **UNIT V** | **INTELLECTUAL PROPERTY RIGHTS (IPR)** | **6** |
| Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. | | **CO5** |
| | | **TOTAL: 30 PERIODS** |

**REFERENCE BOOKS**


1. Asimov, “Introduction to Design”, Prentice Hall, 1962.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners” 2010

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | To understand the concept of research methods and apply in problem solving. |
| CO2 | To analyse the data using statistical tools to solve practical problems. |
| CO3 | To understand the guidelines for effective report writing |
| CO4 | To understand and acquire the knowledge on Intellectual Property Rights |
| CO5 | To acquire knowledge on patent and copyright, trademark, and industrial design |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| **CO2** | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 |
| **CO3** | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| **CO4** | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 1 |
| **CO5** | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 |

| CP1107 | MACHINE LEARNING LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES**

- ❖ The course serves as a comprehensive introduction to various topics in machine learning.
- ❖ Students should be able to design and implement machine learning solutions to classification, regression, and clustering problems
- ❖ Students should able to evaluate and interpret the results of the algorithms.

**LIST OF EXPERIMENTS**

| | |
|---|---|
| 1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. | **CO1** |
| 2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. | |
| 3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. | **CO2** |
| 4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. | |
| 5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets. | |
| 6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set. | |
| 7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API. | **CO3** |
| 8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program. | |
| 9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem. | |
| 10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. | |
| **TOTAL : 60 PERIODS** | |

**REFERENCE BOOKS**


1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems,O'reily,Second edition,2019

**WEB REFERENCES**

1. https://github.com/profthyagu/Python--Candidate-Elimination-Algorithm
2. https://machinelearningmastery.com/tutorial-to-implement-k-nearest-neighbors-in-python-from-scratch/
3. https://www.geeksforgeeks.org/ml-locally-weighted-linear-regression/

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Understand the implementation procedures for the machine learning algorithms. Design Java/Python programs for various Learning algorithms. |
| CO2 | Apply appropriate data sets to the Machine Learning algorithms. |
| CO3 | Identify and apply Machine Learning algorithms to solve real world problems. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |

| CP1201 | INFORMATION STORAGE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the basic components of Storage System Environment.
- To understand the Storage Area Network Characteristics and Components
- To examine emerging technologies including IP-SAN.
- To understand the concepts in Business continuity and backup technologies
- To learn replication and modes off replication

| UNIT I | STORAGE SYSTEMS | 9 |
|---|---|---|
| Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Centre Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array. | | **CO1** |
| **UNIT II** | **STORAGE NETWORKING TECHNOLOGIES** | **9** |
| Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations. | | **CO2** |
| **UNIT III** | **ADVANCED STORAGE NETWORKING AND VIRTUALIZATION** | **9** |
| IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization. | | **CO3** |
| **UNIT IV** | **BUSINESS CONTINUITY** | **9** |
| Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies. | | **CO4** |
| **UNIT V** | **REPLICATION** | **9** |
| Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its technologies, Network Infrastructure | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Somasundaram Gnana Sundaram, Alok Shrivastava, Information Storage Management, John Wiley & sons,2nd Edition 2014.

**REFERENCE BOOKS**

1. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, —Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001
3. http://download.101com.com/GIG/Custom/2010PDFS/StorageMgt/Storage_Management2010.pdf

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Select from various storage technologies to suit for required application. |
| CO2 | Apply security measures to safeguard storage & farm. |
| CO3 | Analyse QoS on Storage. |
| CO4 | Usage of Business continuity and planning in real time |
| CO5 | Understanding local replication technologies. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1202 | COMPILER OPTIMIZATION TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |

**OBJECTIVES**

- ❖ To be aware of different forms of intermediate languages and analysing programs.
- ❖ To understand optimizations techniques for simple program blocks.
- ❖ To apply optimizations on procedures, control flow and parallelism.
- ❖ To learn inter procedural analysis and optimizations.
- ❖ To explore the knowledge about resource utilization.

| UNIT I | INTERMEDIATE REPRESENTATIONS AND ANALYSIS | 9 |
|---|---|---|
| Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis. | | **CO1** |
| **UNIT II** | **EARLY AND LOOP OPTIMIZATIONS** | **9** |
| Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial- Redundancy Elimination - Redundancy Elimination and Re-association - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination | | **CO2** |
| **UNIT III** | **PROCEDURE OPTIMIZATION AND SCHEDULING** | **9** |
| Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining. | | **CO3** |
| **UNIT IV** | **INTER PROCEDURAL OPTIMIZATION** | **9** |
| Symbol table – Runtime Support – Inter procedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph – Inter procedural Data-Flow Analysis Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References. | | **CO4** |
| **UNIT V** | **REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY** | **9** |
| Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations. | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.

**REFERENCE BOOKS**

1. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.
2. Robert Morgan ,Building an Optimizing Compiler, Digital Press, 1998
3. Steven Muchnick, —Advanced Compiler Design and Implementation‖, Morgan Kaufman Publishers, 1997.
4. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Identify the different optimization techniques for simple program blocks. |
| CO2 | Design performance enhancing optimization techniques |
| CO3 | Perform the optimization on procedures |
| CO4 | Ensure better utilization of resources |
| CO5 | Ensure resource allocation and memory optimization |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1203 | SOFT COMPUTING TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |

**OBJECTIVES**

- ❖ Understand Soft Computing concepts, technologies, and applications
- ❖ Understand the underlying principle of soft computing with its usage in various applications.
- ❖ Understand neural networks and its functionalities.
- ❖ Understand different fuzzy tools to solve real life problems.

Understand Genetic algorithms and implement in case studies.

| UNIT I | SOFT COMPUTING INTRODUCTION | 9 |
|---|---|---|
| Overview of Soft Computing, Difference between Soft and Hard computing, Brief descriptions of different components of soft computing including Artificial intelligence systems Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE | | **CO1** |
| **UNIT II** | **LEARNING TECHNIQUES** | **9** |
| Artificial Neural Networks: Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network. | | **CO2** |
| **UNIT III** | **NEURAL NETWORKS** | **9** |
| Neural Networks as Associative Memories - Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks – Competitive Learning, Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network. | | **CO3** |
| **UNIT IV** | **FUZZY LOGIC** | **9** |
| Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference System Fuzzy Logic Crisp & fuzzy sets fuzzy relations fuzzy conditional statements fuzzy rules fuzzy algorithm. Fuzzy logic controller. | | **CO4** |
| **UNIT V** | **GENETIC ALGORITHMS** | **9** |
| Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA case studies. Introduction to genetic programming- basic concepts. | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Eiben A. E. and Smith J. E., “Introduction to Evolutionary Computing”, Second Edition, Springer, Natural Computing Series, 2007.
2. Engelbrecht A. P., “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006.
3. Konar. A, “Computational Intelligence: Principles, Techniques and Applications”, Springer Verlag, 2005.

**REFERENCE BOOKS**


1. Kumar S., “Neural Networks - A Classroom Approach”, Tata McGraw Hill, 2004.
2. Ross T. J., “Fuzzy Logic with Engineering Applications”, McGraw Hill, 1997.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Develop application on different soft computing techniques. |
| CO2 | Develop application on different soft computing techniques in Neural network |
| CO3 | Develop application techniques based on classification algorithms. |
| CO4 | Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system |
| CO5 | Develop application on different soft computing techniques in GA. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **CO1** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1204 | BIG DATA ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

| UNIT I | INTRODUCTION TO BIG DATA | 9 |
|---|---|---|
| Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools. | | CO1 |
| **UNIT II** | **HADOOP FRAMEWORK** | **9** |
| Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN | | CO2 |
| **UNIT III** | **DATA ANALYSIS** | **9** |
| Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R. | | CO3 |
| **UNIT IV** | **MINING DATA STREAMS** | **9** |
| Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. | | CO4 |
| **UNIT V** | **BIG DATA FRAMEWORKS** | **9** |
| Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. 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 | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.

**REFERENCE BOOKS**


1. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Understand how to leverage the insights from big data analytics |
| CO2 | Understand the Hadoop framework |
| CO3 | Analyse data by utilizing various statistical and data mining approaches |
| CO4 | Perform analytics on real-time streaming data |
| CO5 | Understand the various No Sql alternative database models |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1207 | DATA ANALYTICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES**

- The course serves as a comprehensive introduction to various topics in machine learning.
- Students should be able to design and implement machine learning solutions to classification, regression, and clustering problems
- Students should able to evaluate and interpret the results of the algorithms.

**LIST OF EXPERIMENTS**

| | | |
|---|---|---|
| 1. | Install, configure and run Hadoop and HDFS | CO1 |
| 2. | Implement word count / frequency programs using MapReduce | |
| 3. | Implement an MR program that processes a weather dataset | CO2 |
| 4. | Implement Linear and logistic Regression | |
| 5. | Implement SVM / Decision tree classification techniques | |
| 6. | Implement clustering techniques | |
| 7. | Visualize data using any plotting framework | CO3 |
| 8. | Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R. | |

**TOTAL : 60 PERIODS**

**REFERENCE BOOKS**


1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley & Sons


**WEB REFERENCES**

1. https://www.thedatalab.com/skills-talent/online-learning/

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Process big data using Hadoop framework |
| CO2 | Build and apply linear and logistic regression models |
| CO3 | Perform data analysis with machine learning methods and graphical data analysis |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 1 | - | - | 2 | 2 | 2 | - | 2 | 3 | 3 | 2 |

| CP1211 | DESIGN AND ANALYSIS OF PARALLEL ALGORITHMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand different parallel structures and models of computation.
- To introduce the various classes of PRAM algorithms.
- To study MIMD algorithms for basic problems.
- Design and analyse parallel algorithms for matrix operations
- To learn about parallel computing models, design and analyze parallel algorithms Interconnection networks.

| UNIT I | STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS | 9 |
|---|---|---|
| Structures and algorithms for array processors: SIMD Array Processors, Interconnection networks, Parallel algorithms for Array processors. Multiprocessor architecture- Interconnection networks-multiprocessor control and algorithms- parallel algorithms for multiprocessors. | | **CO1** |
| **UNIT II** | **PRAM ALGORITHMS** | **9** |
| Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting – Merging Two Sorted Lists – Matrix Multiplication- Selection - broadcast- all sums- parallel selection. Searching a random sequence, sorted sequence on PRAM models | | **CO2** |
| **UNIT III** | **MIMD** | **9** |
| Merging - A network for merging - merging on PRAM models. Sorting on a linear array, EREW, CREW and CRCW SIMD models, MIMD Enumeration sort. | | **CO3** |
| **UNIT IV** | **MATRIX OPERATIONS** | **9** |
| Matrix operations- Transposition, Matrix by matrix multiplication, matrix by vector multiplication. Numerical problems- solving systems of linear equations, finding roots of non-linear equations on PRAM models. | | **CO4** |
| **UNIT V** | **GRAPHS** | **9** |
| Graphs - Connected components- dense graphs- sparse graphs. Minimum spanning tree- Solli's algorithm, Disconnected components, Ear decomposition, Directed graphs. | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", University press, Second edition , 2011
3. V Rajaraman, C Siva Ram Murthy," Parallel computers- Architecture and Programming ", PHI learning, 2016.

**REFERENCE BOOKS**


1. Kai Wang and Briggs, “Computer Architecture and Parallel Processing”, McGraw Hill, 1985.
2. S. G. Akl, “Designa and Analysis of Parallel Algorithms”, Prentice Hall Inc., 1992.
3. Joseph Jaja, “ An Introduction to parallel Algorithms”, Addison Wesley, 1992.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Develop structures and algorithms for standard problems and applications. |
| CO2 | Analyse efficiency of different parallel algorithms |
| CO3 | Develop parallel algorithms for standard problems and applications. |
| CO4 | Understand matrix operations in parallel algorithms |
| CO5 | To enable the student to design and analyse parallel algorithms |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **CO1** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1212 | OPEN SOURCE PROGRAMING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- Understand the difference between open-source programming and familiarity with Linux operating system.
- To build applications based on Open-Source web technology like PHP
- To understand web database applications
- Understanding and development of web applications using open source web technologies like MySql, PERL, TCL, Python.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System – Ubuntu Linux – Introduction to shell programming. | | CO1 |
| **UNIT II** | **PHP** | **9** |
| PHP Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state. | | CO2 |
| **UNIT III** | **WEB DATABASE APPLICATIONS** | **9** |
| Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL - querying web databases, writing to web databases, validation with Javascript, Form based authentication, protecting data on the web. | | CO3 |
| **UNIT IV** | **MSQL,PERL, TCL, AND PYTHON** | **9** |
| MySQL - MySQL Functions - Inserting Records Selecting Records - Deleting Records - Update Records –PERL: Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. TCL: Introduction to TCL/TK, Python: Introduction to Python. | | CO4 |
| **UNIT V** | **SECURITY IN WEB APPLICATIONS** | **9** |
| Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with Javascript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “Programming PHP”, O’Reilly Media, 2012.
2. Michael Cross, “Developer’s Guide to Web Application Security”, Syngress Publishers, 2007
3. Hugh E. Williams, David Lane, “Web Database applications with PHP and MYSQL”, Second Edition, O’Reilly Media, 2004.

**REFERENCE BOOKS**


1. Tom Christiansen, Brian D Foy, Larry Wall, Jon Orwant, “Programming Perl”, Fourth Edition, O’Reilly Media, 2012.
2. Mark Lutz, “Programming Python”, Fourth Edition, O’Reilly Media, 2010.
3. Online Tutorials and Recent IEEE/ACM Journal Papers


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Understand and use the concepts of open-source programming |
| CO2 | Usage of PHP in web applications |
| CO3 | Develop codes in open-source web applications |
| CO4 | Usage of open-source languages like MYSQL, PERL, TCL and Python |
| CO5 | Understand the risks associated with the open-source codes and write secure CGI scripts. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1213 | PRINCIPLES OF CRYPTOGRAPHY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To provide deeper understanding into cryptography, its application to network security, threats / vulnerabilities to networks and countermeasures.
- ❖ To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
- ❖ To familiarize Digital Signature Standard and provide solutions for their issues.
- ❖ To familiarize with cryptographic techniques for secure (confidential) communication of two parties over an insecure (public) channel; verification of the authenticity of the source of a message.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography. | | **CO1** |
| **UNIT II** | **BLOCK CIPHER AND DATA ENCRYPTION STANDARDS** | **9** |
| Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles. ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4. | | **CO2** |
| **UNIT III** | **PUBLIC KEY CRYPTOGRAPHY AND RSA** | **9** |
| Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, , Elliptic Curve Arithmetic, Elliptic Curve Cryptography. MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC.DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard. | | **CO3** |
| **UNIT IV** | **AUTHENTICATION APPLICATION** | **9** |
| Kerberos, X.509 Authentication Service, Public Key Infrastructure. EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME.IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. | | **CO4** |
| **UNIT V** | **WEB SECURITY** | **9** |
| Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats. FIREWALL: Firewall Design principles, Trusted Systems. | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

**REFERENCE BOOKS**

1. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.
2. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata McGraw-Hill, India
3. Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata McGraw-Hill, India

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Understand security trends and classical cryptography methods. |
| CO2 | Understand Block cipher and encryption standards |
| CO3 | Simulate with RSA and public key cryptography |
| CO4 | Usage of Authentication methods |
| CO5 | Develop web security principles as security measures, |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1214 | COMPUTER GRAPHICS AND IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand basic algorithms for computer graphics and image processing.
- To understand various filters, Point processing, and Arithmetic operations in image processing.
- To understand different applications of graphics and image processing.

| UNIT I | GRAPHICS SYSTEMS AND GRAPHICAL USER INTERFACE | 9 |
|---|---|---|
| Pixel, Resolution, Video display devices - Types – Graphical devices – Direct screen interaction – Logical input function –GKS. User dialogue – Interactive picture construction techniques. | | CO1 |
| **UNIT II** | **GEOMETRIC DISPLAY PRIMITIVES AND ATTRIBUTES** | **9** |
| Geometric display primitives: Points, Lines and Polygons. Point display method – Line drawing: DDA 2D Transformations and Viewing: Transformations - types – matrix representation – Concatenation - Scaling, Rotation, Translation, Shearing, Mirroring. Homogeneous coordinates – Window to view port transformations. Windowing and Clipping: Point, Lines, Polygons - boundary intersection methods. | | CO2 |
| **UNIT III** | **DIGITAL IMAGE FUNDAMENTALS** | **9** |
| Image Formation and types – Basic geometric transformations – Fourier Transforms – Walsh – Hadamard – Discrete Cosine – Hotelling Transforms. | | CO3 |
| **UNIT IV** | **IMAGE ENHANCEMENT AND RESTORATION** | **9** |
| Histogram Modification Techniques – Image Smoothening – Image Sharpening – Image Restoration – Degradation Model – Noise Models – Spatial Filtering – Frequency Domain Filtering. | | CO4 |
| **UNIT V** | **IMAGE SEGMENTATION AND RECOGNITION** | **9** |
| Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Morphology operations. Pattern classification - Clustering and Matching - Knowledge representation and use for scene analysis and image understanding (2D and 3D) - Object recognition and identification – Case study of various applications. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Donald Hearn & M. Pauline Baker , and warren R. Carithers, “Computer Graphics”, Prentice-Hall of India, Fourth edition 2011. (UNIT I & II)
2. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Education, Third edition, 2011. (UNIT III, IV &V)

**REFERENCE BOOKS**


1. Newmann W.M. and Sproull R.F., "Principles of Interactive Computer Graphics", Tata McGraw-Hill, Second edition, 2008
2. Foley J.D., Van Dam A, Fiener S.K. and Hughes J.F., “Computer Graphics", Second edition, Pearson education, 2008.
3. Anil Jain K, “Fundamentals of Digital Image Processing”, Prentice-Hall of India, 2001.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Usage of Graphical systems and GUI |
| CO2 | Develop simpler games using geometric display primitives |
| CO3 | Usage of Digital Image fundamentals. |
| CO4 | Usage off image enhancement and restoration in creation of Animation |
| CO5 | Use image segmentation in pattern recognition applications |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 2 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1215 | INTERNET OF THINGS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low-cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario

| UNIT I | INTRODUCTION TO IoT | 9 |
|---|---|---|
| Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology | | CO1 |
| **UNIT II** | **IoT ARCHITECTURE** | **9** |
| M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture | | CO2 |
| **UNIT III** | **IoT PROTOCOLS** | **9** |
| Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security | | CO3 |
| **UNIT IV** | **BUILDING IoT WITH RASPBERRY PI & ARDUINO** | **9** |
| Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino. | | CO4 |
| **UNIT V** | **CASE STUDIES AND REAL-WORLD APPLICATIONS** | **9** |
| Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Arshdeep Bahga, Vijay Madisetti, -Internet of Things – A hands-on approachǁ, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), -Architecting the Internet of Thingsǁ, Springer, 2011.

**REFERENCE BOOKS**


1. Honbo Zhou, -The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , -The Internet of Things – Key applications and Protocols‖, Wiley, 2012


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Analyze various protocols for IoT |
| CO2 | Develop web services to access/control IoT devices. |
| CO3 | Design a portable IoT using Rasperry Pi |
| CO4 | Deploy an IoT application and connect to the cloud. |
| CO5 | Analyze applications of IoT in real time scenario |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1311 | HUMAN COMPUTER INTERACTION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To know how to analyze and consider user's need in the interaction system
- ❖ To understand various interaction design techniques and models
- ❖ To understand the theory and framework of HCI
- ❖ Understand and analyze the cognitive aspects of human – machine interaction

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output | | CO1 |
| **UNIT II** | **DESIGN PROCESS** | **9** |
| Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centered Design - Methods for User-Centered Design | | CO2 |
| **UNIT III** | **IMPLEMENTATION AND EVALUATION PROCESS** | **9** |
| Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support | | CO3 |
| **UNIT IV** | **MODELS** | **9** |
| Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction. | | CO4 |
| **UNIT V** | **APPLICATIONS** | **9** |
| Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. "Human – Computer Interaction", Second edition, Prentice Hall,1998.


**REFERENCE BOOKS**


1. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. "Human – Computer Interaction", Addison Wesley, 1994.
2. John M.Carrol, "Human Computer Interaction in the New Millenium", Pearson Education, 2002.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | To develop good design for human machine interaction syste |
| CO2 | Analyze the user's need in interaction system |
| CO3 | To design new interaction model to satisfy all types of customers |
| CO4 | Evaluate the usability and effectiveness of various products |
| CO5 | To know how to apply interaction techniques for systems |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1312 | IMAGING AND MULTIMEDIA SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To understand the basics of image processing and image security techniques
- ❖ To study various compression and file formats used in imaging and multimedia systems
- ❖ To analyse different media and design issues related to multimedia systems

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to Image Processing: Steps in Image Processing Systems –Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models.<br>Introduction to Multimedia: Multimedia Elements – Multimedia applications – Multimedia System Architecture – Evolving technologies for Multimedia – Defining objects for Multimedia systems – Multimedia Data interface standards – Multimedia Databases | | CO1 |
| **UNIT II** | **COMPRESSION AND FILE FORMATS** | **9** |
| Compression and Decompression: Need for Data Compression – Types of Compression – Binary Image Compression Schemes – Image Compression – Video Compression – Audio Compression. Data and File Format Standards: Rich Text Format – TIFF File Format – Resource Interface File Format – MIDI File Format - JPEG DIB File Format – AVI Indeo File Format – MPEG Standards –TWAIN. | | CO2 |
| **UNIT III** | **IMAGE COMPUTING AND SECURITY** | **9** |
| Image computing: The basics of processing 2D images- Thresholding -Convolution-Edge Detection-Mathematical Morphology and Shape Descriptors-Noise Reduction- Image Fusion. Image Security: Image Forensics - Steganography -Image Cryptography Techniques-Chaos based and Non-Chaos based methods. | | CO3 |
| **UNIT IV** | **I/O TECHNOLOGIES** | **9** |
| Input and Output Technologies: Multimedia I/O Technologies: Image Scanners – Digital Voice and Audio – Digital Camera – Video Images and Animation – Full Motion Video -Video Motion Analysis. | | CO4 |
| **UNIT V** | **APPLICATION DESIGN** | **9** |
| Multimedia Application Classes – Types of Multimedia Systems – Virtual Reality – Components of Multimedia Systems -Multimedia Authoring Systems – Multimedia Authoring Tools - User Interface Design- Mobile Messaging – Hypermedia Message Components -Hypermedia Linking and embedding. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education, 2011.
2. Ralf Steinmetz, Klara Steinmetz, “Multimedia Computing, Communications & Applications”, Pearson education, 2009.

**REFERENCE BOOKS**


1. A.K. Jain, Fundamentals of Digital Image Processing ,PHI, New Delhi, 2001.
2. William K Pratt, Digital Image Processing, John Willey , 2012.
3. Prabat K Andleigh and Kiran Thakrar, “Multimedia Systems and Design”, Prentice Hall India, 2007,New Delhi.
4. Tay Vaughan, “Multimedia Making It Work”, McGraw Hill, 2011.
5. Parekh R “Principles of Multimedia” Tata McGraw-Hill, 2006.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Know to basics of image processing Systems |
| CO2 | Technics to develop new compression standard |
| CO3 | Understand image computing and secuity |
| CO4 | Acquire skill set to handle all multimedia components efficient |
| CO5 | Develop Integrated and Collaborative multimedia system |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1313 | AGENT BASED INTELLIGENT SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To introduce the basics of Problem-Solving Agents.
- ❖ To study the concepts of Knowledge representation.
- ❖ To learn the planning techniques.
- ❖ To enable the students to know uncertainty techniques to support real-time applications
- ❖ To understand the knowledge of higher-level agents

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics - Constraint Satisfaction Problems - Game playing. | | CO1 |
| **UNIT II** | **KNOWLEDGE REPRESENTATION AND REASONING** | **9** |
| Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events | | CO2 |
| **UNIT III** | **PLANNING AGENTS** | **9** |
| Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events | | CO3 |
| **UNIT IV** | **AGENTS AND UNCERTAINITY** | **9** |
| Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions. | | CO4 |
| **UNIT V** | **HIGHER LEVEL AGENTS** | **9** |
| Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Stuart Russell and Peter Norvig, “Artificial Intelligence - A Modern Approach”,2nd Edition, Prentice Hall, 2002


**REFERENCE BOOKS**


1. Michael Wooldridge, “An Introduction to Multi Agent System”, John Wiley, 2002.
2. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.
3. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand basics of intelligent agents. |
| CO2 | Represent knowledge and implement reasoning techniques. |
| CO3 | Understand various categories of multi agents. |
| CO4 | Explore the deep learning applications |
| CO5 | Analyze optimization and generalization in Higher Level Agents |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1314 | DEEP LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to machine learning- Linear models (SVMs and Perceptron, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates | | CO1 |
| **UNIT II** | **DEEP NETWORKS** | **9** |
| History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning | | CO2 |
| **UNIT III** | **DIMENTIONALITY REDUCTION** | **9** |
| Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization. | | CO3 |
| **UNIT IV** | **OPTIMIZATION AND GENERALIZATION** | **9** |
| Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience | | CO4 |
| **UNIT V** | **CASE STUDY AND APPLICATIONS** | **9** |
| Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

**REFERENCE BOOKS**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand basics of deep learning |
| CO2 | Implement various deep learning models |
| CO3 | Realign high dimensional data using reduction techniques |
| CO4 | Analyze optimization and generalization in deep learning |
| CO5 | Explore the deep learning applications |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1315 | INFORMATION RETRIEVAL TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To understand the basics of information retrieval with pertinence to modelling, query operations and indexing
- ❖ To get an understanding of machine learning techniques for text classification and clustering.
- ❖ To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- ❖ To understand the concepts of digital libraries

| UNIT I | INTRODUCTION: MOTIVATION | 9 |
|---|---|---|
| Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR ––IR Versus Web Search–Components of a Search engine | | CO1 |
| **UNIT II** | **MODELING** | **9** |
| Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing. | | CO2 |
| **UNIT III** | **INDEXING** | **9** |
| Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency | | CO3 |
| **UNIT IV** | **CLASSIFICATION AND CLUSTERING** | **9** |
| Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning | | CO4 |
| **UNIT V** | **SEARCHING THE WEB** | **9** |
| Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition, 2008.
2. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search” (ACM Press Books), Second Edition, 2011.


**REFERENCE BOOKS**


1. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Build an Information Retrieval system using the available tool |
| CO2 | Identify and design the various components of an Information Retrieval system |
| CO3 | Apply various indexing techniques in information retrieval. |
| CO4 | Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval |
| CO5 | Design an efficient search engine and analyze the Web content structure |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1321 | BLOCKCHAIN TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ Understand how blockchain systems (mainly Bitcoin and Ethereum) work
- ❖ To securely interact with them,
- ❖ Design, build, and deploy smart contracts and distributed applications,
- ❖ Integrate ideas from blockchain technology into their own projects

| UNIT I | BASICS | 9 |
|---|---|---|
| Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof. | | CO1 |
| **UNIT II** | **BLOCKCHAIN** | **9** |
| Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain. | | CO2 |
| **UNIT III** | **DISTRIBUTED CONSENSUS** | **9** |
| Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. | | CO3 |
| **UNIT IV** | **CRYPTOCURRENCY** | **9** |
| History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin | | CO4 |
| **UNIT V** | **CRYPTOCURRENCY REGULATION** | **9** |
| Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).


**REFERENCE BOOKS**


1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

| COURSE OUTCOMES<br>Upon completion of the course, students will be able to | |
|---|---|
| CO1 | Design principles of Bitcoin and Ethereum. and Nakamoto consensus |
| CO2 | Learn the simplified Payment Verification protocol and describe differences between proof-of-work and proof-of-stake consensus. |
| CO3 | Interact with a blockchain system by sending and reading transactions. |
| CO4 | Design, build, and deploy a distributed application. |
| CO4 | Evaluate security, privacy, and efficiency of a given blockchain system. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 3 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 1 | 1 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 1 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1322 | SPEECH PROCESSING AND SYNTHESIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

| UNIT I | SPEECH PROCESSING AND SYNTHESIS | 9 |
|---|---|---|
| Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory. | | CO1 |
| **UNIT II** | **SPEECH SIGNAL REPRESENTATIONS AND CODING** | **9** |
| Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder. | | CO2 |
| **UNIT III** | **SPEECH RECOGNITION** | **9** |
| Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques. | | CO3 |
| **UNIT IV** | **TEXT ANALYSIS** | **9** |
| Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation | | CO4 |
| **UNIT V** | **SPEECH SYNTHESIS** | **9** |
| Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Joseph Mariani, —Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, —Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.


**REFERENCE BOOKS**


1. Sadaoki Furui, —Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
2. Thomas F.Quatieri, —Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
2. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, —Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word |
| CO2 | Determine and apply Mel-frequency cepstral coefficients for processing all types of signals |
| CO3 | Justify the use of formant and concatenative approaches to speech synthesis |
| CO4 | Identify the apt approach of speech synthesis depending on the language to be processed |
| CO5 | Determine the various encoding techniques for representing speech. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1323 | ADVANCED SOFTWARE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re -engineering

| UNIT I | SOFTWARE ENGINEERING PROCESS AND FORMAL METHODS | 9 |
|---|---|---|
| Software Process models – Software Life Cycle – Development Activities – Managing Software Development – Unified Modeling Language – Requirement elicitation and specification – Understanding formal methods – motivation for formal methods – informal requirements to formal specifications – validating formal specifications – Overview of Z specification | | CO1 |
| **UNIT II** | **AGILE AND ASPECT ORIENTED SOFTWARE ENGINEERING** | **9** |
| Agile Development: Agility – agile principles- Extreme Programming -– Agile process models – Agile modeling – Agile unified Process – tools set for agile process – Complex Projects: SCRUM — basics, SCRUM Process, Development using SCRUM — Aspect Oriented Software Development: Aspect-Orientation in the Software Lifecycle – Generic Aspect-Oriented Design with UML – Modeling for Aspect-Oriented Software Development-Developing Secure Applications Through Aspect-Oriented Programming. | | CO2 |
| **UNIT III** | **COMPONENT-BASED SOFTWARE ENGINEERING** | **9** |
| Engineering of component-based systems, the CBSE process – Designing class based components – component design for Web Apps – Component-based development – Component-level design patterns – Classifying and retrieving components, and economics of CBSE. | | CO3 |
| **UNIT IV** | **ADVANCED SOFTWARE TESTING TECHNIQUES** | **9** |
| Software Review – Testing Strategies - Testing Conventional Applications – Testing Object- Oriented Applications – Testing Web Applications – Formal Modeling and verification – Metrics : Product, process, project, testing and quality metrics – Software Test Automation | | CO4 |
| **UNIT V** | **SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING** | **9** |
| SPI process – CMMI – SPI frameworks – SPI Trends – Emerging trends ion Software Engineering – identifying soft trends – Technology directions – Tool-related trends – Software Maintenance and Reengineering: software reengineering, reverse reengineering, restructuring, forward reengineering. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Roger S. Pressman, “Software Engineering — A Practioner‟s Approach”, MCGraw Hill, 7thedition, 2009.
2. Ian Sommerville, “Software Engineering”, Addison-Wesley 9th Edition, 2010.
3. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.

**REFERENCE BOOKS**


1. Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, “Aspect-Oriented Software Development”, Addison-Wesley Professional, 2004.
2. Renu Rajni, Pradeep Oak, “Software Testing: Effective Methods, Tools and Techniques”, TataMcGraw Hill, 2004.
3. Jonathan Bowen, "Formal Specification and Documentation using Z - A Case Study Approach",Intl Thomson Computer Press, 1996.
4. Antoni Diller, “Z: An Introduction to Formal Methods”, Wiley, 1994.
5. James Shore, Shane Warden “The Art of Agile Development - Pragmatic guide to agile software development”, O'Reilly Media, October 2007.
6. Ken Schwaber, “Agile Project Management with SCRUM”, Microsoft Press, 2004.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Analytically apply general principles of software development in the development of complex software and software- intensive systems |
| CO2 | Usage of Agile technology in SCRUM Development |
| CO3 | Discuss methods and techniques for advanced software development and also to be able to use these in various development situations |
| CO4 | Apply testing techniques for object-oriented software and web-based systems |
| CO5 | Apply re-engineering concepts in software development process |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1324 | MOBILE NETWORK SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the fundamentals of Mobile communication systems.
- To understand the different multiplexing scheme.
- To understand the significance of different layers in mobile system.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems- frequency reuse, co-channel interference. | | CO1 |
| **UNIT II** | **MAC** | **9** |
| Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls-initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff. | | CO2 |
| **UNIT III** | **COMMUNICATION SYSTEMS** | **9** |
| Mobile Telecommunication standards, GSM, DECT, TETRA, IMT-2000, CTEO, satellite systems – GEO, LEO and MEO, and broadcast systems –Digital audio and video broadcasting, IEEE 802.11, HIPERLAN, Bluetooth, Wireless ATM, WATM services. | | CO3 |
| **UNIT IV** | **MOBILE NETWORK LAYER** | **9** |
| Network support for mobile systems – Mobile IP- IP packet delivery- Agent discovery-tunnelling and encapsulation, reverse tunnelling, IPV6, DHCP. | | CO4 |
| **UNIT V** | **MOBILE TRANSPORT LAYER** | **9** |
| Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, WWW, WAP. | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. Jochen Sciiiller, "Mobile Communications ", Pearson Education India, 2009.

**REFERENCE BOOKS**

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, 2/e, Pearson Education, 2010.
2. William C.Y Lee, "Mobile Cellular Telecommunications ", McGraw Hill International Editions, 1995

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand the concepts of mobile and wireless communications. |
| CO2 | Understand the concepts of MAC in mobile and wireless communication |
| CO3 | Understand the concepts of Communication systems in mobile and wireless communications |
| CO4 | Understand the concepts of packet delivery in mobile and wireless communications |
| CO5 | Apply the knowledge gained in exploring, application and protocol development |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1325 | CYBER SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand fundamentals of Hacking and Hackers process
- To learn finger printing services and system hacking.
- To understand malware threats and denial of service.
- To know webserver hacking and mobile device operation.
- To know about IDS, Honey bots and botnets.

| UNIT I | INTRODUCTION TO ETHICAL HACKING | 9 |
|---|---|---|
| Security Fundamental, Security testing, Hacker and Cracker, Descriptions, Test Plans-keeping It legal, Ethical and Legality- The Attacker's Process, The Ethical Hacker's Process, Security and the Stack | | CO1 |
| **UNIT II** | **FOOTPRINTING AND SCANNING** | **9** |
| Information Gathering, Determining the Network Range, Identifying Active Machines, Finding Open Ports and Access Points, OS Fingerprinting Services, Mapping the Network Attack Surface -Enumeration, System Hacking | | CO2 |
| **UNIT III** | **MALWARE THREATS** | **9** |
| Viruses and Worms, Trojans, Covert Communication, Keystroke Logging and Spyware, Malware Counter measures- Sniffers, Session Hijacking, Denial of Service and Distributed Denial of Service | | CO3 |
| **UNIT IV** | **WEB SERVER HACKING** | **9** |
| Web Server Hacking, Web Application Hacking, Database Hacking- Wireless Technologies, Mobile Device Operation and Security, Wireless LANs. | | CO4 |
| **UNIT V** | **PHYSICAL SECURITY** | **9** |
| Physical Security, Social Engineering- Intrusion Detection Systems, Firewalls, Honeypots-Cloud Computing, Botnets | | CO5 |

**TOTAL : 45 PERIODS**

**TEXT BOOKS**


1. Nancy R Mead,Carol C Woody,Cyber security Engineering,A practical approach for systems and software assurance,CRC press,2016.


**REFERENCE BOOKS**


1. Certified Ethical Hacker, Version 9, Second Edition, Michael Gregg, Pearson IT Certification
2. Hacking the Hacker, Roger Grimes, Wiley, Online ISBN:9781119396260, © 2017 by John Wiley & Sons, Inc.
3. The Unofficial Guide to Ethical Hacking, Ankit Fadia, Premier Press,2002

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Describe and understand the basics of the ethical hacking |
| CO2 | Perform the foot printing and scanning - Demonstrate the techniques for system hacking |
| CO3 | Characterize the malware and their attacks and detect and prevent them |
| CO4 | Determine the signature of different attacks and prevent them |
| CO5 | Detect and prevent the security attacks in different environments |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1331 | CLOUD COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To understand the concepts of virtualization and virtual machines
- ❖ To gain expertise in server, network and storage virtualization. To understand and deploy practical virtualization solutions and enterprise solutions
- ❖ To gain knowledge on the concept of Cloud architecture and virtualization support that is fundamental to cloud computing
- ❖ To understand the security issues in the grid and the cloud environment.
- ❖ To be able to know the insight on the programming model and set up a private cloud

| UNIT I | VIRTUALIZATION | 9 |
|---|---|---|
| Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization –– Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization. | | CO1 |
| **UNIT II** | **VIRTUALIZATION INFRASTRUCTURE** | **9** |
| Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation. | | CO2 |
| **UNIT III** | **CLOUD PLATFORM ARCHITECTURE** | **9** |
| Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms: GAE,AWS – Inter-cloud Resource Management | | CO3 |
| **UNIT IV** | **CLOUD SECURITY** | **9** |
| Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management | | CO4 |
| **UNIT V** | **PROGRAMMING MODEL** | **9** |
| Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
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. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009.

**REFERENCE BOOKS**

1. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
4. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Employ the concepts of storage virtualization, network virtualization and its management |
| CO2 | Apply the concept of virtualization in the cloud computing |
| CO3 | Identify the architecture, infrastructure and delivery models of cloud computing |
| CO4 | Develop services using Cloud computing |
| CO5 | Apply the security models in the cloud environment |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1332 | SOFTWARE ARCHITECTURE AND DESIGN PATTERNS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- Understand the creational and structural patterns.
- Be able to explain the role of analyzing architectures.
- Be capable of applying his knowledge to create an architecture for given application.
- Be able to identify different structural and behavioral patterns.
- To know the usage of design patterns by solving a case study

| UNIT I | ENVISIONING ARCHITECTURE | 9 |
|---|---|---|
| .The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Creating an Architecture- Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture. | | CO1 |
| **UNIT II** | **ANALYZING ARCHITECTURES** | **9** |
| Architecture Evaluation, Architecture design decision making, ATAM, CBAM. Moving from one system to many: Software Product Lines, Building systems from off the shelf components, Software architecture in future. | | CO2 |
| **UNIT III** | **CREATIONAL AND STRUCTURAL PATTERNS** | **9** |
| Patterns: Pattern Description, Organizing catalogs, role in solving design problems ,Selection and usage. Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy. | | CO3 |
| **UNIT IV** | **BEHAVIORAL PATTERNS** | **9** |
| Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor. | | CO4 |
| **UNIT V** | **CASE STUDIES** | **9** |
| A-7E – A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development | | CO5 |

**TOTAL : 45 PERIODS**

**TEXT BOOKS**


1. Len Bass,Paul Clements&Rick Kazman, Software Architecture in Practice, 2nd Edition, Pearson Education, 2003.
2. Erich Gamma, Design Patterns, 1st Edition, Pearson Education,1995
3. http://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Architecture/Design_Patterns.


**REFERENCE BOOKS**


1. Luke Hohmann , Beyond Software architecture, Addison wesley, 2003.
2. David M. Dikel, David Kane and James R. Wilson, Software architecture, 1st Edition, Prentice Hall,2001
4. F.Buschmann , Pattern Oriented Software Architecture, Wiley&Sons,1st Edition,2001

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand the architecture, creating it and moving from one to any, different structural patterns. |
| CO2 | Analyze the architecture and build the system from the components. |
| CO3 | Design creational and structural patterns. |
| CO4 | Learn about behavioural patterns. |
| CO5 | Do a case study in utilizing architectural structures. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1333 | BIG DATA MINING AND ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand big data and data analytics lifecycle
- To learn Basic Data analytic methods using R
- To understand concepts in clustering and regression
- To learn classification techniques in text documents
- To Get a knowledge on advanced analytical methods, technology and tools

| UNIT I | BIG DATA OVERVIEW | 9 |
|---|---|---|
| State of the practice in Analytics-Key roles for new big data ecosystem Data Analytics Lifecycle-Data analytics lifecycle overview- Discovery- Data Preparation-Model Planning-Model Building-Communicate Results operationalize | | CO1 |
| **UNIT II** | **INTRODUCTION TO R** | **9** |
| Exploratory Data Analytics-Statistical methods for evaluation Hadoop & Map Reduce framework for R, R with Relational Database Management Systems, R with Non-Relational (NoSQL) DBs | | CO2 |
| **UNIT III** | **CLUSTERING** | **9** |
| Overview of Clustering-K-means, Association Rules-Overview-Apriori Algorithm-Evaluation of candidate rules-An Example: Transactions in grocery Store-Validation and Testing-Diagnostics, Regression-Linear Regression-Logistic Regression-Reason to choose and Cautions-Additional Regression Models | | CO3 |
| **UNIT IV** | **CLASSIFICATION** | **9** |
| Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional classification methods, Time series Analysis Overview of Time series analysis-ARIMA Model-Additional methods, Text Analysis-Text analysis steps-A text analysis Example-Collecting raw Text-Representing Text-Term Frequency—Inverse document frequency(TFIDF)-Categorizing documents by Topics-Determining Sentiments-Gaining insights | | CO4 |
| **UNIT V** | **ANALYTICS FOR UNSTRUCTURED DATA** | **9** |
| The Hadoop Ecosystem-NoSQL, In-Database Analytics-SQL Essentials-In-Database Text Analysis-Advanced SQL | | CO5 |

**TOTAL : 45 PERIODS**

**TEXT BOOKS**


1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015. .
2. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016


**REFERENCE BOOKS**


1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.
3. Kim H. Pries and Robert Dunnigan, “Big Data Analytics: A Practical Guide for Managers” CRC Press, 2015

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand the big data concepts |
| CO2 | Utilize and apply the Analytical methods, Technology and tools in the industry. |
| CO3 | Apply the techniques of clustering in real time applications |
| CO4 | Apply the concepts off classification to classify text documents. |
| CO5 | Understand Hadoop ecosystem and apply to solve real-life problems |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1334 | SOCIAL NETWORK ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the components of the social Network
- To model and visualize the social network
- To mine the users in the w4
- To understand the evolution of the social Network
- To know the applications in Real Time Systems

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks | | CO1 |
| **UNIT II** | **MODELING AND VISUALIZATION MODELING AND VISUALIZATION** | **9** |
| Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data **–** Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships. | | CO2 |
| **UNIT III** | **MINING COMMUNITIES** | **9** |
| Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks. | | CO3 |
| **UNIT IV** | **EVOLUTION** | **9** |
| Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models | | CO4 |
| **UNIT V** | **APPLICATIONS** | **9** |
| A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012
2. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014
3. Peter Mika, “Social networks and the Semantic Web”, Springer, 2007.
4. Guandong Xu,Yanchun Zhang, and Lin Li, “Web Mining and Social Networking Techniques and Applications”, Springer.

**REFERENCE BOOKS**


1. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011
2. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
3. Przemyslaw Kazienko, Nitesh Chawla,”Applications of Social Media and Social Network Analysis”, Springer,2015


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Work on the internals components of the social network |
| CO2 | Model and visualize the social network |
| CO3 | Mine the behavior of the users in the social network |
| CO4 | Predict the possible next outcome of the social network |
| CO5 | Apply social network in real time application. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **CO1** | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

| CP1335 | COGNITIVE SCIENCE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To know the basic concepts, approaches and issues in the field of cognitive science
- ❖ To increase the awareness of the students to the questions raised in the disciplines of computer science, linguistics, philosophy and psychology;
- ❖ To focus on the interaction of these disciplines in approaching the study of the mind – brain language.
- ❖ Specialization on topics central to cognitive development such as the nature of mental representation, reasoning, perception, language use, learning as well as other cognitive processes of humans and other intelligent systems.
- ❖ To focus on memory and social cognition

| UNIT I | INTRODUCTION TO COGNITIVE SCIENCE | 9 |
|---|---|---|
| Introduction to the study of cognitive sciences. A brief history of cognitive science. Methodological concerns in philosophy, artificial intelligence and psychology. Structure and constituents of the brain; Brief history of neuroscience; Mathematical models; Looking at brain signals | | **CO1** |
| **UNIT II** | **REPRESENTATION OF SENSORY INFORMATION** | **9** |
| Processing of sensory information in the brain- Neural Network Models; Processing of sensory information in the brain; motor and sensory areas; Brain Imaging, fMRI, MEG, PET, EEG- Multisensory integration in cortex; information fusion; from sensation to cognition, cybernetics | | **CO2** |
| **UNIT III** | **LANGUAGE AND LATERALIZATION** | **9** |
| Linguistic knowledge: Syntax, semantics, (and pragmatics); Generative linguistics; Brain and language; Language disorders; Lateralization; Cognitivist and emergent standpoints ; A robotic perspective | | **CO3** |
| **UNIT IV** | **COGNITIVE DEVELOPMENT** | **9** |
| Introduction to Psychology- Attention and related concepts; Human visual attention; Computational models of attention; Applications of computational models-Learning: Categories and concepts; Concept learning; Logic ; Machine learning | | **CO4** |
| **UNIT V** | **MEMORY AND SOCIAL COGNITION** | **9** |
| Constructing memories; Explicit vs. implicit memory; Information processing (three-boxes) model of memory; Sensory memory; Short term memory; Long term memory- Rationality; Bounded rationality; Prospect theory ; Heuristics and biases; Reasoning in computers- social cognition; Context and social judgment; Schemas; Social signals | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Gardner, The Mind's New Science, chapters 2,3,4. Gardner, Howard E. The mind's new science: A history of the cognitive revolution. Basic books, 2008.
2. Wallace, Mark T., and Barry E. Stein. "Sensory organization of the superior colliculus in cat and monkey." Progress in brain research 112 (1996): 301-311.
3. Fromkin, Rodman, and Hyams. An Introduction to Language, Boston, MA: Thomson Wadsworth, 9th edition, 2011.

**REFERENCE BOOKS**


1. "Language and the Brain", https://web.stanford.edu/~zwicky/language-and-the-brain-ch4-8.pdf
2. Simon, Bounded Rationality in Social Science: Today and Tomorrow, Mind & Society, 1, 2000, 25-39


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Apply the basics of Cognitive science. |
| CO2 | Use the sensory information and neural network models in real time. |
| CO3 | Apply Linguistic knowledge in terms of robots perspective |
| CO4 | Learn the computational models |
| CO5 | Apply the knowledge of Memory and Social cognition. |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 1 | 3 | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| CO4 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 1 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |

## OPEN ELECTIVE COURSES – I

| OBY101 | ESSENTIALS OF HAZARDOUS WASTE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- Understand the type, nature and treatment of hazardous wastes.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances. | | |
| **UNIT II** | **HAZARDOUS WASTES MANAGEMENT** | **9** |
| Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification-Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques. | | |
| **UNIT III** | **BIOMEDICAL WASTE MANAGEMENT** | **9** |
| Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection - ,disposal. Infection control Practices. | | |
| **UNIT IV** | **RADIOACTIVE WASTE MANAGEMENT** | **9** |
| Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB. | | |
| **UNIT V** | **E-WASTE MANAGEMENT** | **9** |
| Regulatory aspects of E-l Waste management, Waste characteristics- Generation–- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management | | |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Hazardous waste management Charles A.Wentz. Second edition 1995.McGraw Hill International.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.
3. Criteria for hazardous waste landfills–CPCBguidelines2000


**REFERENCE BOOKS**


1. Basic Hazardous waste management, “William C.Blackman.Jr”, Third Edition, 2001, Lewis Publishers
2. Integrated solidwaste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.
3. Criteria for hazardous waste landfills–CPCB guidelines 2000..
4. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997.
5. Management of Solid waste in developing countries by Frank Flint off, WH Original publication.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | To understand Hazardous Solid Waste |
| CO2 | To introduce students to basic concepts of planning and management of hazardous waste management. |
| CO3 | The content involves importance of necessity of hazardous waste management |
| CO4 | To understand Physico-Chemical Treatment: Incineration |
| CO5 | To understand the Hazard analysis. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | 2 | 1 | 2 | - | - | 1 | 1 | - | - | 1 | - | 2 |
| **CO2** | - | - | - | 2 | 2 | 1 | - | - | 2 | - | - | - | 1 | - | 2 |
| **CO3** | - | - | - | 1 | 1 | 2 | - | - | 1 | 2 | - | - | 1 | - | 2 |
| **CO4** | - | - | - | - | 2 | 1 | - | - | 2 | 1 | - | - | 1 | - | 2 |
| **CO5** | - | - | - | 1 | 2 | - | - | - | 1 | 2 | - | - | 1 | - | 2 |

| OCP101 | BUSINESS DATA ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To understand the basics of business analytics and its life cycle.
- ❖ To gain knowledge about fundamental business analytics.
- ❖ To learn modeling for uncertainty and statistical inference.
- ❖ To understand analytics using Hadoop and Map Reduce frameworks.
- ❖ To acquire insight on other analytical frameworks.

| UNIT I | OVERVIEW OF BUSINESS ANALYTICS | 9 |
|---|---|---|

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

**Suggested Activities:**

- Case studies on applications involving business analytics.
- Converting real–time decision–making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

**Suggested Evaluation Methods:**

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.Quiz on case studies.

**CO1**

| UNIT II | ESSENTIALS OF BUSINESS ANALYTICS | 9 |
|---|---|---|

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, Z–Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

**Suggested Activities:**

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

**Suggested Evaluation Methods:**

- Assignment on descriptive analytics using benchmark data. Quiz on data visualization for univariate, bivariate data.

| UNIT III | MODELING UNCERTAINTY AND STATISTICAL INFERENCE | 9 |
|---|---|---|

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

**Suggested Activities:**

- Solving numerical problems in sampling, probability, probability distributions and
- Hypothesis testing.
- Converting real–time decision–making problems into hypothesis.

**Suggested Evaluation Methods:**

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing. Quizzes on topics like sampling and probability.

| UNIT IV | ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK | 9 |
|---|---|---|

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map–Reduce: Matrix–Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

**Suggested Activities:**

- Practical – Install and configure Hadoop.
- Practical – Use web–based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

**Suggested Evaluation Methods:**

- Evaluation of the practical implementations.

Quizzes on topics like HDFS and extensions to MapReduce.

| UNIT V | OTHER DATA ANALYTICAL FRAMEWORKS | 9 |
|---|---|---|

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

**Suggested Activities:**

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

**Suggested Evaluation Methods:**

Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map–Reduce Tasks and Result Projection

**TOTAL : 45 PERIODS**

**REFERENCE BOOKS**


1. Vignesh Prajapati, 'Big Data Analytics with R and Hadoop', Packt Publishing, 2013
2. Umesh R Hodeghatta, Umesha Nayak, 'Business Analytics Using R – A Practical Approach', A press, 2017
3. Anand Rajaraman, Jeffrey David Ullman, 'Mining of Massive Datasets', Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, 'Essentials of Business Analytics', Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, 'Business Analytics: The Science of Data–Driven Decision Making', Wiley, 2017.
6. A. Ohri, 'R for Business Analytics', Springer, 2012.
7. Rui Miguel Forte, 'Mastering Predictive Analytics with R', Packt Publication, 2015.

| COURSE OUTCOMES<br>Upon completion of the course, students will be able to | |
|---|---|
| CO1 | Identify the real–world business problems and model with analytical solutions. |
| CO2 | Solve analytical problem with relevant mathematics background knowledge. |
| CO3 | Convert any real–world decision–making problem to hypothesis and apply suitable statistical testing. |
| CO4 | Write and demonstrate simple applications involving analytics using Hadoop and MapReduce |
| CO5 | Use open–source frameworks for modeling and storing data and apply suitable visualization technique using R for visualizing voluminous data |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |

| OEC101 | NEXT GENERATION WIRELESS NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- ❖ To know how Convergence of video/voice/data, high-performance wireless networks, mobile networking has been implemented for broad band applications
- ❖ To know about the broad landscape of emerging networking and inter-networking technologies

| UNIT I | HETEROGENEOUS RADIO TECHNOLOGIES | 9 |
|---|---|---|
| Evolution of Wireless Networks - Wireless Local Area Networks - Public Wide-Area Wireless networks. Introduction to 1G/2G/3G/4G Terminology -Evolution of Public Mobile Services – First Wave of Mobile Data Services: Text-Based Instant Messaging - Second Wave of Mobile Data Services: Low Speed Mobile Internet Services - Current Wave of Mobile Data Services: High-Speed and Multimedia Mobile Internet Services - IP-Based Wireless Networks - 3GPP, 3GPP2. | | |
| **UNIT II** | **WIRELESS IP NETWORK ARCHITECTURES** | **9** |
| 3GPP Packet Data Networks - Network Architecture-3GPP2 Packet Data - MWIF All-IP Mobile Networks – Network Architectures - Access to MWIF Networks - Session Management. | | |
| **UNIT III** | **IP MULTIMEDIA SUBSYSTEMS AND APPLICATION-LEVEL SIGNALING** | **9** |
| Signaling in IP Networks -Session Initiation Protocol (SIP) -Session Description Protocol (SDP)3GPP IP Multimedia Subsystem (IMS) - IMS Architecture - Mobile Station Addressing for Accessing the IMS - Reference Interfaces –Service Architecture - Registration with the IMS - Deregistration with the IMS -End-to-End Signalling Flows for Session Control- 3GPP2 IP Multimedia Subsystem (IMS). | | |
| **UNIT IV** | **MOBILITY MANAGEMENT** | **9** |
| Basic Issues in Mobility Management - Mobility Management in IP Networks - Mobility Management in 3GPP Packet Networks -Mobility Management in 3GPP2 - Packet Data Networks – mobility Management in MWIF Networks - Comparison of Mobility Management in IP, 3GPP and 3GPP2 Networks. | | |
| **UNIT V** | **QUALITY OF SERVICE** | **9** |
| Internet QoS - QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS in 3GPP2 - 3GPP2 QoS Architecture - 3GPP2 QoS Management -3GPP2 QoS Classes - QoS Attributes (QoS Profile) -Management of End-to-End IP QoS. | | |
| | | **TOTAL : 45 PERIODS** |

**REFERENCE BOOKS**


1. Jyh-Cheng Chen and Tao Zhang, “IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols,” John Wiley & Sons, Inc. Publication, First Edition, 2008.
2. Crosspoint Boulevard, “Wireless and Mobile All-IP Networks,” Wiley Publication, 2005.
3. Minoru Etoh, “Next Generation Mobile Systems3G and Beyond”, Wiley Publications, First Edition, 2005.
4. SavoGlisic, “Advanced Wireless Communications 4G Technologies,” Wiley Publications, First Edition,2009

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Analyze Packet Switching Services of the Next Generation wireless services |
| CO2 | Explain the architectures of wireless IP network. |
| CO3 | Evaluate the performance of Voice and data over Internet Protocol |
| CO4 | Explain the Mobility management schemes of the Next Generation wireless services. |
| CO5 | Evaluate integrated broadband access using telecommunications systems in terms of QoS. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 1 |
| **CO2** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |

| OMF103 | OPTIMIZATION TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To introduce the various optimization techniques and their advancements.
- To make use of the above techniques while modeling and solving the engineering problems of different fields

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems | | |
| **UNIT II** | **CLASSIC OPTIMIZATION TECHNIQUES** | **9** |
| Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming. | | |
| **UNIT III** | **NON-LINEAR PROGRAMMING** | **9** |
| Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming | | |
| **UNIT IV** | **INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES** | **9** |
| Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem | | |
| **UNIT V** | **ADVANCES IN SIMULATION** | **9** |
| Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Singiresu S. Rao , “Engineering Optimization: Theory and Practice”, Fourth Edition ,John Wiley & Sons, Inc., 2009.
2. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005


**REFERENCE BOOKS**


1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994 Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | The student has the basic knowledge about historical development of optimization problems, formulation of the problem, classification and application to various engineering domain. |
| CO2 | Ability to approach and solve the linear equations of operational research problems which relates to the real engineering business problem. |
| CO3 | Ability to approach and solve the Non-linear equations of operational research problems which relates to the real engineering business problem. |
| CO4 | Ability to use the various optimization techniques for solving the various experimental studies to obtain the optimum objective function value. |
| CO5 | The student has the knowledge about various simulation techniques and knows to relate these techniques to various experimental studies to obtain the optimum objective function value. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 1 |
| **CO2** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |

| OPE101 | RENEWABLE SOURCES OF ELECTRICAL ENERGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To understand the energy scenario and various energy sources.
- To learn the solar photovoltaic and solar thermal systems.
- To impart knowledge on wind energy and bio-mass energy conversion systems.
- To provide knowledge about the Geothermal and Ocean energy conversion system.
- To design and implement hybrid energy conversion system.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| Renewable energy sources and its energy scenario - global and Indian; Environmental aspects and impacts of renewable energy generation on environment; Types of Renewable energy sources: solar - wind - Biomass - Ocean - Tidal - Geothermal and Fuel cell. | | |

| UNIT II | SOLAR ENERGY SYSTEMS | 9 |
|---|---|---|
| Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - Introduction to Solar photo-voltaic (PV) system and Solar - thermal system; Equivalent circuit of a solar cell, solar array and its sizing. Solar thermal collectors: flat plate collectors - concentrating collectors; solar thermal applications - heating, cooling, desalination, drying, cooking - solar thermal electric power plant. | | |

| UNIT III | WIND ENERGY AND BIO-MASS ENERGY | 9 |
|---|---|---|
| Wind Sources: horizontal and vertical axis wind turbine - performance characteristics - types of wind turbine generators - Betz criteria; Bio-mass: Principles of Bio-Conversion - Anaerobic/aerobic digestion - types of Bio-gas digesters - gas yield - combustion characteristics of bio-gas - utilization for cooking. | | |

| UNIT IV | GEOTHERMAL AND OCEAN ENERGY | 9 |
|---|---|---|
| Geothermal: Resources - types of wells - methods of harnessing the energy. Ocean Energy: OTEC- Principles, utilization - setting of OTEC plants - thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques - mini-hydro power plants and their economics. | | |

| UNIT V | HYBRID RENEWABLE ENERGY SYSTEMS | 9 |
|---|---|---|
| Need for Hybrid Systems - Types of Hybrid systems - Case studies of solar and Wind. | | **CO5** |

**TOTAL : 45 PERIODS**

**TEXT BOOKS**


1. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage", Tata McGraw Hill, 1990.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 2011.


**REFERENCE BOOKS**


1. G. L. Johnson, Wind energy systems, Prentice Hall Inc. New Jersey.
2. J. M. Kriender, Principles of Solar Engineering", McGraw Hill, 1987.
3. Twidell&Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011
4. V. S. Mangal, Solar Engineering", Tata McGraw Hill, 1992.
5. N. K. Bansal, Renewable Energy Source and Conversion Technology", Tata McGraw Hill, 1989.
6. P. J. Lunde, Solar Thermal Engineering", John Willey & Sons, New York, 1988.
3. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes", Wiley & Sons, 1990.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand the energy scenario and the various sources of non-conventional energy sources. |
| CO2 | Learn the physics of solar energy and to understand the solar photovoltaic, solar-thermal energy conversion system. |
| CO3 | Acquire knowledge in wind and bio-mass energy conversion system. |
| CO4 | Acquire knowledge in Geothermal and Ocean energy conversion system. |
| CO5 | Design and implement hybrid energy systems. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 1 |
| **CO2** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO4** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CO5** | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |

## AUDIT COURSES

| AD1001 | CONSTITUTION OF INDIA | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

| UNIT I | INTRODUCTION | 9 |
|---|---|---|
| History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features | | CO1 |
| **UNIT II** | **CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES** | **9** |
| Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties | | CO2 |
| **UNIT III** | **ORGANS OF GOVERNANCE** | **9** |
| Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions | | CO3 |
| **UNIT IV** | **EMERGENCY PROVISIONS** | **9** |
| Emergency Provisions - National Emergency, President Rule, Financial Emergency | | CO4 |
| **UNIT V** | **LOCAL ADMINISTRATION** | **9** |
| District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI-Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Able to understand history and philosophy of Indian Constitution. |
| CO2 | Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. |
| CO3 | Able to understand powers and functions of Indian government. |
| CO4 | Able to understand emergency rule. |
| CO5 | Able to understand structure and functions of local administration. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |

| AD1002 | VALUE EDUCATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

| UNIT I | INTRODUCTION TO VALUE EDUCATION | 9 |
|---|---|---|
| Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments | | CO1 |
| **UNIT II** | **IMPORTANCE OF VALUES** | **9** |
| Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline | | CO2 |
| **UNIT III** | **INFLUENCE OF VALUE EDUCATION** | **9** |
| Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth. | | CO3 |
| **UNIT IV** | **REINCARNATION THROUGH VALUE EDUCATION** | **9** |
| Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation | | CO4 |
| **UNIT V** | **VALUE EDUCATION IN SOCIAL EMPOWERMENT** | **9** |
| Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**REFERENCE BOOKS**

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Gain knowledge of self-development |
| CO2 | Learn the importance of Human values |
| CO3 | Develop the overall personality through value education |
| CO4 | Overcome the self destructive habits with value education |
| CO5 | Interpret social empowerment with value education |

| MAPPING OF COs WITH POs AND PSOs | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | 1 | 1 | 1 | - | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | 1 | 1 | 1 | - | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |

| AD1003 | PEDAGOGY STUDIES | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

| UNIT I | INTRODUCTION AND METHODOLOGY | 9 |
|---|---|---|
| Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching. | | CO1 |
| **UNIT II** | **THEMATIC OVERVIEW** | **9** |
| Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education. | | CO2 |
| **UNIT III** | **EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES** | **9** |
| Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies. | | CO3 |
| **UNIT IV** | **PROFESSIONAL DEVELOPMENT** | **9** |
| Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes | | CO4 |
| **UNIT V** | **RESEARCH GAPS AND FUTURE DIRECTIONS** | **9** |
| Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. | | CO5 |

**TOTAL : 45 PERIODS**

**REFERENCE BOOKS**


1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand the methodology of pedagogy |
| CO2 | Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries. |
| CO3 | Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. |
| CO4 | Know the factors necessary for professional development. |
| CO5 | Identify the Research gaps in pedagogy. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |

| AD1004 | STRESS MANAGEMENT BY YOGA | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

| UNIT I | INTRODUCTION TO YOGA | 9 |
|---|---|---|
| Definitions of Eight parts of yog.( Ashtanga ) | | CO1 |
| **UNIT II** | **YAM** | **9** |
| Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan | | CO2 |
| **UNIT III** | **NIYAM** | **9** |
| Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha | | CO3 |
| **UNIT IV** | **ASAN** | **9** |
| Various yog poses and their benefits for mind & body | | CO4 |
| **UNIT V** | **PRANAYAM** | **9** |
| Regularization of breathing techniques and its effects-Types of pranayam | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**REFERENCE BOOKS**


1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Develop healthy mind in a healthy body thus improving social health also improve efficiency |
| CO2 | Learn Do's and Don't's in life through Yam |
| CO3 | Learn Do's and Don't's in life through Niyam |
| CO4 | Develop a healthy mind and body through Yog Asans |
| CO5 | Learn breathing techniques through Pranayam |

| MAPPING OF COs WITH POs AND PSOs | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |

| AD1005 | PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- ❖ Develop basic personality skills holistically
- ❖ Develop deep personality skills holistically to achieve happy goals
- ❖ Rewrite the responsibilities
- ❖ Reframe a person with stable mind

| UNIT I | NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I | 9 |
|---|---|---|
| Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) | | CO1 |
| **UNIT II** | **NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II** | **9** |
| Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) | | CO2 |
| **UNIT III** | **ORGANS OF GOVERNANCE** | **9** |
| Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48 | | CO3 |
| **UNIT IV** | **EMERGENCY PROVISIONS** | **9** |
| Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 | | CO4 |
| **UNIT V** | **LOCAL ADMINISTRATION** | **9** |
| Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63 | | CO5 |
| | | **TOTAL : 45 PERIODS** |

**REFERENCE BOOKS**


1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.


**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | To develop basic personality skills holistically |
| CO2 | To develop deep personality skills holistically to achieve happy goals |
| CO3 | To rewrite the responsibilities |
| CO4 | To reframe a person with stable mind, pleasing personality and determination |
| CO5 | To awaken wisdom in students |

| MAPPING OF COs WITH POs AND PSOs | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - |

| AD1006 | UNNAT BHARAT ABHIYAN | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

| UNIT I | QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN | 9 |
|---|---|---|
| Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area.<br>**Assignment:** Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village. | | CO1 |
| **UNIT II** | **RURAL ECONOMY AND LIVELIHOOD** | **9** |
| Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market.<br>**Assignment:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3. | | CO2 |
| **UNIT III** | **RURAL INSTITUTIONS** | **9** |
| History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles.<br>**Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4. | | CO3 |
| **UNIT IV** | **RURAL DEVELOPMENT PROGRAMMES** | **9** |
| National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.<br>**Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor. | | CO4 |

| UNIT V | FIELD WORK | 9 |
|---|---|---|
| **Each student selects one programme for field visit Field based practical activities:**<br>❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities<br>❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site<br>❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures<br>❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)<br>❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization<br>❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps<br>❖ Participate in Gram Sabha meetings, and study community participation<br>❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries<br>❖ Attend Parent Teacher Association meetings, and interview school drop outs<br>❖ Visit local Anganwadi Centre and observe the services being provided<br>❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.<br>❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys<br>❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness<br>❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants<br>❖ Formation of committees for common property resource management, village pond maintenance and fishing. | | **CO5** |
| | | **TOTAL : 45 PERIODS** |

**TEXT BOOKS**


1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

**REFERENCE BOOKS**

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

**COURSE OUTCOMES**

**Upon completion of the course, students will be able to**

| | |
|---|---|
| CO1 | Understand of rural life, culture and social realities |
| CO2 | Understand the concept of measurement by comparison or balance of parameters. |
| CO3 | Develop a sense of empathy and bonds of mutuality with local community |
| CO4 | Appreciate significant contributions of local communities to Indian society and economy |
| CO5 | Value the local knowledge and wisdom of the community |

**MAPPING OF COs WITH POs AND PSOs**

| COs | PROGRAM OUTCOMES (POs) | | | | | | | | | | | | PROGRAM SPECIFIC OUTCOMES (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| AD1007 | ESSENCE OF INDIAN KNOWLEDGE TRADITION | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

| UNIT I | INTRODUCTION TO CULTURE | 9 |
|---|---|---|
| Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India | | CO1 |
| **UNIT II** | **INDIAN LANGUAGES AND LITERATURE** | **9** |
| Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature | | CO2 |
| **UNIT III** | **RELIGION AND PHILOSOPHY** | **9** |
| Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only) | | CO3 |
| **UNIT IV** | **FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)** | **9** |
| Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India | | CO4 |
| **UNIT V** | **EDUCATION SYSTEM IN INDIA** | **9** |
| Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India | | CO5 |

**TOTAL : 45 PERIODS**

**REFERENCE BOOKS**


1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Understand philosophy of Indian culture. |
| CO2 | Distinguish the Indian languages and literature. |
| CO3 | Learn the philosophy of ancient, medieval and modern India. |
| CO4 | Acquire the information about the fine arts in India. |
| CO5 | Understand education systems in India |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |

| AD1008 | SANGA TAMIL LITERATURE APPRECIATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**OBJECTIVES**

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in SangaTamil Literature.
- 'Attruppadai' in SangaTamil Literature.
- 'Puranaanuru' in SangaTamil Literature.
- 'Pathitrupaththu' in SangaTamil Literature.

| UNIT I | SANGA TAMIL LITERATURE – AN INTRODUCTION | 9 |
|---|---|---|
| Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's GrammarTamil Sangam Literature's parables. | | CO1 |
| **UNIT II** | **'AGATHINAI'AND'PURATHINAI'** | **9** |
| Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai. | | CO2 |
| **UNIT III** | **'ATTRUPPADAI'** | **9** |
| Attruppadai Literature – Attruppadaiin 'Puranaanuru' – Attruppadaiin 'Pathitrupaththu'- Attruppadaiin 'Paththupaattu'. | | CO3 |
| **UNIT IV** | **'PURANAANURU'** | **9** |
| Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru. | | CO4 |
| **UNIT V** | **'PATHITRUPATHTHU'** | **9** |
| Pathitrupaththuin 'Ettuthogai' – Pathitrupaththu's Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu. | | CO5 |

**TOTAL : 45 PERIODS**

**REFERENCE BOOKS**


1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

| **COURSE OUTCOMES**<br>**Upon completion of the course, students will be able to** | |
|---|---|
| CO1 | Appreciate and apply the messages in Sanga Tamil Literature in their life. |
| CO2 | Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life. |
| CO3 | Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life. |
| CO4 | Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life. |
| CO5 | Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life. |

**MAPPING OF COs WITH POs AND PSOs**

| **COs** | **PROGRAM OUTCOMES (POs)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO3** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - |