**SYLLABUS**

**FOR**

**TWO-YEAR M. TECH. PROGRAMME**

**IN**

**COMPUTER SCIENCE AND ENGINEERING**



|  |
| --- |
| **NAAC – A Grade** |

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**COLLEGE OF ENGINEERING & TECHNOLOGY**

**(An Autonomous and Constituent College of BPUT, Odisha)**

**Techno Campus, Mahalaxmi Vihar, Ghatikia,**

**Bhubaneswar-751029, Odisha, INDIA**

[**www.cet.edu.in**](http://www.cet.edu.in)

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**COURSE: M. Tech. (CSE - Computer Science & Engineering), Duration: 2 years (Four Semesters)**

**Abbreviations Used: U= UG, I= Integrated, P= PG**

**PC= Professional Core PE= Professional Elective OE= Open Elective**

**LC= Lab Course MC= Mandatory Course AC= Audit Course**

**L= Lectures P= Practical/Laboratory IA\*= Internal Assessment**

**T= Tutorial PA= Practical Assessment EA=End-Semester Assessment**

**\*Internal Assessment Max. Mark (30 marks) consists of Mid Semester (20 marks) and Quiz+Assignment (10 marks)**

**Subject Code Format:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **Prog (U/I/P)** | **Type (PC/PE/OE/LC/MC/AC)** | | **Department (CE/EE/IE/ME/…)** | | **Semester (1/2/…/0)** | **Serial No. (1/2/3/…/99)** | |

**1st SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Subject**  **Type** | **Subject Code** | **Subject**  **Name** | **Teaching Hours** | | | **Credit** | **Maximum Marks** | | | |
| **L** | **T** | **P** | **IA** | **EA** | **PA** | **Total** |
| 1 | Core1 | PPCCS101 | Mathematical foundations of Computer Science | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| 2 | Core2 | PPCCS102 | Advanced Data Structures and Algorithms | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| 3 | Professional Elective 1  (Any One) | PPECS101 | Internet of Things | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| PPECS102 | Cryptography |
| PPECS106 | Data Mining |
| PPEIT102 | Wireless Sensor Network |  |  |  |  |  |  |  |  |
| 4 | Professional Elective 2  (Any One) | PPECS103 | Soft Computing | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| PPECS104 | Software Project Management |
| PPECS105 | Cloud Computing |
| PPEIT103 | Advanced Database Systems |
| 5 | Mandatory | PMCMH101 | Research Methodology & IPR | 2 | 0 | 0 | 2 | 30 | 70 | - | 100 |
| 6 | Lab 1 | PLCCS101 | Advanced Data Structures & Algorithms Lab | 0 | 0 | 4 | 2 | - | - | 100 | 100 |
| 7 | Lab 2 | PLCCS102 | Computing Lab-I | 0 | 0 | 4 | 2 | - | - | 100 | 100 |
| **Total** | | | | **14** | **0** | **8** | **18** | **150** | **350** | **200** | **700** |
| 8 | Audit 1 | Any one subject from Appendix-I | | | | | | | | | 100 |
| **Grand Total** | | | | | | | | | | | **800** |

**2nd SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Subject**  **Type** | **Subject Code** | **Subject**  **Name** | **Teaching Hours** | | | **Credit** | **Maximum Marks** | | | |
| **L** | **T** | **P** | **IA** | **EA** | **PA** | **Total** |
| 1 | Core 3 | PPCCS201 | High Performance Computing | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| 2 | Core 4 | PPCCS202 | Object Oriented Analysis & Design | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| 3 | Professional Elective 3  (Any One) | PPECS201 | Machine Learning Application | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| PPECS202 | Computer Graphics |
| PPEIT209 | Mobile Computing |
| PPECS203 | Data Analytics |
| 4 | Professional Elective 4  (Any One) | PPECS204 | GPU Computing | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| PPECS205 | Computer Vision |
| PPECS206 | Advanced Operating Systems |
| PPECS207 | Digital Forensics |
| 5 | Practical 1 | PPRCS201 | Minor Project& Seminar | 0 | 0 | 4 | 2 | - | - | 100 | 100 |
| 6 | Lab 3 | PLCCS201 | Object Oriented Analysis & Design Lab | 0 | 0 | 4 | 2 | - | - | 100 | 100 |
| 7 | Elective 4 | PLCCS202 | Computing Lab-II | 0 | 0 | 4 | 2 | - | - | 100 | 100 |
| **Total** | | | | **12** | **0** | **12** | **18** | **120** | **280** | **300** | **700** |
| 8 | Audit 2 | Any one subject from Appendix-II | | | | | | | | | 100 |
| **Grand Total** | | | | | | | | | | | **800** |

**3rd SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Subject**  **Type** | **Subject Code** | | **Subject**  **Name** | **Teaching Hours** | | | **Credit** | **Maximum Marks** | | | |
| **L** | **T** | **P** | **IA** | **EA** | **PA** | **Total** |
| 1 | Professional Elective 5  (Any One) | PPECS301 | | Software Testing | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| PPECS302 | | Human Computer Interaction |
| PPECS303 | | Advanced Graph Theory |
| PPECS304 | | Real Time Systems |
| 2 | Open Elective | Any one subject from Appendix-III | | | 3 | 0 | 0 | 3 | 30 | 70 | - | 100 |
| 3 | Project 1 | PPRCS301 | Phase-I Dissertation | | 0 | 0 | 20 | 10 | - | - | 100 | 100 |
| **Total** | | | | | **6** | **0** | **20** | **16** | **60** | **140** | **100** | **300** |

**4th SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Subject**  **Type** | **Subject Code** | **Subject**  **Name** | **Teaching Hours** | | | **Credit** | **Maximum Marks** | | | |
| **L** | **T** | **P** | **IA** | **EA** | **PA** | **Total** |
| 1 | Project 2 | PPRCS401 | Phase-II Dissertation | 0 | 0 | 32 | 16 | - | - | 100 | 100 |
| **Total** | | | | **0** | **0** | **32** | **16** | **-** | **-** | **100** | **100** |

**Abstract of Credit and Marks Distribution**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Semester** | **Maximum Credits** | **Maximum Marks** |
| 1 | 1st Semester | 18 | 800 |
| 2 | 2nd Semester | 18 | 800 |
| 3 | 3rd Semester | 16 | 300 |
| 4 | 4th Semester | 16 | 100 |
| **Total** | | **68** | **2000** |

**NB:**

* **Any one of the Courses in Appendix-I is to be Decided by the Concerned Department for Audit-1 (1st Sem)**
* **Any one of the Courses in Appendix-II is to be Decided by the Concerned Department for Audit-2 (2nd Sem)**
* **Any one of the Courses in Appendix-III is to be Decided by the Concerned Department for Open Elective (3rd Sem)**

**Semester-1**

**Core 1: Mathematical Foundations of Computer Science (PPCCS101)**

**Module-1:**

Counting: The basics of counting, The pigeonhole principle, Inclusion and exclusion principle and its applications.

Lattices: Partial ordering, Posets, Lattices as posets, Properties of lattices, Lattices as algebraic systems, Sub lattices, Direct product and homomorphism.

Recurrence Relations: Recurrence relations, solving linear recurrence relations, Generating functions, Solving recurrence relation by generating functions.

**Module-2:**

Probability: Single Random variables and probability distributions: Random varaibles - Discrete and continuous. Probability distributions, mass function/ density function of probability distribution. Mathemtical Expectation, Moment about origin, Central moments Moment generating function of probability distribution. Binomial, Poisson & normal distributions and their properties. Moment generating functions of the above three distributions, and hence finding the mean and variance.

**Linear Programming (LP):** Introduction to LP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.

**Module-3:**

Group Theory: Algebraic systems, Semi groups and monoids, Groups , Subgroups, Homomorphism’s, Normal subgroup and cosets , Lagrange’s theorem, Definitions and examples of Rings and Fields.

Linear Algebra: Systems of linear equations, Matrices, Elementary row operations, Row-reduced echelon matrices. Vector spaces, Subspaces, Bases and dimension, Ordered bases and coordinates. Linear transformations, Rank-nullity theorem, Algebra of linear transformations, Isomorphism, Matrix representation, Linear functionals, Annihilator, Double dual, Transpose of a linear transformation.

**TEXT BOOKS:**

1. Ralph.P.Grimaldi., “Discrete and Combinatorial Mathematics: An Applied Introduction”, 4th Edition, Pearson Education Asia, Delhi, 2007.
2. **Kenneth H.Rosen**, “Discrete Mathematics and its Applications”, 7th Edition, Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
3. **C. L. Liu and D. Mohaptra**, “Elements of Discrete Mathematics”, Third Edition, 2008, Tata McGraw Hill Education, New Delhi
4. Probability ans Statistics for Engineers and Scientists by Sheldon M.Ross, Academic Press
5. J K Sharma, Operations Research Theory and Applications, MacMillan India Ltd.
6. K.Hoffman and R.Kunze, Linear Algebra, 2nd Edition, Prentice- Hall of India, 2005.

**REFERENCES:**

1. Thomas Koshy., “Discrete Mathematics with Applications”, Elsevier Publications, 2006.
2. Seymour Lipschutz and Mark Lipson., “Discrete Mathematics”, Schaum’s Outlines, Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Probability and Statistics by T.K.V.lyengar & B.Krishna Gandhi Et
4. **Tremblay J.P. and Manohar R**, “Discrete Mathematical Structures with Applications to Computer Science”, Tata Mc Graw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
5. N D Vohra, Quantitative Techniques in management, Tata McGraw Hill.
6. M. Artin, Algebra, Prentice-Hall of India, 2005.

**Core 2: Advanced Data Structures and Algorithms (PPCCS102)**

**Module-1:**

**Elementary Data Structures and Complexity Analysis:** Overview of Basic Data Structures: Arrays, Linked List, Stack, Queues. Implementation of Sparse Matrices, Algorithm Complexity: asymptotic analysis, Simple Recurrence Relations and use in algorithm analysis, amortized analysis.

**Module-2:**

**Search Structures: Height Balanced Trees:** AVL trees, 2-3 trees, Red-black trees, B-trees, B+-trees.

**Heap Structures:** Min-max heaps~~,~~ Binomial heaps, Fibonacci heaps

**Multimedia Structures:** Segment trees, k-d trees, Point Quad trees

**Graph Algorithms:** Single-source shortest path Algorithms, All-pairs shortest path algorithms including Johnson Algorithm~~,~~ Strongly Connected Components, Articulation Points, Topological sort

Minimum spanning tree algorithm using Boruvka steps

**Module-3:**

**String Matching Algorithms:** Introduction, The Brute-Force- Algorithm, Rabin-Karp Algorithm, String Matching with Finite automata, Knuth-Marries-Pratt Algorithm, Robin Karp algorithm

**Approximation Algorithms:** Travelling Salesperson Problem, Vertex-Cover Problem and Set-Cover Problem

**Text Book:**

1.Thomas Cormen, Charles Leiserson, Ronald Rivest and Clifford Stein, *Introduction to Algorithms*, MIT Press, 2009 (third edition).

**Reference Books:**

1.S. Dasgupta, C.H. Papadimitriou, and U.V. Vazirani, *Algorithms*, Mcgraw-Hill, 2006.

2.J. Kleinberg and E. Tardos, *Algorithm Design,* Addison-Wesley*,* 2006.

3.G. Brassard and P. Bratley, Algorithmics: Theory and Practice, Printice –Hall, 1988.

**PE 1: Wireless Sensor Networks (PPEIT102)**

**Prerequisites**

Computer Networks, Operating system, Mobile Computing

**Course Outcomes**

1. Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
2. Learn key routing protocols for sensor networks and main design issues
3. Learn transport layer protocols for sensor networks, and design requirements
4. Understand the Sensor management, sensor network middleware, operating systems

**Module I**

**Introduction:** Introduction to Wireless Sensor Networks, Node architecture, Operating System, Advantages of Sensor Networks, Application of Sensor Networks, Challenges and Constraints.

**Network deployment:** Structured vs randomized deployment, Network topology, Connectivity in geometric random graphs, Connectivity using power control, Coverage metrics, Mobile deployment.

**Localization:** Issues and approaches, Coarse-grained and Fine-grained node localization, Network-wide localization.

**Time Synchronization:** Reasons and challenges for time synchronization, Basics of time synchronization, Time synchronization protocols – Receiver Broadcast Synchronization, Timing-Sync Protocol for Sensor Networks and Flooding Time Synchronization Protocol.

**Module Il**

**Physical Layer:** Basic components, Source and Channel Encoding, Modulation, Signal Propagation.

**MAC Layer:** Wireless MAC Protocols (CSMA, MACA, MACAW), Characteristics of MAC protocols in Sensor Networks, Contention-Free MAC protocols( TRAMA, YMAC, LEACH), Contention-Based MAC protocols(PAMAS, SMAC, TMAC), Hybrid MAC protocols.

**Network Layer:** Classification of Routing Protocol, Routing metrics, Flooding and gossiping, Data-Centric routing (SPIN, Directed Diffusion, Gradient), Proactive routing (DSDV, OLSR), On-Demand routing (AODV, DSR), Hierarchical routing, Location-Based routing (UNICAST, MULTICAST, GAF), QoS-Based routing protocols

**Module III**

**Reliability and congestion control:** Basic mechanisms, Reliability guarantees, Congestion control, Real-time scheduling.

**Security:** Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks.

**Text Books:**

1. Fundamentals of Wireless Sensor Network: Theory and Practice: Waltenegus Dargie and Christian Poellabauer, Wiley Publication, 2010.
2. Networking Wireless Sensors: BhaskarKrismachari, Cambridge University Press

**References Books:**

1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas, Morgan Kaufmann Series in Networking 2004
2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Springer

**PE 1: Internet of Things (PPECS101)**

**Module-1:**

What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, Working Definition, IoT Frameworks

Physical Design of IoT- Things in IoT , IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics , Communication Protocols ,Embedded Systems, IoT Levels & Deployment Templates Introduction, M2M-Difference between IoT and M2M.

**Module-2:**

RADIO FREQUENCY IDENTIFICATION TECHNOLOGY

RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPC Global Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things.

Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.

RESOURCE MANAGEMENT IN THE INTERNET OF THINGS

Clustering, Software Agents, Clustering Principles in an Internet of Things Architecture, Design Guidelines, and Software Agents for Object Representation, Data Synchronization.

**Module-3:**

INTERNET OF THINGS PRIVACY, SECURITY AND GOVERNANCE

Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT.

BUSINESS MODELS FOR THE INTERNET OF THINGS

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Application: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Low-power design (Bluetooth Low Energy),

**Text Books**

1. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Parikshit N. Mahalle& Poonam N. Railkar, “Identity Management for Internet of Things”, River
4. Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).

**Reference Books**

1. Hakima Chaouchi, “ The Internet of Things Connecting Objects to the Web” ISBN : 978-1-84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
3. Daniel Kellmereit, Daniel Obodovski, “The Silent Intelligence: The Internet of Things”,. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
4. Fang Zhaho, Leonidas Guibas, “Wireless Sensor Network: An information processing approach”, Elsevier, ISBN: 978-81-8147-642-5.

**PE 1: Cryptography (PPECS102)**

**Module-1:**

Algebra: Group, cyclic group, cyclic subgroup, field, probability. Number Theory: Fermat's theorem, Cauchy's theorem, Chinese remainder theorem, primality testing algorithm, Euclid’s algorithm for integers, quadratic residues, Legendre symbol, Jacobi symbol etc.

**Module-2:**

Cryptography and cryptanalysis, Classical Cryptography, substitution cipher, different type of attack: CMA, CPA, CCA etc, Shannon perfect secrecy, OTP, Pseudo random bit generators, stream ciphers and RC4.

**Module3:**

Block ciphers: Modes of operation, DES and its variants, AES, linear and differential cryptanalysis.

One-way function, trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie Hellman key exchange algorithm, Elgamal Cryptosystem.

Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA, digital signature, Elgamal digital signature.

**Textbook:**

1. W. Stallings, Cryptography and Network Security Principles and practice, 5/e, Pearson Education

Asia, 2012.

2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security,

second edition, Tata McGraw Hill, 2011

**Reference Books:**

1. Thomas Koshy, Elementary Number Theory with applications, Elsevier India, 2005.

Stinson. D. Cryptography: Theory and Practice, third edition, Chapman & Hall/CRC, 2010.

**PE 1: Data Mining (PPECS106)**

**Module-1:**

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.

Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

**Module-2:**

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

**Module-3:**

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

Mining Object, Spatial, Multimedia, Text and Web Data:

Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

**Text Book**

1. Jiawei Han, Micheline Kamber and Jian Pei“Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

**Reference Books**

1 Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.

2 K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter

Economy Edition, Prentice Hall of India, 2006.

3 G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice

Hall of India, 2006.

4 Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson

Education, 2007.

**PE 2: Soft Computing (PPECS103)**

**Module-1:**

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques Artificial Neural Networks, Biological neurons and its working, Simulation of biolgical neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real life problems.

**Module-2:**

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

**Module-3:**

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using Gas, Multi-objective Optimization Problem Solving, Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

**Reference Books:**

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S. Rajasekaran, G. A. Vijayalakshami, PHI.

2. Chin Teng Lin, C. S. George Lee, Neuro-Fuzzy Systems, PHI

3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)

4. E. Goldberg, Genetic Algorithms: Search and Optimization, Addision-Wesley

5. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Wiley, 2nd edition

6. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)

7. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)

8. Neural Networks and Learning Machines Simon Haykin (PHI)

9. [AN INTRODUCTION TO NEURAL NETWORKS](https://www.phindia.com/Books/BookDetail/OTc4ODEyMDMxMzUxNA), [ANDERSON, JAMES A.](https://www.phindia.com/Books/Author/OTc4ODEyMDMxMzUxNA), PHI

**PE 2: Software Project Management (PPECS104)**

**Module-1:**

**Introduction:** Project Management Fundamentals, PMI Processes, Project management life cycle, Project charter, Project portfolio management, Business case, Statement of Work (SOW)

**Planning Phase:**, Stepwise project planning, Selection of an appropriate project approach, Waterfall-based models., RAD, Agile models: Extreme programming, Scrum, Lean, Selecting an appropriate project model.

**Module-2:**

**Estimation and Budgeting:** Estimation techniques, Expert judgment, Delphi, Albrecht function point analysis, Budgeting, Project selection, NPV, ROI, Payback models, Cost Estimation: COCOMO model, COCOMO II, , Staffing patterns. Tool support.

**Scheduling:** Project network diagram fundamentals, PERT techniques, Gantt charts, Critical path method (CPM),, Shortening project duration. Project scheduling tool support.

**Risk and Change Management:** Risk categories, Risk management approaches, Applying PERT technique, Monte-Carlo Simulation, Critical chain concepts

**Monitoring and Control:** Visualizing progress, Cost monitoring, Earned value analysis, Visualizing progress, change monitoring, software configuration management (SCM), tool support.

**Module-3:**

**Managing people:** Organizational behavior, Motivation, Oldham-Hackman job characteristic model, Stress management, Ethical concerns.

**Working in teams:**  Organization and team structures, Communication, Leadership

**Software quality:** ISO 9126, process and product metrics, ISO model, SEI CMMI, software reliability.

**Test Process:** Test specifications, Black box and white box testing, Test scripts, Unit and integration testing, Acceptance test specifications, Test tools,

**Project closeout:** Reasons for project closure, closure process, financial closure, closeout report.

**Text / References:**

1. Kathy Schwalbe, “Information Technology Project Management”, Cengage Learning, 7/e, 2013.

2. M. Cottrell and B. Hughes, and R. Mall, "Software Project Management", McGraw-Hill, 6th/e, 2017.

3. QuantumPM, “Microsoft Office Project Server 2003 Unleashed”, Pearson Education India, 2005.

4. Robert T. Futrell, Donald F. Shafer and Linda Isabell Shafer , “Quali ty Software Project”, Pearson India, 2002.

5. D. J. Henry, “Software Project Management – A Real-World Guide to Success”, Addison-Wesley, 2003.

**PE 2: Cloud Computing (PPECS105)**

**Module-1:**

**Introduction:** Cloud-definition, benefits, usage scenarios, History of Cloud Computing – Cloud Architecture – Types of Clouds – Business models around Clouds – Major Players in Cloud Computing – issues in Clouds – Eucalyptus – Nimbus – Open Nebula, CloudSim, Risks Involved in Cloud Computing. **Cloud Services:** Types of Cloud services: Software as a service – Platform as a Service – Infrastructure as a Service – database as a Service – Monitoring as a Service – Communication as services, Service providers – Google, Amazon, Microsoft Azure, IBM, Salesforce.

**Module-2:**

**Collaborating Using Cloud Services:** Email Communication over the Cloud – CRM Management – Project Management – Event Management – Task Management – Calendar – Schedules – Word Processing – Presentation – Spreadsheet – Databases – Desktop – Social Networks and Groupware, Work Loan Management in Cloud. **Virtualization For Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties – Interpretation and binary translation, HLL VM – Hypervisors – Xen, KVM, VMWare, Virtual Box, Hyper-V.

**Module-3:**

**Data & Cloud Storage:** Enterprise Data Storage (SAN, NAS), Cloud File System, Cloud Data stores & Data management for cloud storage.

**Other Ways to Collaborate Online:** Collaborating via Web – Based Communication Tools – Evaluating Web Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis.

**Security, Standards and Applications:** Security in Cloud: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed Management Task Force – Standards for application Developer – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

**Text/ References:**

1. John Rittinghouse and James Ransome, “Cloud Computing, Implementation, Management and Strategy”, CRC Press, 2009.
2. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate”, Que Publishing, August 2008.
3. James E Smith and Ravi Nair, “Virtual Machines”, Morgan Kaufmann, 2006.
4. David E. Y. Sarna, “Implementing and Developing Cloud Application”, CRC press 2011.
5. Lee Badger, Tim Grance, Robert Patt-Corner and Jeff Voas, NIST Draft cloud computing synopsis and recommendation, 2011.
6. Anthony T Velte, Toby J Velte and Robert Elsenpeter, “Cloud Computing: A Pract ical Approach”, Tata McGraw-Hill, 2009.

**PE 2:** **Advanced Database Systems (PPEIT103)**

**Prerequisites**

Data Base Management System, Computer Networks

**Course Outcomes**

* + 1. Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems
    2. Learn alternative designs and architectures for databases
    3. Discuss and evaluate different query optimization techniques.
    4. Analyze the background processes involved in transactions and explain how these impact on database operation and design

**Module-I:**

Introduction to Distributed Database: Distributed Data Processing, Concept of Distributed Database, distributed vs Centralized Database System; advantages and Application

Levels of Distribution Transparency- Reference architecture for distributed databases, types of data fragmentation- Horizontal, Vertical and Mixed, Distribution Transparency for Read-Only operations, Integrity Constraints in Distributed Database

Distributed Database Design: A framework for Distributed Database Design, The Design of Database Fragmentation, The Allocation of Fragments

**Module -II:**

Distributed Query Processing: Overview of Query Processing, Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing, Query Decomposition and Data Localization, Optimization of Distributed Queries, Query Optimization-Centralized Query Optimization, Join Ordering in Distributed Queries, Distributed Query Optimization

**Module -III:**

Transaction Management- Definition and its types

Concurrency Control mechanism -Distributed Concurrency Control, Taxonomy of Concurrency Control Mechanisms, Locking-Based Concurrency Control Algorithms - Distributed Two phase Locking Protocol

Timestamp-Based Concurrency Control Algorithms- Basic TO Algorithm, Conservative TO Algorithm, Multiversion TO Algorithm

Deadlock Management - Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Resolution

“Relaxed” Concurrency Control - Non-Serializable Histories Nested Distributed Transactions

Distributed DBMS Reliability- Reliability Concepts and Measures, Failures in Distributed DBMS, Distributed Reliability Protocols Components of Distributed Reliability Protocols Two-Phase Commit Protocol

**Text Book**

1. S. Ceri, G. Pelagatti , Distributed databases : Principles and Systems, McGraw Hill
2. Ozsu, M. Tamer and Patrick Valduriez, Principles of Distributed Database Systems, 3rd edition, Springer

**Reference Book**

1. Silberschatz, Abraham, Henry F. Korth and S. Sudarshan: Database System Concepts, 6th Edition (2010), McGrawHill International Edition
2. Ramez Elmasri, Shamkant B. Navathe: Fundamentals of Database Systems, 7th Edition (2016), Pearson.

**MC: Research Methodology & IPR (PMCMH101)**

**Module I:**

Introduction to RM: Meaning and significance of research. Importance of scientific research in decision making. Types of research and research process. Identification of research problem and formulation of hypothesis. Research Designs.

Types of Data: Primary data Secondary data, Design of questionnaire; Sampling fundamentals ad sample designs, Methods of data collection, Measurements and Scaling Techniques, Validity & Reliability Test.

**Module II:**

Data Processing and Data Analysis-I, Data editing, Coding, Classification and Tabulation, Descriptive and Inferential Analysis, Hypothesis Testing- Parametric Test (z test, t test, F test) and non-parametric test (Chi square Test, sign test, Run test, Krushall-wallis test).

**Module III:**

Data Analysis II: Multivariate Analysis- Factor Analysis, Multiple Regression Analysis. Discriminant Analysis, Use of Statistical Packages.

**Reference Books:**

1. Research Methodology, Chawla and Sondhi, Vikas

2. Research Methodology, Paneerselvam, PHI

**Course Outcomes:**

**CO1:** Understood the Meaning of research problem, Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

**CO2:** Got the knowledge of How to get new ideas (Criticizing a paper) through the Literature Survey (i.e. Gap Analysis).

**CO3:** Understood the Filing patent applications- processes, Patent Search, Various tools of IPR, Copyright, Trademarks.

**CO4:** Understood How to apply for Research grants and Significance of Report Writing, Steps in Report Writing, Mechanics and Precautions of Report Writing, Layout of Research Report.

**CO5:** Got the knowledge of How to write scientific paper & Research Proposal - Structure of a conference and journal paper, how (and How Not) to write a Good Systems Paper:

**Lab 1: Advanced Data Structures & Algorithms Lab (PLCCS101)**

**List of Experiments**

1. Implementation of Sparse Matrices.
2. Implementation of Binary search trees.
3. Implementation of AVL-trees, insertion and deletion into AVL trees.
4. Implementation of Red – Black trees.
5. Implementation of B-trees
6. Implementation of Priority queues
7. Implementation of Heaps: Min-max Heap, Binomial and Fibonacci Heaps.
8. Implementation of Graph Traversals: BFS and DFS.
9. Implementation of Shortest Path Problems: Dijkastra’s Algorithm
10. Implementation of All Pair Shortest Path: Floyd-Warshall~~’s~~ algorithm
11. Implementation of Minimum Spanning tree : Kruskal’s Algorithm, Prim’s Algorithm
12. Implementation of String Matching Algorithms: KMP only

**Lab 2: Computing Lab-1 (PLCCS102)**

**[This will be designed by the Department based on electives]**

**Audit-1**

**[To be decided by the Department]: Refer Appendix-I**

**Semester-2**

**Core 3: High Performance Computing (PPCCS201)**

**Module-1:**

Introduction: review of basic computer architecture, quantitative techniques in computer design, measuring and reporting performance. CISC and RISC processors. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards, and structural hazards, techniques for handling hazards.

**Module-2:**

Array processors: SIMD array processor, SIMD computer organization, SIMD Interconnection network. Vector processor, characteristics.

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super-pipelined and VLIW processor architectures.

**Module-3:**

Multiprocessor architecture: functional structures: UMA, NUMA, Distributed Memory architectures, Loosely Coupled & Tightly Coupled Multiprocessor, Processor characteristics of multiprocessor, Interconnection networks. Parallel memory organizations: Interleaved memory, L-M organization, cache coherence.

**Reference Books:**

1. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, McGraw-Hill.

2. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach,

Morgan Kaufmann.

3. John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill.

4. M. J. Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House.

**Core 4: Object Oriented Analysis and Design (PPCCS202)**

**Module-1:**

**Introduction:** Overview Of OOL; Object Oriented Concepts, Object Oriented System Development Lifecycle, Object Oriented Methodologies; The Unified Approach

**Unified Modeling Language:** Overview of Unified Modeling Language (UML), Static and Dynamic Models, UML Diagrams, UML Class Diagrams, Use-Case Diagrams, UML Dynamic Modeling, Implementation diagrams, Model Management: Package and Model Organization, UML Extensibility, UML Meta-Model.

**Module-2:**

**Object Oriented Analysis – Identifying Use-Cases:** Complexity in Object Oriented Analysis, Business Process Modeling and Business Object Analysis, Use-Case Driven Object Oriented Analysis, Use-Case Model, Developing Efficient Documentation.

**Object Analysis: Classification:** Object Analysis, Classification Theory, Approaches for Identifying Classes, Class Responsibility Collaboration.

**Object Oriented Analysis – Identifying Relationships, Attributes, and Methods:** Introduction, Associations, Inheritance Relationships, A Part of Relationship-Aggregation, Class Responsibility: Identifying Attributes and Methods, Class Responsibility: Defining Attributes, Object Responsibility: Methods and Messages.

**Object Oriented Design Process and Design Axioms:** Design Process, Design Axioms, Corollaries, Design Patterns.

**Designing Classes:** The Object Oriented Design Principles, UML Object Constraint Language (OCL), Strategies for Designing Classes, Class Visibility: Designing Public Private and Protected Protocols, Designing Classes: Refining Attributes, Designing Methods and Protocols, Packages and Managing Classes.

**Module-3:**

**Access Layer:** Object Store and Persistence, Database Management Systems, Logical and Physical Database Organization and Access Control, Object Oriented Database Management Systems (OODBMS), Object Relational Systems, Designing Access Layer Classes.

**View Layer:** User Interface Design as a Creative Process, Designing View Layer Classes, Purpose of a View Layer Interface, Prototyping the User Interface.

**Software Quality Assurance:** Quality Assurance Tests, Software Testing Techniques, Testing Strategies, Impact of Object Orientation on Testing, Test Cases, Test Plan, Myer’s Debugging Principles.

**System Usability and Measuring User Satisfaction:** Usability Testing, User Satisfaction Test, Analyzing User Satisfaction by Satisfaction Test Template, Developing Usability Test Plans and Test Cases.

**Text/References:**

1. Ali Bahrami, “Object Oriented System Development”, McGraw Hill, 1999.

2. Grady Booch, J. Rambaugh and Ivar Jacobson, “The UML Users guide”, Addison-Wesely, 2/e, 2005.

3. J. Rambaugh and M. R. Blaha, “Object Oriented Modeling and Design”, Prentice Hall, 2/e, 2004.

4. Andrew Haigh, “Object Oriented Analysis and Design”, Tata McGrawHill, 2001.

5. Stephen R. Schach, “Object Oriented and Classical Software Engineering”, 8/e, 2010.

**PE 3: Machine Learning Application (PPECS201)**

**Module-1:**

Introduction to Machine learning system: Types of learning, Algorithmic models of learning, Classification, Regression, hypothesis space and inductive bias, Evaluation.

Basic Mathematical and Statistical concepts: Metric, Matrices, Eigen values and Eigen vectors, mean, median, mode, variance, co-variance, correlation, Binomial distribution and normal distribution, Basic concepts in probabilistic models such as Bayes theorem, Bayesian, maximum a posteriori and minimum description length frameworks.

**Module-2:**

Algorithm models of learning, Learning classifiers**,** Linear, Nonlinear, Multiple and logistic Regression, Linear Discriminant Analysis (LDA), Decision trees, K-mean and Hierarchical clustering, Support Vector Machine (SVM), Bayesian networks, Markov and Hidden Markov models, k-nearest neighbor classifiers,

**Module-3:**

Neural networks: Perceptron, Multilayer Artificial Neural Network, Back Propagation Learning Algorithm, Radial Basis Network, Applications on ANN.

Computational learning theory, mistake bound analysis, Occam learning, accuracy and confidence boosting. Dimensionality reduction, Principal Component Analysis (PCA), feature selection and visualization.

Reinforcement learning, learning from heterogeneous, distributed data and knowledge. Selected applications in data mining, automated knowledge acquisition, pattern recognition, text and language processing, human-computer interaction.

**Text Book:**

* 1. Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag
  2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
  3. Ethem Alpaydin , Introduction to Machine Learning, MIT Press (MA), 2004.

**Reference Books:**

1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press.
2. Baldi, P., Frasconi, P., Smyth, P. (2003). Modeling the Internet and the Web - Probabilistic Methods and Algorithms. New York: Wiley.
3. Bishop, C. M. Neural Networks for Pattern Recognition. New York: OxfordUniversity Press (1995).
4. Chakrabarti, S. (2003). Mining the Web, Morgan Kaufmann.
5. Cohen, P.R. (1995) [Empirical Methods in Artificial Intelligence](http://babs.cs.umass.edu/emai.html). Cambridge, MA: MIT Press.
6. Cowell, R.G., Dawid, A.P., Lauritzen, S.L., and Spiegel halter, D.J. (1999). Graphical Models and Expert Systems.Berlin: Springer.
7. Cristianini, N. and Shawe-Taylor, J. (2000). An Introduction to Support Vector Machines. London: Cambridge University Press.Duda, R., Hart, P., and Stork, D. (2001). Pattern Classification. New York: Wiley.

**PE 3: Computer Graphics (PPECS202)**

**Module – I**

Three Dimensional Geometric and Modeling Transformations: Translation, Rotation, Scaling,

Reflections, shear, Composite Transformation. Projections: Parallel Projection, Perspective Projection. ellipse

**Module – II**

Two Dimensional Object Representations: Spline Representation, Bezier Curves, B-Spline Curves.

Fractal Geometry: Fractal Classification and Fractal Dimension, inverse problem in fractals

Wireframe model, surface rendering, 3-D modeling

Virtual Reality: VR, augmented reality, hardware and software for VR, senses to recognize a VR system

**Module – III**

Illumination Models: Basic Models, Displaying Light Intensities.

Computer Animation: Types of Animation, Key frame Vs. Procedural Animation, Methods of

Controlling Animation, Morphing.

**Textbook:**

1. Computer Graphics Principle and Practice, J.D. Foley, A. Dam, S.K. Feiner, Addison Wesley.

2. Procedural Elements of Computer Graphics, David Rogers, TMH.

**Reference Books:**

1. Computer Graphics: Algorithms and Implementations, D.P Mukherjee, D. Jana, PHI.

2. Computer Graphics, Z. Xiang, R. A. Plastock, Schaum’s Outlines, McGrow Hill.

3. Computer Graphics, S. Bhattacharya, Oxford University Press.

**PE 3: Mobile Computing (PPEIT209)**

**Prerequisites**

Computer Network, Data Communication, Operating System

**Course Outcomes**

1. Explain the basic concepts of wireless network and wireless generations.
2. Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc
3. Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
4. Explain the design considerations for deploying the wireless network infrastructure.

**Module – I:**

Introduction: Three Tier Architecture Mobile Computing Architecture, Evolution of Wireless Technology

Wireless Transmission: Signal, Antenna, Signal Propagation, Multiplexing, Modulation, Spread Spectrum

Cellular System: Cell, Cluster, Cell Splitting, Frequency Reuse, Frequency Management, Channel Assignment Strategies, Components of Cellular System, Operation of Cellular System

**Module – II:**

Global System for Mobile Communication (GSM): Overview, Architecture, Addresses and identifiers, Network signaling, Radio interfaces, Channels, Mobility Management.

General Packet Radio Services (GPRS): Architecture, GPRS Interfaces, Network Protocols, GPRS Handsets

Wireless LAN (WLAN): Application, Requirement, IEEE 802.11(Ad-hoc Mode, Infrastructure Mode, Protocol Architecture), Bluetooth (Piconet, Scatternet, Protocol Stack, Bluetooth Profile)

Mobile Ad-Hoc Network: Types, Topology, Applications, Proactive Routing (DSDV, OLSR), Reactive Routing (AODV, DSR), Hybrid Routing (ZRP)

**Module – III:**

Wireless Application Protocol (WAP): WAP Gateway and Protocols, Wireless Markup Languages (WML)

Mobile IP: Terminology, Operations, Location Management, Mobility Management

IMT 2000: Vision, IMT-2000 Family, UMTS (Architecture, Interfaces)

Emerging Technologies: WiFi, WiMax, LTE

**Text Books:**

1. Mobile Communication: J. Schiller, 2ND Edition, Pearson Education
2. Mobile Computing: Asoke Talukdar, 2nd Edition, TMH.

**Reference Books:**

1. Mobile Computing: P.K. Patra, S.K. Dash, 2nd Edition, Scitech Publications.
2. Fundamentals of Mobile Computing, Prashanta Kumar Patnaik and Rajib Mall, PHI, 2nd Edition, 2015
3. Mobile Computing, Raj Kamal, 2nd Edition, Oxford University Press
4. Wireless Communications, T.L. Singhal, TMH

**PE 3: Data Analytics (PPECS203)**

**Module-1:**

**Introduction:** Big Data Overview, The rising and importance of data sciences, Big data analytics in industry verticals

**Hadoop Architecture:** Hadoop Architecture, Hadoop ecosystem components, Hadoop Storage: HDFS, Hadoop Processing: MapReduce Framework, Hadoop Server Roles

**Module-2:**

**Data Analytics Lifecycle and methodology:** Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Communicating results, Deployment, Data exploration & preprocessing

**Module-3:**

**Data Analytics - Theory & Methods:** Measures and evaluation, Supervised learning, Linear/Logistic regression, Decision trees, Naïve Bayes, Unsupervised learning, K-means clustering, Association rules, Unstructured Data Analytics, Technologies & tools, Text mining, Web mining

**The Endgame:** Opertionalizing an Analytics project, Data Visualization Techniques, Creating final deliverables

**BOOKS RECOMMENDED:**

1. Hadoop: The Definitive Guide by Tom White

2. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph by David Loshin

3. Machine Learning by Tom M. Mitchell

**PE 4: GPU Computing (PPECS204)**

**Module 1:**

Basics of computer graphics: concepts, pipeline, transformation, lighting, Overview of GPUs: architecture, features, programming model

**Module 2:**

System issues: cache and data management, languages and compilers, stream processing, GPU-CPU load balancing

**Module 3:**

GPU-specific implementations; may include 3D computer graphics topics, sorting and searching, linear algebra, signal processing, differential equations, numerical solvers

**Text Book:**

1. R. Fernando and M. Kilgard, "The Cg Tutorial: The Definitive Guide to Programmable Real-Time Graphics", Addison-Wesley, 2003.

**PE 4: Computer Vision (PPECS205)**

**Module1:**

Digital Image Formation and low-level processing

Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. apparel

**Module2:**

Feature Extraction

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

**Module3:**

Pattern Analysis Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

**Textbooks**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

**References**

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

**PE 4: Advanced Operating Systems (PPECS206)**

**Module I**

**FUNDAMENTALS OF OPERATING SYSTEMS:**

Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

**Module II**

**DISTRIBUTED OPERATING SYSTEMS**

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport’s Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

**DISTRIBUTED RESOURCE MANAGEMENT**

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.

**Module III**

**REAL TIME AND MOBILE OPERATING SYSTEMS**

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real

Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Micro Kernel

Design - Client Server Resource Access – Processes and Threads - Memory Management - File

system.

**REFERENCES:**

1. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.

2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, “Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004.

3. Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, 2005.

4. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.

5. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Fourth Edition, Payload media, 2011.

6. Pradeep K. Sinha, "Distributed Operating System-Concepts and design", PHI.

7. Andrew S. Tanenbaum, "Distributed Operating System", Pearson Education.

**PE 4: Digital Forensics (PPECS207)**

**Module-1:**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

**Module-2:**

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

**Module-3:**

Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

**Text Books:**

1. Warren G. Kruse II andJay G. Heiser**, “**Computer Forensics: Incident Response Essentials”, Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C**.**, **“**Guide to Computer Forensics and Investigations, 2nd **e**d**.**, Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

**Reference Books:**

1. Vacca, J, *Computer Forensics, Computer Crime Scene Investigation*, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

**Mini Project with Seminar (PPRCS201)**

**Suggested domains for Mini-project.**

1. Passport automation system.
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Software personnel management system
8. Recruitment system
9. e-book management system

**Lab 3: Object Oriented Analysis & Design Lab (PLCCS201)**

To develop a mini-project following the 13 exercises listed below.

1. To develop a problem statement.
2. Develop an IEEE standard SRS document. Also develop risk management and project plan (Gantt chart).
3. Identify Use Cases and develop the Use Case model.
4. Identify the business activities and develop an UML Activity diagram.
5. Identity the conceptual classes and develop a domain model with UML Class diagram.
6. Using the identified scenarios find the interaction between objects and represent them using UML Interaction diagrams.
7. Draw the State Chart diagram.
8. Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.
9. Implement the Technical services layer.
10. Implement the Domain objects layer.
11. Implement the User Interface layer.
12. Draw Component and Deployment diagrams.

**Lab 4: Computing Lab-II (PLCCS202)**

**[This will be designed by the department, based on electives]**

**Audit-2**

**[To be decided by the Department]: Refer Appendix-II**

**Semester-3**

**PE 5: Software Testing (PPECS301)**

**Module-1:**

**INTRODUCTION:** Testing as an Engineering Activity – Testing as a Process – Testing axioms – Basic definitions – Software Testing Principles – The Tester‟s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support of Developing a Defect Repository – Defect Prevention strategies.

**TEST CASE DESIGN:** Test case Design Strategies – Using Black Bod Approach to Test Case Design – Random Testing – Requirements based testing – Boundary Value Analysis – Equivalence Class Partitioning – State- based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Evaluating Test Adequacy Criteria.

**Module-2:**

**LEVELS OF TESTING:** The need for Levers of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination

System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing – Compatibility testing – Testing the documentation – Website testing.

**Module-3:**

**TEST MANAGEMENT:** People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group.

**TEST AUTOMATION:** Software test automation – skill needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.

**TEXT BOOKS:**

1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006.

2. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson Education, 2007.

**REFERENCES:**

* 1. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2003.
  2. Edward Kit,” Software Testing in the Real World – Improving the Process”, Pearson Education, 1995.
  3. Boris Beizer,” Software Testing Techniques” – 2 nd Edition, Van Nostrand Reinhold, New York, 1990.
  4. Aditya P. Mathur, “Foundations of Software Testing \_ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

**PE 5: Human Computer Interaction (PPECS302)**

**Module-1**   
The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

**Module-2**  
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW. Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

**Module-3**

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

**TEXT BOOKS:**

* Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
* Brian Fling, “Mobile Design and Development”, First Edition, O’Reilly Media Inc., 2009
* Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O’Reilly, 2009.

**PE 5: Advanced Graph Theory (PPECS303)**

**Module-1:**

Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the

automorphism group; Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix Tree theorem, minimum spanning trees; Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, the Traveling Salesman problem, diameter and maximum degree, shortest paths;

**Module-2:**

Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs),factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem; Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem;

**Module-3:**

Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces; Directed graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branchings; Networks and flows: Flow cuts, max flow min cut theorem, perfect square;

Selected topics: Dominating sets, the reconstruction problem, intersection graphs, perfect graphs, random graphs.

**References**

1. Douglas B. West, Introduction to Graph Theory, Prentice Hall of India.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science. PrenticeHall.
3. Frank Harary, Graph Theory, Narosa.
4. R. Ahuja, T. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications, Prentice-Hall.

**PE 5: Real-Time Systems (PPECS304)**

**Module-1:**

Introduction to real time computing - Concepts; Example of real-time applications – Structure of a real time system – Characterization of real time systems and tasks - Hard and Soft timing constraints - Design Challenges - Performance metrics - Prediction of Execution Time: Source code analysis, Micro-architecture level analysis, Cache and pipeline issues- Programming Languages for Real-Time Systems

**Module-2:**

Real time OS – Threads and Tasks – Structure of Microkernel – Time services – Scheduling Mechanisms Communication and Synchronization – Event Notification and Software interrupt Task assignment and Scheduling - Task allocation algorithms - Single-processor and Multiprocessor task scheduling - Clock-driven and priority-based scheduling algorithms- Fault tolerant scheduling

**Module-3:**

Real Time Communication -Network topologies and architecture issues – protocols – contention based, token based, polled bus, deadline-based protocol, Fault tolerant routing. RTP and RTCP.

Real time Databases – Transaction priorities – Concurrency control issues – Disk scheduling algorithms – Two phase approach to improve predictability.

**Text Book**

1. C.M. Krishna, Kang G. Shin – “Real Time Systems”, International Edition, McGraw Hill Companies, Inc., New York, 1997

**Reference Books**

1. Jane W.S. Liu, Real-Time Systems, Pearson Education India, 2000.
2. Philip A. Laplante and Seppo J. Ovaska, “Real-Time Systems Design and Analysis: Tools for the Practitioner’’ IV Edition IEEE Press, Wiley. 2011

**Open Elective**

**[To be decided by the Department]: Refer Appendix-III**

**Project 1: (PPRCS301)**

**[To be decided by the Department]: Dissertation (Phase-I)**

**Semester-4**

**Project 2: (PPRCS401)**

**[To be decided by the Department]: Dissertation (Phase-II)**