# RAJALAKSHMI ENGINEERING COLLEGE
# CURRICULUM AND SYLLABUS
# B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS
# REGULATIONS 2019

## VISION

To promote competent industry relevant education, skillful research and innovation for socially responsible computer science professionals with human values.

## MISSION

- To impart high technical knowledge strong in fundamentals, practical skills and creative thinking that solves real world problems.
- To grow and become competent through innovation.
- To discover new knowledge through inventive research that encourages entrepreneurship and economic development of global society.
- To provide a creative balance of academic, professional and ethical values.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To equip students with state of the art contemporary technology in computer science and basic engineering science.
2. To expose students to the business principles aligned with their domain.
3. To educate on the service orientation principles for various business disciplines.
4. To encourage innovative research through creative thinking and critical analytical ability.
5. To inculcate ethical and moral values in the individuals benefitting the society.

## PROGRAM OUTCOMES (POs)

A graduate of the Computer Science and Business Systems program will demonstrate:

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

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

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

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

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

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

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

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

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

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

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

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

**PROGRAM SPECIFIC OBJECTIVES (PSOs)**

A graduate of the Computer Science and Business Systems program will demonstrate:

1. The students graduating will have sound knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

2. The students will explore emerging topics such as Analytics, Machine Learning, Cloud Computing, and Internet of Things and apply the knowledge to design and develop solutions to societal needs.

3. The students will be industry ready with required business skills in service orientation.

# CURRICULUM

## B.Tech COMPUTER SCIENCE AND BUSINESS SYSTEMS
## Regulation 2019 | Total Credits: 165

## CHOICE BASED CREDIT SYSTEM

**SEMESTER I**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | MA19154 | Discrete Mathematics | BS | 4 | 3 | 1 | 0 | 4 |
| 2. | MA19155 | Introductory topics in Statistics, Probability and Calculus | BS | 3 | 3 | 0 | 0 | 3 |
| 3. | HS19152 | Business Communication & Value Science – I | HS | 3 | 2 | 1 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 4. | CB19141 | Fundamentals of Computer Science | PC | 7 | 3 | 0 | 4 | 5 |
| 5. | EE19141 | Principles of Electrical Engineering | ES | 4 | 2 | 0 | 2 | 3 |
| 6. | PH19143 | Fundamentals of Physics | BS | 5 | 3 | 0 | 2 | 4 |
| | | | **TOTAL** | **26** | **16** | **2** | **8** | **22** |

**SEMESTER II**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | MA19253 | Linear Algebra | BS | 4 | 3 | 1 | 0 | 4 |
| 2. | BA19208 | Fundamentals of Economics | MS | 2 | 2 | 0 | 0 | 2 |
| 3. | HS19251 | Business Communication & Value Science – II | HS | 3 | 2 | 1 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 4. | MA19241 | Statistical Modeling | BS | 5 | 3 | 0 | 2 | 4 |
| 5. | CB19241 | Data Structures &Algorithms | PC | 7 | 2 | 1 | 4 | 5 |
| 6. | EC19242 | Principles of Electronics | ES | 4 | 2 | 0 | 2 | 3 |
| **MANDATORY COURSES** | | | | | | | | |
| 7. | MC19201 | Environmental Sciences (Non Credit) | MC | 3 | 3 | 0 | 0 | 0 |
| | | | **TOTAL** | **28** | **17** | **3** | **8** | **21** |

**SEMESTER III**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | CB19301 | Formal Language and Automata Theory | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | CB19302 | Computer Organization & Architecture | PC | 3 | 3 | 0 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 3. | CB19341 | Object Oriented Programming | PC | 6 | 2 | 0 | 4 | 4 |
| 4. | CB19342 | Computational Statistics | PC | 5 | 3 | 0 | 2 | 4 |
| 5. | CB19442 | Database Technology | PC | 5 | 3 | 0 | 2 | 4 |
| **MANDATORY COURSES** | | | | | | | | |
| 6. | MC19102 | Indian Constitution and Freedom Movement (Non-Credit) | MC | 3 | 3 | 0 | 0 | 0 |
| | | | **TOTAL** | **25** | **17** | **0** | **8** | **18** |

**SEMESTER IV**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | CB19401 | Introduction to Innovation, IP Management & Entrepreneurship | EEC | 3 | 3 | 0 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 2. | CB19441 | Operating System Concepts | PC | 5 | 3 | 0 | 2 | 4 |
| 3. | CB19343 | Software Engineering | PC | 5 | 3 | 0 | 2 | 4 |
| 4. | CB19541 | Analysis of Algorithms and Design | PC | 5 | 2 | 1 | 2 | 4 |
| 5. | MA19441 | Optimization Techniques | BS | 5 | 3 | 0 | 2 | 4 |
| **LABORATORY COURSES** | | | | | | | | |
| 6. | HS19411 | Business Communication & Value Science – III | HS | 4 | 0 | 0 | 4 | 2 |
| **MANDATORY COURSES** | | | | | | | | |
| 7. | MC19301 | Essence of Indian Traditional Knowledge(Non Credit) | MC | 3 | 3 | 0 | 0 | 0 |
| **EMPLOYABILITY ENHANCEMENT COURSES** | | | | | | | | |
| 8. | GE19421 | Soft Skills I | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **32** | **17** | **1** | **14** | **22** |

**SEMESTER V**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | BA19501 | Fundamentals of Management | MS | 2 | 2 | 0 | 0 | 2 |
| 2. | BA19502 | Business Strategy | MS | 2 | 2 | 0 | 0 | 2 |
| 3. | CB19501 | Design Thinking | EEC | 3 | 3 | 0 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 4. | CB19443 | Software Design with UML | PC | 4 | 2 | 0 | 2 | 3 |
| 5. | CB19542 | Compiler Design Techniques | PC | 5 | 2 | 1 | 2 | 4 |
| 6. | | Elective I | PE | 5 | 2 | 1 | 2 | 4 |
| **LABORATORY COURSES** | | | | | | | | |
| 7. | CB19511 | Innovative Project Lab for Computer Science and Business Systems | EEC | 2 | 0 | 0 | 2 | 1 |
| **EMPLOYABILITY ENHANCEMENT COURSES** | | | | | | | | |
| 8. | GE19521 | Soft Skills II | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **25** | **13** | **2** | **10** | **20** |

**SEMESTER VI**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | BA19601 | Financial & Cost Accounting | MS | 2 | 2 | 0 | 0 | 2 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 2. | CB19641 | Computer Network Technology | PC | 5 | 3 | 0 | 2 | 4 |
| 3. | CB19642 | Information Security | PC | 5 | 3 | 0 | 2 | 4 |
| 4. | CB19643 | Artificial Intelligence | PC | 5 | 3 | 0 | 2 | 4 |
| 5. | | Elective II | PE | 5 | 3 | 0 | 2 | 4 |
| **LABORATORY COURSES** | | | | | | | | |
| 6. | HS19611 | Business Communication & Value Science – IV | HS | 4 | 0 | 0 | 4 | 2 |
| 7. | CB19611 | Industrial Project | EEC | 0 | 0 | 0 | 0 | 1 |
| **EMPLOYABILITY ENHANCEMENT COURSES** | | | | | | | | |
| 8. | GE19621 | Problem Solving Techniques | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **28** | **14** | **0** | **14** | **22** |

**SEMESTER VII**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | BA19701 | Principles of Financial Management | MS | 2 | 2 | 0 | 0 | 2 |
| 2. | BA19702 | Essentials of Human Resources Management | MS | 2 | 2 | 0 | 0 | 2 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 3. | CB19741 | Usability Design of Software Applications | PC | 5 | 3 | 0 | 2 | 4 |
| 4. | CB19742 | IT Workshop | PC | 4 | 2 | 0 | 2 | 3 |
| 5. | | Elective III | PE | 5 | 2 | 1 | 2 | 4 |
| 6. | | Elective IV | PE | 5 | 2 | 1 | 2 | 4 |
| **LABORATORY COURSES** | | | | | | | | |
| 7. | CB19711 | Project Evaluation I | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **25** | **13** | **2** | **10** | **20** |

**SEMESTER VIII**

| Sl.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY COURSES** | | | | | | | | |
| 1. | BA19801 | Marketing Research & Marketing Management | MS | 2 | 2 | 0 | 0 | 2 |
| 2. | BA19802 | Services Science & Service Operational Management | MS | 3 | 3 | 0 | 0 | 3 |
| **LAB ORIENTED THEORY COURSES** | | | | | | | | |
| 3. | CB19841 | IT Project Management | PC | 5 | 3 | 0 | 2 | 4 |
| 4. | | Elective V | PE | 5 | 3 | 0 | 2 | 4 |
| 5. | | Elective VI | PE | 5 | 3 | 0 | 2 | 4 |
| **LABORATORY COURSES** | | | | | | | | |
| 6. | CB19811 | Project Evaluation II | EEC | 6 | 0 | 0 | 6 | 3 |
| | | | **TOTAL** | **26** | **14** | **0** | **12** | **20** |

**TOTAL NO. OF CREDITS: 165**

**PROFESSIONAL ELECTIVES**

| S. No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | CB19P41 | Conversational Systems | PE | 5 | 2 | 1 | 2 | 4 |
| 2. | CB19P42 | Cloud, Microservices and Application | PE | 5 | 2 | 1 | 2 | 4 |
| 3. | CB19P43 | Machine Learning | PE | 5 | 2 | 1 | 2 | 4 |
| 4. | CB19P44 | Robotics and Embedded Systems | PE | 5 | 3 | 0 | 2 | 4 |
| 5. | CB19P45 | Modern Web Applications | PE | 5 | 3 | 0 | 2 | 4 |
| 6. | CB19P46 | Data Mining and Analytics | PE | 5 | 3 | 0 | 2 | 4 |
| 7. | CB19P47 | Cognitive Science and Analytics | PE | 5 | 2 | 1 | 2 | 4 |
| 8. | CB19P48 | Fundamentals of IoT | PE | 5 | 2 | 1 | 2 | 4 |
| 9. | CB19P49 | Cryptology | PE | 5 | 2 | 1 | 2 | 4 |
| 10. | CB19P01 | Quantum Computation and Quantum Information | PE | 4 | 3 | 1 | 0 | 4 |
| 11. | CB19P4A | Mobile Computing | PE | 5 | 2 | 1 | 2 | 4 |
| 12. | CB19P4B | Image Processing and Pattern Recognition | PE | 5 | 3 | 0 | 2 | 4 |
| 13. | CB19P4C | Enterprise Systems | PE | 5 | 3 | 0 | 2 | 4 |
| 14. | CB19P4D | Advanced Social, Text and Media Analytics | PE | 5 | 3 | 0 | 2 | 4 |
| 15. | BA19P61 | Behavioral Economics | PE | 3 | 3 | 0 | 0 | 3 |
| 16. | BA19P82 | Computational Finance &Modeling | PE | 3 | 3 | 0 | 0 | 3 |
| 17. | BA19P83 | Industrial Psychology | PE | 3 | 3 | 0 | 0 | 3 |
| 18. | BA19P84 | Advance Finance | PE | 3 | 3 | 0 | 0 | 3 |

**Summary:**

| B.Tech Computer Science and Business Systems | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No.** | **Category** | **Credits per semester** | | | | | | | | **Total Credits** |
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | |
| **1.** | **HS** | 3 | 3 | | 2 | | 2 | | | **10** |
| **2.** | **BS** | 11 | 8 | | 4 | | | | | **23** |
| **3.** | **ES** | 3 | 3 | | | | | | | **6** |
| **4.** | **PC** | 5 | 5 | 18 | 12 | 7 | 12 | 7 | 4 | **70** |
| **5.** | **MS** | | 2 | | | 4 | 2 | 4 | 5 | **17** |
| **6.** | **PE** | | | | | 4 | 4 | 8 | 8 | **24** |
| **7.** | **EEC** | | | | 4 | 5 | 2 | 1 | 3 | **15** |
| **8.** | **Mandatory Course** | | 0 | 0 | 0 | | | | | **0** |
| **Total** | | **22** | **21** | **18** | **22** | **20** | **22** | **20** | **20** | **165** |

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MA19154 | DISCRETE MATHEMATICS | BS | 3 | 1 | 0 | 4 |

| Objectives: | |
|---|---|
| ● | To extend student's Logical and Mathematical maturity and ability to deal with abstraction. |
| ● | To understand discrete structures of many levels and to know the principle of counting. |

| UNIT-I | MATHEMATICAL LOGIC | 12 |
|---|---|---|
| Propositional calculus - propositions and connectives, syntax; Semantics - truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness | | |
| **UNIT-II** | **COMBINATORICS** | **12** |
| Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle. | | |
| **UNIT-III** | **GRAPH THEORY** | **12** |
| Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four- color theorem. | | |
| **UNIT-IV** | **ABSTRACT ALGEBRA** | **12** |
| Set, relation – Algebraic System: Groups, sub groups, homomorphism, cosets, Lagrange's theorem – Ring and Field (definition). | | |
| **UNIT-V** | **BOOLEAN ALGEBRA** | **12** |
| Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map. | | |
| | **Total Contact Hours : 60** | |

| Course Outcomes:<br>On completion of the course, students will be able to | |
|---|---|
| ● | Apply the concepts of logic to test the validity of a program and to arrive at inferences on logical structures. |
| ● | Use the counting principles in implementing various programmes. |
| ● | Handle a class of functions which transform a finite set into another finite set which relates to input and output |
| ● | Apply the concepts and properties of algebraic structures such as semi groups, monoids and groups. |
| ● | Apply the concepts of Boolean algebra in analyzing logic gates. |

| Text Books: | |
|---|---|
| 1 | M. Morris Mano, "Digital Logic & Computer Design", Pearson. |
| 2 | C. L. Liu, "Elements of Discrete Mathematics", (Second Edition) McGraw Hill, New Delhi |

| Reference Books / Web links: | |
|---|---|
| 1 | Gilbert Strang, "Introduction to linear algebra". |
| 2 | R. A. Brualdi, "Introductory Combinatorics", North-Holland, New York. |
| 3 | N. Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, Englewood |
| 4 | E. Mendelsohn, Van-Nostrand, "Introduction to Mathematical Logic", (Second Edition), London. |
| 5 | J. A. Bondy and U. S. R. Murty, "Graph Theory with Applications", Macmillan Press, London. |
| 6 | L. Zhongwan, "Mathematical Logic for Computer Science", World Scientific, Singapore. |
| 7 | I. N. Herstein, John Wiley and Sons, "Topics in Algebra" |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MA19154.1** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | 2 | 1 | 3 | 3 | 2 |
| **MA19154.2** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | 2 | 1 | 3 | 3 | 2 |
| **MA19154.3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **MA19154.4** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **MA19154.5** | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **Average** | 3.0 | 3.0 | 3.0 | 2.0 | 1.6 | 1.0 | 1.0 | - | - | - | 2.0 | 1.0 | 3.0 | 2.4 | 2.0 |

Correlation levels 1, 2 or 3 are as defined below:
1:Slight(Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation:"-"

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MA19155 | INTRODUCTORY TOPICS IN STATISTICS, PROBABILITY AND CALCULUS | BS | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To provide basic tools of calculus for the purpose of modelling Engineering problems. |
| ● | To equip the students in using Statistical techniques to solve problems. |

| UNIT-I | DIFFERENTIAL CALCULUS | 9 |
|---|---|---|
| Limits and continuity – Differentiation – Rules of Differentiation – Maxima and Minima of single variable. | | |
| **UNIT-II** | **INTEGRAL CALCULUS** | **9** |
| Definite and Indefinite integrals – Integration by parts – Double and Triple integrals in Cartesian form – Area and Volume. | | |
| **UNIT-III** | **INTRODUCTION TO STATISTICS** | **9** |
| Definition of Statistics, basic objectives, applications in various branches of science with examples - Collection of Data: Internal and external data, Primary and secondary Data - Population and sample, Representative sample - Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves - Descriptive measures - Central tendency and Dispersion - Bivariate data: Summarization, marginal and conditional frequency distribution. | | |
| **UNIT-IV** | **PROBABILITY** | **9** |
| Concept of experiments, sample space, event - Definition of Combinatorial Probability, Conditional Probability, Bayes Theorem - Expected values and moments: Mathematical expectation and its properties - Moments (including variance) and their properties – interpretation - Moment generating function. | | |
| **UNIT-V** | **PROBABILITY DISTRIBUTIONS** | **9** |
| Discrete & Continuous distributions: Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes: | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Apply the concept of differentiation to solve maxima and minima problems. |
| ● | Solve problems involving integration using different methods. |
| ● | To collect, analyse and process the data for various purposes. |
| ● | Solve problems involving conditional Probability and moments. |
| ● | Use various distributions that arise in data analysis. |

| Text Books: | |
|---|---|
| 1 | Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", Vol. I & II, A., World Press. |
| 2 | B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi. |

| Reference Books / Web links: | |
|---|---|
| 1 | S.M. Ross, "A first course in Probability",Prentice Hall. |
| 2 | I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers", (Fourth Edition), PHI. |
| 3 | A.M. Mood, F.A. Graybilland D.C. Boes, "Introduction to the Theory of Statistics", McGraw Hill Education. |

| | |
|---|---|
| **4** | Peter V. O'Neil, "Advanced Engineering Mathematics", (Seventh Edition), Thomson Learning. |
| **5** | M. D. Greenberg, "Advanced Engineering Mathematics", (Second Edition), Pearson Education. |
| **6** | P. N. Wartikarand, J. N. Wartikar,VidyarthiPrakashan, "Applied Mathematics", Vol. I & II, |
| **7** | S.M. Ross, "Introduction of Probability Models", Academic Press, N.Y. |


## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MA19155.1** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 3 | 2 | 3 | 2 | 3 |
| **MA19155.2** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 3 | 2 | 3 | 2 | 3 |
| **MA19155.3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | 3 | 3 | 3 | 3 | 3 |
| **MA19155.4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | 3 | 3 | 3 | 3 | 3 |
| **MA19155.5** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | 3 | 3 | 3 | 3 | 3 |
| **Average** | 3.0 | 3.0 | 2.6 | 2.6 | 2.6 | 2.0 | 2.0 | - | - | - | 3.0 | 2.6 | 3.0 | 2.6 | 3.0 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| HS19152 | BUSINESS COMMUNICATION & VALUE SCIENCE – I | HS | 2 | 1 | 0 | 3 |

| **Objectives:** | |
|---|---|
| ● | Understand what life skills are and their importance in leading a happy and well-adjusted life. |
| ● | Motivate students to look within and create a better version of self. |
| ● | Introduce them to key concepts of values, life skills and business communication. |

| **UNIT-I** | **HUMAN VALUES** | **9** |
|---|---|---|
| Values – Self exploration – Values of individuals: Presentation on favourite personality and the skills and values they demonstrate – interviewing a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them – Writing: newspaper report on an IPL match – record conversation between a celebrity and an interviewer. | | |
| **UNIT-II** | **GRAMMAR AND LANGUAGE DEVELOPMENT** | **9** |
| Parts of Speech - Applications of tenses - Sentence formation, sentence structure, show sequence - Voices – Questioning –Vocabulary**:** Word formation: - Synonyms, antonyms, abbreviations - compound words –single word substitution. | | |
| **UNIT-III** | **ESSENTIALS OF TECHNICAL COMMUNICATION** | **9** |
| Email -: Formal and informal emails - words from General Service List (GSL) by West, Academic word list (AWL) - technical specific terms related to the field of technology - phrases, idioms, significant abbreviations - formal business vocabulary. | | |
| **UNIT-IV** | **BASIC WRITING SKILLS** | **9** |
| Reading articles – Summary writing, story writing - writing your comprehensive CV - Create a podcast on a topic. | | |
| **UNIT-V** | **APPLICATION OF LIFE SKILLS** | **9** |
| Life Skills: Movie based learning – identifying skills and values - critical life skills - appreciation of diversity - Community service – work with an NGO and make a presentation. | | |
| | **Total Contact Hours** : | **45** |

| **Course Outcomes:** | |
|---|---|
| | On completion of the course, students will be able to |
| ● | Recognize the need for life skills and values |
| ● | Recognize own strengths and opportunities |
| ● | Apply the life skills to different situations |
| ● | Understand the basic tenets of communication |
| ● | Apply the basic communication practices in different types of communication |

| Reference Books / Web links: | |
|---|---|
| **1** | Alan Mc'carthy and O'dell, "English vocabulary in use". |
| **2** | APAART: Speak Well 1 (English language and communication) |
| **3** | APAART: Speak Well 2 (Soft Skills) |
| **4** | Dr.SarojHiremath, "Business Communication" |
| **Web References** | |
| **1** | Train your mind to perform under pressure- Simon sinek |
| **2** | Brilliant way one CEO rallied his team in the middle of layoffs |
| **3** | Will Smith's Top Ten rules for success |
| **Online Resources** | |
| **1** | https://www.coursera.org/learn/learning-how-to-learn |
| **2** | https://www.coursera.org/specializations/effective-business-communication |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HS19152.1** | - | - | 1 | - | 1 | 3 | 1 | 3 | 3 | 3 | 2 | - | 3 | - | 2 |
| **HS19152.2** | - | - | 1 | - | 1 | 1 | 1 | 2 | 3 | 3 | 1 | - | 3 | - | 1 |
| **HS19152.3** | - | - | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 3 | 2 | - | 3 |
| **HS19152.4** | - | - | - | 1 | - | - | 1 | - | 2 | 3 | 1 | 1 | 2 | - | 2 |
| **HS19152.5** | - | - | - | 2 | - | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 1 | - | 3 |
| **Average** | - | - | 1.3 | 1.7 | 1.3 | 2.0 | 1.0 | 2.0 | 2.6 | 3.0 | 1.2 | 1.7 | 2.2 | 0.0 | 2.2 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19141 | FUNDAMENTALS OF COMPUTER SCIENCE | PC | 3 | 0 | 4 | 5 |

| Objectives: | |
|---|---|
| ● | To develop simple algorithms for arithmetic and logical problems. |
| ● | To develop C Programs using basic programming constructs. |
| ● | To develop C programs using arrays and strings. |
| ● | To develop applications in C using functions, pointers and structures. |
| ● | To do input/output and file handling in C. |
| ● | To learn some basic Unix system interface. |

| UNIT-I | GENERAL PROBLEM SOLVING CONCEPTS AND C LANGUAGE | 9 |
|---|---|---|
| Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops- Introduction- C Structure- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, proper variable naming and Hungarian Notation - Standard I/O, Formatted Output – printf- Formatted Input – scanf- Statements and Blocks. | | |
| **UNIT-II** | **TYPES OF OPERATOR, EXPRESSIONS AND CONTROL FLOW** | **9** |
| Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, If-Else-If, Switch, Loops – while, do, for, break and continue, goto Labels-structured and unstructured programming. | | |
| **UNIT-III** | **ARRAYS, STRINGS AND FUNCTIONS** | **9** |
| Arrays – string – string operations – functions - types, Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialization, Recursion, Variable-length argument lists, C Pre-processors, Standard Library Functions and return types. | | |
| **UNIT-IV** | **POINTERS AND ARRAYS** | **9** |
| Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional arrays and row/column major formats, Initialization of Pointer Arrays, Command line arguments, Pointers to functions, complicated declarations and evaluations. | | |
| **UNIT-V** | **STRUCTURES AND UNIX SYSTEM INTERFACE** | **9** |
| Basic Structures, Structures and Functions, Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, Bit-fields, File Access -Error Handling, Line I/O, Miscellaneous Functions. Unix system Interface: File Descriptor, Low level I/O, read and write, Open, create; close and unlink, Random access –lseek, Discussions on Listing Directory, Storage allocator. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| **1** | Algorithm and flowcharts of small problems like GCD |
| | Structured code writing with: |
| **2** | Small but tricky codes |
| **3** | Proper parameter passing |
| **4** | Command line Arguments |
| **5** | Variable parameter |
| **6** | Pointer to functions |

| | | | | |
|---|---|---|---|---|
| **7** | User defined header | | | |
| **8** | Make file utility | | | |
| **9** | Multi file program and user defined libraries | | | |
| **10** | Interesting substring matching / searching programs | | | |
| **11** | Parsing related assignments | | | |
| **12** | Mini Project | | | |
| | | **Contact Hours** | **:** | **60** |
| | | **Total Contact Hours** | **:** | **105** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, the students will be able to | |
| ● | Formulate simple algorithms for arithmetic and logical problems. |
| ● | Implement conditional branching, iteration and recursion. |
| ● | Decompose a problem into functions and synthesize a complete program using divide and conquer approach. |
| ● | Use arrays, pointers and structures to formulate algorithms and programs. |
| ● | Apply programming to solve matrix addition and multiplication problems and searching and sorting problems. |

| **Text Book (s):** | |
|---|---|
| **1** | Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Second Edition, PHI. |
| **2** | Byron Gottfried, "Programming with C", Second Edition, Schaum Outline Series. |
| **Reference Books(s) / Web links:** | |
| **1** | Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill. |
| **2** | YashavantKanetkar, "Let Us C", BPB Publications. |

## CO - PO – PSO MATRICES OF THE COURSE

| **PO/PSO / CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19141.1** | 1 | 2 | 2 | 2 | 1 | - | - | - | 1 | 2 | 1 | 1 | 2 | 3 | 1 |
| **CB19141.2** | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 2 | 2 | - |
| **CB19141.3** | 1 | 1 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 2 | 2 | 1 |
| **CB19141.4** | 2 | 2 | 3 | 2 | 1 | - | - | - | 1 | - | 2 | 1 | 2 | 3 | 1 |
| **CB19141.5** | 2 | 2 | 3 | 2 | 1 | - | - | - | - | - | 2 | 1 | 2 | 2 | 2 |
| **Average** | 1.4 | 1.6 | 2.2 | 1.6 | 1.0 | - | - | - | 1.0 | 2.0 | 1.4 | 1.0 | 2.0 | 2.4 | 1.3 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| EE19141 | PRINCIPLES OF ELECTRICAL ENGINEERING | ES | 2 | 0 | 2 | 3 |

| Objectives: | |
|---|---|
| ● | To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems. |
| ● | To impart knowledge on the phenomenon of resonance in series and parallel circuits and also to obtain the transient response of RC, RL and RLC circuits. |
| ● | To provide knowledge on the principles of electrostatics and electromechanical energy conversion devices. |
| ● | To learn the electrical measurement concepts and energy saving methods by different ways of illumination. |
| ● | To teach methods of experimentally analysing electrical circuits and transducers. |

| UNIT-I | INTRODUCTION | 6 |
|---|---|---|
| Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy. | | |
| **UNIT-II** | **DC CIRCUITS** | **6** |
| Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem. | | |
| **UNIT-III** | **AC CIRCUITS** | **6** |
| AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phase representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits(⅄-Δ&⅄-⅄). | | |
| **UNIT-IV** | **PRINCIPLE OF ELECTROSTATICS AND ELECTROMECHANICS** | **6** |
| Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion. | | |
| **UNIT-V** | **MEASUREMENTS AND SENSORS** | **6** |
| Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices & system.<br><br>**For Further Reading -** Principle of batteries, types, construction and application, Magnetic material and B-H Curve, Basic concept of indicating and integrating instruments. | | |
| | **Total Contact Hours** : | **30** |

| List of Experiments | | | | |
|---|---|---|---|---|
| **1** | Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits. | | | |
| **2** | Determination of resistance temperature coefficient. | | | |
| **3** | Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem). | | | |
| **4** | Simulation of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$ & $X_L = X_C$. | | | |
| **5** | Simulation of Time response of RC circuit. | | | |
| **6** | Verification of relation in between voltage and current in three phase balanced star and delta connected loads. | | | |
| **7** | Demonstration of measurement of electrical quantities in DC and AC systems. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **60** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Analyse DC and AC circuits and apply circuit theorems. |
| ● | Realize series and parallel resonant circuits. |
| ● | Evaluate power in three phase AC circuits. |
| ● | Understand the principles of electrostatics and electromechanical energy conversion devices. |
| ● | Experimentally analyse the electric circuits and transducers. |

| **Text Book (s):** | |
|---|---|
| **1** | B.L.Theraja, "A Textbook of Electrical Technology", Vol. I Basic Electrical Engineering, S. Chand and Company |
| **2** | R.Muthusubramanian, S.Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw Hill |
| **3** | H.Partab, "Art and Science of Utilisation of Electrical Energy", DhanpatRai and Co., New Delhi, 2004. |
| **Reference Books(s) / Web links:** | |
| **1** | A. E. Fitzgerald, KingselyJr Charles, D. Umans Stephen, "Electric Machinery", Sixth Edition Tata McGraw Hill. |
| **2** | V. K. Mehta, "Basic Electrical Engineering", S. Chand and Company Ltd., New Delhi. |
| **3** | J. Nagrath and Kothari, "Theory and problems of Basic Electrical Engineering", Second Edition Prentice Hall of |
| **4** | Edward Hughes, "Electrical Technology", Tenth Edition, Pearson Education Publication. |
| **5** | Vincent. Del. Toro, "Electrical Engineering Fundamentals", Second Edition, Prentice Hall, India. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EE19141.1** | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | - | 3 | - | - | - |
| **EE19141.2** | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | - | - | 3 | - | - | - |
| **EE19141.3** | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | - | 3 | - | - | - |
| **EE19141.4** | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | - | 3 | - | - | - |
| **EE19141.5** | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | - | - | 3 | - | - | - |
| **Average** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | - | - | - | 3.0 | - | - | 3.0 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| PH19143 | FUNDAMENTALS OF PHYSICS | BS | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand the fundamentals of waves and optics as applicable to computing. |
| ● | To understand the foundational aspects of physics in quantum computing. |

| UNIT-I | OSCILLATION | 9 |
|---|---|---|

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple springs mass system –resonance: definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.

| UNIT-II | FUNDAMENTALS OF WAVE OPTICS | 9 |
|---|---|---|

Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating - Temporal and Spatial Coherence.

Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

| UNIT-III | QUANTUM MECHANICS AND CRYSTALLOGRAPHY | 9 |
|---|---|---|

Introduction - Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one-dimensional potential box, Heisenberg Picture.

Crystallography - Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Debye Scherrer powder method, Laue method- Atomic packing factor for SC, BCC, FCC and HCP structures. Semiconductor Physics - conductor, semiconductor and Insulator; Basic concept of Band theory.

| UNIT-IV | LASER AND FIBER OPTICS | 9 |
|---|---|---|

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers.

| UNIT-V | THERMODYNAMICS AND ELECTROMAGNETISM | 9 |
|---|---|---|

Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes, third law of thermodynamics.

Electromagnetism: Continuity equation for current densities – Maxwell's equations in vacuum and non-conducting medium.

| | | | |
|---|---|---|---|
| | **Contact Hours** | **:** | **45** |

**List of Experiments**

| | |
|---|---|
| **1** | Determination of wave length of light by Newton's Ring method |
| **2** | Determination of wave length of light by Laser diffraction method |
| **3** | Determination of Plank constant |
| **4** | Determination of Hall coefficient of semi-conductor |
| **5** | Determination of laser and optical fiber parameters |
| **6** | Magnetic field along the axis of current carrying coil – Stewart and Gee |
| **7** | Determination of Stefan's Constant. |

| | | | |
|---|---|---|---|
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes**<br><br>On completion of the course, students will be able to | |
|---|---|
| ● | Apply the mathematical model of oscillations to various physical systems |
| ● | Understand the various phenomena involving waves and their applications |
| ● | Understand the advanced concepts of quantum mechanics in computational sciences |
| ● | Use the concepts of laser and fiber optics in communication. |
| ● | Apply the concepts of thermodynamics and electromagnetism for various systems. |

| **Text Books:** | |
|---|---|
| **1** | Beiser A, "Concepts of Modern Physics", Fifth Edition, McGraw Hill International. |
| 2 | David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", Wileyplus. |

| **Reference Books / Web links:** | |
|---|---|
| **1** | AjoyGhatak, "Optics" Fifth Edition, Tata McGraw Hill. |
| **2** | Sears &Zemansky, "University Physics", Addison-Wesley. |
| **3** | Jenkins and White, "Fundamentals of Optics", Third Edition, McGraw-Hill. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PH19143.1** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| **PH19143.2** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| **PH19143.3** | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| **PH19143.4** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| **PH19143.5** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |
| **Average** | 3.0 | 3.0 | 2.0 | 2.0 | 1.0 | 1.4 | 1.2 | 1.0 | 2.0 | 1.0 | 2.0 | 2.0 | 2.0 | 1.0 | 2.0 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MA19253 | LINEAR ALGEBRA | BS | 3 | 1 | 0 | 4 |

| Objectives: | |
|---|---|
| ● | To gain knowledge in using matrix algebra techniques to solve system of linear equations. |
| ● | To understand the concept of vector spaces to use in the principal component analysis. |

| UNIT-I | MATRICES AND DETERMINENTS | 12 |
|---|---|---|
| Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix. | | |
| **UNIT-II** | **APPLICATION OF MATRICES** | **12** |
| Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices. | | |
| **UNIT-III** | **VECTOR SPACE** | **12** |
| Vector space; Dimension; Basis; Orthogonality; Projections; Gram-Schmidt orthogonalization and QR decomposition. | | |
| **UNIT-IV** | **EIGENVALUE PROBLEMS** | **12** |
| Eigen values and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices. | | |
| **UNIT-V** | **PRINCIPAL COMPONENT ANALYSIS** | **12** |
| Singular value decomposition and Principal component analysis; Introduction to their applications in Image Processing and Machine Learning. | | |
| | **Total Contact Hours** : | **60** |

| Course Outcomes: | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Use matrix algebra techniques to solve system of linear equations. |
| ● | Solve system of equations using the concept of matrix decomposition. |
| ● | Use the concept of vector spaces in generating ortho-normal bases. |
| ● | Solve problems of linear transformation using eigen values and eigen vectors. |
| ● | Use principal component analysis for applications in image processing and machine learning. |

| Text Books: | |
|---|---|
| 1 | B. S. Grewal,"Higher Engineering Mathematics". |

| Reference Books / Web links: | |
|---|---|
| 1 | Peter V. O'Neil , "Advanced Engineering Mathematics", 7th Edition. |
| 2 | Michael. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition. |
| 3 | Gilbert Strang, "Introduction to linear algebra", 5th Edition. |
| 4 | P. N. Wartikar& J. N. Wartikar, "Applied Mathematics (Vol. I & II) ". |
| 5 | R C Gonzalez and R E Woods , "Digital Image Processing". |
| 6 | https://machinelearningmastery.com/introduction-matrices-machine-learning/ |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MA19253.1** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 | 1 |
| **MA19253.2** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 | 1 |
| **MA19253.3** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 | 1 |
| **MA19253.4** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 3 | 1 |
| **MA19253.5** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | 3 | 1 |
| **Average** | 3.0 | 2 | 2 | 1.4 | 2 | - | - | - | - | - | - | 2 | 2.4 | 2.4 | 1 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight(Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation:"-"

| Subject Code | Subject Name (Theory course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19208 | FUNDAMENTALS OF ECONOMICS | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | To explain the fundamental principles of micro economics relevant to managing an organization. |
| ● | To describe the fundamental principles of macroeconomics to have the understanding of economic environment of business. |
| ● | To understand the various aspects of India's economy. |

| UNIT-I | INTRODUCTION | 6 |
|---|---|---|
| Principles of Demand and Supply- Supply Curves of Firms - Elasticity of Supply; Demand Curves of Households- Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve) | | |
| **UNIT-II** | **CONSUMER ANALYSIS** | **6** |
| Welfare Analysis- Consumers' and Producers' Surplus - Price Ceilings and Price Floors; Consumer Behavior - Axioms of Choice - Budget Constraints and Indifference Curves; Consumer's Equilibrium- Effects of a Price Change, Income and Substitution Effects -Derivation of a Demand Curve | | |
| **UNIT-III** | **PRODUCTION AND COSTING** | **6** |
| Applications- Tax and Subsidies - Intertemporal Consumption - Suppliers' Income Effect; Theory of Production - Production Function and Iso-quants - Cost Minimization; Cost Curves- Total, Average and Marginal Costs - Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition | | |
| **UNIT-IV** | **MACROECONOMIC REFORMS** | **6** |
| National Income and its Components- GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector- Taxes and Subsidies; External Sector- Exports and Imports; Money- Definitions; Demand for Money-Transactionary and Speculative Demand; Supply of Money- Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets- IS, LM Model | | |
| **UNIT-V** | **POLICY GOVERNANCE** | **6** |
| Business Cycles and Stabilization- Monetary and Fiscal Policy - Central Bank and the Government; The Classical Paradigm- Price and Wage Rigidities - Voluntary and Involuntary Unemployment | | |
| | **Total Contact Hours : 30** | |

| Course Outcomes: | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Become familiar with both principles of micro and macroeconomics. |
| ● | Understand about approaches to consumer behaviour and relation between production and cost function. |
| ● | Describe and discuss on interaction of product and factor market. |
| ● | Get awareness about importance and development of Indian economy and economic reforms. |
| ● | Have thorough knowledge in the areas of inflation, unemployment, monetary policy, fiscal policy and international trade. |

| Text Books: | |
|---|---|
| 1 | Pindyck, Robert S., and Daniel L. Rubinfeld, "Microeconomics", 7th edition Pearson |
| 2 | Dornbusch, Fischer and Startz," Macroeconomics", 12th edition McGraw Hill |
| 3 | Paul Anthony Samuelson, William D. Nordhaus, "Economics",19th edition, McGraw Hill |
| **Reference Books / Web links:** | |
| 1 | Hal R, Varian, "Intermediate Microeconomics: A Modern Approach", 8th edition |
| 2 | N. Gregory Mankiw, "Principles of Macroeconomics", 6th edition, Cengage India |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19212.1** | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 |
| **BA19212.2** | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 3 |
| **BA19212.3** | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **BA19212.4** | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **BA19212.5** | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 |
| **Average** | 2 | 2.4 | 1.2 | 2.2 | 1.8 | 1.4 | 1.8 | 2.8 | 2.6 | 3 | 3 | 3 | 2.4 | 1.6 | 1.6 |

Correlation levels 1, 2 or 3 are as defined below:
1:Slight(Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation:"-"

| Subject Code | Subject Name (Theory course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| HS19251 | BUSINESS COMMUNICATION & VALUE SCIENCE – II | HS | 2 | 1 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | Develop effective writing, reading, presentation and group discussion skills |
| ● | Help students identify personality traits and evolve as a better team player. |
| ● | Introduce them to key concepts of a) Morality b) Behavior and beliefs c) Diversity & Inclusion |

| UNIT-I | LAUNCHING E MAGAZINE | 9 |
|---|---|---|
| **Writing**: Good and bad writing - Common errors, punctuation rules, use of words - writing techniques of Catherine Morris and Joanie McMahon's – Creating and launching E-magazine. **Speaking:** Icebreaker - Participating in 'Join Hands Movement' - Individual identification of social issues – addressing social issues - **Reading:** Sharing the learning points from GD – SATORI. **Group Practical** –Research read and generates a report based on social causes and findings. Grade points on the Leaderboard. **Practical:** Plan, design and launching an E-Magazine–contributing article to the magazine – Quiz Time | | |
| **UNIT-II** | **FORMULATING AN ORGANIZATIONAL STRUCTURE** | **9** |
| Each group forming an NGO - create vision, mission, value statement, and tagline and design a logo. Introduction to basic presentation skills & ORAI app - Groups to present their NGOs – Presentation recording and sharing the findings from recording. **Writing**: individual write up for E- magazine and evaluation - preparation and publication of second episode of E-Magazine. Speed Reading session: Introduction to skimming and scanning; SATORI– Join the dots - Quiz Time | | |
| **UNIT-III** | **TEAM PLAY** | **9** |
| Ad campaign - Brain storming session - discussing and exploring the means of articulating and amplifying the social issue their NGOs are working for - Designing skits: write the script articulating the message of their respective NGOs - Promote the play through a social media and gather audience - Enact the play - reviews. Group Activity: Prepare and publish the third episode of the E Magazine. Berbin's 8 Team roles and Lindgren's big 5 personality traits – SATORI joining dots and Quiz Time. | | |
| **UNIT-IV** | **DIVERSITY AND INCLUSION** | **9** |
| Learn from movies - film on diversity – discussion on key take away of the film - Theory to connect and concept of empathy. Create story – Group activity – a person's life affected by the social issue – narration of story in first person - Feedbacks by other groups. Research on a book, incident or film based on the topic of your respective NGO - Write a review in a blog on the topics they are covering in their research. Diversity & Inclusion - Different forms of Diversity in our society - Debate on diversity with an angle of ethics, morality and respect for individual. Prepared speech - Every student will narrate the challenges faced by a member of a diverse group. Video recording interviews of people from diverse groups with 5 questions. **Practical:** Touch the target, film: 'The Fish and I' by BabakHabibifar.<br><br>Group Activity: Discussion on TCS values, Respect for Individual and Integrity. Preparation of final episode of the E Magazine. **Revisit your resume:** Include your recent achievements in your resume. SATORI and Quiz Time. | | |
| **UNIT-V** | **ORGANIZING AWARENESS CAMPAIGN** | **9** |
| **Project-** 1) Each team to look for an NGO/ social group in the city which is working on the issue their college group is supporting. 2) Spend **a day with the NGO/ social group** to understand exactly how they work and the challenges they face. 3) Render voluntary service to the group for one day 4) Invite the NGO/ social group to address their university students for couple of hours. Plan the entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with the NGO spokesperson 5) The groups to present their experience of **a day with the NGO** and inspire students to work for the cause. | | |
| | **Total Contact Hours** : | **45** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Understand and use tools of structured written communication |
| ● | Develop materials to create an identity for an organization dedicated to a social cause |
| ● | Identify individual personality types and role in a team. |
| ● | Understand the basic concepts of Morality and Diversity |
| ● | Organize an event to generate awareness and get support for a cause |

| **Reference Books / Web links:** | |
|---|---|
| **1** | Dr. A.P.J Abdul Kalam, ArunTiwari, ”Guiding Souls : Dialogues on the purpose of life”,2005. |
| **2** | Dr. A.P.J Abdul Kalam, AcharyaMahapragya , ”The Family and the Nation”, 2015. |
| **3** | Dr. A.P.J Abdul Kalam, Y.S.Rajan, ” The Scientific India: A twenty First Century Guide to the World around Us”,2011. |
| **4** | Dr. A.P.J Abdul Kalam , ”Forge Your Future: Candid, Forthright, Inspiring” ,2014 |
| **5** | Peter H. Diamandis and Steven Kotler, ”Abundance: The Future is Better Than You Think”, 2012. |
| **6** | Simon Sinek , ”Start With Why: How Great Leaders Inspire Everyone to Take Action”, Penguin,2011. |
| **7** | Sandra Moriarty, Nancy D. Mitchell, William D. Wells,” Advertising & IMC: Principles and Practice”, Pearson Education India,2016 |

| **Web References** | |
|---|---|
| **1** | ETHICS FUNDAMENTALS AND APPROACHES TOETHICS https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf |
| **2** | A Framework for Making Ethical Decisionshttps://www.brown.edu/academics/science-and-technology-studies/framework-makingethical-decisions |
| **3** | Five Basic Approaches to Ethical Decision http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf |

| **Online Resources** | |
|---|---|
| **1** | https://youtu.be/CsaTslhSDI |
| **2** | https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M |
| **3** | https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y |
| **4** | https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HS19251.1** | 1 | 3 | - | 2 | - | 2 | 1 | - | 3 | 3 | - | 1 | 1 | 1 | 1 |
| **HS19251.2** | - | - | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | - | 3 | 2 | - | 2 |
| **HS19251.3** | - | - | - | 1 | - | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 1 | - | 1 |
| **HS19251.4** | - | - | 1 | - | - | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | - | 1 |
| **HS19251.5** | - | - | - | 1 | - | 2 | 2 | - | 1 | 2 | 3 | 3 | 1 | 1 | - |
| **Average** | 0.2 | 0.6 | 0.6 | 1.2 | 0.2 | 1.8 | 1.8 | 1.2 | 2.4 | 2.2 | 1.8 | 2.4 | 1.4 | 0.4 | 1 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MA19241 | STATISTICAL MODELING | BS | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To gain knowledge of sampling techniques and use testing of hypothesis for parameter estimation. |
| ● | To understand the use of statistical models for forecasting. |
| ● | To gain the knowledge of using R programming in simulation and modelling. |

| UNIT-I | SAMPLING AND ESTIMATION THEORY | 9 |
|---|---|---|
| Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling - Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation. Concept & examples, complete sufficiency, their application in estimation | | |
| **UNIT-II** | **LINEAR STATISTICAL MODELS** | **9** |
| Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Multiple regression& multiple correlation, Analysis of variance (one way, two way with as well as without interaction). | | |
| **UNIT-III** | **TEST OF HYPOTHESIS** | **9** |
| Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing .Non-parametric Inference**:** Comparison with parametric inference, Use of order statistics. | | |
| **UNIT-IV** | **NON PARAMETRIC TESTS** | **9** |
| Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test. Tolerance region. | | |
| **UNIT-V** | **BASICS OF TIME SERIES ANALYSIS & FORECASTING** | **9** |
| Stationary, ARIMA Models: Identification, Estimation and Forecasting. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Introduction to R, Functions, Control flow and Loops | | |
| **2** | Working with Vectors and Matrices | | |
| **3** | Reading in and Writing Data | | |
| **4** | Working with Data | | |
| **5** | Manipulating Data | | |
| **6** | Simulation | | |
| **8** | Linear model | | |
| **9** | Data Frame | | |
| **10** | Graphics in R | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Apply the concept of sampling distribution and estimation theory in forecasting. |
| ● | Apply the concept of correlation, regression using R programming and design experiments. |
| ● | Use the concepts of Testing of Hypothesis for industrial problems. |
| ● | Use the concepts of Non Parametric Testing for Non-Normal Populations. |
| ● | Apply the concept of time series analysis in real life situation. |

| **Text Books:** | |
|---|---|
| **1** | I.R. Miller, J.E. Freund and R. Johnson , "Probability and Statistics for Engineers ",4th Edition. |
| **2** | A. Goon, M. Gupta and B.Dasgupta , "Fundamentals of Statistics ",Vol. I & Vol. II, |
| **3** | Chris Chatfield ,"The Analysis of Time Series: An Introduction". |

| **Reference Books / Web links:** | |
|---|---|
| **1** | D.C. Montgomery & E.Peck, "Introduction to Linear Regression Analysis". |
| **2** | A.M. Mood, F.A. Graybill & D.C. Boes , "Introduction to the Theory of Statistics". |
| **3** | N. Draper & H. Smith,"Applied Regression Analysis". |
| **4** | Garrett Grolemund,"Hands-on Programming with R". |
| **5** | Jared P. Lander,"R for Everyone: Advanced Analytics and Graphics". |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MA19241.1** | 3 | 2 | 2 | 3 | 2 | 1 | - | - | - | 1 | 2 | - | 2 | 3 | 1 |
| **MA19241.2** | 3 | 2 | 2 | 3 | 2 | 1 | - | - | - | 1 | 2 | - | 2 | 3 | 1 |
| **MA19241.3** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 2 | - | 2 | 3 | 2 |
| **MA19241.4** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 2 | - | 2 | 3 | 3 |
| **MA19241.5** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 2 | - | 2 | 3 | 3 |
| **Average** | 3.0 | 2.6 | 2 | 3 | 2.6 | 1.6 | - | - | - | 1.6 | 2 | - | 2 | 3 | 2 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (Lab oriented Theory Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19241 | DATA STRUCTURES AND ALGORITHMS | PC | 2 | 1 | 4 | 5 |

| Objectives: | |
|---|---|
| ● | To learn linear and non-linear data structures. |
| ● | To recognize and distinguish the applications of various linear and non-linear data structures. |
| ● | To analyse the concepts of tree and graph data structures. |
| ● | To be able to incorporate various searching and sorting techniques in real time scenarios. |
| ● | To understand the concept of files and its operations. |

| UNIT-I | BASIC TERMINOLOGIES & INTRODUCTION TO ALGORITHM AND DATA | 9 |
|---|---|---|
| Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction. | | |
| **UNIT-II** | **LINEAR DATA STRUCTURE** | **9** |
| Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures. | | |
| **UNIT-III** | **NON-LINEAR DATA STRUCTURE** | **9** |
| Trees - Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree , Graphs Directed, Undirected - Various Representations - Operations - search and traversal algorithms and complexity analysis & Applications of Non-Linear Data Structures. | | |
| **UNIT-IV** | **SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES** | 9 |
| Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing. | | |
| **UNIT-V** | **FILE** | **9** |
| Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes. | | |
| | **Contact Hours** : | **45** |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Towers of Hanoi using user defined stacks. | | |
| **2** | Reading, writing, and addition of polynomials. | | |
| **3** | Line editors with line count, word count showing on the screen. | | |
| **4** | Trees with all operations. | | |
| **5** | All graph algorithms. | | |
| **6** | Saving / retrieving non-linear data structure in / from a file. | | |
| | **Contact Hours** | : | **60** |
| | **Total Contact Hours** | : | **105** |

| Course Outcomes: | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Analyse the various data structure concepts. |
| ● | Apply the different linear data structures to problem solutions. |
| ● | Apply the different non-linear data structures to problem solutions. |
| ● | Critically analyse the various sorting algorithms. |
| ● | Exemplify the concept of files and its operations. |

| Text Book(s): | |
|---|---|
| 1 | E. Horowitz and S. Sahni , ”Fundamentals of Data Structures”, 1977. |
| 2 | Alfred V. Aho, John E. Hopperoft, Jeffrey D. UIlman, ”Data Structures and Algorithm”. |

| Reference Books(s) / Web links: | |
|---|---|
| 1 | Donald E. Knuth , ”The Art of Computer Programming: Fundamental Algorithms”, Volume 1. |
| 2 | Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein,” Introduction to Algorithms”. |
| 3 | Pat Morin ,“Open Data Structures: An Introduction (Open Paths to Enriched Learning)”, 31st ed. Edition. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19241.1** | 3 | 3 | 2 | 3 | 2 | - | 1 | 1 | 1 | - | 2 | 1 | 3 | 1 | - |
| **CB19241.2** | 3 | 3 | 3 | 3 | 2 | - | - | 1 | 1 | - | 1 | 1 | 3 | 1 | - |
| **CB19241.3** | 3 | 3 | 3 | 3 | 2 | - | - | 1 | 1 | - | 1 | 1 | 3 | 1 | - |
| **CB19241.4** | 3 | 3 | 3 | 3 | 1 | - | - | 1 | 1 | - | 1 | 1 | 3 | 1 | - |
| **CB19241.5** | 3 | 3 | 3 | 3 | 2 | - | - | 1 | 1 | - | 1 | 1 | 3 | 1 | - |
| **Average** | 3 | 3 | 2.8 | 3 | 1.8 | - | 0.2 | 1 | 1 | - | 1.2 | 1 | 3 | 1 | - |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-“

| Subject Code | Subject Name ( Lab oriented Theory Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| EC19242 | PRINCIPLES OF ELECTRONICS | ES | 2 | 0 | 2 | 3 |

| Objectives: | |
|---|---|
| ● | To study the operation of semiconductor diodes and their characteristics. |
| ● | To acquire knowledge about the operation and characteristics of BJT under various configurations. |
| ● | To introduce the structure and terminal characteristics of FET and MOSFET. |
| ● | To understand the concepts of feedback and operational amplifiers with its applications. |
| ● | To gain knowledge about digital logic circuits. |

| UNIT-I | SEMICONDUCTORS DIODES AND CIRCUITS | 6 |
|---|---|---|
| **Semiconductors:** Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers. **Diodes and Diode Circuits:** Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation. | | |
| **UNIT-II** | **BIPOLAR JUNCTION TRANSISTORS** | **6** |
| Formation of PNP / NPN junctions; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor | | |
| **UNIT-III** | **FIELD EFFECT TRANSISTORS** | **6** |
| Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles | | |
| **UNIT-IV** | **FEED BACK AMPLIFIER AND OPERATIONAL AMPLIFIERS** | **6** |
| Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability. Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator | | |
| **UNIT-V** | **DIGITAL ELECTRONICS FUNDAMENTALS** | **6** |
| Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters. | | |
| | **Contact Hours** : | **30** |

| List of Experiments | | | | |
|---|---|---|---|---|
| **1** | Characteristics of PN Junction Diode | | | |
| **2** | Zener diode Characteristics | | | |
| **3** | Study of Full wave rectifier. | | | |
| **4** | Common Emitter input-output Characteristics | | | |
| **5** | FET Characteristics | | | |
| **6** | Verification of Logic gates. | | | |
| **7** | Verification of Half adder | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **60** |

| **Course Outcomes:** | |
|---|---|
| | On completion of the course, students will be able to |
| ● | Demonstrate the characteristics of the diode. |
| ● | Analyse the BJT terminal characteristics and its utilization. |
| ● | Develop a high degree of familiarity with the FET and MOSFET. |
| ● | Design suitable amplifiers for any specific applications. |
| ● | Construct simple digital logic circuits. |

| **Text Book(s):** | |
|---|---|
| **1** | Adel S. Sedra and Kenneth Carless Smith, "Microelectronics Circuits", Fifth Edition, Oxford University Press, |
| **2** | Jacob Millman, Christos Halkias and Chetan Parikh, "Millman's Integrated Electronics", Second Edition, Tata |
| **3** | M. Morris Mano, "Digital Logic & Computer Design", Pearson India Education Services, 2016. |

| **Reference Books(s) / Web links:** | |
|---|---|
| **1** | Robert L. Boylestad, Louis Nashelsky. "Electronic Devices and Circuit Theory", 8th Edition, Pearson Education Limited, 2002. |
| **2** | Ben Streetman, Sanjay Banerjee ,"Solid State Electronic Devices", 6th Edition, 2002. |
| **3** | Albert Paul Malvino and David J.Bates, "Electronic Principle",7th Edition, Tata McGraw- Hill, 2008. |
| **4** | D Schilling, C Belove, T Apelewicz, R Saccardi, "Electronics Circuits: Discrete & Integrated", 3rd Edition, Tata McGraw- Hill, 2008. |
| **5** | Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Edition, Tata McGraw- Hill, 2009. |
| **6** | S. Salivahanan, N. Suresh Kumar and A.Vallavaraj, " Electronics Devices & Circuits", Tata McGraw- Hill, |
| **7** | Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 10thEdition, Pearson Education Limited, 2009. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EC19242.1** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| **EC19242.2** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 1 |
| **EC19242.3** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 1 |
| **EC19242.4** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 1 |
| **EC19242.5** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 2 | 2 | 1 |
| **Average** | 2.8 | 2.8 | 2.8 | 2.8 | 1.8 | 2 | 2 | 1 | 2.6 | 1.8 | 1.8 | 1.6 | 1.2 | 2 | 1 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (Mandatory Non-credit course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MC19201 | ENVIROMENTAL SCIENCES | MC | 3 | 0 | 0 | 0 |

| Objectives: | |
|---|---|
| ● | To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment. |
| ● | To understand the importance of resources and various causes for environmental degradation and the study of nature and the facts about environment. |
| ● | To provide the students about the current social issues and environmental legislations. |

| UNIT-I | ENVIRONMENT AND ECOSYSTEM | 9 |
|---|---|---|
| Environment -definition - scope and importance of environmental science- structure and composition of atmosphere, hydrosphere, lithosphere and biosphere- Ecosystem -structure - biotic and abiotic components - functions - energy flow in ecosystems, energy flow models, food chain and food web- types of ecosystem - forest, aquatic and grass land ecosystems- Biogeochemical cycles - water, carbon, nitrogen and oxygen cycle - Ecological succession-stages involved- primary and secondary succession. | | |
| **UNIT-II** | **BIODIVERSITY** | **9** |
| Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and option values – significance of medicinal plants – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of | | |
| **UNIT-III** | **NATURAL RESOURCES** | **9** |
| Forest resources -use and over exploitation –Water resources -use and over utilization - dams - benefits and problems - water conservation -Energy resources - growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources -Land resources -land degradation - role of an individual in conservation of natural resources. | | |
| **UNIT-IV** | **ENVIRONMENTAL POLLUTION** | **9** |
| Air Pollution-definition - causes, effects and control measures of air pollution -chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, and ozone depletion-Water pollution - definition-causes-effects and control measures-Soil pollution - definition-causes-effects and control measures-Noise pollution - definition - causes, effects and control measures-Radioactive pollution – causes, effects and control measures. | | |
| **UNIT-V** | **SOCIAL ISSUES AND THE ENVIRONMENT** | **9** |
| Sustainable development -concept, components and strategies - social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine - consumerism and waste products - environment and human health - role of information technology in environment and human health -disaster management– floods, earthquake, cyclone and landslide. | | |
| | **Total Contact Hours** : | **45** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, students will be able to | |
| ● | Realize the importance of ecosystems. |
| ● | Preserve the values of biodiversity. |
| ● | Be conversant to utilize resources in a sustainable manner. |
| ● | Find ways to protect the environment and play proactive roles. |
| ● | Develop and improve the standard of better living |

| **Text Books:** | |
|---|---|
| **1** | Benny Joseph, "Environmental Science and Engineering", 2nd edition, Tata McGraw- Hill, New Delhi,2008. |
| **2** | B.K.Sharma and H. Kaur, Environmental Chemistry, Goel Publishing House, Meerut, 1996. |

| **Reference Books / Web links:** | |
|---|---|
| **1** | ErachBharucha, "Textbook of Environmental Studies", 3rdedition, Universities Press(I) PvtLtd, Hyderabad. |
| **2** | G. Tyler Miller and Scott E. Spoolman, "Environmental Science", 15th edition, Cengage Learning India PVT, LTD, Delhi, 2014. |
| **3** | Rajagopalan, R, "Environmental Studies-From Crisis to Cure", 3rdedition, Oxford University Press, 2015. |
| **4** | De. A.K., "Environmental Chemistry", New Age International, New Delhi, 1996. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MC19201.1** | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 1 | - | 1 | 2 | 1 | 1 | - |
| **MC19201.2** | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 1 | - | 1 | 2 | 1 | 1 | - |
| **MC19201.3** | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | - |
| **MC19201.4** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 |
| **MC19201.5** | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| **Average** | 3 | 2.8 | 2.6 | 1.4 | 1.4 | 3 | 3 | 2.4 | 1.6 | 1.2 | 1 | 2 | 1 | 1.2 | 0.6 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (Theory course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19301 | FORMAL LANGUAGE AND AUTOMATA THEORY | PC | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To give an overview of the theoretical foundations of computer science and illustrate finite state machine and regular grammar. |
| ● | To illustrate pushdown automata, linear bounded automata and Turing machine to solve problems in computing. |
| ● | To familiarize context frees grammars, context sensitive grammars and various normal forms. |
| ● | To determine the decidability and undecidability of computational problems. |
| ● | To understand the theory of Class P, NP and NP complete problems. |

| UNIT-I | INTRODUCTION TO LANGUAGES AND FINITE AUTOMATA | 9 |
|---|---|---|
| **Introduction:** Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. **Finite automata:** Deterministic finite automata (DFA) and nondeterministic finite automata (NFA) and equivalence with DFA, Finite Automata with Epsilon transitions, Equivalence of NDFA's with and without Epsilon moves. | | |
| **UNIT-II** | **REGULAR LANGUAGES AND GRAMMARS** | **9** |
| Regular expressions and languages, Regular grammars and equivalence with finite automata, properties of regular languages, Kleene's theorem, pumping lemma for regular languages, Myhill-Nerode theorem and its uses, minimization of finite automata. Context-free grammars (CFG) and languages (CFL), parse trees, ambiguity in CFG, Chomsky and Greibach normal forms. | | |
| **UNIT-III** | **GRAMMARS AND PUSHDOWN AUTOMATA** | **9** |
| Nondeterministic pushdown automata (PDA) and equivalence with CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. | | |
| **UNIT-IV** | **TURING MACHINES** | **9** |
| The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. | | |
| **UNIT-V** | **UNDECIDABILITY AND THEORY OF P, NP AND NP COMPLETENESS** | **9** |
| Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages. Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP- completeness, Cook's Theorem, other NP - Complete problems. | | |
| | **Total Contact Hours : 45** | |

| List of Practice Lab Experiments | |
|---|---|
| **1** | Deterministic Finite Automata (DFA) and Non Deterministic Finite Automata (NFA) |
| **2** | Conversion of NFA to DFA |
| **3** | Conversion of Finite Automata to Regular Expression |
| **4** | Context Free Grammars (CFG) |
| **5** | Pushdown Automata (PDA) |
| **6** | Turing Machine |

| Platform Needed: | |
|---|---|
| **HARDWARE** | Personal Computer with Dual Core Processor with 8 GB RAM. |
| **SOFTWARE** | LEX and YACC Compiler, JLAP Tool |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the basics of the languages and grammars, fundamental foundations of theoretical science. |
| ● | Design finite state machines, pushdown automata, linear bounded automata and Turing machine to solve problems in computing. |
| ● | Construct regular expressions, context free grammars, context sensitive grammars for various languages. |
| ● | Determine the decidability and intractability of computational problems. |
| ● | Classify problems into class P, NP and NP complete. |

| **Text Books(s):** | |
|---|---|
| **1** | John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation ",Third Edition, Pearson Education, 2013. |

| **Reference Books(s):** | |
|---|---|
| **1** | Peter Linz, "An introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016 |
| **2** | K.V.N Sunitha and N.Kalyani , "Formal Languages and Automata Theory", Pearson Education India, 2015 |
| **3** | Harry R. Lewis and Christos H. Papadimitriou,"Elements of the Theory of Computation", Second Edition, Prentice Hall of India,2003. |
| **4** | Dexter C. Kozen, "Automata and Computability", Springer-Verlag, Berlin, 1997. |
| **5** | Michael Sipser, "Introduction to the Theory of Computation , "Third Edition, Cengage Learning, 2013. |
| **6** | John C. Martin, "Introduction to Languages and the Theory of Computation ", Fourth Edition, McGraw-Hill, 2011. |
| **7** | M. R. Garey and D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP Completeness ", A Series of Books in the Mathematical Sciences, W. H. Freeman and Company, 1979. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19301.1** | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CB19301.2** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | 2 | - | 2 | 1 | 1 |
| **CB19301.3** | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 | - |
| **CB19301.4** | 2 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | 1 | - | 2 | 2 | - |
| **CB19301.5** | 2 | 2 | 2 | - | - | 1 | - | - | - | 1 | - | - | 2 | 2 | 2 |
| **Average** | 2.0 | 2.4 | 2.0 | 1.5 | - | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.5 | - | 2.0 | 1.75 | 1.5 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19302 | COMPUTER ORGANIZATION & ARCHITECTURE | PC | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To learn the basic structure, operation of digital computer through Boolean logic and learn instruction set architectures. |
| ● | To familiarize with the arithmetic and logic unit and implementation of fixed point and floating-arithmetic operations. |
| ● | To learn the design of a simple CPU, pipelining and hazards. |
| ● | To understand the input/output systems, interfaces and interrupts. |
| ● | To impart knowledge on memory system organization. |

| UNIT-I | INTRODUCTION & INSTRUCTION SET | 9 |
|---|---|---|
| Revision of basics in Boolean logic and Combinational/Sequential Circuits. Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs. | | |
| **UNIT-II** | **DATA REPRESENTATION AND COMPUTER ARITHMETIC** | **9** |
| Data representation: Signed number representation, fixed and floating point representations, character representation. Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format. | | |
| **UNIT-III** | **PROCESSOR AND CONTROL UNIT** | **9** |
| Introduction to x86 architecture. CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency. | | |
| **UNIT-IV** | **INPUT/OUTPUT SYSTEMS** | **9** |
| Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB. | | |
| **UNIT-V** | **MEMORY ORGANIZATION** | **9** |
| Memory system design: Semiconductor memory technologies, memory organization. Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies. | | |
| | **Contact Hours : 45** | |

| List of Practice Lab Experiments | |
|---|---|
| **1** | **Design of digital circuits**<br>(a) Implementation of Combinational Digital/Boolean Circuits: Adder, Subtractor, Multiplication Module, Division Module, Multiplexer, Demultiplexer, Encoder, Decoder.<br>(b) Implementation of Sequential Circuits: Counters, Linear Feedback Shift Registers (LFSR). |
| **2** | Implementation of C++ program to understand the formats of char, int, float, double, long data types. |
| **3** | Implementation of machine language programming on x86 version kits<br>(i) Add/subtract/multiplication/division/GCD/LCM<br>(ii) Accessing some specific memory locations/ports<br>(iii) Counting odd and even integers from a series of memory locations<br>(iv) Printing values of selected registers<br>(v) Handing interrupts |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Apply boolean logic to understand basic system architecture and instruction sets. |
| ● | Apply fixed and floating-point arithmetic operations. |
| ● | Gain knowledge on simple CPU design, pipelining and hazards. |
| ● | Understand the input/output systems and interfaces. |
| ● | Acquire knowledge on memory system design organization. |

| **Text Books(s):** | |
|---|---|
| **1.** | . M. Mano," Computer System Architecture", Third edition, Prentice Hall of India, New Delhi, 1993. |
| **2.** | David A. Patterson and John L.Hennessy," Computer Organization and Design: The Hardware/Software Interface",Fifth Edition, Morgan Kaufmann, 2014. |
| **3.** | arl Hamacher, ZvonkoVranesic, SafwatZakyand NaraigManjikian," Computer Organization and Embedded Systems", Sixth Edition, McGraw Hill, 2012. |

| **Reference Books(s):** | |
|---|---|
| **1** | John P. Hayes, "Computer Architecture and Organization ", Third Edition, Tata Mc-Graw Hill, 2012. |
| **2** | William Stallings," Computer Organization and Architecture: Designing for Performance", Eleventh Edition, Pearson, 2019. |
| **3** | Vincent P. Heuring and Harry F. Jordan," Computer System Design and Architecture", Second Edition, Pearson, 2004. |

## CO - PO – PSO MATRICES OF THE COURSE

| **PO/PSO / CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19302.1** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19302.2** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19302.3** | 3 | 2 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19302.4** | 3 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19302.5** | 3 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **Average** | 3.0 | 2.4 | 3.0 | 2.6 | 2.4 | 2.0 | 2.0 | 1.0 | - | 1.0 | 1.0 | 2.0 | 3.0 | 2.0 | - |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial
(High) No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19341 | OBJECT ORIENTED PROGRAMMING | CS | 2 | 0 | 4 | 4 |

| Objectives: | |
|---|---|
| ● | To learn the difference between procedural programming and object-oriented programming. |
| ● | To familiarize and build C++ classes using appropriate encapsulation and design principles. |
| ● | To introduce essential C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, exception handling, etc. |
| ● | To understand the Generic Programming and File I/O. |
| ● | To apply object-oriented concepts to solve real time computing problems. |

| UNIT-I | PROCEDURAL PROGRAMMING AND SOME DIFFERENCE BETWEEN C AND C++ | 6 |
|---|---|---|
| An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (*C*-way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive. Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments. | | |
| **UNIT-II** | **FUNDAMENTALS OF OBJECT-ORIENTED PROGRAMMING** | **6** |
| Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object. **More extensions to C in C++ to provide OOP Facilities:** Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception). | | |
| **UNIT-III** | **ESSENTIALS OF OBJECT-ORIENTED PROGRAMMING** | **6** |
| Operator overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling. | | |
| **UNIT-IV** | **GENERIC PROGRAMMING AND I/O** | **6** |
| **Generic Programming:** Template concept, class template, function template, template specialization. **Input and Output:** Streams, Files, Library functions, formatted output. | | |
| **UNIT-V** | **OBJECT ORIENTED DESIGN AND MODELLING** | **6** |
| UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design. | | |
| | **Contact Hours** : | **30** |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Study of different UML diagrams | | |
| **2** | Programs on concept of classes and objects | | |
| **3** | Programs using friend functions | | |
| **4** | Programs using static polymorphism | | |
| **5** | Programs using constructors | | |
| **6** | Programs using inheritance | | |
| **7** | Programs on dynamic polymorphism | | |
| **8** | Programs on exception handling | | |
| **9** | Programs on generic programming using template function & template class | | |
| **10** | Programs on file handling | | |
| | **Contact Hours** | : | **60** |
| | **Total Contact Hours** | : | **90** |

| **Course Outcomes:** On completion of the course, students will be able to | |
|---|---|
| ● | Understand the concepts and relative merits of C++ . |
| ● | Gain knowledge on C++ classes using appropriate encapsulation and design principles. |
| ● | Implement programs using object oriented concepts such as encapsulation, inheritance and polymorphism. |
| ● | Understand and implement the Generic Programming and File I/O. |
| ● | Acquire knowledge on Object Oriented Design and Modeling. |

| **Text Books:** | |
|---|---|
| **1** | BjarneStroustrup, "The C++ Programming Language ", Fourth Edition, Addison Wesley, 2013. |
| **2** | Debasish Jana," C++ and Object-Oriented Programming Paradigm", Third Edition, PHI Learning Pvt. Ltd, 2014. |

| **Reference Books / Web links:** | |
|---|---|
| **1** | BjarneStroustrup, " Programming – Principles and Practice Using C++", Second Edition, Addison Wesley, 2014. |
| **2** | BjarneStroustrup," The Design and Evolution of C++", First Edition, Addison Wesley, 1994. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19341.1** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19341.2** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19341.3** | 3 | 2 | 2 | 3 | 2 | - | 2 | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19341.4** | 3 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **CB19341.5** | 3 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 2 | 3 | 2 | - |
| **Average** | 3.0 | 2.4 | 3.0 | 2.6 | 2.4 | 2.0 | 2.0 | 1.0 | - | 1.0 | 1.0 | 2.0 | 3.0 | 2.0 | - |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19342 | COMPUTATIONAL STATISTICS | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To study the mean, variance, linear regression models and error term for use in Multivariate data analysis. |
| ● | To understand the relationship of the data collected for decision making. |
| ● | To know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected. |

| | | |
|---|---|---|
| **UNIT-I** | **MULTIVARIATE NORMAL DISTRIBUTION** | **9** |
| Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters. | | |
| **UNIT-II** | **DISCRIMINANT ANALYSIS** | **9** |
| Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties. | | |
| **UNIT-III** | **PRINCIPAL COMPONENT ANALYSIS** | **9** |
| Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot. | | |
| **UNIT-IV** | **FACTOR ANALYSIS** | **9** |
| Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores. | | |
| **UNIT-V** | **CLUSTER ANALYSIS** | **9** |
| Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters | | |
| | **Contact Hours** : | **45** |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing | | |
| | Data Wrangling: Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions | | |
| **2** | Data Aggregation, Group Operations, Time series: GoupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting | | |
| **3** | Visualization in Python:Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches | | |
| | **Contact Hours** | : | **30** |
| | **Total Contact Hours** | : | **75** |

| Course Outcomes: On completion of the course, students will be able to | |
|---|---|
| ● | Analyze means and variances of the individual variables in a multivariate set and also the correlations between those variables. |
| ● | To find discriminants, rules to optimally assign new objects to the labelled classes. |
| ● | Apply the principal component techniques to reduce data and to interpret. |
| ● | To reduce the number of variables in regression models using Factor analysis |
| ● | Apply the techniques of clustering methods for massive amounts of data. |

| Text Books: | |
|---|---|
| 1 | T.W. Anderson."An Introduction to Multivariate Statistical Analysis". Wiley, Third edition, 2003 |
| 2 | J.D. Jobson,"Applied Multivariate Data Analysis", Volume I & II, Springer texts in statistics, New York, Fourth Edition 1999. |
| 3 | Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.<br>Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005. |
| 4 | Mark Lutz.,"ProgrammingPython"O'Reilly Media ,Germany, Fourth edition, 2011. |

| Reference Books / Web links: | |
|---|---|
| 1 | D.A. Belsey, E. Kuh and R.E. Welsch ,"Regression Diagnostics , Identifying Influential Data and Sources of Collinearety" |
| 2 | Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, "Introduction to Linear Regression Analysis", Fifth Edition, Wiley, 2012. |
| 3 | Johnson R.A. &Wichern, D.W, "Applied Multivariate Statistical Analysis ", Sixth Edition, Pearson, 2018. |
| 4 | Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Third Edition, Apress, 2005. |
| 5 | M.R. Anderberg, "Cluster Analysis for Applications", Academic Press. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19342.1** | 3 | 2 | 3 | 3 | 2 | 1 | - | - | - | 2 | 2 | - | 2 | 2 | 2 |
| **CB19342.2** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | 1 | 2 | - | 2 | 2 | 2 |
| **CB19342.3** | 3 | 3 | 2 | 3 | 3 | 1 | - | - | - | 1 | 2 | - | 2 | 3 | 2 |
| **CB19342.4** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 2 | - | 2 | 3 | 3 |
| **CB19342.5** | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 2 | - | 2 | 3 | 3 |
| **Average** | 3.0 | 2.8 | 2.2 | 3.0 | 2.6 | 1.4 | - | - | - | 1.6 | 2.0 | - | 2.0 | 2.6 | 2.4 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19442 | DATATBASE TECHNOLOGY | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To discuss the fundamentals of data models to conceptualize and depict a database system. |
| ● | To illustrate the relational database implementation using SQL with effective relational model. |
| ● | To explain the fundamental concepts of transaction processing- concurrency control. |
| ● | To demonstrate Query evaluation and optimization techniques. |
| ● | To introduce the concepts of Database Security, Object Oriented, Data Warehousing and Data Mining. |

| UNIT- I | INTRODUCTION AND DATABASE SYSTEM ARCHITECTURE | 9 |
|---|---|---|

**Introduction:** Introduction to Database. Hierarchical, Network and Relational Models.

**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

| UNIT- II | DATA MODELS AND RELATIONAL QUERY LANGUAGE | 9 |
|---|---|---|

**Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

| UNIT- III | RELATIONAL DATABASE DESIGN, QUERY PROCESSING AND OPTIMIZATION | 9 |
|---|---|---|

**Relational database design:** Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

**Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

| UNIT- IV | STORAGE STRATEGIES AND TRANSACTION PROCESSING | 9 |
|---|---|---|

**Storage strategies:** Indices, B-trees, Hashing.

**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

| UNIT- V | DATABASE SECURITY AND ADVANCED TOPICS | 9 |
|---|---|---|

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

| | Contact Hours | : | 45 |
|---|---|---|---|

| LIST OF EXPERIMENTS | |
|---|---|
| 1. | Conceptual Database design using E-R DIAGRAM |
| 2. | Implementation of SQL commands DDL, DML, DCL and TCL |
| 3. | Queries to demonstrate implementation of Integrity Constraints |
| 4. | Practice of Inbuilt functions |
| 5. | Implementation of Join and Nested Queries and Set operators |
| 6. | Implementation of virtual tables using Views |
| 7. | Practice of Procedural extensions (Procedure, Function, Cursors, Triggers) |
| 8. | Application Development using front end tools |
| 9. | Study of Cloud Storage<br>i) Health Information System<br>ii) Blood Donation System<br>iii) E-Ticket Booking System<br>iv) Traffic Light Information System |
| 10. | Mini Project (Application Development using DB) |

| | | | |
|---|---|---|---|
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes**<br>On completion of the course, students will be able to: | |
|---|---|
| ● | Distinguish database systems from file systems and describe data models and DBMS architecture. |
| ● | Identify the basic issues of transaction processing and concurrency control. |
| ● | Demonstrate with understanding of SQL Programming language and normalization theory. |
| ● | Practice the query evaluation techniques, query optimization and familiar with basic database storage structures and access techniques. |
| ● | Analyze and derive an information model expressed in the form of an entity relation diagram and transform into a relational database schema. |

| **Text Books:** | |
|---|---|
| 1. | Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, Seventh Edition, McGraw Hill Publisers, 2019. |

| **Reference Books:** | |
|---|---|
| 1. | J. D. Ullman, Principles of Database and Knowledge – Base Systems, Volume 1, Computer Science Press, 1993. |
| 2. | R. Elmasri and S. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2017. |
| 3. | Serge Abiteboul, Richard Hull, Victor Vianu, Foundations of Databases, Pearson Education, 1994. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19442.1** | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | - | 1 | 1 | 2 | 2 | 2 |
| **CB19442.2** | 2 | 2 | 3 | 3 | 3 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| **CB19442.3** | 2 | 2 | 2 | 3 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| **CB19442.4** | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 1 | 1 | 2 | 3 | 2 |
| **CB19442.5** | 2 | 2 | 3 | 3 | 2 | - | - | - | 2 | - | 2 | 2 | 2 | 2 | 3 |
| **Average** | 2 | 2 | 2.2 | 2.6 | 2.2 | - | - | - | 1.8 | 2 | 1.6 | 1.2 | 2 | 2.2 | 2.2 |

Correlation levels 1, 2 or 3 as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (Theory course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MC19102 | INDIAN CONSTITUTION AND FREEDOM MOVEMENT | MC | 3 | 0 | 0 | 0 |

| Objectives: | |
|---|---|
| ● | To inculcate the values enshrined in the Indian constitution. |
| ● | To create a sense of responsible and active citizenship. |
| ● | To know about Constitutional and Non- Constitutional bodies. |
| ● | To understand sacrifices made by the freedom fighters. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens. Constitution meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. | | |
| **UNIT-II** | **STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT** | **9** |
| Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. | | |
| **UNIT-III** | **STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCALBODY** | **9** |
| State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Panchayat Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials. | | |
| **UNIT-IV** | **CONSTITUTIONAL FUNCTIONS AND BODIES** | **9** |
| Indian Federal System – Center – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies. | | |
| **UNIT-V** | **INDIAN FREEDOM MOVEMENT** | **9** |
| British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the functions of the Indian government |
| ● | Understand and abide the rules of the Indian constitution. |
| ● | Gain knowledge on functions of State Government and Local bodies |
| ● | Gain Knowledge on constitution functions and role of constitutional bodies and non-constitutional bodies. |
| ● | Understand the sacrifices made by freedom fighters during freedom movement. |

| Text Book(s): | |
|---|---|
| 1 | Durga Das Basu, "Introduction to the Constitution of India ", Twenty First Edition, Lexis Nexis, New Delhi, 2013. |
| 2 | Bipan Chandra, "History of Modern India", Orient Black Swan, 2009. |
| 3 | Bipan Chandra, "India's Struggle for Independence ", Penguin Books, 2016. |
| 4 | Maciver and Page," Society: An Introduction Analysis ", Second Edition, MacMilan India Ltd., New Delhi, 2014. |
| 5 | P K Agarwal and K N Chaturvedi, PrabhatPrakashan," Constitution of India", First Edition, 2017. |

| Reference Books(s) / Web links: | |
|---|---|
| 1 | Sharma, Brij Kishore, "Introduction to the Constitution of India ",Sixth Edition, Prentice Hall of India, New Delhi,2011. |
| 2 | U.R.Gahai,"Indian Political System", New Academic Publishing House, Jalandhar, 1998. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MC19102.1** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | 2 | - | - |
| **MC19102.2** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | 2 | - | - |
| **MC19102.3** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | 2 | - | - |
| **MC19102.4** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | 2 | - | - |
| **MC19102.5** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | 2 | - | - |
| **Average** | - | - | - | - | - | 1.0 | 1.0 | 3.0 | 2.0 | - | - | 1.0 | 2.0 | - | - |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19401 | INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP | PC | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To study the fundamentals of technology innovation, intellectual property rights and entrepreneurship. |
| ● | To identify and discover market needs. |
| ● | To create, protect and assetize and commercialize intellectual property. |
| ● | To learn the opportunities and challenges for entrepreneurs. |
| ● | To learn the fundamentals of a business model based on technology innovation. |

| | | |
|---|---|---|
| **UNIT-I** | **INNOVATION** | **9** |
| A primer on Innovation, IP Rights and Entrepreneurship - Types of Innovation - incremental, disruptive, Lifecycle of Innovation - idea, literature survey, PoT, PoC, Challenges in Innovation - time, cost, data, infrastructure- Case study. | | |
| **UNIT-II** | **INTELLECTUAL PROPERTY RIGHT** | **9** |
| Types of IPR - patents, copyrights, trademarks, Geographical Indication, Lifecycle of IP -creation, protection, assetization, monetization, Balancing IP risks & rewards - Right Access and Right Use of Open Source and 3rd party products, technology transfer & licensing, IP valuation - methods, examples, limitations- Case study. | | |
| **UNIT-III** | **ENTREPRENEURSHIP** | **9** |
| Opportunity identification in technology entrepreneurship - customer pain points, competitive context, Market research, segmentation & sizing, Product positioning & pricing, go-to market strategy, Innovation assessment - examples, patentability analysis. | | |
| **UNIT-IV** | **BUSINESS MODELS** | **9** |
| Start-up business models - fund raising, market segments, channels, co-innovation and open innovation - academia, start-ups and corporates, Technology innovation – Case study. | | |
| **UNIT-V** | **INNOVATION, INCUBATION & ENTREPRENEURSHIP IN CORPORATE CONTEXT** | **9** |
| Innovation, Incubation & Entrepreneurship in Corporate Context, Technology-driven Social Innovation & Entrepreneurship, Manage innovation, IP and Entrepreneurship Programs- Processes, Governance and Tools. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes: | |
|---|---|
| Upon completion of the course, the students will be able to | |
| ● | Understand the innovation life cycle and types of innovation. |
| ● | Gain knowledge on the importance of intellectual property rights and procedure of filing an IPR. |
| ● | Interpret the market needs and analyze the marketing strategy. |
| ● | Build a business model based on technology innovation |
| ● | Convert an innovative idea into a venture and protect it through intellectual property rights. |

| Text Book(s): | |
|---|---|
| **1** | e Tidd, John Bessant, Managing Innovation: Integrating Technological, Market and Organizational Change, Sixth Edition, John Wiley & Sons Limited, 2018. |
| **2** | John Bessant and Joe Tidd, Innovation and Entrepreneurship, Third Edition, John Wiley & Sons Limited, 2015. |
| **3** | Vivien Irish, Intellectual Property Rights for Engineers, Second Edition, The Institution of Engineering and Technology, 2015. |

| Reference Book(s)/Web Links/Online Resources: | |
|---|---|
| **1** | www.lead-innovation.com |
| **2** | www.tatainnovista.com |
| **3** | Social Innovation: A Guide to Achieving Corporate and Societal Value (Insight Report, World Economic Forum, 2016) |
| **4** | Valuation and Deal making of Technology-Based Intellectual Property: Principles, Methods and Tools, http://razgaitis.com/books/dealmaking/ |
| **5** | www.wipo.int |
| **6** | Indian Patent Act, 1970 |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19401.1** | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| **CB19401.2** | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 3 | 1 | 1 | 3 | 1 | 1 | 3 | 3 |
| **CB19401.3** | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 1 |
| **CB19401.4** | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 3 |
| **CB19401.5** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Average** | 2.0 | 2.4 | 2.6 | 2.4 | 1.0 | 2.8 | 2.2 | 2.2 | 1.0 | 1.0 | 2.2 | 1.0 | 1.0 | 2.6 | 2.0 |

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19441 | OPERATING SYSTEM CONCEPTS | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Learn basics of operating system and concept of virtual machine |
| ● | Understand the concepts of process, scheduling and synchronization |
| ● | Acquire knowledge about deadlocks and concurrent programming |
| ● | To study about the various memory management schemes |
| ● | Know about the I/O, file and disk management |

| UNIT-I | INTRODUCTION | 8 |
|---|---|---|
| Concept of Operating Systems (OS) - Generations of OS - Types of OS - OS Services - Interrupt handling and System Calls- Basic architectural concepts of an OS- Concept of Virtual Machine - Resource Manager view- process view - hierarchical view of an OS. | | |
| **UNIT-II** | **PROCESS MANAGEMENT** | **10** |
| Processes – Concept-Process Scheduling – Threads-Types - Concept of multithreads – CPU Scheduling- – Scheduling algorithms- FCFS - SJF - RR - Multiprocessor scheduling – Real Time scheduling- RM and EDF – Inter-process Communication- Concurrent processes, precedence graphs, Critical Section- Race Conditions- Mutual Exclusion- Hardware Solution- Semaphores- Strict Alternation- Peterson's Solution- The Producer / Consumer Problem- Event Counters- Monitors- Message Passing – Classical IPC Problems - Reader's & Writer Problem - Dinning Philosopher Problem - Barber's shop problem. | | |
| **UNIT-III** | **DEADLOCK AND CONCURRENT PROGRAMMING** | **8** |
| Deadlocks – Necessary and sufficient conditions for Deadlock - Deadlock Prevention - Deadlock Avoidance - Banker's algorithm- Deadlock detection and Recovery – Concurrent Programming -Critical region - Conditional critical region – Monitors - Concurrent languages – Communicating Sequential Process (CSP). | | |
| **UNIT-IV** | **MEMORY MANAGEMENT** | **9** |
| Memory Management – Basic concept - Logical and Physical address maps- Memory allocation– Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction– Virtual Memory- Basics of Virtual Memory – Hardware and control structures – Locality of reference- Page allocation- Partitioning- Paging- Page fault- Working Set- Segmentation- Demand paging– Page Replacement algorithms- Optimal- First in First Out (FIFO)- Second Chance (SC)- Not recently used (NRU)- Least Recently used (LRU). | | |
| **UNIT-V** | **FILE AND I/O MANAGEMENT** | **10** |
| I/O Hardware -I/O devices, Device controllers, Direct Memory Access, Principles of I/O Concept of File - Access methods - File types - File operation - Directory structure - File System structure - Allocation methods (contiguous, linked, indexed) - Free-space management (bit vector, linked list, grouping) - directory implementation (linear list, hash table) - efficiency and performance -Disk structure - Disk scheduling - FCFS - SSTF - SCAN - C-SCAN - Disk reliability - Disk formatting - Boot-block - Bad blocks - Case Study: Unix File System | | |
| | **Contact Hours** : | **45** |

| LIST OF EXPERIMENTS | | | |
|---|---|---|---|
| 1 | Implement shell scripts with filters and pipes (grep, sort, uniq, cut, tr) | | |
| 2 | Implement shell script for system monitoring with email alert | | |
| 3 | Implement UNIX/Linux I/O system calls (create, open, close, read, write) | | |
| 4 | Inter-process communication using shared memory | | |
| 5 | Scheduling algorithms – FCFS, SJF, Priority and RR | | |
| 6 | Producer Consumer problem solution using semaphores | | |
| 7 | Bankers deadlock avoidance algorithm | | |
| 8 | Contiguous Memory Allocation - First Fit and Best Fit | | |
| 9 | Page Replacement Algorithms - FIFO & LRU | | |
| 10 | Implement a character device driver in Unix/Linux | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| COURSE OUTCOMES: | |
|---|---|
| **On successful completion of this course, the student will be able to:** | |
| • | Grasp the basic concepts of an operating system |
| • | Thoroughly analyze the various scheduling algorithms |
| • | Able to do concurrent programming |
| • | Compare and contrast the various memory management scheme |
| • | Evaluate various disk scheduling algorithms |

| TEXT BOOKS: | |
|---|---|
| 1. | Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts Essential, Second Edition, Wiley, 2013. |

| REFERENCE BOOKS | |
|---|---|
| **1** | William Stallings, Operating Systems – Internals and Design Principles, Ninth Edition, Pearson, 2018. |
| **2** | Charles Patrick Crowley, Operating System: A Design-oriented Approach, First Edition, McGraw Hill Education, 2017. |
| **3** | Gary J. Nutt, Operating Systems: A Modern Perspective, Third Edition, Deitel, 2007. |
| **4** | Maurice J. Bach, Design of the Unix Operating Systems, First Edition, Pearson, 2015. |
| **5** | Daniel Pierre Bovet, Marco Cesati, Understanding the Linux Kernel, Third Edition, O'Reilly, 2006. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19441.1** | 2 | 1 | 1 | 1 | 3 | - | 1 | - | 2 | 1 | 2 | 2 | 3 | - | 1 |
| **CB19441.2** | 2 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | 2 | 2 | 2 | 3 | 2 |
| **CB19441.3** | 2 | 2 | 2 | 1 | 2 | - | - | - | 1 | - | 2 | 2 | 2 | 3 | 2 |
| **CB19441.4** | 2 | 2 | - | - | 2 | - | - | - | 2 | - | 2 | 2 | 2 | 2 | 1 |
| **CB19441.5** | 2 | 1 | - | - | 2 | - | - | - | 2 | - | 1 | 2 | 2 | - | 1 |
| **Average** | 2 | 1.6 | 1.6 | 1 | 2.4 | - | 1 | - | 1.8 | 1 | 1.8 | 2 | 2.2. | 2.8 | 1.6 |

Correlation levels 1, 2 or 3 as defined below:

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19343 | SOFTWARE ENGINEERING | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Understand the phases in a software project. |
| ● | Gain knowledge in fundamental concepts of software project management and quality. |
| ● | Obtain knowledge on requirements engineering and Analysis Modelling. |
| ● | Learn various testing and maintenance measures |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline, Software Engineering Historical Development from Jackson Structured Programming to Agile Development. | | |
| **UNIT-II** | **SOFTWARE PROJECT MANAGEMENT** | **9** |
| Basic concepts of life cycle models – different models and milestones; software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management. Agile Software Engineering: Concepts of Agile Methods, Extreme Programming; Agile Process Model - Scrum, Feature; Scenarios and Stories | | |
| **UNIT-III** | **SOFTWARE QUALITY AND RELIABILITY** | **9** |
| Software quality; Garvin's quality dimensions, McCall's quality factor, ISO 9126 quality factor; Software Quality Dilemma; Introduction to Capability Maturity Models (CMM and CMMI); Introduction to software reliability, reliability models and estimation. | | |
| **UNIT-IV** | **SOFTWARE REQUIREMENTS AND OO ANALYSIS, DESIGN AND CONSTRUCTION** | **9** |
| Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics-based control methods; measures of code and design quality. Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object oriented metrics. | | |
| **UNIT-V** | **SOFTWARE TESTING** | **9** |
| Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection; Unit Testing, Integration Testing, System Testing and Acceptance Testing. | | |
| | **Contact Hours** : | **45** |

| List of Experiments | | | | |
|---|---|---|---|---|
| **1** | Development of requirements specification. | | | |
| **2** | Function oriented design using SA/SD. | | | |
| **3** | Object-oriented design using UML. | | | |
| **4** | Test case design. | | | |
| **5** | Implementation using C++. | | | |
| **6** | Testing. | | | |
| **7** | Use of CASE tools and other tools such as configuration management tools. | | | |
| **8** | Program analysis tools. | | | |
| | **Contact Hours** | : | **30** | |
| | **Total Contact Hours** | : | **75** | |

| **Course Outcomes:** On completion of the course, students will be able to | |
|---|---|
| ● | Work in software projects. |
| ● | Identify the key activities in managing a software project. |
| ● | Know the various quality models and reliability in software. |
| ● | Make analysis, modelling and coding for software projects. |
| ● | Perform the various testing methods for software projects |

| **Text Books:** | |
|---|---|
| **1** | Ian Sommerville, "Software Engineering ", Ninth edition, Pearson Education, 2010. |
| **2** | Roggers S. Pressman and Bruce R. Maxim., "Software Engineering A Practitioner's Approach", McGraw Hill Education,2009. |

| **Reference Books:** | |
|---|---|
| 1 | Roger S. Pressman," Software Engineering – A Practitioner's Approach", Seventh edition, 2010. |
| 2 | Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino," Fundamentals of Software Engineering", second edition, Pearson publication. |
| 3 | Michael Jackson," Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices", first edition, ACM Press. |
| 4 | Ivar Jacobson, Grady Booch, James Rumbaugh,"The Unified Development Process", Addison-Wesley, 1999. |
| 5 | Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns: Elements of Object-Oriented Reusable Software", First edition. |
| 6 | Norman E Fenton, Shari Lawrence Pfleeger," Software Metrics: A Rigorous and Practical Approach", Second edition, International Thomson Computer Press, 1997. |
| 7 | Shari Lawrence Pfleeger and Joanne M. Atlee, "Software Engineering: Theory and Practice", fourth edition, Pearson. |
| 8 | Bertrand Meyer, second edition," Object-Oriented Software Construction", Prentice-hall International Series, 1997. |
| 9 | Ivar Jacobson, "Object Oriented Software Engineering: A Use Case Driven Approach", First edition, ACM Press. |
| 10 | Bertrand Meyer, "Touch of Class: Learning to Program Well with Objects and Contracts ", First edition, Springer-Verlag Berlin Heidelberg. |
| 11 | Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language ", Third edition, Addison Wesley, 2003. |
| 12 | Manoj Kumar Lal, "Introduction to Business Domains for Software Engineers", Kindle Edition, 2021. |
| 13 | Manoj Kumar Lal, "Knowledge Driven Development – Bridging Waterfall and Agile Methodologies", Kindle Edition, 2018. |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19343.1** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 |
| **CB19343.2** | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CB19343.3** | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 1 |
| **CB19343.4** | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 2 | 1 | 2 | 2 | 1 |
| **CB19343.5** | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 1 |
| **Average** | 2.0 | 1.8 | 2.0 | 2.0 | 1.8 | 1.6 | 1.4 | 1.4 | 2.8 | 2.2 | 2.0 | 1.2 | 1.8 | 1.6 | 1.0 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19541 | ANALYSIS OF ALGORITHMS AND DESIGN | PC | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Learn and understand the algorithm analysis techniques and complexity notations |
| ● | Become familiar with the different algorithm design techniques for effective problem solving in computing. |
| ● | Learn to apply the design techniques in solving various kinds of problems in an efficient way. |
| ● | Understand the limitations of algorithm power. |
| ● | Solve variety of problems using different design techniques |

| UNIT-I | ANALYSIS OF ALGORITHMS | 9 |
|---|---|---|
| Introduction: Characteristics of Algorithm. Analysis of Algorithm: Performance Measurements of Algorithm, Time and Space Trade-Offs, Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour; Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem. | | |
| **UNIT-II** | **FUNDAMENTALS OF ALGORITHIMIC STRATEGIES** | **9** |
| Brute-Force, Heuristics, Greedy, Divide and Conquer, Dynamic Programming Methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem. | | |
| **UNIT-III** | **ALGORITHIMIC STRATEGIES** | **9** |
| Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving , n-Queens Problem , Graph Coloring , Knapsack, Travelling Salesman Problem. | | |
| **UNIT-IV** | **GRAPH AND TREE ALGORITHMS** | **9** |
| Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm. | | |
| **UNIT-V** | **TRACTABLE, INTRACTABLE PROBLEMS AND ADVANCED TOPICS** | **9** |
| Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| 1 | Finding Time Complexity of Algorithms. | | |
| 2 | Design and implement algorithms using Brute Force Technique. | | |
| 3 | Design and implement algorithms using Divide and Conquer Technique. | | |
| 4 | Design and implement algorithms using Greedy Technique. | | |
| 5 | Design and implement algorithms using Dynamic Programming. | | |
| 6 | Design and implement algorithms using Backtracking. | | |
| 7 | Design and implement algorithms using Branch and Bound. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Analyse the time and space complexity of various algorithms and compare algorithms with respect to complexities. |
| ● | Ability to decide and Apply Brute Force and Divide and Conquer design strategies to Synthesize algorithms for appropriate computing problems. |
| ● | Ability to decide and Apply Greedy and Dynamic Programming techniques to Synthesize algorithms for appropriate computing problems. |
| ● | Ability to decide and Apply Backtracking and Branch and Bound techniques to Synthesize algorithms for appropriate computing problems. |
| ● | Ability to identify an algorithm is tractable or intractable. |

| **Text Book (s):** | |
|---|---|
| 1 | E. Horowitz and S. Sahni., "Fundamental of Computer Algorithms", Second Edition, Computer Science Press, 2008. |
| 2 | A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", Fourth edition, Pearson India, 2009. |

| **Reference Books(s) :** | |
|---|---|
| 1 | T. H. Cormen, C. E. Leiserson and R. L. Rivest, "Introduction to Algorithms", Third Edition, MIT Press, 2009. |
| 2 | S. Baase, "Computer Algorithms: Introduction to Design and Analysis", Third Edition, Pearson, 2000. |
| 3 | .D. E. Knuth ,"The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3", Third Edition, Mathematical Science Publishers,1997. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19541.1** | 3 | - | - | - | - | - | - | - | - | - | - | 1 | 3 | 2 | 2 |
| **CB19541.2** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 | 1 |
| **CB19541.3** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 | 1 |
| **CB19541.4** | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 | 1 |
| **CB19541.5** | 1 | 2 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 | 1 |
| **Average** | 2 | 2.75 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 2.8 | 1.2 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MA19441 | OPTIMIZATION TECHNIQUES | BS | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To learn the concepts of operations research applied in decision making. |
| ● | To learn optimization techniques in business administration. |
| ● | To learn queuing theory and its applications in business. |
| ● | To learn project evaluation techniques to optimise cost of implementation. |
| ● | To learn inventory control techniques and simulation in business options. |

| UNIT-I | INTRODUCTION TO LINEAR PROGRAMMING | 9 |
|---|---|---|

Origin of OR and its definition- Concept of optimizing performance measure- Types of OR problems: Deterministic vs. Stochastic optimization - Phases of OR problem approach: problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

Linear programming: Examples from industrial cases- formulation & definitions- Matrix form. Implicit assumptions of LPP.

Some basic concepts and results of linear algebra: Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.
Geometric method: 2-variable case- Special cases: infeasibility, unboundedness, redundancy &degeneracy, Sensitivity analysis. Simplex Algorithm – slack, surplus & artificial variables, computational details - big-M method, identification and resolution of special cases through simplex iterations.
Duality: formulation, results, fundamental theorem of duality- dual-simplex and primal-dual algorithms.

| UNIT-II | TRANSPORTATION AND ASSIGNMENT PROBLEMS | 9 |
|---|---|---|

TP - Examples, Definitions: Decision variables, supply & demand constraints – formulation -Balanced & unbalanced situations
- Solution methods: NWCR, minimum cost and VAM - test for optimality (MODI method) - degeneracy and its resolution.
AP - Examples, Definitions: Decision variables, constraints – formulation - Balanced &unbalanced situations -
Solution method: Hungarian - test for optimality (MODI method) - degeneracy & its resolution.

| UNIT-III | QUEUEING THEORY AND SIMULATION METHOD | 9 |
|---|---|---|

Definitions: queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queueing system, queue types (channel vs. phase).
Kendall's notation - Little's law - steady state behaviour - Poisson's Process & queue - Models with examples - M/M/1 and its performance measures - M/M/m and its performance measures - brief description about some special models.

Definition and steps of simulation - random number, random number generator - Discrete Event System Simulation – clock, event list - Application in Queuing systems.

| UNIT-IV | PERT -CPM | 9 |
|---|---|---|

Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off-Scheduling using simulation methods

| UNIT-V | INVENTORY CONTROL | 9 |
|---|---|---|

Functions of inventory and its disadvantages - ABC analysis - Concept of inventory costs - Basics of inventory policy (order, lead time, types) - Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units- sensitivity analysis and Robustness - Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations – Inventory systems using simulation methods.

| | Contact Hours | : | 45 |
|---|---|---|---|

| | LIST OF EXPERIMENTS | | | |
|---|---|---|---|---|
| 1 | Linear Programming | | | |
| 2 | Sensitivity Analysis | | | |
| 3 | Transportation Models | | | |
| 4 | Assignment Models | | | |
| 5 | Random Number Generation | | | |
| 6 | Queuing Theory Models – Single server model | | | |
| 7 | PERT and scheduling | | | |
| 8 | Deterministic inventory models | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course students will be able to | |
|---|---|
| ● | Solve optimization problems using simplex method. |
| ● | Analyse problems involving materials and workforce using transportation and assignment models |
| ● | Analyse problems involving queuing theory and optimize using simulation techniques. |
| ● | Use PERT and CPM for problems in project management |
| ● | Solve inventory problems to find optimal quantities of stock. |

| **Text Books:** | |
|---|---|
| **1** | Hamdy A Taha, Operations Research: An Introduction, Prentice Hall India, Eighth Edition |

| **Reference Books / Web links:** | |
|---|---|
| **1** | Linear Programming. K.G. Murthy. |
| **2** | Linear Programming. G. Hadley. |
| **3** | Principles of OR with Application to Managerial Decisions. H.M. Wagner. |
| **4** | Introduction to Operations Research. F.S. Hiller and G.J. Lieberman. |
| **5** | Elements of Queuing Theory. Thomas L. Saaty. |
| **6** | Operations Research and Management Science, Hand Book: Edited By A. Ravi Ravindran. |
| **7** | Management Guide to PERT/CPM. Wiest & Levy. |
| **8** | Modern Inventory Management. J.W. Prichard and R.H. Eagle. |

| Subject Code | Subject Name (Laboratory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| HS19411 | BUSINESS COMMUNICATION & VALUE SCIENCE – III | HS | 0 | 0 | 4 | 2 |

| Objectives: | |
|---|---|
| ● | Introduce students to Self-analysis techniques like SWOT & TOWS |
| ● | Expose students to key concepts of Pluralism & cultural spaces, Cross-cultural communication |
| ● | Enhance the technical writing skills of the students and help them understand the science of nation building |
| ● | Create awareness about Artificial Intelligence and how to communicate with machines |
| ● | Inculcate social consciousness among the students and make them realize their responsibility in addressing the social issues |

| UNIT-I | FRAMEWORK OF ANALYSIS | 9 |
|---|---|---|

**Concepts**: Person analysis: SWOT analysis - SWOT and Life Positions –Analysis of others' lives – Analysis of one's own life. - TOWS Analysis: How to turn threat into opportunity – VUCA - Volatility, uncertainty, complexity and ambiguity - Application of analysis in real life scenarios – Maslow's theory of motivation.

**Activity:** SWOT analysis of a well-known individual's life - Creatingone's own SWOT – TED talk on biomimicry – Group activity - Presentation on strengths identified to survive in the VUCA World – Watching videos of motivation & discussion.

| UNIT-II | PLURALISM IN CULTURAL SPACES | 9 |
|---|---|---|

**Concepts:** Identifying Pluralism in cultural spaces - uniqueness and differences - Global, Glocal and Translocational cultures – benefits, differences and implications of multi-culture – Gender awareness - Roles and relations of different genders.

**Activity:** Group activity – Exploring cultures and traditions of different states – Performing Indian dance forms - Debate on Global, Glocal and Translocational impacts – cultural misunderstanding – Group discussion on implications of cross cultural communication –Gender awareness campaign: College, Workplace, Family, Friend

| UNIT-III | ROLE OF SCIENCE IN NATION BUILDING | 9 |
|---|---|---|

**Concepts:** Role of science in nation building – Pre & Post Independent scientific inventions and inventors – development of Information Technology – Technical writing – Introduction and application of Technical writing

**Activity:** Discussion on the role of scientists and mathematicians – Presentation on eminent scientists and mathematicians – Quiz on Scientists and inventions – Writing a technical article - Explaining something to visually impaired person.

| UNIT-IV | ARTIFICIAL INTELLIGENCE | 9 |
|---|---|---|

**Concepts:** Artificial Intelligence – Recognizing the importance of AI– Future of AI– Communicating with machines – Technical writing in profession.

**Activity:** Skit on Voice Assistant in future – Discussion on AI in everyday life – Deliberation on future colleges and workplaces - Watching DrBimal Ray's videos on cryptology–Explaining IOT

| UNIT-V | PROJECT CAMPAIGN | 9 |
|---|---|---|

**Concepts:** Social consciousness – contributing to society.

**Activity:** Project visit to rural area/ underprivileged parts of city to address some of the local issues; if relevant, suggest a practical technology solution to the issues.

| | Total Contact Hours | | 45 |
|---|---|---|---|

| **Course Outcomes:** On completion of the course, students will be able to | |
|---|---|
| CO1 | Apply & analyse the basic principles of SWOT & life positions, and understand the power of motivation |
| CO2 | Identify & respect pluralism and gender differences in cultural spaces |
| CO3 | Recognize the role of science in Nation building and also creating technical documents effectively |
| CO4 | Understand the importance of Artificial Intelligence in every walk of life &Identify the best practices of technical writing |
| CO5 | Understand the Social issues and suggest technical solutions |

| **Reference Books / Web links:** | |
|---|---|
| **1** | Self-Analysis by Ron Hubbard, Bridge Pubns; 2007th edition |
| **2** | Managing a Diverse Workforce: Learning Activities, Gary N. Powell, Sage Publication |
| **3** | Unity in Diversity: The Indian Experience in Nation-building, M.S. Gore, Rawat Publication |
| **4** | Artificial Intelligence, Russell, Pearson Education India |
| **Web References** | |
| **1** | Examples of Technical Writing for Students<br>https://freelance-writing.lovetoknow.com/kinds-technical-writing |
| **2** | 11 Skills of a Good Technical Writer<br>https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/ |
| **3** | 13 benefits and challenges of cultural diversity in the workplace<br>https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/ |
| **Online Resources** | |
| **1** | https://youtu.be/CsaTslhSDI |
| **2** | https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M |
| **3** | https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y |
| **4** | https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be |
| **5** | https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be |

## CO - PO – PSO MATRICES OF THE COURSE

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HS19411.1** | 1 | 3 | - | 2 | - | 2 | 1 | - | 3 | 3 | - | 1 | 1 | 1 | 1 |
| **HS19411.2** | - | - | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | - | 3 | 2 | - | 2 |
| **HS19411.3** | - | - | - | 1 | - | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 1 | - | 1 |
| **HS19411.4** | - | - | 1 | - | - | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | - | 1 |
| **HS19411.5** | - | - | - | 1 | - | 2 | 2 | - | 1 | 2 | 3 | 3 | 1 | 1 | - |
| **Average** | 0.2 | 0.6 | 0.6 | 1.2 | 0.2 | 1.8 | 1.8 | 1.2 | 2.4 | 2.2 | 1.8 | 2.4 | 1.4 | 0.4 | 1 |

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

| Subject Code | Subject Name (MANDATORY COURSES) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| MC19301 | ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | MC | 3 | 0 | 0 | 0 |

| Objectives: | |
|---|---|
| ● | To impart basic principles of thought process, reasoning and inference. |
| ● | To acquire knowledge in holistic life style of yoga science and wisdom in modern society with rapid technological advancements and societal disruptions. |
| ● | To gain knowledge in Indian perspective of modern science. |
| ● | Be familiarized with Indian philosophical, linguistic and artistic traditions. |

| UNIT-I | INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM | 9 |
|---|---|---|
| Basic structure of the Indian Knowledge System –Veda – Upaveda - Ayurveda, Dhanurveda - Gandharvaveda, Sthapathyaveda and Arthasasthra. Vedanga (Six forms of Veda) – Shiksha, Kalpa, Nirukta, Vyakarana, Jyothisha and Chandas- Four Shasthras - Dharmashastra, Mimamsa, Purana and Tharkashastra. | | |
| **UNIT-II** | **MODERN SCIENCE AND YOGA** | 9 |
| Modern Science and the Indian Knowledge System – a comparison - Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga-different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies | | |
| **UNIT-III** | **INDIAN PHILOSOPHICAL TRADITION** | 9 |
| Sarvadharshan/Sadhdharshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies. | | |
| **UNIT-IV** | . **INDIAN LINGUISTIC TRADITION** | 9 |
| Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology –Syntax and Semantics-Case Studies | | |
| **UNIT-V** | **INDIAN ARTISTIC TRADITION** | 9 |
| Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathya kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Understand basic structure of the Indian Knowledge System. |
| ● | Apply the basic knowledge of modern science and Indian knowledge system in practice. |
| ● | Understand the importance Indian Philosophical tradition. |
| ● | Appreciate the Indian Linguistic Tradition. |
| ● | Understand the concepts of traditional Indian art forms. |

| Text Book (s): | |
|---|---|
| **1** | V. Sivaramakrishnan (Ed.), "Cultural Heritage of India-course material", Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014. |
| **2** | Swami Jitatmanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan. |
| **3** | Swami Jitatmanand, "Holistic Science and Vedant", Bharatiya Vidya Bhavan. |
| **4** | Fritzof Capra, "Tao of Physics". |
| **5** | Fritzof Capra, "The Wave of life". |

| Reference Books(s) : | |
|---|---|
| **1** | VN Jha (Eng. Trans.), "Tarkasangraha of Annam Bhatta", International ChinmayFoundation,Velliarnad, Arnakulam. |
| **2** | Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata. |
| **3** | GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,VidyanidhiPrakashan, Delhi 2016. |
| **4** | RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, VidyanidhiPrakashan, Delhi 2016. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MC19301.1** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |
| **MC19301.2** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |
| **MC19301.3** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |
| **MC19301.4** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |
| **MC19301.5** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |
| **Average** | - | - | - | - | - | 1 | 1 | 3 | 2 | - | - | 1 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (Employability Enhancement Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| GE19421 | SOFT SKILLS I | EEC | 0 | 0 | 2 | 1 |

| Description | |
|---|---|
| ● | The course, **"VAP"** intends to enhance the students' confidence to communicate in front of an audience effectively. |
| ● | The emphasis is on improving the spoken skills of the students so that they can communicate both, in the college and in the corporate setting to deliver their message successfully |
| ● | In today's technology driven world, communicating with confidence is imperative. |
| ● | Hence, this course aims at providing students with the necessary practice in the form of debates, discussions and role plays. |

| Program Learning Goals: | |
|---|---|
| ● | This program will help our students to build confidence and improve their English communication in order to face the corporate world as well as providing them with opportunities to grow within an organization. |

| Objectives: | |
|---|---|
| ● | To help students break out of shyness. |
| ● | To build confidence. |
| ● | To enhance English communication skills. |
| ● | To encourage students' creative thinking to help them frame their own opinions. |

| Week | Activity Name | Description | Objective |
|---|---|---|---|
| 1 | Introduction | The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves. | To set expectations about the course and the students are made aware of the rules and regulations involved in this program |
| 2 | If I ruled the world | This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion. | The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely. |
| 3 | Picture Narrating | This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating. | The aim of this activity is to make the students develop creative way of thinking. |
| 4 | Brainstorming | On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas. | The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions. |
| 5 | Debate | Is competition necessary in regards to the learning process? | The aim of this activity is to develop the students ability to debate and think out of the box |
| 6 | Short Talks | Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference. | The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important. |

| | | | |
|---|---|---|---|
| 7 | Debate | Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating? | This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate |
| 8 | The Art of diplomacy | The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation. | The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation. |
| 9 | Debate | Are humans too dependent on computers? | The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life. |
| 10 | Story Completion | The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes theplot and the ending. | This activity aims at building their narrating skills as well as their creativity and ability to work in a team. |
| 11 | Role play debate | Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others. | The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly. |
| 12 | I Couldn't Disagree More | This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion | The aim of this activity is to improve general communication skills and confidence. |
| 13 | Feedback | At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits | The aim is to do both give feedback to students as well as obtain feedback on the course from them. |
| | | | **Total Contact Hours: 30** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, the students will be able to: | |
| ● | Be more confident. |
| ● | Speak in front of a large audience. |
| ● | Be better creative thinkers. |
| ● | Be spontaneous. |
| ● | Know the importance of communicating in English. |

| **Reference Books(s):** | |
|---|---|
| **1.** | Kings Learning work sheets. |

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19501 | FUNDAMENTALS OF MANAGEMENT | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | The course will cover the management theories, evolution of management over the years and few basic concepts without going into the details. |
| ● | To expose the students to know the functions of management, the organizational design, leadership and ethics in management. |

| UNIT-I | MANAGEMENT THEORIES | 6 |
|---|---|---|
| Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-onward). Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc. | | |
| **UNIT-II** | **FUNCTIONS OF MANAGEMENT & LEADERSHIP** | 6 |
| Planning, Organizing, Staffing, Directing, Controlling, Leadership - Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid. | | |
| **UNIT-III** | **ORGANIZATIONAL DESIGN** | 6 |
| Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure). | | |
| **UNIT-IV** | **ORGANIZATION BEHAVIOR** | 6 |
| Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making, Problems in Decision Making, Decision Making, Organizational Culture, Managing Cultural Diversity. | | |
| **UNIT-V** | **MANAGERIAL ETHICS** | 6 |
| Ethics and Business, Ethics of Marketing & advertising, Ethics of Finance & Accounting, Decision – making frameworks, Business and Social Responsibility, International Standards, Corporate Governance, Corporate Citizenship, Corporate Social Responsibility. | | |
| | **Total Contact Hours : 30** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the theories, concept, and evolution of management. |
| ● | Demonstrate the ability to employ 'the management way of thinking'. |
| ● | Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc. |
| ● | Understand the qualities of a leader in the managerial aspect in future terms. |
| ● | Understand the managerial ethics and CSR and its importance. |

| Text Book (s): | |
|---|---|
| 1 | Richard L. Daft, Understanding the Theory and Design of Organization, Eleventh Edition, Cengage Learning India Private Limited, 2020. |

| Reference Books(s) : | |
|---|---|
| 1 | Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior, Eighteenth Edition, Pearson India,2019. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19501.1** | 2 | 2 | 1 | - | - | 2 | 2 | - | - | - | 2 | 1 | - | - | - |
| **BA19501.2** | 2 | 2 | 2 | - | - | 2 | 3 | - | - | - | 2- | 1 | - | - | - |
| **BA19501.3** | 2 | 3 | 1 | - | - | 1 | 2 | - | - | - | 2 | 3 | - | - | - |
| **BA19501.4** | 3 | 2 | - | - | - | 2 | 2 | - | - | - | 1 | 2 | - | - | - |
| **BA19501.5** | 2 | 1 | - | - | - | 2 | 2 | - | - | - | 2 | 2 | - | - | - |
| **Average** | 2.2 | 2.0 | 1.3 | - | - | 1.8 | 2.2 | - | - | - | 1.8 | 1.8 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19502 | BUSINESS STRATEGY | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | The course will cover the determination of the concept and process of strategic management. |
| ● | Expose the students to analyze the internal and external environment. |
| ● | The insights of creating and formulation of strategies, implementation and evaluation of strategies. |
| ● | The course will cover case studies and latest business events. |

| UNIT-I | INTRODUCTION TO STRATEGIC MANAGEMENT | 6 |
|---|---|---|
| Importance of Strategic Management-Vision and Objectives - Schools of thought in Strategic Management- Strategy Content, Process, and Practice - Fit Concept and Configuration Perspective in Strategic Management. | | |
| **UNIT-II** | **INTERNAL ENVIRONMENT OF FIRM** | **6** |
| Recognizing a Firm's Intellectual Assets - Core Competence as the Root of Competitive Advantage - Sources of Sustained Competitive Advantage -Business Processes and Capabilities-based approach to Strategy. | | |
| **UNIT-III** | **EXTERNAL ENVIRONMENTS OF FIRM** | **6** |
| Competitive Strategy - Five Forces of Industry Attractiveness that Shape Strategy- The concept of Strategic Groups, and Industry Life Cycle - Generic Strategies, Generic Strategies and the Value Chain. | | |
| **UNIT-IV** | **CORPORATE STRATEGY AND GROWTH STRATEGIES** | **6** |
| The Motive for Diversification - Related and Unrelated Diversification- Business Portfolio Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures and Mergers & Acquisitions – case studies. | | |
| **UNIT-V** | **STRATEGY IMPLEMENTATION** | **6** |
| Structure and Systems - The 7S Framework - Strategic Control and Corporate Governance. | | |
| | **Total Contact Hours : 30** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Become familiar with both internal and external environment. They would also become familiar with corporate and growth strategies, appreciate implementation of such strategies. |
| ● | Learn the fundamental concepts of strategic management to analyse business situations and apply these concepts to solve business problems. |
| ● | Understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, and HR and information technology. |
| ● | Apply the inter-relationships of business to individuals, other organizations, government and society. |
| ● | Analyze complex, unstructured qualitative and quantitative problems, using appropriate tools. |

| Text Book (s): | |
|---|---|
| 1 | Robert M. Grant , Contemporary Strategic Management, Blackwell, Seventh Edition,2012. |
| 2 | D N Dwivedi, Managerial Economics, 8th Edition, Vikas Publishing House, 2018. |
| 3 | Kazmi, Azhar, Business Policy and Strategic Management, Third Edition, Tata McGrawhill, New Delhi, 2008. |
| 4 | Upendra Kachru: Strategic Management Concepts and Cases, First Edition, Excel Publications, 2005. |

| Reference Books(s) / Web links: | |
|---|---|
| 1 | M.E. Porter, Competitive Strategy, The Free Press, New York, 1980.https://doi.org/10.1002/smj.4250020110 |
| 2 | Michael E.Porter, Competitive Advantage, The Free Press, New York, 1985. |
| 3 | Richard Rumelt , Good Strategy Bad Strategy: The Difference and Why It Matters. Profile Books, Fourth edition, 2011. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19502.1** | 1 | 2 | - | - | - | 2 | 1 | - | - | - | 2 | 2 | - | - | - |
| **BA19502.2** | 2 | 1 | - | - | - | 1 | 1 | - | - | - | 2- | 2 | - | - | - |
| **BA19502.3** | 2 | 1 | - | - | - | 2 | 1 | - | - | - | 1 | 2 | - | - | - |
| **BA19502.4** | 2 | 1 | - | - | - | 2 | 1 | - | - | - | 2 | 2 | - | - | - |
| **BA19502.5** | 2 | 1 | - | - | - | 1 | 1 | - | - | - | 2 | 2 | - | - | - |
| **Average** | 1.8 | 1.2 | - | - | - | 1.6 | 1 | - | - | - | 1.8 | 2 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19501 | DESIGN THINKING | EEC | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To familiarize design thinking and its phases. |
| ● | To perform immersion activity in empathize phase of design thinking. |
| ● | To create problem statements in the define phase of design thinking. |
| ● | To ideate and find solutions to the problem defined. |
| ● | To develop a prototype and perform testing. |

| UNIT-I | INTRODUCTION TO DESIGN THINKING | 9 |
|---|---|---|
| Introduction to design thinking - Importance of design thinking for business – Phases of design thinking – Experiential activity – Case study. | | |
| **UNIT-II** | **EMPATHIZE PHASE** | **9** |
| Empathize phase - Steps involved - Immersion activity- Questionnaire – Empathy map for case study. | | |
| **UNIT-III** | **DEFINE PHASE** | **9** |
| Creation of personas in define phase – steps in problem statement creation - problem statement definition – Examples – Key problem statements. | | |
| **UNIT-IV** | **IDEATION PHASE** | **9** |
| Ideation phase steps – Ideation games – Ideate to find solutions – Doodling – Storytelling in presenting ideas and prototypes. | | |
| **UNIT-V** | **PROTOTYPE AND TESTING** | **9** |
| Importance of prototype in design thinking –Guidelines - Prototyping the idea – Value proposition statement – Testing in design thinking – Prototype testing – Documentation – Design thinking in functional work – Mapping design thinking to agile methodologies. | | |
| | **Contact Hours : 45** | |

| Course Outcomes: | |
|---|---|
| On completion of the course, the students will be able to | |
| • | Understand the phases of design thinking process. |
| • | Conduct an immersion activity to create an empathy map. |
| • | Define the key problems of the personas created. |
| • | Apply the ideation phase steps to present the prototype ideas. |
| • | Create a prototype with value propositions and test the prototype. |

| Text Book(s): | |
|---|---|
| 1 | Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct Publishing, November 2018. https://www.researchgate.net/publication/329310644_Handbook of Design Thinking |
| **2** | Dan Senor and Saul Singer, "Start-Up Nation", Grand Central Publishing, Twelfth Edition, 2009. |
| **3** | Nir Eyal and Ryan Hoover, "Hooked: How to Build Habit-Forming Products", Library of Congress, 2014. |

| Reference Books(s) /Web Resources : | |
|---|---|
| **1** | Corral, Luis & Fronza, Ilenia, "Design Thinking and Agile Practices for Software Engineering: An Opportunity for Innovation", 2018. 26-31. 10.1145/3241815.3241864. |
| **2** | Design thinking 101: Principles, Tools & Examples to transform your creative process. https://justcreative.com/design-thinking-101/ |
| **3** | https://www.interaction-design.org/courses/design-thinking-the-ultimate-guide |
| **4** | Stanford Webinar- Design Thinking = Method, Not Magic |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19501.1** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 |
| **CB19501.2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 3 | 3 | 1 |
| **CB19501.3** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 3 | 1 |
| **CB19501.4** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 3 | 3 | 1 |
| **CB19501.5** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 2 |
| **Average** | 2.8 | 2.4 | 2.4 | 2.8 | 2.8 | 2.8 | 2.2 | 2.6 | 2.8 | 1 | 1.4 | 1.2 | 2.6 | 2.8 | 1.2 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19443 | SOFTWARE DESIGN WITH UML | PC | 2 | 0 | 2 | 3 |

| Objectives: | |
|---|---|
| ● | Understand the object-oriented software development process |
| ● | Design suitable pattern to develop software models |
| ● | Analyze requirements to create requirements design model |
| ● | Apply business modelling and modelling languages to design software |
| ● | Develop correct and robust software deployment models |

| UNIT-I | INTRODUCTION TO OBJECT ORIENTED TECHNOLOGIES | 6 |
|---|---|---|
| Software development process: The Waterfall Model vs. The Spiral Model - The Software Crisis, description of the real world using the Objects Model. - Classes, inheritance and multiple configurations. - Quality software characteristics - Description of the Object-Oriented Analysis process vs. the Structure Analysis Model. | | |
| **UNIT-II** | **INTRODUCTION TO THE UML LANGUAGE AND DESIGN PATTERNS** | **6** |
| Standards - Elements of the language. - General description of various models -The process of Object-Oriented software development. - Description of Design Patterns - Technological Description of Distributed Systems. | | |
| **UNIT-III** | **BUSINESS MODEL DIAGRAMS** | **6** |
| **Requirements Analysis Using Case Modeling -** Analysis of system requirements - Actor definitions. - Writing a case goal - Use Case Diagrams. - Use Case Relationships. **Dynamic Model: State Diagram / Activity Diagram-** Description of the State Diagram - Events Handling - Description of the Activity Diagram - Exercise in State Machine - Case studies to implement in design lab. | | |
| **UNIT-IV** | **THE LOGICAL VIEW DESIGN DIAGRAMS** | **6** |
| **Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams -** Description of goal - Defining UML Method, Operation, Object Interface, Class - Sequence Diagram - Finding objects from Flow of Events - Describing the process of finding objects using a Sequence Diagram - Describing the process of finding objects using a Collaboration Diagram –Mapping use case to sequence diagram - **The Static Structure Diagrams. -** The Class Diagram Model - Attributes descriptions - Operations descriptions - Connections descriptions in the Static Model - Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity- Case studies to implement in design lab. | | |
| **UNIT-V** | **TECHNICAL STACK DIAGRAMS** | **6** |
| **Package Diagram Model -** Description of the model. - White box, black box - connections between packagers - Interfaces - Create Package Diagram - Drill Down - **Component Diagram Model -** Physical Aspect - Logical Aspect - Connections and Dependencies - User face - Initial DB design in a UML environment. - **Deployment Model -** Processors - Connections - Components - Tasks - Threads<br>- Signals and Events. – Mapping class diagram to create skeleton code to implement - Case studies to implement in design lab. | | |
| | **Contact Hours** : | **30** |

| LIST OF EXPERIMENTS | |
|---|---|
| 1 | Students should design a mini project and should apply the following experiments |
| 2 | Requirements Engineering<br>1. Writing Problem Statement<br>2. Writing Requirement Specification<br>a. SRS<br>b. Use Case<br>3. Planning Project with PERT Diagram |

| | | | | |
|---|---|---|---|---|
| | **Designing Project**<br>1. Use Case Diagrams<br>2. Interaction Diagrams<br>3. State chart Diagrams and Activity Diagrams<br>4. Class Diagrams<br>5. Package Diagrams<br>6. Component Diagrams and Deployment Diagrams | | | |
| 3 | Mapping Design to code | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **60** |

| **SOFTWARE:** | |
|---|---|
| 1. | IBM Rational Rose/AGRO UML/STAR UML for Design |

| **Course Outcomes**<br>On completion of the course, students will be able to: | |
|---|---|
| ● | To understand how to model object-oriented languages |
| ● | To decide a suitable software model for a project |
| ● | To elicit requirements and design a user interface model |
| ● | To design a project business model |
| ● | To create a deployment model |

| **Text Books:** | |
|---|---|
| 1. | Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering: using UML, Patterns, and Java, Third Edition, Pearson, 2010. |

| **Reference Books:** | |
|---|---|
| 1. | Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison Wesley, 1994. |
| 2 | Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, 3rd Edition, Pearson Education, 2005. |
| 3 | Simon Bennett, Steve Mc Robb and Ray Farmer, “Object Oriented Systems Analysis and Design Using UML”, Fourth Edition, Mc-Graw Hill Education, 2010. |
| 4 | Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third edition, Addison Wesley, 2003. |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19443.1** | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 3 | - |
| **CB19443.2** | - | 2 | - | 1 | 2 | 1 | - | 1 | 1 | 1 | 2 | - | 1 | 2 | - |
| **CB19443.3** | 2 | 3 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | 1 | 2 | 2 | - |
| **CB19443.4** | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | - |
| **CB19443.5** | 1 | 1 | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | - |
| **Average** | 1.2 | 1.8 | 1.0 | 1.0 | 1.6 | 1.4 | 0.8 | 1.2 | 1.0 | 1.4 | 1.8 | 0.8 | 1.4 | 2.0 | - |

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19542 | COMPILER DESIGN TECHNIQUES | PC | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Learn the various phases of a Compiler. |
| ● | Analyze the various parsing techniques and different levels of translation. |
| ● | Understand Semantic analysis and run-time environment. |
| ● | Understand intermediate code generation and optimization. |
| ● | Learn how about code improvement and type systems. |

| UNIT-I | INTRODUCTION TO COMPILERS | 9 |
|---|---|---|
| Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex). | | |
| **UNIT-II** | **SYNTAX ANALYSIS** | **9** |
| Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison). | | |
| **UNIT-III** | **SEMANTIC ANALYSIS** | **9** |
| Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory location, scope. | | |
| **UNIT-IV** | **INTERMEDIATE CODE GENERATION AND CODE OPTIMIZATION** | **9** |
| Translation of different language features, different types of intermediate forms. Control-flow, data-flow dependence local optimization, global optimization, loop optimization, peep-hole optimization. | | |
| **UNIT-V** | **ARCHITECTURE DEPENDENT CODE IMPROVEMENT** | **9** |
| Register allocation and target code generation. Type systems, data abstraction, compilation of object oriented features and non-imperative programming languages, Instruction scheduling (for pipeline), loop optimization (for cache memory) – RISC architecture. | | |
| | **Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Implement a lexical analyzer to recognize tokens in C. (Ex. identifiers, constants, operators, keywords etc.). | | |
| **2** | Design a Calculator using LEX. | | |
| **3** | Identify an arithmetic expression using LEX and YACC. | | |
| **4** | Evaluate expression that takes digits, *, + using YACC. | | |
| **5** | Generate Three address codes for a given expression (arithmetic expression, flow of control). | | |
| **6** | Implement Code Optimization Techniques like copy propagation, dead code elimination, common sub expression elimination. | | |
| **7** | Generate Target Code (Assembly language) for the given set of Three Address Code. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Demonstrate the functioning of a Compiler. |
| ● | Develop language specifications using context free grammars (CFG). |
| ● | Develop syntax tree and demonstrate the memory management process. |
| ● | Apply the various optimization techniques. |
| ● | Generate a target code. |

| Text Books: | |
|---|---|
| **1** | Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", Second Edition, Pearson Education, 2007. |

| Reference Books | |
|---|---|
| **1** | Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", First Edition, Morgan Kaufmann Publishers, 2002. |
| **2** | Steven S. Muchnick, "Advanced Compiler Design and Implementation", First Edition, Morgan Kaufmann publishers, 2003. |
| **3** | D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, "Modern Compiler Design", Wiley, 2008 |
| **4** | Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19542.1** | - | - | 1 | - | 1 | - | - | - | - | - | - | - | 1 | - | - |
| **CB19542.2** | - | - | 2 | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **CB19542.3** | - | - | 2 | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **CB19542.4** | - | - | 2 | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **CB19542.5** | - | - | 3 | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **Average Mapping** | - | - | 2 | - | 1.8 | - | - | - | - | - | - | - | 1.8 | - | - |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name ( Laboratory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19511 | INNOVATIVE PROJECT LAB FOR COMPUTER SCIENCE AND BUSINESS SYSTEMS | EEC | 0 | 0 | 2 | 1 |

| Objectives: | |
|---|---|
| ● | To identify a problem statement with creativity and innovation |
| ● | To analyze a problem and find out requirements |
| ● | To Design a project |
| ● | To implement a project |
| ● | To test and document a project |

| PHASES OF INNOVATIVE PROJECT DEVELOPMENT | |
|---|---|
| 1 | **Phase 1:** Identify a real world situation related to socio economic issues or industry oriented issues. Brainstorm the need for the problem that helps in exploring variables that promote creativity and innovation and write down problem statement. |
| 2 | **Phase 2:** Analyze the problem statement and list out the innovative thrust find outs of the project. Do state of art and list out PROs and CONs of the project. Do requirement analysis to identify Functional and Nonfunctional requirements'. Analyze the time line and resource of project using PERT chart. |
| 3 | **Phase 3:** Identify the domain to implement the problem. Design the project using any design tool related to the project domain they have chosen. Construct the software architecture of the project. |
| 4 | **Phase 4:** Implement the project and make the project live to handle real life situations with attractive User Interface Design. Test the design with unit and integration testing. |
| 5 | **Phase 5:** Document the project with a business idea out of the project. Provide manual to install project exe and to execute the project. Do Usability testing and System testing. Document the test cases. Present the project and convert it to a journal/conference paper. |
| | Sample domains for Project<br>• Machine Learning<br>• Robotics<br>• Internet of Things<br>• Computer Vision<br>• Block Chain<br>• Web analytics<br>But not limited to the above domains, can include any innovative development ideas. |
| | **Contact Hours : 30** |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Identify innovative projects from day to day life problems. |
| ● | Familiar with the state of art in their respective domains. |
| ● | Apply the concepts learnt to relevant practical applications. |
| ● | Design the innovative idea to prototype |
| ● | Develop the prototype as product ready for release and document it. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19511.01** | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 1 |
| **CB19511.02** | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 1 |
| **CB19511.03** | 3 | - | 3 | - | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| **CB19511.04** | 3 | - | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| **CB19511.05** | 3 | - | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| **Average Mapping** | **2.6** | **1.2** | **1.8** | **2.2** | **3** | **3** | **2.4** | **3** | **3** | **3** | **2.2** | **3** | **3.0** | **3.0** | **1.2** |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name (Employability Enhancement Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| GE19521 | SOFT SKILLS - II | EEC | 0 | 0 | 2 | 1 |

| Objectives: | |
|---|---|
| • | To help students break out of shyness. |
| • | To build confidence. |
| • | To enhance English communication skills. |
| • | To encourage students' creative thinking to help them frame their own opinions. |

| Week | Activity Name | Description | Objective |
|---|---|---|---|
| 1 | The News hour | Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own | The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary. |
| 2 | Court Case | The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients. | The aim of the lesson is to encourage creative and out-of-the -box thinking to ensure a good debate and defense skills. |
| 3 | The ultimate weekend | The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them. | The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions. |
| 4 | The Four Corners | This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move to the corner that they feel best explains their opinions | This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions. |
| 5 | Debate | Boarding school or day school? Which is more beneficial for a student? | The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability |
| 6 | Grand Master | The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd. | The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills. |
| 7 | Debate | Does violence on the TV and Video games influence children negatively? | This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on. |
| 8 | Turn Tables | This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'. | The aim of this activity is to make the participants become spontaneous and have good presence of mind. |
| 9 | Debate | Do marks define the capabilities of a student? | This debate activity aims at allowing the students to argue on this worrisome adage of marks. |

| | | | |
|---|---|---|---|
| 10 | FictionAD | The Participants are asked to create an Ad for a challenging topic only using fictional characters. | The activity aims at developing their creativity and presentation skills. |
| 11 | Debate | Are social networking sites effective, or are they just a sophisticated means for stalking people? | This activity aims at refining the students debating skills on a very real life situation |
| 12 | Talent Hunt | Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills. | The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd |
| | Feedback | At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits. | The aim is to do both give feedback to students as well as obtain feedback on the course from them. |
| | | **Contact Hours :** | **30** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, the students will be able to | |
| • | Be more confident |
| • | Speak in front of a large audience without hesitation |
| • | Think creatively |
| • | Speak impromptu |
| • | Communicate in English |

| Subject Code | Subject Name (Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19601 | FINANCIAL & COST ACCOUNTING | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | To create an awareness about the importance and usefulness of the accounting concepts and their managerial implications. |
| ● | To develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements. |
| ● | To create awareness about cost accounting, different types of costing and cost management. |
| ● | Understand how financial statement information can help solve business problems and increase the ability to read and understand financial statements and related information |

| UNIT-I | ACCOUNTING CONCEPT | 6 |
|---|---|---|
| Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements. Company Accounts and Annual Reports- Audit Reports and Statutory Requirements, Directors Report, Notes to Accounts, Pitfalls. | | |
| **UNIT-II** | **ACCOUNTING PROCESS** | **6** |
| Book Keeping and Record Maintenance, Fundamental Principles and Double Entry, Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts ,Cash Book and Subsidiary Books, Rectification of Errors. | | |
| **UNIT-III** | **FINANCIAL STATEMENTS** | **6** |
| Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards. **Class Discussion:** Corporate Accounting Fraud- A Case Study of Satyam. | | |
| **UNIT-IV** | **CASH FLOW AND FUND FLOW TECHNIQUES** | **6** |
| Introduction, How to prepare – Cash flow and Fund flow, Difference between them. | | |
| **UNIT-V** | **COSTING SYSTEMS** | **6** |
| Elements of Cost, Cost Behavior, Cost Allocation, Overhead Allocation, Unit Costing, Process Costing, Job Costing, Absorption Costing, Marginal Costing, Cost Volume Profit Analysis, Budgets, ABC Analysis. **Class Discussion:** Application of costing concepts in the Service Sector. | | |
| | **Contact Hours : 30** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the theories, concept, and evolution of management. |
| ● | Demonstrate the ability to employ the management way of thinking. |
| ● | Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc. |
| ● | Understand the qualities of a leader in the managerial aspect in future terms. |
| ● | Understand the managerial ethics and CSR and its importance. |

| Text Book (s): | |
|---|---|
| 1 | Robert N Anthony, David Hawkins, Kenneth Marchant, "Accounting: Texts and Cases", Thirteenth Edition, McGraw-Hill, 2017. |
| 2 | M.Y.Khan & P.K.Jain, "Management Accounting", Tata McGraw Hill, 2011. |
| 3 | R.Narayanaswamy, Financial Accounting – A managerial perspective, Fifth Edition, PHI Learning, New Delhi, 2011. |

| Reference Books(s) : | |
|---|---|
| 1 | Jan Williams, "Financial and Managerial Accounting – The basis for business Decisions", Fifteenth Edition, Tata McGraw Hill Publishers, 2010. |
| 2 | Horngren, Surdem, Stratton, Burgstahler, Schatzberg, "Introduction to Management Accounting", Sixteenth Edition, PHI Learning, 2014. |

| | |
|---|---|
| **3** | Stice & Stice," Financial Accounting Reporting and Analysis", Eight Edition, Cengage Learning, 2010. |
| **4** | Singhvi Bodhanwala, "Management Accounting -Text and cases", Third Edition, PHI Learning, 2018. |
| **5** | Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsevier, 2009. |


**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19601.01** | 2 | 1 | 2 | 1 | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | - |
| **BA19601.02** | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | - | - | 2 | 2 | - | - | - |
| **BA19601.03** | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | - |
| **BA19601.04** | 2 | 1 | 2 | 3 | 2 | 3 | 1 | 1 | - | - | 2 | 2 | - | - | - |
| **BA19601.05** | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | - |
| **Average Mapping** | 2 | 1 | 2 | 2.4 | 2 | 3 | 2.2 | 2 | - | - | 2 | 2 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19641 | COMPUTER NETWORK TECHNOLOGY | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Understand the concepts of computer networks and learn techniques for bandwidth utilization. |
| ● | Be exposed to various addressing schemes and error detection-correction of data. |
| ● | Learn the routing protocols, transport layer, flow control and congestion control algorithms. |
| ● | Be familiar with real time applications of networking devices and tools. |
| ● | To write different applications using different types of sockets. |

| UNIT-I | FUNDAMENTALS AND PHYSICAL LAYER | 9 |
|---|---|---|
| Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures. Data communication components: Representation of data and its flow, Various connection topology, Protocols and standards, OSI model, Transmission Media. LAN: Wired LAN, Wireless LAN, Virtual LAN. Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum. | | |
| **UNIT-II** | **DATA LINK LAYER AND MEDIUM ACCESS SUB LAYER** | **9** |
| Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA. | | |
| **UNIT-III** | **NETWORK LAYER** | **9** |
| Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. | | |
| **UNIT-IV** | **TRANSPORT LAYER** | **9** |
| Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms. | | |
| **UNIT-V** | **APPLICATION LAYER AND SECURITY** | **9** |
| Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls. Network Security: Electronic mail, directory services and network management, Basic concepts of Cryptography. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Learn to use basic commands | | |
| **2** | Configuration of Network in Linux Environment. | | |
| **3** | Assignment of IP Address to computers. | | |
| **4** | Implementation of Subnet mask in IP addressing. | | |
| **5** | Implementation of setup of a Local Area Network (using Switches) – Minimum 3 nodes and Internet | | |
| **6** | To capture, save, and analyse network traffic on TCP / UDP / IP / HTTP / ARP /DHCP /ICMP /DNS using Wireshark Tool. | | |
| **7** | Write a socket PING program to test the server connectivity. | | |
| **8** | Study of system administration and network administration | | |
| **9** | Study of socket programming and client server model using TCP and UDP. | | |
| **10** | Programs using TCP Sockets (like date and time server & client, echo server & client, chat etc.) | | |
| **11** | Programs using UDP Sockets (like echo server, chat, simple DNS). | | |
| **12** | Simulation of sliding window. | | |
| **13** | Implementation of ARP. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Choose the required functionality at each layer for given application. |
| ● | Trace the flow of information from one node to another node in the network. |
| ● | Apply the knowledge of addressing scheme and various routing protocols in data communication to select optimal path. |
| ● | Monitor the traffic within the network and analyse the transfer of packets. |
| ● | Develop real time applications of networks using socket programming. |

| **Text Book (s):** | |
|---|---|
| **1** | Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th edition, Pearson education, 2016. |
| **2** | William Stallings, "Data and Computer Communication", 10th edition, Pearson education, 2017. |

| **Reference Books(s) / Web links:** | |
|---|---|
| **1** | Kaufman, R. Perlman and M. Speciner, "Network Security", Pearson education, 2017. |
| **2** | W. Richard Stevens, "UNIX Network Programming, Vol. 1,2 & 3", Prentice-Hall of India, 2004. |

**CO - PO – PSO matrices of course**

| **PO/PSO / CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19641.01** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 3 |
| **CB19641.02** | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CB19641.03** | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 1 |
| **CB19641.04** | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 | 2 |
| **CB19641.05** | 2 | 2 | 3 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 3 | 3 | 3 |
| **Average Mapping** | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19642 | INFORMATION SECURITY | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand the overview of computer security. |
| ● | To understand the information security policy and system design. |
| ● | To understand techniques of system security. |
| ● | To learn about various applications of system security. |
| ● | To learn about operating system and database security. |

| UNIT-I | OVERVIEW OF COMPUTER SECURITY | 9 |
|---|---|---|
| The Basic Components- Confidentiality, integrity and availability; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and operational issues; Security Life Cycle -Access Control Models: Role based Model. | | |
| **UNIT-II** | **SECURITY POLICIES AND SYSTEM DESIGN** | **10** |
| Types of Security Policies-Confidentiality policies: Goals of Confidentiality Policies, The Bell-LaPadula Model-Integrity policies: Biba Integrity Model, Clark-Wilson Integrity Model -Hybrid policies: Chinese Wall Model, Clinical Information Systems Security Policy. Access Control Mechanisms: Access Control Lists- Information Flow: Compiler-Based Mechanisms, Execution-Based Mechanisms- Confinement Problem: Isolation, Covert Channels-Assurance: Building Secure and Trusted Systems- Evaluating Systems: Goals of Formal Evaluation. | | |
| **UNIT-III** | **SYSTEM SECURITY** | **10** |
| Malicious Logic: Trojan Horses, Computer Viruses, Computer Worms- Vulnerability Analysis: Penetration Studies, Vulnerability Classification-Auditing: Anatomy of an Auditing System, Auditing Mechanisms, Audit Browsing-Intrusion Detection: Architecture, Organization of Intrusion Detection Systems- Design Principles- Representing Identity: Files and Objects, Users, Groups and Roles, Naming and Certificates. | | |
| **UNIT-IV** | **APPLICATIONS** | **10** |
| Network Security: Policy Development, Network Organization- System Security: Policy- User Security: Policy, Access, Files and Devices- Program Security: Requirements and Policy, Design, Case Study: Common Security-Related Programming Problems. | | |
| **UNIT-V** | **OPERATING SYSTEM AND DATABASE SECURITY** | **6** |
| Operating System Security: Security Architecture, Analysis of Security in Linux/Windows-Database Security: Security Architecture, Database Auditing-Case Study: Discretionary Access Control. | | |
| | **Contact Hours : 45** | |

| LIST OF EXPERIMENTS | | | |
|---|---|---|---|
| 1 | Analysis of security in Unix/Linux. | | |
| 2 | Administration of users, password policies, privileges and roles. | | |
| 3 | Implementation of discretionary access control and mandatory access control. | | |
| 4 | Demonstrate intrusion detection system (ids) using any tool Eg. Snort or any other software. | | |
| 5 | Implementation of IT audit, malware analysis and vulnerability assessment and generate the report. | | |
| 6 | Implementation of mobile audit and generate the report of the existing artifacts. | | |
| 7 | Implementation of OS hardening and RAM dump analysis to collect the artifacts and other information. | | |
| 8 | Implementation of digital forensics tools for disk imaging, data acquisition, data extraction and data analysis and recovery. | | |
| 9 | Perform mobile analysis in the form of retrieving call logs, SMS log, all contacts list using the forensics tool like SAFT. | | |
| 10 | Implementation to identify web vulnerabilities, using OWASP project. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| • | Discuss the basics of information security and international standards. |
| • | Analyse information security policy and system design. |
| • | Comprehend system level security. |
| • | Apply system level security in various environments. |
| • | Analyze the operating system and database security methods. |

| **Text Book(s):** | |
|---|---|
| 1 | Ross Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", Third Edition, Wiley, 2021. |
| **2** | M. Bishop, "Computer Security: Art and Science", 2nd Edition, Pearson Education, 2019. |
| **3** | M. Stamp, "Information Security: Principles and Practice", 2nd Edition, Wiley, 2011. |

| **Reference Books(s) /Web Resources :** | |
|---|---|
| **1** | C.P. Pfleeger, S.L. Pfleeger, J. Margulies, "Security in Computing", 5th Edition, Prentice Hall, 2015. |
| **2** | David Wheeler, "Secure Programming HOW TO", v3.010 Edition, 2003. |
| **3** | Michael Zalewski, "Browser Security Handbook", Google Inc., 2009. |
| **4** | M. Gertz, S. Jajodia, "Handbook of Database Security", Springer, 2008. |

**CO - PO – PSO matrices of course**

| **PO/PSO / CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19642.01** | 3 | 1 | 1 | 1 | 1 | 2 | - | 3 | - | - | - | 2 | 2 | 1 | 1 |
| **CB19642.02** | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | 1 | 3 |
| **CB19642.03** | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 3 | 1 | 2 |
| **CB19642.04** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | - | 2 | 3 | 2 | 3 |
| **CB19642.05** | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | - | - | - | 2 | 3 | 1 | 2 |
| **Average Mapping** | 3 | 1 | 1 | 1 | 1 | 2 | - | 3 | - | - | - | 2 | 2 | 1 | 1 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19643 | ARTIFICIAL INTELLIGENCE | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand the intelligent agents and formulate a problem in search space. |
| ● | To analyze the problem and learn the different search techniques. |
| ● | To learn the constraint satisfaction problem and game theory. |
| ● | To study the system of knowledge representation using rules and reasoning. |
| ● | To gain knowledge on probabilistic reasoning and expert systems. |

| UNIT-I | INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT | 9 |
|---|---|---|
| Intelligent agents, agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Problems of AI, AI technique, Tic - Tac - Toe problem. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs. | | |
| **UNIT-II** | **SEARCH TECHNIQUES** | **9** |
| Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies - Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search. | | |
| **UNIT-III** | **CONSTRAINT SATISFACTION PROBLEMS AND GAME THEORY** | **9** |
| Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening. | | |
| **UNIT-IV** | **KNOWLEDGE & REASONING** | **9** |
| Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge. | | |
| **UNIT-V** | **PROBABILISTIC REASONING AND EXPERT SYSTEMS** | **9** |
| Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.<br>Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| **1** | Programs on Problem Solving<br>a. Write a program to solve 8 Queens problem<br>b. Solve any problem using depth first search<br>c. Implement MINIMAX algorithm<br>d. Implement A* algorithm |
| **2** | Programs on Decision Making and Knowledge Representation<br>a. Introduction to PROLOG<br>b. Implementation of Unification and Resolution Algorithm.<br>c. Implementation of Backward Chaining |
| **3** | Programs on Planning and Learning<br>a. Implementation of Blocks World program.<br>b. Implementation of SVM for an application using python.<br>c. Implementing Artificial Neural Networks for an application using python.<br>d. Implementation of Decision Tree<br>e. Implementation of K-mean algorithm |
| | **Contact Hours : 30** |
| | **Total Contact Hours : 75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Formulate a problem and build intelligent agents. |
| ● | Build systems to analyze a problem and make decisions using suitable search techniques. |
| ● | Understand the constraint satisfaction problem and game theory. |
| ● | Apply reasoning and rules on knowledge representation. |
| ● | Gain knowledge on probabilistic reasoning and expert systems. |

| **Text Book (s):** | |
|---|---|
| 1 | Stuart J. Russell, Peter Norwig , "Artificial Intelligence –A Modern approach", 3rd Pearson Education, 2016. |
| 2 | Artificial Intelligence, Russel, Pearson |

| **Reference Books(s) :** | |
|---|---|
| 1 | Ritch & Knight, "Artificial Intelligence", Third Edition, Tata McGraw Hill, 2009. |
| 2 | Patterson, "Introduction to Artificial Intelligence & Expert Systems", First Edition, Pearson, 2015. |
| 3 | Saroj Kaushik, "Logic & Prolog Programming", First Edition, New Age International, 2008. |
| 4 | Joseph C. Giarratano, Gary D. Riley,"Expert Systems: Principles and Programming", Fourth Edition, Cengage, 2007. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19643.01** | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2.2 | 1 | 2 | 1 | 1 |
| **CB19643.02** | 2 | 2 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| **CB19643.03** | 3 | 3 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 2 | 3 | 2 |
| **CB19643.04** | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 |
| **CB19643.05** | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 3 |
| **Average Mapping** | 2.4 | 2.4 | 1.0 | 2.0 | 2.4 | 0.6 | 1.2 | 0.8 | 0.2 | 0.0 | 2.0 | 1.8 | 2.0 | 2.0 | 2.0 |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name( Laboratory Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| HS19611 | BUSINESS COMMUNICATION & VALUE SCIENCE – IV | HS | 0 | 0 | 4 | 2 |

| Objectives: | |
|---|---|
| ● | To recognize the best practices of communicative writing. |
| ● | To understand the importance of emotional intelligence in personal and professional lives. |
| ● | To understand how stress impacts life and work. |
| ● | To use the best practices to manage stress. |
| ● | To understand how to make start-ups and public speaking. |

| UNIT-I | COMMUNICATIVE WRITING | 12 |
|---|---|---|
| Concepts: Principles of Communicative writing – Formal Business letters – Writing Proposals – Use of charts in communicative writing – use of business idioms – corporate terms. Activity: Group business proposals – presentation of proposal – Story telling using charts and graphs (demonstrative speech). | | |
| **UNIT-II** | **EMOTIONAL INTELLIGENCE** | **12** |
| Concepts: Concepts of emotional intelligence – Its importance in human life and professional life – difference between Emotional quotient and Intelligent quotient – Corporate etiquette Activity: Any two Anubhaav activities – 10 ways to build Emotional Intelligence by Daniel Goleman – Mock interview. | | |
| **UNIT-III** | **CONFLICT MANAGEMENT** | **12** |
| Concepts: Conflicts – Corporate and workplace conflicts – reason and impacts of conflicts – guidelines to manage conflicts. Teams - role of team player – stress – stress management – importance of feedbacks – Time Management. Activity: Creating posters with stress management tips – open house discussion on challenges of time management – Tracking time activity. | | |
| **UNIT-IV** | **CORPORATE SOCIAL RESPONSIBILITY** | **12** |
| Concepts: Corporate Social Responsibility - Social responsibilities of companies - Diversity in workplace – Individual social responsibility – Social connect – life skills – empathy. Activity: Discussion & Role play in diversity – Ubuntu story of social responsibility – creating audio embedded PPT on the concept of social responsibility. | | |
| **UNIT-V** | **DESIGN THINKING & PUBLIC SPEAKING** | **12** |
| Concepts: Design thinking – importance of start-ups – Proof of concept for start-ups – Best practices – Art of Public speaking Activity: Pitch in start-up idea – watching videos of public speaking – Finding similarities among world famous speeches – watching videos of Sw. Vivekananda's speech – Martin Luther King's My Dream speech. | | |
| | **Contact Hours : 60** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Recognize the best practice of Communicative writing. |
| ● | Apply emotional intelligence in real life scenarios. |
| ● | Identify the best practices of stress management. |
| ● | Recognize the attributes needed to function and grow in a corporate environment. |
| ● | Apply the best practices of public speaking. |

| Reference Books / Web links: | |
|---|---|
| 1 | Daniel Goleman," Emotional Intelligence: Why it Can Matter More Than IQ", Bloomsbury, 2004. |
| 2 | Ryback David, "Putting Emotional Intelligence To Work", CRC Press, 1998. |
| 3 | Dale Carnegie, "How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion", Ebury Publishing, 1998. |
| 4 | Chris Anderson, "TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations", Hachette, 2016. |

| Web References | |
|---|---|
| 1 | https://www.tata.com/about-us/tata-group-our-heritage |
| 2 | https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms |

| Online Resources | |
|---|---|
| 1 | https://youtu.be/reu8rzD6ZAE |
| 2 | https://youtu.be/Wx9v_J34Fyo |
| 3 | https://youtu.be/F2hc2FLOdhI |
| 4 | https://youtu.be/wHGqp8lz36c |
| 5 | https://youtu.be/hxS5He3KVEM |

**CO - PO – PSO matrices of course**

| PO/PSO CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HS19611.1** | 1 | 3 | - | 2 | - | 2 | 1 | - | 3 | 3 | - | 1 | 1 | 1 | 1 |
| **HS19611.2** | - | - | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | - | 3 | 2 | - | 2 |
| **HS19611.3** | - | - | - | 1 | - | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 1 | - | 1 |
| **HS19611.4** | - | - | 1 | - | - | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | - | 1 |
| **HS19611.5** | - | - | - | 1 | - | 2 | 2 | - | 1 | 2 | 3 | 3 | 1 | 1 | - |
| **Average** | 0.2 | 0.6 | 0.6 | 1.2 | 0.2 | 1.8 | 1.8 | 1.2 | 2.4 | 2.2 | 1.8 | 2.4 | 1.4 | 0.4 | 1 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name (Employability Enhancement Courses) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| GE19621 | PROBLEM SOLVING TECHNIQUES | EEC | 0 | 0 | 2 | 1 |

| Objectives: | |
|---|---|
| • | To improve the numerical ability |
| • | To improve problem-solving skills. |

| Topics | | | | |
|---|---|---|---|---|
| 1 | Numbers system | | | |
| 2 | Reading comprehension | | | |
| 3 | Data arrangements and Blood relations | | | |
| 4 | Time and Work | | | |
| 5 | Sentence correction | | | |
| 6 | Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning | | | |
| 7 | Percentages, Simple interest and Compound interest | | | |
| 8 | Sentence completion and Para-jumbles | | | |
| 9 | Profit and Loss, Partnerships and Averages | | | |
| 10 | Permutation, Combination and Probability | | | |
| 11 | Data interpretation and Data sufficiency | | | |
| 12 | Logarithms, Progressions, Geometry and Quadratic equations. | | | |
| 13 | Time, Speed and Distance | | | |
| | | **Total Contact Hours** | **:** | **30** |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| • | Have mental alertness |
| • | Have numerical ability |
| • | Solve quantitative aptitude problems with more confident |

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19701 | PRINCIPLES OF FINANCIAL MANAGEMENT | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | Understand the functional distinctions of a Finance Manager. |
| ● | Comprehend the technique of making decisions related to finance function. |
| ● | Understand the techniques involved in deciding upon purchase or sale of securities. |
| ● | An overview and generating investment project proposals. |
| ● | Motives for holding cash and receivables. |

| UNIT-I | INTRODUCTION | 6 |
|---|---|---|
| Introduction to Financial Management - Goals of the firm - Financial Environments. Time Value of Money: Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor. | | |
| **UNIT-II** | **VALUATION OF SECURITIES** | **6** |
| Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. Risk & Return: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM). | | |
| **UNIT-III** | **CAPITAL BUDGETING** | **6** |
| The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods. | | |
| **UNIT-IV** | **COST OF CAPITAL, OPERATING & FINANCIAL LEVERAGE** | **6** |
| Cost of Capital : Concept , Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital 4L.<br>Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage and Indifference Analysis in leverage study. | | |
| **UNIT-V** | **WORKING CAPITAL MANAGEMENT** | **6** |
| Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital. Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period. 4L. Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring. | | |
| | **Total Contact Hours : 30** | |

| Course Outcomes:<br>On completion of the course, the students will be able to | |
|---|---|
| ● | Identify the basic concepts of financial management and time value of money. |
| ● | Understand the various processes involved in securities market. |
| ● | Evaluate and choose the best project from alternatives based on cost-benefit analysis. |
| ● | Compute the fundamental concepts of financial management. |
| ● | Influence the concept for deciding financial angle of IT projects. |

| Text Book (s): | |
|---|---|
| 1 | Chandra Prasanna, “Financial Management - Theory & Practice”, Tata McGraw Hill, 10th Edition, 2019. |
| 2 | M.Y.Khanand and P.K.Jain, “Financial management, Text, Problems and Cases”, Tata Mc Graw Hill, 5th Edition, 2000. |
| 3 | I.M.Pandey, “Financial Management”, Vikas Publishing House Pvt.Ltd., 8th Edition, 2007. |
| 4 | Aswat Damodaran, “Corporate Finance Theory and Practice”, John Wiley & Sons, 2nd Edition, 2008. |
| 5 | James C.Vanhorne, “Fundamentals of Financial Management”, PHI Learning, 11th Edition, 2008. |

| Reference Books(s) : | |
|---|---|
| 1 | Van Horne and Wachowicz, "Fundamentals of Financial Management", Prentice Hall, 13th Edition, 2009. |
| 2 | Brigham and Ehrhardt, "Financial Management Theory and Practice", 11th edition, Cengage Learning, 2011. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19701.1** | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 3 | 2 | - | - | - |
| **BA19701.2** | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | - | - | - |
| **BA19701.3** | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | - | - | - |
| **BA19701.4** | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | - | - | - |
| **BA19701.5** | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | - | - | - |
| **Average** | 1 | 1 | 1.2 | 1.2 | 1.6 | 1.2 | 1.2 | 1 | 1 | 1 | 2.2 | 1.8 | - | - | - |

Correlation levels 1, 2 or 3 are as defined below:

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

No correlation: "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19702 | ESSENTIALS OF HUMAN RESOURCES MANAGEMENT | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | Facilitate student to imbibe knowledge about understanding the basic concepts and importance of Human Resources Management, Recruitment, Training, Communications, Employee Empowerment, Employee Interaction, Various Human Resources Applications and Practices, Managerial functions etc. |

| | | |
|---|---|---|
| **UNIT-I** | **HUMAN RESOURCES MANAGEMENT** | **6** |
| Concept and Challenges, HR Philosophy, Policies, Procedures and Practices. | | |
| **UNIT-II** | **HUMAN RESOURCE SYSTEM DESIGN** | **6** |
| HR Profession and HR Department, Line Management Responsibility in HRM, Measuring HR, Human Resources Accounting and Audit, Human Resource Information system. | | |
| **UNIT-III** | **FUNCTIONAL AREAS OF HRM** | **6** |
| Recruitment and Staffing, benefits, compensation, Employee Relations, HR Compliance, Organizational Design, Training and Development, Human Resources Information systems (HRIS) and Payroll. | | |
| **UNIT-IV** | **HUMAN RESOURCES PLANNING** | **6** |
| Demand Forecasting, Action Plans – Retention, Training, Redeployment and staffing, succession Planning. | | |
| **UNIT-V** | **STRATEGIC MANAGEMENT OF HUMAN RESOURCES** | **6** |
| SHRM, relationship between HR strategy and overall Corporate Strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace. | | |
| | **Total Contact Hours : 30** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Be aware of the basic principles of Human Resource Management. |
| ● | Be familiarize with the system design of Human Resource Management. |
| ● | Know the concepts, roles, functional areas and activities of HR. |
| ● | Understand organization's employee, their interest, motivation, satisfaction belief of fair treatment. |
| ● | Get awareness on actual impact on the firm's current performance and sustainability in the long run. |

| Text Book (s): | |
|---|---|
| 1 | Prof. Gary Dessler , Human Resources Management, Pearson, 16th Edition, 2020. |
| 2 | Prof.John M.Ivancevich, "Human Resource Management", Tata McGraw Hill Publication, 12th Edition, 2003. |
| 3 | Prof.Aswathappa, "Human Resource Management and Personnel Management", 3rd Edition, Tata McGraw Hill, 2002. |

| Reference Books(s) / Web links: | |
|---|---|
| 1 | Dr.C.B.Gupta, "Human Resource Management ", Sultan Chand & Sons, New Delhi, 1st Edition, 2018. |
| 2 | Prof.S.S.Khanka, "Human Resource Management", Chand & Company, New Delhi, 2019. |
| 3 | Dr.S.Seetharaman et al., "Human Resource Management", SciTech Publications Pvt Ltd. Chennai,2012. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19702.1** | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 1 |
| **BA19702.2** | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 3 |
| **BA19702.3** | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 1 |
| **BA19702.4** | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| **BA19702.5** | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 |
| **Average** | **1.4** | **2** | **2** | **2.4** | **2** | **1.8** | **2** | **1.8** | **2** | **2.4** | **2** | **2.6** | **2.2** | **2** | **2** |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19741 | USABILITY DESIGN OF SOFTWARE APPLICATIONS | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To learn the fundamentals of User Centered Design, their relevance and contribution to businesses. |
| ● | To study the principles of heuristic evaluation for interactive design. |
| ● | To understand the appreciation of user research, solution conceptualization and validation as interwoven activities in the design and development lifecycle. |
| ● | To familiarize the facets of User Experience (UX) Design, particularly as applied to the digital artefacts. |
| ● | To implement complex mobile/web applications. |

| UNIT-I | INTRODUCTION TO USER CENTRED DESIGN | 9 |
|---|---|---|
| Basics of User Centred Design-Elements-Models and approaches-User Centred Design Principles-Usability-UCD Process-Analysis tools: personas, scenarios, and essential use cases with examples-User-Centred Design and Agile aspects of User Centred Design. | | |
| **UNIT-II** | **INTERACTIVE DESIGN EVALUATION** | **9** |
| Introduction to Interactive Design process – Interactive design in practice – Introducing evaluation – Evaluation: Inspection, Analysis and Models – Inspection: Heuristic Evaluation: 10 Heuristic Principles, Examples – Case study: A Heuristic Evaluation of Iraq E-Portal. | | |
| **UNIT-III** | **DEVELOPMENT OF APPLICATION** | **9** |
| Case Study: Development of any application like mobile or web based on User Centred Design – Design lifecyle: Establishing Requirements, Design, Prototyping and Construction. | | |
| **UNIT-IV** | **UX RESEARCH** | **9** |
| Understanding users, their goals, context of use, and environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX. | | |
| **UNIT-V** | **ITERATIVE PRODUCT DEVELOPMENT** | **9** |
| The Problem with Complexity - Iterative Product Development - Scenarios and Persona Technique, Design Thinking Technique: Discovery and brainstorming - Concept Development - Prototyping Techniques : Paper, Electronic, Prototyping Tools – Review and feedback | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | Product Appreciation Assignment – Evaluating the product from User Centred Design aspects such as functionality, ease of use, ergonomics, and aesthetics. |
| 2 | Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations. |
| 3 | Students will identify a project in the given domain (Healthcare, E-Commerce, Online Learning Platforms, Gaming, Point-of-Sale, Smart Things) and its related website or mobile app to redesign. They will take this redesign project through the design lifecycle:<br>Discovery<br>Define<br>Design<br>Implement (Design Prototype)<br>Usability Testing<br>The below design methods and techniques will be imparted w.r.t. the group project selected by the students. |
| 4 | Presentation of Persona for the group project |
| 5 | Task flow detailing for the project |
| 6 | Project Prototyping Iteration 1 |
| 7 | Project Prototyping Iteration 2 |
| 8 | Final Product Demo( Mobile or Web Application) |
| | **Contact Hours : 30** |
| | **Total Contact Hours : 75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the fundamentals and importance of User-Centred design. |
| ● | Perform design evaluation by applying the heuristic principles. |
| ● | Develop an application focusing on the design aspects. |
| ● | Do research on understanding user requirement. |
| ● | Perform iterative product development using prototyping technique. |

| **Text Book (s):** | |
|---|---|
| 1 | Jenny Preece, Helen Sharp and Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 3rd Edition, 2004. |
| 2 | Jonny Schneider , "Understanding Design Thinking, Lean, and Agile", 1st Edition, 2020. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Alan Cooper and Robert Reimann, "About Face", John Wiley, 4th Edition. |
| 2 | Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, "Observing the User Experience: A Practitioner's Guide to User Research", 2nd Edition, 2012. |
| 3 | Jesse James Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond, 2nd Edition, 2010. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19741.1** | 2 | 2 | 2 | - | - | - | - | - | 1 | - | - | 2 | 2 | - | - |
| **CB19741.2** | 2 | 2 | 3 | 1 | - | - | - | - | 1 | - | - | 2 | 2 | - | - |
| **CB19741.3** | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | 2 | 2 | 2 | - |
| **CB19741.4** | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | - | - |
| **CB19741.5** | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 2 | 2 |
| **Average** | 2 | 2.2 | 2.8 | 1.6 | 1.4 | 0.8 | 1.2 | 1 | 1.4 | 0.8 | 0.8 | 2 | 2 | 0.8 | 0.4 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19742 | IT Workshop | PC | 2 | 0 | 2 | 3 |

| Objectives: | |
|---|---|
| ● | To introduce the students with the basic features of MATLAB for problem solving. |
| ● | To introduce the students about the Mathematical functions like matrix generation and Plotting with |
| ● | multiple data sets, line styles and colors. |
| ● | To introduce the students about the Array operations and solving Linear equations in MATLAB. |
| ● | To introduce the students about the control flow and operators using if-end structures and loops. |

| UNIT-I | INTRODUCTION TO MATLAB | 6 |
|---|---|---|
| Introduction to MATLAB: History, basic features, strengths and weaknesses, good programming practices and plan your code.<br>Working with variables, workspace and miscellaneous commands: Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands. | | |
| **UNIT-II** | **MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS** | **6** |
| Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions. | | |
| **UNIT-III** | **BASIC PLOTTING** | **6** |
| Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours. | | |
| **UNIT-IV** | **INTRODUCTION TO PROGRAMMING** | **6** |
| Introduction to programming: Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands.<br>Control flow and operators: "if ... end" structure, relational and logical operators, "for ... end" loop, "while ... end" loop, other flow structures, operator precedence, saving output to a file. | | |
| **UNIT-V** | **DEBUGGING M-FILES** | **6** |
| Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file. | | |
| | **Total Contact Hours : 30** | |

| List of Experiments | |
|---|---|
| 1 | Programs using mathematical, relational expressions and the operators. |
| 2 | Vectors and Matrices: Programs using array operations and matrix operations (such as matrix multiplication). |
| 3 | Programs on input and output of values. |
| 4 | Selection Statements: Experiments on if statements, with else and elseif clauses and switch statements. |
| 5 | Loop Statements and Vectorizing Code: Programs based on the concepts of counted (for) and conditional (while) loops. |
| 6 | Programs based on scripts and user-defined functions. |
| 7 | Programs on Built-in text manipulation functions and conversion between string and number types. |
| 8 | Programs based on two main data structures: cell arrays and structures. |
| 9 | Programs based on Data Transfer |
| 10 | Programs based on Advanced Functions. |
| 11 | Introduction to Object-Oriented Programming and Graphics. |
| 12 | Programs based on Advanced Plotting Techniques. |
| 13 | Programs based on sound files and image processing. |
| 14 | Programs based on Advanced Mathematics. |
| | **Contact Hours : 30** |
| | **Total Contact Hours : 60** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Write fundamental programs in MATLAB, creating variables and mathematical functions. |
| ● | Understand how to program matrix operations, array operations and how to solve the system of linear equations. |
| ● | Program the fundamentals concepts of basic Plotting consisting of simple and multiple data sets in one plot. |
| ● | Understand how to program M-file scripts, M- file functions, Input –output Arguments and program control flow operators, loops, flow structures. |
| ● | Use the debugging process and debugging M-files. |

| **Text Book (s):** | |
|---|---|
| 1 | Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004. |
| 2 | Stormy Attaway, Butterworth-Heinemann, "MATLAB: A Practical Introduction to Programming and Problem Solving", 5th Edition, 2018. |

| **Reference Books(s) :** | |
|---|---|
| 1 | https://www.mathworks.com/content/dam/mathworks/mathworks-dot com/moler/exm/book.pdf |
| 2 | https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19742.1** | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CB19742.2** | 3 | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CB19742.3** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CB19742.4** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CB19742.5** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| **Average** | **3** | **3** | **3** | **2.2** | **2** | **1.4** | **1.6** | **2** | **1.6** | **2** | **2.6** | **2** | **3** | **2** | **3** |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19801 | MARKETING RESEARCH & MARKETING MANAGEMENT | MS | 2 | 0 | 0 | 2 |

| Objectives: | |
|---|---|
| ● | The course will enable in understanding the concepts of marketing with respect to the changing business environment. It will also provide a balance of the theoretical and practical aspects of marketing research and encourage the students to take up a critical and analytical thinking through research. |

| UNIT-I | MARKETING CONCEPTS | 6 |
|---|---|---|
| Introduction to marketing —Core concepts — Marketing of Services ; importance of marketing in service sector — Marketing planning and Environment ; Elements of marketing mix; analyzing the needs and trends in Environment- Macro, Economical, Political, Technical and Social — Understanding the Consumers – Determinants and factors - Market Segmentation – Meaning and concept; Basis of segmentation, selection of segments, Segmentation strategies, Target marketing, target Positioning. | | |
| **UNIT-II** | **PRODUCT MANAGEMENT** | **6** |
| Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging. | | |
| **UNIT-III** | **PRICING, PROMOTION AND DISTRIBUTION STRATEGY** | **6** |
| Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising. | | |
| **UNIT-IV** | **MARKETING RESEARCH** | **6** |
| Introduction, Type of Market Research, Scope, Objectives & Limitations - Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research.<br>**Data Analysis**: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis. | | |
| **UNIT-V** | **INTERNET MARKETING** | **6** |
| Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing. **Business to Business Marketing:** Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy | | |
| | **Total Contact Hours** : | **30** |

| Course Outcomes:<br>On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the basic marketing concepts. |
| ● | Comprehend the dynamics of marketing and analyze how various components interact with each other in the real world. |
| ● | Leverage marketing concepts for effective decision making. |
| ● | Understand the basic concepts and the application of statistical tools in marketing research. |
| ● | Understand internet marketing, Business to Business marketing, Promotion in business markets, CRM and Strategies adopted in B2B markets. |

| Text Book (s): | |
|---|---|
| 1 | Philip Kotler and Kevin Lane Keller, "Marketing Management", PHI 14th Edition, 2012. |
| 2 | Donald R. Cooper, Pamela S. Schindler and J K Sharma, "Business Research Methods", 11th Edition, Tata McGraw Hill, New Delhi, 2012. |
| 3 | Uma Sekaran and Roger Bougie, "Research methods for Business", 5th Edition, Wiley India, New Delhi, 2012. |
| 4 | KS Chandrasekar, "Marketing management-Text and Cases", Tata McGraw Hill First edition, 2010. |

| Reference Books(s) : | |
|---|---|
| 1 | Paul Baines, Chris Fill and Kelly Page, "Marketing", Oxford University Press, 2nd Edition, 2011. |
| 2 | William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari,Mitch Griffin, "Business Research methods, A South Asian Perspective", 8th Edition, Cengage Learning, New Delhi, 2012. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19801.1** | 2 | 1 | 1 | - | - | 2 | 1 | - | 1 | - | 2 | 2 | 2 | 2 | 2 |
| **BA19801.2** | 2 | 1 | 1 | - | - | 2 | 1 | - | 1 | - | 2- | 2 | 2 | 2 | 2 |
| **BA19801.3** | 2 | 1 | - | - | - | 2 | 1 | - | 1 | - | 2 | 2 | 1 | 1 | 1 |
| **BA19801.4** | 2 | 1 | - | - | - | 2 | 1 | - | 1 | - | 2 | 2 | 1 | 1 | 1 |
| **BA19801.5** | 2 | 1 | - | - | - | 2 | 1 | - | 1 | - | 2 | 2 | 2 | 2 | 2 |
| **Average** | 2 | 1 | 1 | - | - | 2 | 1 | - | 1 | - | 2 | 2 | 2 | 2 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19802 | SERVICES SCIENCE & SERVICE OPERATIONAL MANAGEMENT | MS | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | Understand the services and service operations management concepts. |
| ● | Comprehend the techniques of service operations. |
| ● | Understand the service quality and service design aspects. |
| ● | Understand the service innovation aspects. |
| ● | To analyse how services are different from products by its characteristics. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters. Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value co-creation. | | |
| **UNIT-II** | **SERVICE STRATEGY AND COMPETITIVENESS** | **10** |
| Development of Strategic Service Vision (SSV), Data Envelopment Analysis-New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system - Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design - Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools. | | |
| **UNIT-III** | **SERVICE GUARANTEE & SERVICE RECOVERY** | **8** |
| Service quality GAP analysis, Service guarantee-Service encounter-service profit chain. | | |
| **UNIT-IV** | **FORECASTING DEMAND FOR SERVICES** | **9** |
| Types of demand forecasting methods for Managing Capacity and Demand: Strategies for matching capacity and demand, managing waiting line in services. Managing Facilitating Goods: inventory models, Role of inventory in services - Managing service supply relationship: Understanding the supply chain, Strategies for managing suppliers of service - Vehicle Routing Problem: understanding services that involve transportation of people and vehicle. | | |
| **UNIT-V** | **SERVICE INNOVATION** | **9** |
| Services Productivity, Need for Services Innovation, service innovation in different service sector – educational, health and hospitality sectors. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes: | |
|---|---|
| On completion of the course, the students will be able to | |
| ● | Understand concepts about services and distinguish it from goods. |
| ● | Able to identify characteristics and nature of services. |
| ● | Comprehend ways to design services and evaluate them using service qualities. |
| ● | Understand how various methods can be used to operate and manage service businesses. |
| ● | Understand how innovation can be approached from services point of view. |

| Text Book (s): | |
|---|---|
| 1 | Fitzsimmons & Fitzsimmons, "Service Management: Operations, Strategy, Information Technology", McGraw Hill publications, 7th Edition, 2017. |
| 2 | Christopher H.Lovelock and JochenWirtz, "Services Marketing", Pearson Education, New Delhi, 7th Edition, 2011. |
| 3 | Richard Metters, Karthryn King-Metters, Madeleine pullman, Steve Walton, "Successful Service Operations Management", South-Western, Cengage Learning, 2nd Edition, 2008. |
| 4 | Cengiz Haksever, Barry Render, Roberta S Russell, Pobert G Mirdick, "Service Management and Operations", Pearson Education, 2nd Edition, 2000. |

| Reference Books(s) : | |
|---|---|
| 1 | Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D., " Services marketing: Integrating customer focus across the firm", McGraw Hill, 2012 |
| 2 | Lovelock, C,Services, " Marketing", Pearson Education India, 7th Edition ,2011. |
| 3 | Robert Johnson, Graham clark, "Service Operations Management", Pearson Education, 2nd Edition, 2005. |
| 4 | Reason, Ben, and Lovlie, Lavrans, "Service Design for Business: A Practical Guide to Optimizing the Customer Experience", Pan Macmillan India, 2016. |
| 5 | Chesbrough, H, "Open Services Innovation: Rethinking Your Business To Grow and Compete in a New Era". John Wiley & Sons, 2010. |


## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19802.1** | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 3 | 2 | - | 1 | 2 |
| **BA19802.2** | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | - | 1 | 2 |
| **BA19802.3** | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | - | 1 | 2 |
| **BA19802.4** | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | - | 1 | 2 |
| **BA19802.5** | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | - | 1 | 2 |
| **Average** | 1 | 1 | 1.2 | 1.2 | 1.6 | 1.2 | 1.2 | 1 | 1 | 1 | 2.2 | 1.8 | - | 1 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19841 | IT PROJECT MANAGEMENT | PC | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Gain knowledge on fundamental concepts of project and project scheduling. |
| ● | Understand Project Cost Control, Scheduling and Management Features. |
| ● | Obtain knowledge on Agile Project Management. |
| ● | Know about the Scrum framework in detail. |
| ● | Obtain knowledge on DevOps and its related concepts. |

| UNIT-I | PROJECT OVERVIEW AND PROJECT SCHEDULING | 9 |
|---|---|---|
| Project Overview and Feasibility Studies: Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal- Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity. | | |
| **UNIT-II** | **COST CONTROL, SCHEDULING AND MANAGEMENT FEATURES** | **9** |
| Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling - Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination. | | |
| **UNIT-III** | **AGILE PROJECT MANAGEMENT** | **9** |
| Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal. | | |
| **UNIT-IV** | **SCRUM** | **9** |
| Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study. | | |
| **UNIT-V** | **DEVOPS** | **9** |
| DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | | |
|---|---|---|---|---|
| A mini-project to be identified in the given domain (Crowd Source System, Day Book, Smart Transport System, Resume Builder, E-Commerce, Expert System, Puzzle Corner) to apply the IT Project Management Principles. | | | | |
| 1 | Estimation of project cost and control activity using open-source tools. | | | |
| 2 | Scheduling of project with PERT and CPM techniques to estimate the completion time. | | | |
| 3 | Assessment of IT Project Risk Analysis using open-source tools. | | | |
| 4 | Perform IT Project Audit and generate a report using open-source tools. | | | |
| 5 | Study of Agile project management tools. | | | |
| 6 | Application of Scrum practices in the project. | | | |
| 7 | Design and perform automated testing. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Learn to effectively plan, and schedule projects within time and cost targets. |
| ● | Have Knowledge in Cost Control, Scheduling and Management Features. |
| ● | Be aware of different Agile Project Methodologies. |
| ● | Know in detail about Scrum. |
| ● | Obtain good knowledge in DevOps. |

| **Text Book (s):** | |
|---|---|
| 1 | Mike Cohn, "Succeeding with Agile: Software Development Using Scrum", Addison-Wesley Professional Publisher, 1st Edition, 2009. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Roman Pichler, "Agile Product Management with Scrum", Addison-Wesley publisher, 1st Edition, 2010. |
| 2 | Ken Schwaber, "Agile Project Management with Scrum (Microsoft Professional)", Microsoft Press US publisher, 1st Edition, 2004. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19841.1** | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 1 | 2 | 0 |
| **CB19841.2** | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 2 |
| **CB19841.3** | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| **CB19841.4** | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| **CB19841.5** | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| **Average** | 1.2 | 1.8 | 2 | 1.8 | 2.2 | 1.6 | 1.6 | 1.6 | 3 | 2.8 | 1.8 | 0.8 | 2 | 2 | 1.6 |

Correlation levels 1, 2 or 3 are as defined below:

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

(High) Nocorrelation: "-"

# PROFESSIONAL ELECTIVES

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P41 | CONVERSATIONAL SYSTEMS | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To be familiar with the basic knowledge about conversational systems. |
| ● | To understand the different techniques of natural language processing |
| ● | To learn the working knowledge of a chatbot and the prerequisite knowledge. |
| ● | Study the fundamental role of machine learning in building conversational systems. |
| ● | To know the various applications of conversational systems and its future developments. |

| UNIT-I | FUNDAMENTALS OF CONVERSATIONAL SYSTEMS | 9 |
|---|---|---|
| Overview, Explanation about different modes of engagement for a human being, History and impact of AI - Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, Natural Language Generation, Speech-To-Text, Text-To-Speech, Computer Vision. Introduction to Top players in Current Market – Messaging Platforms. Ethical and Legal Considerations in AI Overview. | | |
| **UNIT-II** | **NATURAL LANGUAGE PROCESSING** | **9** |
| Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chatbots. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfilment. Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis. | | |
| **UNIT-III** | **BUILDING A CHATBOT/CONVERSATIONAL AI SYSTEMS** | **9** |
| Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation - UX design, APIs and SDKs, Usage of Conversational Design Tools - Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot - Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps - Overview of CE Testing techniques, A/B Testing, Introduction to Testing Frameworks - Botium /Mocha ,Chai Security & Compliance – Data Management, Storage, GDPR, PCI. | | |
| **UNIT-IV** | **ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES** | **9** |
| Understanding on how conversational systems uses ML technologies in ASR, NLP - Advanced Dialog management - Language Translation - Emotion/Sentiment Analysis - Information extraction to effectively converse. | | |
| **UNIT-V** | **CONVERSATIONAL ANALYTICS AND THE FUTURE OF COVERSATIONAL SYSTEMS** | **9** |
| Introduction to contact centers – Impact & Terminologies - Case studies & Trends, How does a Virtual Agent/Assistant fit in here? - Conversation Analytics: The need of it. Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - What to expect next? – Future technologies and market innovations overview. | | |
| | **Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | A python program to identify morphological features of a word by analysing it. |
| 2 | A python program to generate word forms from root and suffix information. |
| 3 | A python program to perform morphological analysis of a word by the use of Add-Delete table. |
| 4 | A python program to calculate the bigrams from a given corpus and calculate probability of a sentence. |
| 5 | A python program to do sentiment analysis for the given dataset and to classify sentences based on their categories. |

| | | | | |
|---|---|---|---|---|
| 6 | A python program to find Parts – Of - Speech tags of words in a sentence. | | | |
| 7 | A python program to know the importance of context and size of training corpus in learning Parts of Speech and understand the concept of chunking and get familiar with the basic chunk tagset. | | | |
| 8 | A python program to detect the entities from the dataset and tag them based on their categories. | | | |
| 9 | A python program to build a Neural Network to recognize handwritten digits using MNIST dataset. | | | |
| 10 | A python program to build a Recurrent Neural Model with Keras. | | | |
| 11 | Formulate a problem statement for mini-project to build a chatbot for an application that proves its importance from a social perspective. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Will be familiar with the basic technologies required for building a conversational system. |
| ● | Will be familiar with the NLTK tool kit and the pre-processing techniques of natural language processing. |
| ● | Build a chatbot for any application and deploy it. |
| ● | Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour. |
| ● | Will be able build a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies. |

| **Reference Books** | |
|---|---|
| **1** | Michael McTear, "Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots", Second Edition, Moran and Claypool Publishers, 2020. |
| **2** | Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences", O'REILLY, 2016. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P41.01** | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2.2 | 1 | 2 | 1 | 1 |
| **CB19P41.02** | 2 | 2 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| **CB19P41.03** | 3 | 3 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 2 | 3 | 2 |
| **CB19P41.04** | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 |
| **CB19P41.05** | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 3 |
| **Average Mapping** | 2.4 | 2.4 | 1.0 | 2.0 | 2.4 | 0.6 | 1.2 | 0.8 | 0.2 | 0.0 | 2.0 | 1.8 | 2.0 | 2.0 | 2.0 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name ( Lab Oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P42 | CLOUD, MICROSERVICES & APPLICATION | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To know basic components and fundamentals of cloud computing. |
| ● | To develop an application using various services in cloud. |
| ● | Understand how to design the web application development in cloud. |
| ● | To learn the basic and important concepts of python to implement in an application. |
| ● | Understand the issues and solutions for cloud security and cloud monitoring. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Cloud Fundamentals-Cloud Service Components-Cloud Service, Deployment Models-Cloud components-Guiding principle with respect to utilization, Security, Pricing- Application of Cloud Computing. Case Study: Design and Implementation of Public and Private Cloud Environments – Open Stack and AWS. | | |
| **UNIT-II** | **CLOUD BASED APPLICATIONS DEVELOPMENT** | **9** |
| Application Architectures-Monolithic & Distributed, Microservice Fundamental and Design Approach-Cloud Native Applications-12 Factors App-Application Integration Process and APIfication Process- API Fundamental-Microservice and API Management- Spring Boot Fundamental and Design of Microservice - API Tools - Developer Portal-Applications of Microservice and APIfication. | | |
| **UNIT-III** | **WEB DEVELOPMENT TECHNIQUES** | **9** |
| Devops fundamentals - Devops Role and Responsibility-Tools and Applications- Containerization Process and Application-Evolution of APP Deployment- Docker Fundamentals - Docker Architecture- Docker Commands. Case study Orchestration, Kubernetes, Docker Container. | | |
| **UNIT-IV** | **CLOUD SECURITY AND MONITORING TOOL** | **9** |
| Cloud Security-Cloud Security Shared Responsibility Architecture-Security By Design Principles-Identity And Access Management-Cloud Security Layers Illustration-Cloud Network, Host And Data Security Concepts-Security Operations and Major Cloud Service Provider Tools-Security Compliance and Regulations-Cloud Monitoring-Benefits of Cloud Monitoring-Overview of Cloud Monitoring Tools. | | |
| **UNIT-V** | **BUILDING AN APPLICATION USING PYTHON** | **9** |
| Developing and Deploying an Application in the Cloud- Building a python project based on Design-Development-Testing-Deployment of an application in the cloud using a development framework and deployment platform.<br>Case Study: Python Use case and Python Framework. | | |
| | **Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | Find procedure to run the virtual machine of different configuration using virtual-manager. |
| 2 | Virtualize a machine and check how many virtual machines can be utilized at a particular time. |
| 3 | Create a VM Clone and attach virtual block to the cloned virtual machine and check whether it holds the data even after the release of the virtual machine. |
| 4 | Create a Snapshot of a VM at a given point in time and test the snapshot by restoring the VM to that time. (Note: Testing can be done by installing an application and then restore it.) |
| 5 | Develop a simple application to understand the concept of PAAS using GAE/Amazon Elastic Beanstalk/IBM Blue Mix and launch it. |
| 6 | Test how a SaaS applications scales in response to demand. |
| 7 | Find the procedure to launch a Cloud instance using a Public IaaS cloud like AWS/GCP. |
| 8 | Setup a Private Cloud by performing the procedure using a Single node OPENSTACK implementation. |
| 9 | Find the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure). |
| 10 | Find the procedure to develop a DevSecOps – Cluster (Kubernetes). |
| 11 | Find the procedure to develop a Container (Docker). |
| 12 | To Build and Test Your Docker Images in the Cloud with Docker commands. |

| | | | | |
|---|---|---|---|---|
| 13 | Perform the installation steps and configure Google App Engine. | | | |
| 14 | Find the Procedure to develop a SalesForce application in cloud. | | | |
| 15 | Create an Application in SalesForce.com using Apex programming Language. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Demonstrate the main concepts of cloud, its characteristics, advantages, key technologies and its various delivery and deployment models. |
| ● | Develop and design an application using various tools in cloud environment. |
| ● | Acquire the basic and important design concepts and issues of web application development techniques in cloud. |
| ● | Structure simple python program for developing an application in cloud. |
| ● | Analyze the issue of cloud such as security, energy efficiency and interoperability, and provide an insight into future prospects of computing in the cloud monitoring. |

| **Text Books** | |
|---|---|
| **1** | Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", Prentice Hall, 2013. |
| **2** | Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press, 2012. |
| **3** | Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012. |
| **4** | Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011. |

| **Reference Books** | |
|---|---|
| **1** | Michael J. Kavis "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", 1st Edition, Wiley, 2014. |
| **2** | https://www.techrepublic.com/blog/the enterprise cloud/mini glossary cloud computing terms you should know/ |
| **3** | Azure Virtual Machines https://docs.microsoft.com/en us/azure/virtual machines/ |
| **4** | Google App Engine https://cloud.google.com/appengine#all features |
| **5** | Google Kubernetes Engine https://cloud.google.com/kubernetes engine#all features |
| **6** | Docker Tutorial : https://docker curriculum.com |
| **7** | Google Cloud Infrastructure security setup overview: https://cloud.google.com/security/infrastructure/design |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P42.01** | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | - | 3 | 1 | 3 | 3 | 3 | 2 |
| **CB19P42.02** | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 2 |
| **CB19P42.03** | - | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| **CB19P42.04** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| **CB19P42.05** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| **Average Mapping** | 2 | 2.2 | 3 | 3 | 3 | 2 | 1.2 | 2 | 1.6 | 2.6 | 2 | 2.4 | 3 | 2.8 | 2 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P43 | MACHINE LEARNING | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Have a thorough understanding of the existing machine learning techniques. |
| ● | Know the basic concepts of supervised learning techniques. |
| ● | Study the working of neural networks and similar models. |
| ● | Familiarize with unsupervised learning algorithms. |
| ● | Understand the concepts of mining and applications based on it. |

| UNIT-I | INTRODUCTION TO MACHINE LEARNING | 9 |
|---|---|---|
| Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML. | | |
| **UNIT-II** | **SUPERVISED LEARNING ALGORITHMS** | **9** |
| Model evaluation (precision, recall, F1-mesure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces; Bayesian networks; Decision Tree and Random Forests; k-Nearest neighbour classification; Support Vector Machines; Regression: Multi-variable regression; Least squares regression. | | |
| **UNIT-III** | **CLASSIFICATION AND TEMPORAL MODELS** | **9** |
| Artificial neural networks including backpropagation; Applications of classifications; Ensembles of classifiers including bagging and boosting. Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression. Naive Bayes classification, - Hidden Markov Models (HMM) with forward-backward and Viterbi algorithms; Sequence classification using HMM; Conditional random fields. | | |
| **UNIT-IV** | **UNSUPERVISED LEARNING ALGORITHMS** | **9** |
| Clustering: Average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbours clustering; BIRCH; CURE; DBSCAN. | | |
| **UNIT-V** | **INFORMATION MINING** | **9** |
| Association rule mining algorithms including apriori - Expectation-Maximization (EM) Algorithm for unsupervised learning anomaly and outlier detection methods. Applications of sequence classification such as part-of-speech tagging. | | |
| | **Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | 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. |
| 2 | 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. A python program to implement decision tree |
| 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. |
| 4 | 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 Python ML libraries. |
| 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 support vector Classifier model to perform this task. Python can be used to write the program. Calculate the accuracy, precision, and recall for your data set. |
| 7 | Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML libraries can be used for this problem. |
| 8 | Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. |
| 9 | Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. |
| 10 | 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 Python ML API in the program. |

| | | | | |
|---|---|---|---|---|
| 11 | Implementation of a mini project – Stock prices predictor/ Sports predictor/ Sentiment analyzer/ Healthcare predictor. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Distinguish between, supervised, unsupervised and semi-supervised learning. |
| ● | Modify existing machine learning algorithms to improve classification efficiency. |
| ● | Build a basic neural network for real-time data. |
| ● | Use unsupervised models for clustering data. |
| ● | Design a system that uses the information mining models of machine learning. |

| **Reference Books** | |
|---|---|
| **1** | R.O. Duda, P.E. Hart, D.G. Stork, "Pattern Classification", Second Edition, Wiley, 2001. |
| **2** | C. Bishop,"Pattern Recognition and Machine Learning", Springer, 2007. |
| **3** | E. Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice-Hall, 2014. |
| **4** | A. Rostamizadeh, A. Talwalkar, M. Mohri, "Foundations of Machine Learning", MIT Press. |
| **5** | A. Webb, "Statistical Pattern Recognition", Third Edition, Wiley, 2011. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CB19P43.01 | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2.2 | 1 | 2 | 1 | 1 |
| CB19P43.02 | 2 | 2 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| CB19P43.03 | 3 | 3 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 2 | 3 | 2 |
| CB19P43.04 | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 |
| CB19P43.05 | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 3 |
| **Average Mapping** | 2.4 | 2.4 | 1.0 | 2.0 | 2.4 | 0.6 | 1.2 | 0.8 | 0.2 | 0.0 | 2.0 | 1.8 | 2.0 | 2.0 | 2.0 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name (Lab Oriented Theory course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P44 | Robotics and Embedded Systems | PE | 3 | 0 | 2 | 4 |

| Objectives: |
|---|
| • To understand the concept of Industry 4.0 and technologies for cognitive robotics |
| • To understand the fundamentals of robotics operating systems |
| • To understand the role of AI in cognitive robotics |
| • To understand and demonstrate the role of Data Science and their working principles in robotics |
| • To demonstrate the concepts of cloud computing with robot on various real time applications |

| UNIT-I | INTRODUCTION TO MODERN DAY ROBOTICS AND THEIR INDUSTRIAL APPLICATIONS | 9 |
|---|---|---|

Industry 4.0 Concept: Background and Overview-Industry 4.0 technologies: implementation patterns in manufacturing companies-Evolution of Industrial Robots and their Applications-Advancements in Robotics and Its Future Uses-Types of robotics in various fields for applications

**Technologies essential for Cognitive Robotics:** Computer systems and Technologies relevant to modern day robotics-Robotic Process Automation: Overview of RPA and its applications-RPA, AI, and Cognitive Technologies for Leaders-Introduction to Robotics: Analysis, Control, Applications

| UNIT-II | BASICS OF ROBOTIC OPERATING SYSTEM | 9 |
|---|---|---|

**Basics of Robotic operating System:** ROS for beginners an overview- Introduction to the Robot Operating System (ROS) Middleware - Secure communication for the Robot Operating System - An Introduction to Robot Operating System: The Ultimate Robot Application Framework by Adnan

Quality of Service and Cybersecurity Communication Protocols -Analysis for the Robot Operating System

Robotics systems communication- Threat modelling using ROS

**Towards cloud robotic system:** A case study of online co-localization for fair resource competence-A Case Study on Model-Based Development of Robotic Systems using Monti Arc with Embedded Automata

| UNIT-III | AI IN THE CONTEXT OF COGNITIVE ROBOTICS AND ROLE OF AI IN ROBOTICS | 9 |
|---|---|---|

Foundation for Advanced Robotics and AI- A Concept for a Practical Robot Design Process- Demo to train A Robot Using AI - Deep learning core applications-Deep learning business applications

**Introduction to computer vision and application of Vision Systems in Robotics:** Concepts of computer vision and the how vision systems are becoming essential part of Robotics-Computer Vision: Models, Learning, and Inference - Mastering Computer Vision with TensorFlow 2.x: Build advanced computer vision applications using machine learning and deep learning techniques- Machine Vision Applications- Application areas for vision systems-Robot inspection case study-Autonomous driving using 3D imaging case study.

| UNIT-IV | DATA SCIENCE AND BIG DATA IN THE CONTEXT OF COGNITIVE ROBOTICS | 9 |
|---|---|---|

**Cognitive Technologies:** The Next Step Up for Data and Analytics in robotics-Cognitive Deep Learning Technology for Big Data Cognitive Assistant Robots for Reducing Variability in Industrial Human-Robot Activities

**Introduction to Python and R Programming in the context of Robotics:** Introduction to Python - Python Functions for Data Science-Basic ROS Learning Python for robotics- An introduction to R -The R in Robotics rosR: A New Language Extension for the Robot Operating System

**Artificial Intelligence and Robotics** - The Review of Reliability Factors Related to Industrial Robots -Failure analysis of mature robots in automated production- Data Analytics for Predictive Maintenance of Industrial Robots - Failure Is an Option: How the Severity of Robot Errors Affects Human-Robot Interaction

| UNIT-V | CONCEPTS OF CLOUD COMPUTING, CLOUD PLATFORMS AND IT APPLICATIONS IN ROBOTICS | 9 |
|---|---|---|

**Learning Cloud Computing:** Core Concepts - Cloud Computing: Private Cloud Platforms -Robot as a Service in Cloud Computing -Cloud Computing Technology and Its Application in Robot Control - A Comprehensive Survey of Recent Trends in Cloud

**Robotics Architectures and Applications** - Google's cloud robotics and high computing needs of industrial automation and systems-The role of cloud and opensource software in the future of robotics-The Power of Cloud Robotics by Robotics Industry Association

| | Contact Hours | : | 45 |
|---|---|---|---|

| List of Experiments | | | | |
|---|---|---|---|---|
| | | | | |
| **1** | Build a Self-Driving Robot that can automatically follow a line | | | |
| **2** | Build a basic obstacle-avoiding robot and improve the design to help it avoid getting stuck | | | |
| **3** | Build a Humanoid Robot | | | |
| **4** | Autonomous Robot Navigation using Computer Vision for exhaustive path-finding | | | |
| **5** | A Mobile Autonomous Chemical Detecting Robot | | | |
| **6** | Build a voice controlled robot | | | |
| **7** | Web-Controlled Mobile Video-Enabled Robotic Litter Collection Device | | | |
| **8** | Utilizing Artificial Neural Networks to Create a Learning Robot | | | |
| **9** | Hospital Sanitizing Robot | | | |
| **10** | Autonomous Robotic Vehicle: Saving lives, preventing accidents one at a time | | | |
| **11** | Build a robot with Python and 3D Printed Robotic Arm | | | |
| **12** | Build an Intelligent Irrigation Control System | | | |
| **13** | AI-powered Hearing Aid | | | |
| **14** | Fire Extinguishing Robot | | | |
| **15** | Remote Operated Spy Robot Circuit | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** | |
|---|---|
| • | Develop skills of using advanced software for solving practical problems in robotics pertaining to various industries |
| • | Understand the basics of Robotic operating systems and communication system |
| • | Understand basic concepts and technological advancements in AI and robotics |
| • | Understand and apply several statistical analysis techniques, business analytics for cognitive robotics and programming of robots using python and R languages |
| • | Understand and apply the cloud computing concepts in robotics |

| **Text Book (s):** | |
|---|---|
| **1** | Saeed Benjamin Niku, “Introduction to Robotics: Analysis, Control, Applications”, Wiley Publishers, 2nd edition, 2011. |
| **2** | Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012. |
| **3** | Francis X. Govers,” Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques”, Packt publishing, 2018. |

| **Reference Books(s) / Web links:** | |
|---|---|
| **1** | Krishnendu Kar, “Mastering Computer Vision with TensorFlow 2.x: Build Advanced Computer Vision Applications Using Machine Learning and Deep Learning Techniques”, Packt publishing, 2020. |
| **2** | Armando Vieira, Bernardete Ribeiro,” Introduction to Deep Learning Business Applications for Developers from Conversational Bots in Customer Service to Medical Image processing”,Apress, 2018. |
| **3** | Steve Heath, "Embedded System Design 2nd Edition", EDN Series for Design Engineers, 2003 |

**CO - PO – PSO matrices of course**

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P44.1** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |
| **CB19P44.2** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| **CB19P44.3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| **CB19P44.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CB19P44.5** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **Average** | 3 | 2.8 | 2.8 | 2.6 | 2.8 | 2.8 | 2.4 | 2.4 | 2.4 | 2.4 | 2.8 | 2.8 | 2.2 | 3 | 2.8 |

Note: Enter correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
If there is no correlation, put "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P45 | MODERN WEB APPLICATIONS | PE | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand different internet technologies. |
| ● | Know the importance of object oriented aspects of scripting. |
| ● | Understand creating database connectivity using PHP and MySQL. |

| | | |
|---|---|---|
| **UNIT-I** | **INTRODUCTION TO INTERNET & WORLD WIDE WEB** | **9** |
| History of the Internet & World- Wide Web, Web Browsers, Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Categories of Web Applications, Characteristics of Web Applications, Tiered Architecture. | | |
| **UNIT-II** | **HYPERTEXT MARKUP LANGUAGE (HTML) AND CASCADING STYLE SHEETS (CSS)** | **9** |
| HTML: Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements.<br>CSS: Inline, Internal and External Style Sheet, Bootstrap-CSS Text, CSS forms, CSS components drop down. | | |
| **UNIT-III** | **JAVASCRIPT AND EXTENSIBLE MARKUP LANGUAGE(XML)** | **9** |
| **JavaScript:** Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script, Bootstrap- JS Alert, JS Button, JS popover.<br>**XML:** Introduction, Structuring Data, Document Type Definition, XML Vocabularies, Document Object Model (DOM) with JavaScript, Extensible Stylesheet Language Transforms (XSL). | | |
| **UNIT-IV** | **PHP BASICS** | **9** |
| **Writing Basic PHP Programs:** Creating PHP Programs, Numbers and Strings, Literals and Variables, Operators and Functions.<br>**Form & PHP:** Creating Form Controls, Using Values Returned From, Forms Using PHP | | |
| **UNIT-V** | **PHP DATABASE CONNECTIVITY** | **9** |
| **PHP Database Connectivity:** Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection.<br>**Manipulating Data in MySQL Using PHP:** Inserting, Viewing, Updating and Deleting Records, Manipulating joined tables.<br>**User Authentication:** Creating Session, Authorization Level. | | |
| | **Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| **1** | Create a HTML page with frames, links, tables and other tags for highlighting the facilities in the Department in your College. State the assumptions you make (business logic you are taking into consideration). |
| **2** | Create a web page with the following using HTML:<br>a. To embed a map in a web page.<br>b. To fix the hot spots in that map.<br>c. Show all the related information when the hot spots are clicked.<br>Embed an image map picture (India map) on a Web page that provides different links to other Web pages (different states) and show the all the related information depending on where a user clicks on the image.<br>Create a webpage to embed a human body image, identify and display all the related information about the human body parts (head, eye, nose, finger etc.) based on the user clicks on the human body image map. |
| **3** | Create a web page with the following:<br>a. Cascading style sheets.<br>b. Embedded style sheets.<br>c. Inline style sheets.<br>d. Use your college information for the web pages. |

| | |
|---|---|
| | |
| **4** | Create a User Registration form with First Name, Last name, Address, City, State, Country, Pincode, Username and Password fields for a General login webpage and satisfy the following criteria:<br>a. Create a validate() function that does the following:<br>b. Checks that the First Name, Last Name, City, Country, Username, and Password fields are filled out.<br>c. Checks that the Pincode is exactly 6 numeric.<br>d. Checks that the state is exactly two characters.<br>e. Checks that the email is a valid email address.<br>• false if email has fewer than 6 characters<br>• false if email does not contain an @ symbol<br>• false if email does not contain a period (.)<br>• true otherwise |
| **5** | Write a DTD for a XML document that declares an address book containing contacts. Each contact has a name and address. An address should contain attributes for street name, state and phone number. Write a XML document and validate it against this DTD. |
| **6** | Create and save a XML document at the server, which contains 10 users information. Write a Program, which takes user Id as an input and returns the user details by taking the user information from the XML document. |
| **7** | Create a XML to represent the BOOKS catalog that has the following elements (TITLE, ISBN NO, AUTHOR, PUBLISHER, and PRICE). Display the book details styled with XSLT. |
| **8** | Create an Extensible markup language to represent the students mark information of a class. Create a webpage to display all the students consolidated mark statement with pass (green color) or fail (red color) using XSLT. |
| **9** | Write programs in PHP to create three-tier applications:<br>a. for conducting on-line examination.<br>b. for displaying student mark list. Assume that student information is available in a database which has been stored in a database server. |
| **10** | Session tracking using hidden form fields and Session tracking for a hit count. |
| **11** | Convert the static webpages of programs 1 to 4 into dynamic web pages using PHP and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml. |
| **12** | Write a PHP program for Employee Details which includes EmpID, Name, Designation, Salary, DOJ, etc., to connect with the database and execute queries to retrieve and update data. Prepare the report for single and group of employees based on the end user needs. |
| **13** | Consider a Library Management System. Develop a JavaScript program that will validate the controls in the forms you have created for the application. State the assumptions you make (business logic you are taking into consideration). Note: Your application must access a database using PHP. |

| | | | |
|---|---|---|---|
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:**<br>On completion of the course, the students will be able to | |
|---|---|
| • | Construct a basic website using HTML and Cascading Style Sheets. |
| • | Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms. |
| • | Construct simple web pages in PHP and to represent data in XML format. |
| • | Design and implement server side programs using PHP. |
| • | Do database manipulation using MySQL and authenticate data. |

| Text Books: | |
|---|---|
| **1** | Deitel P. J., Deitel H. M. and Deitel A., "Internet and World Wide Web: How to Program", Fifth Edition, Pearson Prentice Hall, 2012. |
| **2** | Jon Duckett, "HTML & CSS: Design and Build Websites", First Edition, John Wiley & Sons, 2011. |
| **3** | Naramore E., Gerner J., Scouarnec Y.L., et al., "Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer", John Wiley & Sons Inc., 2005. |

| Reference Books | |
|---|---|
| **1** | Sebesta R. W.," Programming the World Wide Web", Eight Edition, Pearson, 2014. |
| **2** | Pressman R. and Lowe D.," Web Engineering: a practitioner's approach", First Edition, Mc GrawHill, 2008. |
| **3** | Kappel G., et al.," Web Engineering: The Discipline of systematic Development of Web Applications", First Edition, John Wiley & Sons, 2006. |
| **4** | Suh W., "Web Engineering: Principles and Techniques", Idea Group Inc., 2005. |
| **5** | Ullman L ," PHP for the Web: Visual Quick Start Guide", Fifth Edition, Peach pit Press, 2016. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P45.01** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | - | 1 | 3 | 3 | 3 | 1 |
| **CB19P45.02** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 1 | 1 | 3 | 3 | 1 |
| **CB19P45.03** | 3 | 3 | 3 | 3 | 3 | - | - | 2 | 2 | - | 2 | 2 | 3 | 3 | 1 |
| **CB19P45.04** | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | 2 | 3 | 3 | 3 | 1 |
| **CB19P45.05** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | 3 | 3 | 3 | 3 | 1 |
| **Average Mapping** | **3** | **3** | **3** | **3** | **3** | **1.8** | **1** | **1.2** | **1.4** | **0.4** | **1.8** | **2.1** | **3** | **3** | 1 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

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

If there is no correlation, put "-"

| Subject Code | Subject Name ( Lab oriented Theory Course) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P46 | DATA MINING AND ANALYTICS | PE | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To introduce the fundamental concepts of data mining and data representation. |
| ● | To learn the data preprocessing task and attribute oriented analysis |
| ● | To understand the association rules, classification and prediction algorithms |
| ● | To learn and apply the linear and non-linear models of data analysis |
| ● | To understand the time series analysis and aspects of prescriptive analysis |

| UNIT-I | INTRODUCTION AND KNOWLEDGE REPRESENTATION | 9 |
|---|---|---|
| Introduction - Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques, Applications. | | |
| **UNIT-II** | **DATA PREPROCESSING** | **9** |
| **Data preprocessing**: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. **Attribute-oriented analysis:** Attribute generalization, Attribute relevance, Class comparison, Statistical measures | | |
| **UNIT-III** | **ASSOCIATION AND MINING METHODS** | **9** |
| Association rules: Motivation and terminology, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules. Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models. | | |
| **UNIT-IV** | **LINEAR AND NON-LINEAR MODELS** | **9** |
| **Descriptive analytics:** Data Modeling, Trend Analysis, Simple Linear Regression Analysis<br>**Forecasting models**: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models.<br>**Generalized Linear model**: Link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.<br>**Non Linear Regression (NLS):** Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods.<br>Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods | | |
| **UNIT-V** | **TIME SERIES ANALYSIS** | **9** |
| **Time Series Analysis:** Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing.<br>**Linear time series models:** Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARIMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARIMA Processes, Forecasting using ARIMA models.<br>**Prescriptive Analytics**: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modeling, Decision and Risk analysis, Decision trees. | | |
| | **Contact Hours : 45** | |

| List of Experiments | | | | |
|---|---|---|---|---|
| 1 | Installing Weka and exploring a dataset. | | | |
| 2 | Loading a dataset and visualizing the Data | | | |
| 3 | Preprocessing a dataset from a real domain (Medical/Retail/Banking) | | | |
| 4 | Building a classifier- Run Decision Tree, Naïve Bayesian Classifier, NN classifier and SVM. | | | |
| 5 | Mining Association Rules- Run Apriori Algorithm. | | | |
| 6 | Building a statistical model using a sample dataset – preprocessing, hypothesis building, model fitting, model validation and interpretation of results. | | | |
| 7 | Implementation of linear regression technique for statistical model building. | | | |
| 8 | Implementation of Non-linear regression technique for statistical model building. | | | |
| | | **Contact Hours** | **:** | **30** |
| | | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** | |
|---|---|
| On completion of the course, the students will be able to | |
| ● | Understand the fundamentals of data mining and data representation. |
| ● | Perform preprocessing tasks for the data set. |
| ● | Apply association rules and predictive methods for data mining. |
| ● | Build data models using linear and non-linear regression techniques. |
| ● | Gain knowledge on time series analysis and prescriptive analysis. |

| **Text Books:** | |
|---|---|
| **1** | Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012. |
| **2** | Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010. |
| **3** | Ian H. Witten, Eibe Frank and Mark A. Hall "Data Mining: Practical Machine Learning Tools and Techniques", Fourth Edition, Elsevier, 2017. |

| **Reference Books** | |
|---|---|
| **1** | Draper, N. R. and Smith, H., "Applied Regression Analysis", Third Edition, John Wiley, 1998. |
| **2** | Hosmer, D. W. and Lemeshow, S., "Applied Logistic Regression", Third Edition, Wiley, 2003. |
| **3** | Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006. |
| **4** | Jason Brownlee "Machine Learning Mastery with Weka" ,2020. |
| **5** | http://garfield.library.upenn.edu/classics1989/A1989AV48500001.pdf |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P46.01** | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2.2 | 1 | 2 | 1 | 1 |
| **CB19P46.02** | 2 | 2 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| **CB19P46.03** | 3 | 3 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 2 | 3 | 2 |
| **CB19P46.04** | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 |
| **CB19P46.05** | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 3 |
| **Average Mapping** | 2.4 | 2.4 | 1.0 | 2.0 | 2.4 | 0.6 | 1.2 | 0.8 | 0.2 | 0.0 | 2.0 | 1.8 | 2.0 | 2.0 | 2.0 |

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation, put "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P47 | COGNITIVE SCIENCE AND ANALYTICS | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Introduction to cognitive science, psychology, nervous system and brain. |
| ● | Understand brain and sensory motor information, representation of sensory information. |
| ● | Analyze from sensation to cognition; Roots of cognitive science. |
| ● | Develop language and embodiment. |
| ● | Implement affordances in biological and artificial systems, cognitive development. |

| UNIT-I | INTRODUCTION TO THE STUDY OF COGNITIVE SCIENCES | 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 - Processing of sensory information in the brain. | | |
| **UNIT-II** | **COGNITIVE MODELS** | **9** |
| Brain Imaging - FMRI, MEG - PET, EEG - Multisensory integration in cortex - Information fusion - From sensation to cognition – Cybernetics - From physics to meaning, Analog vs. Digital: Code duality. | | |
| **UNIT-III** | **LINGUISTIC KNOWLEDGE** | **9** |
| Linguistic knowledge: Syntax, semantics, (and pragmatics) - Generative linguistic - Brain and language - Language disorders – Lateralization - The great past tense debate - Cognitivist and emergent stand points - A robotic perspective. | | |
| **UNIT-IV** | **AFFORDANCES** | **9** |
| Direct perception - Ecological Psychology - Affordance learning in robotics - Child and robotic development - Attention and related concepts - Human visual attention - Computational models of attention - Applications of computational models of attention. | | |
| **UNIT-V** | **CATEGORIES AND CONCEPTS** | **9** |
| Logic; Machine learning - 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 - Key points in social cognition - Context and social judgment; Schemas; Social signals. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | | |
|---|---|---|---|---|
| 1 | Overview and practice: Cognitive Science and its methodology concerns in philosophy. | | | |
| 2 | Experimental approach to processing sensory information in the brain using python. | | | |
| 3 | Perform stemming operation in python using NLTK | | | |
| 4 | Perform lemmatization in python using NLTK | | | |
| 5 | Perform parts of speech tagging in python using NLTK | | | |
| 6 | Writing and running Robot programs – Activity of PICK and Place of an object. | | | |
| 7 | Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. | | | |
| 8 | RNN NLU: Build a Recurrent Neural Network model using Microsoft Cognitive Tool Kit for spoken language understanding, mainly for intent detection and slot filling. | | | |
| 9 | LSTM Human Activity Recognition: Build a Recurrent Neural Network model using Python for Human Activity Recognition (HAR) using TensorFlow on smartphone sensors dataset and a LSTM RNN. | | | |
| 10 | NER-LSTM Build a Recurrent Neural Network model using Python for Named Entity Recognition. | | | |
| | **Contact Hours** | **:** | **30** | |
| | **Total Contact Hours** | **:** | **75** | |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Know introduction to cognitive science, psychology, nervous system and brain. |
| ● | Understand brain and sensory motor information, representation of sensory information. |
| ● | Analyse from sensation to cognition; Roots of Cognitive Science. |
| ● | Implement affordances in biological and artificial systems, cognitive development. |
| ● | Make attention, learning, memory, reasoning, social cognition. |

| **Text Book (s):** | |
|---|---|
| 1 | Pradeep Kumar Mallick, Samarjeet Borah," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2020. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P47.1** | 3 | 3 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2.2 | 1 | 2 | 1 | 1 |
| **CB19P47.2** | 2 | 2 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| **CB19P47.3** | 3 | 3 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 2 | 3 | 2 |
| **CB19P47.4** | 2 | 3 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 2 | 2 | 3 |
| **CB19P47.5** | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 0 | 3 | 3 | 3 | 3 | 3 |
| **Average** | 2.4 | 2.4 | 1.0 | 2.0 | 2.4 | 0.6 | 1.2 | 0.8 | 0.2 | 0.0 | 2.0 | 1.8 | 2.0 | 2.0 | 2.0 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P48 | FUNDAMENTALS OF IoT | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand about the fundamentals of Internet of Things and its building blocks along with their characteristics. |
| ● | To gain knowledge about IoT Architecture. |
| ● | To understand and learn about Sensors and industrial systems. |
| ● | To understand the other associated technologies like networking and communication in the domain of IoT. |
| ● | To understand the data processing and standards designed for IoT and the current research on it. |

| UNIT-I | INTRODUCTION TO IOT AND USE CASES | 9 |
|---|---|---|
| Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains. | | |
| **UNIT-II** | **ARCHITECTURE** | **9** |
| IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing. | | |
| **UNIT-III** | **SENSORS AND INDUSTRIAL SYSTEMS** | **9** |
| Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions. | | |
| **UNIT-IV** | **NETWORKING AND COMMUNICATION FOR IOT** | **9** |
| Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications - web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers). | | |
| **UNIT-V** | **IOT DATA PROCESSING AND STORAGE** | **9** |
| Time series data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | Setting up the Arduino development environment, connecting analog sensors to an Arduino board and reading analog sensor data. |
| 2 | Digital input and output reading using an Arduino board and Arduino development environment. |
| 3 | Integrate an Arduino board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi. |
| 4 | Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language. |
| 5 | Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images and video. |
| 6 | Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication. |
| 7 | Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol. |
| 8 | Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi via MQTT protocol. On receipt of the message, toggle the LED lights on the Arduino. |
| 9 | Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file. |
| 10 | Develop a mobile application to view the images captured by the R Pi camera. |
| | **Contact Hours : 30** |
| | **Total Contact Hours : 75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. |
| ● | Get an overview of an end to end IoT system encompassing the edge, cloud and application tiers. |
| ● | Build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own. |
| ● | Lead to building an IoT end-to-end application. |
| ● | Apply the concept to do research. |

| **Text Book (s):** | |
|---|---|
| 1 | Samuel Greengard, "The Internet of Things-Essential Knowledge Series", MIT Press, 1st Edition, 2015. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm |
| 2 | World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things |
| 3 | 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/ |
| 4 | Ben Fry, "Visualizing Data-Exploring and Explaining Data with the Processing Environment", O'Reilly Media, 2007. |
| 5 | Andrew K Dennis, "Raspberry Pi Computer Architecture Essentials", 2016. |
| 6 | M. Banzi, "Getting Started with Arduino", O Reilly Media. |
| 7 | GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/ |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P48.1** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| **CB19P48.2** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| **CB19P48.3** | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| **CB19P48.4** | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CB19P48.5** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| **Average** | 2.8 | 2 | 2.8 | 3 | 2.6 | 2.8 | 2.6 | 2 | 2.4 | 2.4 | 2.6 | 2.6 | 2.6 | 2.4 | 2.6 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P49 | CRYPTOLOGY | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To understand the Basics of Number Theory. |
| ● | To be able to secure a message over an insecure channel by various means. |
| ● | To use a variety of public key cryptosystems and authentication methods. |
| ● | To gain a better understanding of the different security applications. |
| ● | To acquire a deeper insight of quantum computing on cryptography and security. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems. Basic security services: confidentiality, integrity, availability, non-repudiation, privacy. | | |
| **UNIT-II** | **SYMMETRIC KEY CRYPTOSYSTEMS** | **10** |
| Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC; Block Ciphers: DES, AES and Modes of Operation. | | |
| **UNIT-III** | **PUBLIC KEY CRYPTOSYSTEM & AUTHENTICATION** | **8** |
| Public Key Cryptosystems: RSA, ECC; Digital signatures; Hash Functions; Authentication. | | |
| **UNIT-IV** | **SECURITY APPLICATIONS** | **9** |
| Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications. | | |
| **UNIT-V** | **QUANTUM CRYPTANALYSIS & POST-QUANTUM CRYPTOGRAPHY** | **9** |
| Quantum cryptography, quantum encryption, Issues related to Quantum Cryptanalysis. Post-Quantum Cryptography: Lattice-based cryptography : NTRU, Hash-based cryptography :SPHINCS, Multivariate cryptography: Rainbow. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | |
|---|---|
| 1 | Implement the following Substitution and Transposition Techniques:<br>a) Caesar Cipher<br>b) Playfair Cipher<br>c) Hill Cipher<br>d) Vigenere Cipher<br>e) Rail fence – row & Column Transformation<br>f) Affine Cipher |
| 2 | Implement the following algorithms<br>a) DES<br>b) RSA Algorithm<br>c) MD5<br>d) SHA-1 |
| 3 | Implement the Digital Signature Algorithm (DSA). |
| 4 | Implement Linux Privilege Escalation Checker. |
| 5 | Implement a Keylogger to record the keystrokes. |
| 6 | Set Up a honey pot and monitor the honeypot on network (Pentbox or Honeyd or any other equivalent s/w). |
| 7 | Demonstrate Intrusion Detection System using any tool (snort or any other equivalent s/w). |
| 8 | Demonstrate various exploits of Windows OS using Metasploit framework. |
| 9 | Install and Configure Firewalls for a variety of options (iptables or pfsense). |
| 10 | Demonstrate simple MITM attack (ettercap). |
| | **Contact Hours : 30** |
| | **Total Contact Hours : 75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Understand and apply the various concepts of basics of Number Theory. |
| ● | Secure a message over an insecure channel by numerous symmetric key cryptosystem. |
| ● | Apply diverse Public Key Cryptosystem & Authentication. |
| ● | Implement varied security applications. |
| ● | Understand the implications of quantum computing on cryptography and security. |

| **Text Book (s):** | |
|---|---|
| 1 | Douglas R. Stinson, "Cryptography, Theory and Practice", CRC Press, 3rd Edition, 2018. |
| 2 | A. Menezes, P. Van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC Press, 5th printing, 2001. |
| 3 | Stallings William, "Cryptography and Network Security - Principles and Practice", Pearson, Seventh Edition, 2017. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Neal Koblitz, "A course in number theory and cryptography", GTM, Springer. |
| 2 | Ross Anderson**, "S**ecurity Engineering", Wiley, 3rd Edition, 2020. |
| 3 | http://theory.caltech.edu/~preskill/ph229/ |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P49.**1 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | - | 1 | 2 |
| **CB19P49.**2 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | - | 1 | 1 | - | 1 | 2 |
| **CB19P49.**3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | - | 1 | 1 | - | 1 | 2 |
| **CB19P49.**4 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | - | 1 | 1 | - | 1 | 2 |
| **CB19P49.**5 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | - | 1 | 2 |
| **Average** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | 1 | 1 | - | 1 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P01 | QUANTUM COMPUTATION AND QUANTUM INFORMATION | PE | 3 | 1 | 0 | 4 |

| Objectives: | |
|---|---|
| ● | To learn about Quantum information. |
| ● | To gain knowledge about Quantum algorithms. |
| ● | To understand and learn about Quantum random number generators. |
| ● | To study the basis of Post-Quantum cryptography. |

| UNIT-I | INTRODUCTION TO QUANTUM INFORMATION | 12 |
|---|---|---|
| States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits. | | |
| **UNIT-II** | **QUANTUM ALGORITHMS** | **12** |
| Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems. | | |
| **UNIT-III** | **QUANTUM TRUE RANDOM NUMBER GENERATORS** | **12** |
| Detailed design and issues of quantumness, Commercial products and applications. | | |
| **UNIT-IV** | **QUANTUM KEY DISTRIBUTION** | **12** |
| BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products. | | |
| **UNIT-V** | **INTRODUCTORY TOPICS IN POST-QUANTUM CRYPTOGRAPHY** | **12** |
| API-Public-key Signatures, Key Encapsulation Mechanism (KEM), Digital Signature standard, Pair-Wise Key Establishment-Discrete Logarithm Cryptography, Integer Factorization Cryptography. | | |
| | **Total Contact Hours : 60** | |

| Course Outcomes: On completion of the course, the students will be able to | |
|---|---|
| ● | Apply quantum gates and circuits using quantum information. |
| ● | Apply quantum algorithms in cryptosystems. |
| ● | Understand the importance of Quantum random number generator. |
| ● | Understand the importance of Quantum key distribution. |
| ● | Apply the concept of post-quantum cryptography. |

| Text Book (s): | |
|---|---|
| 1 | M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Edition, 2010. |
| 2 | Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/ |

| Reference Books(s) : | |
|---|---|
| 1 | P. Kaye, R. Laflamme, and M. Mosca, "An Introduction to Quantum Computing". Oxford University Press, New York. |
| 2 | N. David Mermin, "Quantum Computer Science", Cambridge University Press. |
| 3 | Quantum Cryptography. D. Unruh:, Available online: https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/ |
| 4 | SAPV Tharrmashastha, D. Bera, A. Maitra and S. Maitra, "Quantum Algorithms for Cryptographically Significant Boolean Functions - An IBMQ Experience", Springer, 2020. |
| 5 | Quantum Algorithm Zoo. https://quantumalgorithmzoo.org/ |
| 6 | A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, "Handbook of Applied Cryptography", CRC Press. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P01.1** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | 2 | 2 | 3 | 3 | 1 |
| **CB19P01.2** | 3 | 3 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | 3 | 3 | 1 |
| **CB19P01.3** | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | 3 | 3 | 1 |
| **CB19P01.4** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | 1 | 1 | 3 | 3 | 1 |
| **CB19P01.5** | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | 1 | 1 | 3 | 3 | 1 |
| **Average** | 3.0 | 3.0 | 2.4 | 2.6 | 2.2 | 1.2 | - | - | - | - | 1.4 | 1.4 | 3.0 | 3.0 | 1.0 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P4A | MOBILE COMPUTING | PE | 2 | 1 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To learn about the mobile infrastructure, radio resource management, overview of generation 1G to 5G. |
| ● | To illustrate the location management involved in GSM, Mobile IP. |
| ● | To illustrate the transmission, transaction technology involved in mobile. |
| ● | To explore the wireless network in mobile. |
| ● | To discover the cognitive radio networks in mobile. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| Overview of wireless and mobile infrastructure, Preliminary concepts on cellular architecture, Design objectives and performance issues, Radio resource management and interface, Propagation and path loss models, Channel interference and frequency reuse, Cell splitting, Channel assignment strategies, Overview of generations:- 1G to 5G. | | |
| **UNIT-II** | **LOCATION AND HANDOFF MANAGEMENT** | **10** |
| Introduction to location management (HLR and VLR), Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based), Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model), Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based), Terminal Paging (Simultaneous paging, Sequential paging), Location management and Mobile IP, Overview of handoff process, Factors affecting handoffs and performance evaluation metrics, Handoff strategies, Different types of handoffs (soft, hard, horizontal, vertical). | | |
| **UNIT-III** | **WIRELESS TRANSMISSION FUNDAMENTALS** | **8** |
| Introduction to narrow and wideband systems, Spread spectrum, Frequency hopping, Introduction to MIMO, MIMO Channel Capacity and diversity gain, Introduction to OFDM, MIMO-OFDM system, Multiple access control (FDMA, TDMA, CDMA, SDMA), Wireless local area network, Wireless personal area network (Bluetooth and zigbee). | | |
| **UNIT-IV** | **WIRELESS NETWORK** | **9** |
| Mobile Ad-hoc networks - Characteristics and applications; Coverage and connectivity problems, Routing in MANETs, Wireless sensor networks - Concepts, basic architecture, design objectives and applications; Sensing and communication range, Coverage and connectivity, Sensor placement, Data relaying and aggregation, Energy consumption, Clustering of sensors, Energy efficient Routing (LEACH). | | |
| **UNIT-V** | **COGNITIVE RADIO NETWORKS** | **9** |
| Fixed and dynamic spectrum access, Direct and indirect spectrum sensing, Spectrum sharing, Interoperability and co-existence issues, Applications of cognitive radio networks, Introduction to D2D communications-High level requirements for 5G architecture, Introduction to the radio resource management, power control and mode selection problems, Millimeter wave communication in 5G. | | |
| | **Total Contact Hours** : | **45** |

| List of Experiments | | | |
|---|---|---|---|
| Design and Development of different wireless network protocols using network simulators such as NS-3/ OMNET++ | | | |
| 1. | MAC Protocol | | |
| 2. | Routing Protocol | | |
| 3. | Transport Protocol | | |
| 4. | Congestion Control Protocol | | |
| 5. | Application Protocol | | |
| 6. | Security Protocol | | |
| | **Contact Hours** | : | **30** |
| | **Total Contact Hours** | : | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Understand and apply the various concepts of Basics of Number Theory |
| ● | Secure a message over an insecure channel by numerous symmetric key cryptosystem |
| ● | Apply diverse Public Key Cryptosystem & Authentication |
| ● | Implement varied Security Applications |
| ● | Understand the implications of quantum computing on cryptography and security |

| **Text Book (s):** | |
|---|---|
| 1 | Jochen Schiller, "Mobile Communications", Second Edition, Pearson, 2004. |
| 2 | Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Theodore Rappaport, "Wireless Communications: Principles and Practice", Pearson Education, 2014. |
| 2 | Ezio Biglieri, MIMO, "Wireless Communications", Cambridge University Press, 2009. |
| 3 | Ivan Stojmenovic, "Handbook of Wireless Networking and Mobile Computin", Wiley, 2002. |
| 4 | James Cowling, "Dynamic Location Management in Heterogeneous Cellular Networks", 2004. |
| 5 | MIT Thesis. http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov 2004.pdf |
| 6 | Travis Keshav, Location Management in Wireless Cellular Networks. 2006. https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location.pdf. |
| 7 | Fahd A. Batayneh, Location Management in Wireless Data Networks. 2006 https://www.cse. wustl.edu/~jain/cse574-06/ftp/wireless_location.pdf. |
| 8 | Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, "Principles of Mobile Communication", Springer, 2017. |
| 9 | Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, "Principles of Cognitive Radio", Cambridge University Press, 2012. |
| 10 | Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, 2003. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P4A.**1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | - | 1 | 3 | 3 | 3 | 2 |
| **CB19P4A.**2 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | 1 | 1 | 3 | 3 | 2 |
| **CB19P4A.**3 | - | 2 | 3 | 3 | 3 | - | 2 | 2 | 2 | - | 2 | 2 | 3 | 2 | 3 |
| **CB19P4A.**4 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CB19P4A.**5 | 2 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | - | 3 | 3 | 3 | 3 | 3 |
| **Average** | 2 | 2.8 | 3 | 3 | 3 | 1.2 | 1 | 1.2 | 1.4 | 0.4 | 1.8 | 2.1 | 3 | 2.8 | 2.4 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No

correlation: "-

| Subject Code | Subject Name ( LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P4B | IMAGE PROCESSING AND PATTERN RECOGNITION | PE | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| • | To learn the fundamentals of image formation and formats. |
| • | To understand the intensity transformations and filtering techniques. |
| • | To acquire knowledge on image segmentation operations. |
| • | To learn the feature extraction and image registration process. |
| • | To understand the components of colour image processing. |

| UNIT-I | INTRODUCTION AND IMAGE FORMATION | 9 |
|---|---|---|
| **Introduction** - Image processing systems and its applications - Basic image file formats.<br>**Image formation:** Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics. | | |
| **UNIT-II** | **INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING** | **9** |
| Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG- Morphological Filtering Basics - Dilation and Erosion Operators, Top Hat Filters. | | |
| **UNIT-III** | **IMAGE SEGMENTATION** | **9** |
| Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform. | | |
| **UNIT-IV** | **FEATURE EXTRACTION AND IMAGE REGISTRATION** | **9** |
| Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties.<br>Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation. | | |
| **UNIT-V** | **COLOUR IMAGE PROCESSING** | **9** |
| Fundamentals of different Colour models - RGB, CMY, HSI, YCbCr, Lab; False Colour; Pseudo Colour; Enhancement. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| 1 | Write a program for Histogram Mapping and Equalization. | | |
| 2 | Write a program for Image Smoothening and Sharpening. | | |
| 3 | Write a program for Morphological Operations on Binary Images. | | |
| 4 | Write a program for Edge Detection using Sobel, Prewitt and Roberts Operators. | | |
| 5 | Write a program for Canny Edge Detector. | | |
| 6 | Write a program to calculate the GLCM of the given image. | | |
| 7 | Write a program to perform image registration of the given images. | | |
| 8 | Write a program to implement colour model conversion. | | |
| 9 | Write a program for pseudo-colour operation on the given image. | | |
| 10 | Write a program for Image Intensity slicing technique for image enhancement. | | |
| 11 | Write a program to analyze the given set of camera captured images and identify the nature of the image. | | |
| 12 | Write a program to detect the face from the given set of images and determine the type of animal. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Be familiar with the fundamentals of image formation and formats. |
| ● | Perform image transformation functions and filtering operations. |
| ● | Apply the segmentation techniques on the images. |
| ● | Extract the features of an image and perform image registration. |
| ● | Able to do colour image processing and conversion operations. |

| **Text Books** | |
|---|---|
| **1** | R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson, 4th Edition, 2018. |
| **2** | Maria Petrou and Panagiota Bosdogianni, "Image Processing: The Fundamentals", John Wiley & Sons, Ltd, 2nd Edition , 2010. |
| **3** | K. R. Castleman, "Digital Image Processing", Prentice Hall, Englewood Cliffs, 1st Edition, 1995. |

| **Reference Books** | |
|---|---|
| **1** | A. Blake and A. Zisserman, "Visual Reconstruction", MIT Press, Cambridge. https://doi.org/10.7551/mitpress/7132.001.0001 |
| **2** | A. N. Netravali and B. G. Haskell, "Digital Pictures", Plenum Press, 2nd Edition, 1995 |
| **3** | A. B. Watson, "Digital Images and Human Vision", MIT Press, Cambridge, 1993. |

## CO - PO – PSO matrices of course

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P4B.1** | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - | 1 | 2 | 2 | - |
| **CB19P4B.2** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | 1 | 3 | 3 | - |
| **CB19P4B.3** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | 1 | 3 | 3 | - |
| **CB19P4B.4** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | 1 | 3 | 3 | - |
| **CB19P4B.5** | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | 1 | 3 | 3 | - |
| **Average** | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 0.8 | 0.8 | 0.8 | - | - | - | 1 | 2.8 | 2.8 | - |

Note: Enter correlation levels 1, 2 or 3 as defined below:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| Subject Code | Subject Name ( LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P4C | ENTERPRISE SYSTEMS | PE | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | Understand the concept of Simple Web Applications using MVC. |
| ● | Be exposed to different models in SOA and ERP. |
| ● | Be exposed to CRM models. |
| ● | Be exposed to interactive networks and applications. |
| ● | Be familiar with configuration of networking. |

| UNIT-I | WEB APPLICATIONS USING MVC | 9 |
|---|---|---|
| Overview of Database Management Systems; Overview of Model - View - Control (MVC); Control (MVC) method of software development in a 3 tier environment - Tools and Technologies; Brief overview of the following : Java server pages; Related Java Technologies; Microsoft .NET framework; PHP; Ruby on Rails; JavaScript; Ajax; Angular/React JS. | | |
| **UNIT-II** | **SOA AND ERP MODELS** | **9** |
| Service Oriented Architecture (SOA); Principles of loose coupling, encapsulation; Inter-operatibility; Web Services as the implementation vehicle protocols, usage; Enterprise Resource Planning (ERP); systems and their architecture; Overview of SAP and Oracle Applications; Generic ERP Modules : Finance; HR; Materials Management; Investment, etc. ; Examples of Domain Specific Modules. | | |
| **UNIT-III** | **CRM MODELS** | **9** |
| Electronic Data Exchange; Customer Relationship Management (CRM); Customer Relationship Management (CRM); Supplier Relationship Management (SRM) ; Security Issues - Authentication, Authorisation, Access control ; Roles; single-sign-on ; Directory servers, Audit trails; Digital signatures; Encryption: review of IPSec, SSL and other technologies; Simple Applications Demo; Case study. | | |
| **UNIT-IV** | **INTERACTIVE NETWORK AND APPLICATION** | **9** |
| Overview of : MPLS ; Virtual Private Networks (VPN) ; Firewalls ; Network monitoring and enforcement of policies ; Software Acquisition Process ; Tendering; conditions of contract ; Commercial off the shelf software (COTS) versus Bespoke Implementations; Total cost of ownership; Issues on using Open source software or free software; Licensed software; Case study. | | |
| **UNIT-V** | **CONFIGURATION OF NETWORKING** | **9** |
| Hardware Architectures for Enterprise Systems; Servers; Clustering; Storage area networks; Storage units; Back-up strategies; Local Area Network (LAN) technologies and products; Data Centres; Disaster recovery site design and implementation issues; Hardware Acquisition Issues; Case study. | | |
| | **Total Contact Hours : 45** | |

| List of Experiments | | | |
|---|---|---|---|
| **1** | Create a Movie Database Application using MVC. | | |
| **2** | Creating an ASP.NET MVC Web Application Project. | | |
| **3** | Explore the client/server architecture of SAP. Learn how to use the user interface. | | |
| **4** | Create customer, material master data. Execute the sales process in SAP. | | |
| **5** | Create vendor, material master data for purchasing. Execute the Purchasing process in SAP. | | |
| **6** | A model of customer relationship management and business intelligence systems for catalogue and online retailers. | | |
| **7** | A model of customer relationship management and business intelligence systems for catalogue and online retailers with access control. | | |
| **8** | Configure firewall settings for an interactive network. | | |
| **9** | Configure and Implement a COTS. | | |
| **10** | Mini project. | | |
| | **Contact Hours** | **:** | **30** |
| | **Total Contact Hours** | **:** | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Design and deploy Simple Web Applications using MVC. |
| ● | Design SOA and ERP models. |
| ● | Design of CRM models. |
| ● | Design interactive network and application. |
| ● | Manage, Maintain and configuration of Networking. |

| **Text Books** | |
|---|---|
| **1** | Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 3rd Edition, 2017. |
| **2** | Alexis Leon, "Enterprise Resource Planning – Diversified",TMH, 2nd Edition. |

| **Reference Books** | |
|---|---|
| **1** | Ravi Shankar & S. Jaiswal, Galgotia, "Enterprise Resource Planning", 1st Edition, 1999. |
| **2** | Dr. Ravi Kalakota, "E-Business Network Resource planning using SAP R/3 Baan and Peoples soft: A Practical Roadmap For Success", Pearson, 2nd Edition, 2001. |

## CO – PO – PSO matrices of course

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P4C.1** | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 2 | 1 | 2 | 2 | 3 |
| **CB19P4C.2** | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 3 |
| **CB19P4C 3** | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| **CB19P4C.4** | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 3 |
| **CB19P4C.5** | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 3 |
| **Average** | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 2 | 2 | 3 |

Note: Enter correlation levels 1, 2 or 3 as defined below:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| Subject Code | Subject Name (LAB ORIENTED THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| CB19P4D | ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS | PE | 3 | 0 | 2 | 4 |

| Objectives: | |
|---|---|
| ● | To learn the fundamentals of text mining analysis. |
| ● | To be able to use various tools for text mining and carry out pattern discovery, predictive modeling. |
| ● | Explore the use of social network analysis to understand the growing connectivity and complexity. |
| ● | Perform social network analysis to identify important network properties in social media sites. |
| ● | Analysing interactions between people, and determine structural patterns in such interactions in real time application. |

| UNIT-I | INTRODUCTION TO TEXT MINING | 9 |
|---|---|---|
| Introduction- Defining text mining, general architecture of text mining systems. Core text mining operations- Using background knowledge for text mining, Text mining query languages. Pre-processing techniques-Task oriented approaches. Categorization-Applications of text categorizations, Definition of the problem, Document representations, Knowledge engineering approach to TC, Machine learning approach to TC, Using unlabeled evaluation of text classifiers. | | |
| **UNIT-II** | **CLUSTERING AND INFORMATION EXTRACTION** | **9** |
| Information extraction –Introduction, Historical evolution, Examples, Architecture of IE systems, Anaphora Resolution,Inductive algorithms, Structural IE.<br>Probabilistic models for information extraction- Hidden Markov Models, Stochastic Context Free Grammars, Maximal entropy 138odeling, Maximal entropy Markov Models, Conditional Random Fields. Text mining applications. | | |
| **UNIT-III** | **TEXT MINING METHODS & APPROACHES** | **9** |
| Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling; Sentiment Analysis; Sentiment Prediction. | | |
| **UNIT-IV** | **WEB ANALYTICS** | **9** |
| Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models. | | |
| **UNIT-V** | **SOCIAL MEDIA ANALYTICS** | **9** |
| Social network and web data and methods. Graphs and Matrices-Why Graphs? Graphs, Directed Graphs, Signed Graphs, Valued Graphs, Multigraphs, Hypergraphs, Relations, Matrices. Basic measures for individuals and networks. Information visualization: Architectural considerations, common visualization approaches for text mining, visualization technique in link analysis; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis. | | |
| | **Total Contact Hours** : | **45** |

| List of Experiments | | | | |
|---|---|---|---|---|
| 1 | Installation of NLTK and perform simple tokenize on any web page. | | | |
| 2 | Find the frequency distribution of words for the given web page. | | | |
| 3 | Perform word stemming using NLTK. | | | |
| 4 | Perform an experiment for text summarization applying Deep Learning. | | | |
| 4 | Collect the Tweets of a particular Movie and interpret the influence of the Movie providing thePositive/Negative Comments. | | | |
| 5 | Analyse emoticons feedbacks of consumable product and conclude whether to buy a product or not from e-newspaper. | | | |
| 6 | Based upon the counts of share, like, comments for a post in Facebook, analyse and comment the Post. | | | |
| 7 | Consider the role of a marketing manager for an apparel software company and develop a campaign for LinkedIn target audience. | | | |
| 8 | Use Tableau to derive decision for knowledge worker from available previous data sets. | | | |
| 9 | In a video frame sequence use snapchat to raise trigger to skip horror frames by analysing the video. | | | |
| 10 | Create an ontology for news article in English contents that are good/bad to the country. | | | |
| | | **Contact Hours** | : | **30** |
| | | **Total Contact Hours** | : | **75** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Perceive the trends in recent years on online social networks. |
| ● | Draw the graphical relation between the community. |
| ● | Know various social network algorithms related to predictive modelling and pattern discovery. |
| ● | Determine the relation between the participants of various social media. |
| ● | Understand Social Network Mining Tools and apply in real time problems. |

| **Text Book (s):** | |
|---|---|
| 1 | Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006. |
| 2 | Hansen, Derek, Ben Sheiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights from a Connected World", Morgan Kaufmann, 2011. |
| 3 | Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability", 2009. |
| 4 | Hanneman, Robert and Mark Riddle, "Introduction to Social Network Method", 2005. |
| 5 | Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2006. |

| **Reference Books(s) :** | |
|---|---|
| 1 | Wasserman, S. & Faust, K.. "Social Network Analysis: Methods and Applications", New York: Cambridge University Press, 1994. |
| 2 | Monge, P. R. & Contractor, N. S., "Theories of Communication Networks", New York: Oxford University Press, 2003. http://nosh.northwestern.edu/vita.html |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CB19P4D.1** | 2 | 2 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | 1 | 3 | 2 | 3 |
| **CB19P4D2** | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 3 | 2 | 3 |
| **CB19P4D.3** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 1 | 3 | 2 | 3 |
| **CB19P4D.4** | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 3 | 2 | 3 |
| **CB19P4D.5** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | 1 | 3 | 2 | 3 |
| **Average** | 2.4 | 2.4 | 3 | 2 | 2 | 2 | 2 | 0.8 | - | - | 0.4 | 1 | 3 | 2 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name ( THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19P61 | BEHAVIORAL ECONOMICS | PE | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To understand the concept and theory of economics. |
| ● | To acquire knowledge on the choices and behavior of firms, households and other economics entities. |
| ● | To learn the behavioral science perspective in economics. |
| ● | To know the current ideas and concepts regarding decision making in economics. |
| ● | To study the intertemporal choice in economics. |

| UNIT-I | INTRODUCTION | 9 |
|---|---|---|
| The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications – gains and losses, money illusion, charitable donation. | | |
| **UNIT-II** | **BASICS OF CHOICE THEORY** | **10** |
| Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis – consumption and addiction, environmental protection, retail therapy; applications – pricing, valuation, public goods, choice anomalies. | | |
| **UNIT-III** | **BELIEFS, HEURISTICS AND BIASES** | **8** |
| Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self-projection; inconsistent and biased beliefs; probability estimation; trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia, policy analysis – norms and markets, labor markets, market clearing, public goods; applications – logic and knowledge, voluntary contribution, compensation design. | | |
| **UNIT-IV** | **CHOICE UNDER UNCERTAINTY** | **9** |
| Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications – ownership and trade, income and consumption, performance in sports. Strategic choice-Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signalling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry. | | |
| **UNIT-V** | **INTERTEMPORAL CHOICE** | **9** |
| Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts – future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis – mobile calls, credit cards, organization of government; applications – consumption and savings, clubs and membership, consumption planning.<br>Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes:<br>On completion of the course, the students will be able to | |
|---|---|
| ● | Understand and apply various concepts in traditional and modern Microeconomics. |
| ● | Focus on decision making, and develop a holistic understanding of these concepts and their interconnections. |
| ● | Explore the knowledge on behavioural science perspective in Economics. |
| ● | Understand current ideas and concepts regarding decision making in Economics. |
| ● | Students will be able to understand the intertemporal choice in Economics. |

| Text Book (s): | |
|---|---|
| 1 | N. Wilkinson and M. Klaes , "An Introduction to Behavioral Economics", 2017. |
| 2 | Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, "Economics", 19th edition, Tata McGraw Hill, 2010. |
| 3 | M.L.Trivedi, "Managerial Economics:Theory & Applications", Tata McGraw-Hill Education, 4th Edition, 2002. |
| 4 | Robert H. Frank, 2014, "Microeconomics and Behaviour", McGraw-Hill, 9th Edition, 2014. |
| 5 | Philip Corr, Anke Plagnol, "Behavioral Economics: The Basic", Routledge; 1st edition, 2018. |

| Reference Books(s) : | |
|---|---|
| 1 | William Boyes and Michael Melvin, "Textbook of Economics", DTECH, 6th Edition, 2004. |
| 2 | N. Gregory Mankiw, "Principles of Economics", Thomson learning, 3rd Edition, 2003. |
| 3 | Richard Lipsey and Alec Charystal, "Economics", Oxford, University Press, 12th Edition, 2011. |

## CO - PO – PSO matrices of course

| PO/PSO / CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19P61.1** | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 2 | 3 | - | 1 | 2 |
| **BA19P61.2** | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | - | 1 | 2 |
| **BA19P61.3** | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | - | 1 | 2 |
| **BA19P61.4** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | - | 1 | 2 |
| **BA19P61.5** | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | - | 1 | 2 |
| **Average** | 1.6 | 1.6 | 2.4 | 2.4 | 2.6 | 1.8 | 2.6 | 2.6 | 2 | 2 | 2.2 | 2.6 | - | 1 | 2 |

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

| Subject Code | Subject Name ( THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19P82 | COMPUTATIONAL FINANCE & MODELING | PE | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | To make the students to understand how the techniques in computational finance applied in risk hedging and pricing of options. |

| UNIT-I | NUMERICAL METHODS AND MODELS | 9 |
|---|---|---|
| Numerical methods relevant to integration, differentiation and solving the partial differential equations of mathematical finance- examples of exact solutions including Black Scholes and its relatives. Finite difference methods including algorithms and question of stability and convergence. Treatment of near and far boundary conditions-the connection with binomial models- interest rate model- early exercise- the corresponding free boundary problems. Introduction to numerical methods for solving multi-factor models. | | |
| **UNIT-II** | **BLACK-SCHOLES FRAMEWORK** | **9** |
| Black-Scholes PDE: simple European calls and puts; put-call parity. The PDE for pricing commodity and currency options. Discontinuous payoffs - Binary and Digital options. Option Greeks and their role in hedging. The mathematics of early exercise - American options: perpetual calls and puts; optimal exercise strategy and the smooth pasting condition. Volatility considerations - actual, historical, and implied volatility; local volatility surfaces.<br>Simulation including random variable generation, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature. The technical topics addressed include importance sampling, Monte Carlo integration, Simulation of Random walk and approximations to diffusion processes, martingale control variables, stratification, and the estimation of the "Greeks." | | |
| **UNIT-III** | **FINANCIAL PRODUCTS AND MARKETS** | **9** |
| Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging. | | |
| **UNIT-IV** | **APPLICATION AREAS** | **9** |
| The pricing of American options- pricing interest rate dependent claims, and credit risk. The use of importance of sampling for Monte Carlo simulation of VaR for portfolios of options. | | |
| **UNIT-V** | **STATISTICAL ANALYSIS OF FINANCIAL RETURNS** | **9** |
| Fat-tailed and skewed distributions, outliers, stylized facts of volatility, implied volatility surface, and volatility estimation using high frequency data. Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage. | | |
| | **Total Contact Hours : 45** | |

| Course Outcomes:<br>On completion of the course, the students will be able to | |
|---|---|
| ● | Understand existing financial models in a quantitative and mathematical way. |
| ● | Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering. |
| ● | Explain the approaches required to calculate the price of options. |
| ● | Identify the methods required to analyse information from financial data and trading systems. |
| ● | Understand the various statistical methods to analyse the financial data. |

| Text Books | |
|---|---|
| 1 | R. Seydel, "Tools for Computational Finance", 2nd edition, Springer-Verlag, New York, 2004 |
| 2 | P. Glasserman, "Monte Carlo Methods in Financial Engineering", Springer-Verlag, New York, 2004. |
| 3 | W. Press, S. Teukolsky, W. Vetterling and B. Flannery, "Numerical Recipes in C: The Art of Scientific Computing", 1997. Cambridge University Press, Cambridge, UK. Available on-line at: http://www.nr.com/ |
| 4 | A. Lewis, " Option Valuation under Stochastic Volatility", Finance Press, Newport Beach, California, 2000 |
| 5 | A. Pelsser, "Efficient Methods for Valuing Interest Rate Derivatives", Springer-Verlag, New York, 2000. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19P82.1** | 3 | 1 | 2 | 3 | 2 | 0 | 2 | 2 | - | - | - | - | - | - | - |
| **BA19P82.2** | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | - |
| **BA19P82.3** | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | - | - | - | - | - | - | - |
| **BA19P82.4** | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | - | - | - | - | - | - | - |
| **BA19P82.5** | 1 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - |
| **Average** | **2.4** | **2.2** | **2** | **2.8** | **2** | **1.6** | **1.8** | **2.8** | - | - | - | - | - | - | - |

Note: Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| Subject Code | Subject Name (THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19P83 | INDUSTRIAL PSYCHOLOGY | PE | 3 | 0 | 0 | 3 |

| **Objectives:** | |
|---|---|
| ● | Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues. Topics include employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety. Using an applied approach, this course will help prepare students for their roles as employees and managers. |

| **UNIT-I** | | **10** |
|---|---|---|
| Industrial/Organizational Psychology : Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modeling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment. | | |
| **UNIT-II** | | **8** |
| Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods. | | |
| **UNIT-III** | | **9** |
| Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance. | | |
| **UNIT-IV** | | **8** |
| Employee Motivation, Satisfaction and Commitment, Fairness and Diversity. | | |
| **UNIT-V** | | **10** |
| Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behavior, Stress Management: Demands of Life and Work. | | |
| | **Total Contact Hours** : | **45** |

| **Course Outcomes:** On completion of the course, the students will be able to | |
|---|---|
| ● | Become conversant about the major content areas of Industrial Psychology. |
| ● | Gain further comfort with statistical concepts in the context of making personnel decisions. |
| ● | Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being. |
| ● | Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions. |
| ● | Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management. |

| **Text Books** | |
|---|---|
| **1** | Elmes, D., Kantowitz, B., & Roediger, H, "Research methods in psychology", Cengage Learning, 9th Edition, 2011. |
| **2** | Landy, F. J. and Conte, J. M, "Work in the 21st Century", Oxford: Blackwell Publishing, 4th Edition, 2013. |
| **3** | TV.Rao, "Performance Management towards Organizational Excellence", Sage, 2nd Edition, 2016. |
| **4** | Stephen Robbins, Tim Judge, Neharika Vohra, "Organizational Behaviour", Pearson, 18th Edition, 2019. |
| **5** | Pratibha Goyal , Alok Chakrawal , "Stress Management", Studera Press, 1st Edition, 2016. |

| Reference Books | |
|---|---|
| **1** | Breakwell, G.M., Smith, J.A., &Wright, D.B, "Research methods in psychology", Sage, 4th Edition, 2012. |

**CO - PO – PSO matrices of course**

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19P83.1** | 0 | 1 | - | - | - | - | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | - |
| **BA19P83.2** | 1 | 2 | - | - | - | - | 2 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | - |
| **BA19P83.3** | 0 | 3 | - | - | - | - | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | - |
| **BA19P83.4** | 1 | 1 | - | - | - | - | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | - |
| **BA19P83.5** | 0 | 1 | - | - | - | - | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | - |
| **Average** | 0.4 | 1.6 | - | - | - | - | 1.4 | 2.4 | 1.8 | 0 | 0 | 0 | 0.4 | 1.6 | - |

Note: Enter correlation levels 1, 2 or 3 as defined below:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| Subject Code | Subject Name ( THEORY COURSE) | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| BA19P84 | ADVANCE FINANCE | PE | 3 | 0 | 0 | 3 |

| Objectives: | |
|---|---|
| ● | Imbibe knowledge about the decisions and decision variables in Finance. |
| ● | Comprehend the technique of making decisions related to finance function. |

| UNIT-I | SOURCES OF FUNDS | 9 |
|---|---|---|
| Sources of Funds (including regulatory framework) Types of securities- Issuing the capital in market- Pricing of issue - Valuation of Stocks and bonds<br>Dividend Decisions: Traditional Approach, Dividend Relevance Model, Miller and Modigliani Model, Stability of Dividends, Forms of Dividends, Issue of bonus shares, Stock Split. | | |
| **UNIT-II** | **EVALUATION OF LEASE CONTRACTS** | **9** |
| Evaluation of Lease Contracts- Corporate Restructuring -Mergers and Acquisitions- Types of Mergers, Evaluation of Merger Proposal-Take-over-Amalgamation-Leverage buy-out-Management buy-out-Corporate Failure and Liquidation. | | |
| **UNIT-III** | **FINANCIAL RESTRUCTURING** | **9** |
| Share Split – Consolidation -Cancellation of Paid-up Capital -Other Mechanisms. | | |
| **UNIT-IV** | **WORKING CAPITAL MANAGEMENT** | **9** |
| Working Capital Planning- Monitoring and Control of Working Capital-Working Capital Financing -Managing the Components of Working Capital- Cash Management- Receivable Management -Inventory Management. | | |
| **UNIT-V** | **INTRODUCTION TO DERIVATIVES** | **9** |
| Basics of Futures, Forwards, Options, Swaps -Interest rate Payoff Diagrams, Pricing of Futures, Put Call Parity, Option Pricing using Binomial Model and Black Scholes Model -Use of Derivatives for Risk-Return Management- Credit Default Swaps | | |
| | **Contact Hours : 45** | |

| Course Outcomes:<br>On completion of the course, the students will be able to | |
|---|---|
| ● | Understand the sources of funds including regulatory framework. |
| ● | Understand the Corporate Restructuring. |
| ● | Develop skills for the interpretation of business information and application of financial theory in corporate investment decisions. |
| ● | Predict the working capital requirements of a concern. |
| ● | Understand Basics of Derivatives. |

| Text Books | |
|---|---|
| 1 | John.C.Hull, Options, "Futures and other Derivative Securities", PHI Learning, 9th Edition, 2012. |
| 2 | Fred Weston, Kwang S Chung, Susan E Hoag Mergers, "Restructuring And Corporate Control", Pearson Education, 4th Edition. |
| 3 | I.M.Pandey, "Financial Management", Vikas Publishing House Pvt. Ltd., 9th Edition, 2014. |

| Reference Books | |
|---|---|
| 1 | Stulz, "Risk Management and Derivatives", Cengage Learning, 2nd Edition, 2011. |
| 2 | Rajinder S. Aurora, Kavita Shetty and Sharad R. Kale, "Mergers and Acquisitions", Oxford University Press, 2011. |
| 3 | M.Y.Khan and P.K.Jain, "Financial Management, Text, Problems and Cases", Tata McGrawHill,5th edition, 2008. |


## CO - PO – PSO matrices of course

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BA19P84.1** | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 1 |
| **BA19P84.2** | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 3 |
| **BA19P84.3** | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 1 |
| **BA19P84.4** | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| **BA19P84.5** | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| **Average** | 2 | 1.4 | 2 | 2.4 | 2 | 2 | 1.8 | 1.8 | 2 | 2.4 | 2 | 2.2 | 2.6 | 2 | 2 |

Note: Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)If there is no correlation, put "-"