Department of Computer Science & Engineering
Ph. D. (Computer Science and Engineering) Course work
Scheme of Examination
w. e. f. Winter Session 2024-25

Scheme of Examination:

Sr. No.	Course Code	Nomenclature of the Course	L	Credits	Internal	External	Max. Marks	Exam. Duration
1	PPD-101	Research Methodology	4	4	30	70	100	3 Hrs
2	PPD-102	Review of Literature & Seminar	2	2	50	--	50	--
3	PPD-103	Departmental Elective Course	4	4	30	70	100	3 Hrs.
4	PPD-104	Research & Publication Ethics	2	2	15	35	50	2 Hrs.
Total			12	12	125	175	300	

List of Departmental Elective Course

1. PPD-103 (I) Communication Networks
2. PPD-103(II) Software Engineering
3. PPD-103(III) Data Mining and Applications
4. PPD-103(IV) Soft Computing Concepts and Techniques

Duration of Ph. D, Course work: The duration of Ph. D, Course Work will be of one semester. It will consist of 04 papers.

PPD-101: Research Methodology

For Engineering Discipline the entire course will run under the faculty of Engineering and Technology. PPD-101 will be of 4 credits .The duration of exam is of 3 hours and maximum marks of Examination is 100.

PPD-102: Review of literature and Seminar

It includes discussions on research ethics, presenting a seminar on review of published research or on own published review/survey paper or training or field work done in the relevant area of research etc. The scholar shall review 20 to 30 research papers and shall submit the report as well

14/7/24 14/7/24

as present seminar before a three members committee duly constituted by the Dean, Research and Development and headed by Chairperson or Senior Teacher of the Department for evaluation of PPD-102 at the Department level.

PPD-103: Departmental Elective Course

It includes an elective course related to the relevant field of research and it will be offered by the respective department. Not more than 4 departmental Elective courses will be offered by each department.

PPD-104: Research and Publication Ethics (RPE)

It includes basics of philosophy of Science & ethics, research integrity, publication ethics. It is of 2 credits. The maximum marks are 50 and the duration of exam is 2 hours.

The external examinations PPD-101, 103 & 104 will be conducted centrally by Controller of Examinations during Saturday Sunday/ Holiday.

14/7/25 14/7/25

PPD-103(I) Communication Networks

(Departmental Elective Course)

General Course Information:

Course Code: PPD-103(I) Course Credits: 4.0 Type: Elective Course Contact Hours: 4 hours/week (4 Lectures) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** **Internal Examination (30 Marks):** *Two minor tests each of 20 marks will be conducted. The highest marks obtained by a student in any of the two minor examinations will be considered, Class Performance will be measured through percentage of lectures attended (4 marks) , Assignment, quiz etc. (6 marks)* **External End semester examination (70 marks)** *The Examiner is required to set 9 questions in all. The first question will be compulsory covering the entire syllabus and consisting of 4 short answers type questions of 3.5 marks each. In addition to that, 8 questions have to be set consisting of 2 questions from each unit. A candidate is required to attempt five questions in all, selecting one question from each unit and the compulsory question No. 1. All questions carry equal marks.*

Pre-requisites: Good understanding of network architectures, protocols (like TCP/IP), and routing algorithms.

Syllabus

Unit I

COMPUTER NETWORKS

Gigabit Ethernet: Overview of fast Ethernet, Gigabit Ethernet — overview, specifications, layered protocol architecture, network design using Gigabit Ethernet, applications, 10GB Ethernet - overview, layered protocol architecture, applications.

Wireless Networks: Existing and emerging standards, Wireless LAN (802.11), Broadband Wireless (802.16), Bluetooth (802.15) their layered protocol architecture and security.

Unit II

MOBILE NETWORKS

Mobile Network Layer: Mobile IP - goals, assumption, requirement, entities, terminology, IP packet delivery, Agent advertisement and discovery, registration, tunneling, encapsulation, optimization, reverse tunneling, IPV6.

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP fast retransmission/ recovery, transmission/time out freezing, selective retransmission, Transaction oriented TCP.

Unit III

MOBILE COMMUNICATION

Generations of Mobile Communication: 1G, 2G (GSM, GPRS), 3G (UMTS), 4G (LTE), and 5G.Specific Technologies:GSM, CDMA, UMTS, LTE,Wi-Fi, Bluetooth, and their characteristics.

Wireless Application Protocol: WAP Architecture, overview, WML scripts, WAP service, WAP session protocol, wireless transaction, Wireless datagram protocol.

Unit IV

WIRELESS SENSOR NETWORKS

Introduction: Introduction, Sensor Network Architecture, DataDissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery,Quality of a Sensor Network, Evolving Standards, Other Issues. S-MAC, IEEE 802.15.4.
Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

Recommended Books/Sources:

1. "Building high speed Networks", Tere Parnell, TMH.
2. "High Speed Networks and Internets", William stalling, Pearson Education.
3. Jochen Schiller," Mobile Communication", Pearson Education,2002.
4. Lee, "Mobile Cellular Telecommunications" McGRAW- WILL, 2nd Edition.
5. Dharma Prakash Agrawal and Qing-An Zeng, Introduction to Wireless and Mobile Systems, Tomson, 2010, 3rd edition
6. Tanenenbaum, " ComputerNetwork",PHI
7. Wireless Sensor Networks: Technology, Protocols and Applications by TaiebZnati Kazem Sohraby, Daniel Minoli
8. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam,TaiebZnati,Springer

14/07/25

PPD-103(II) SOFTWARE ENGINEERING

(Departmental Elective Course)

General Course Information:

Course Code: PPD-103(II) Course Credits: 4.0 Type: Elective Course Contact Hours: 4 hours/week (4 Lectures) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** **Internal Examination (30 Marks):** *Two minor tests each of 20 marks will be conducted. The highest marks obtained by a student in any of the two minor examinations will be considered, Class Performance will be measured through percentage of lectures attended (4 marks) , Assignment, quiz etc. (6 marks)* **External End semester examination (70 marks)** *The Examiner is required to set 9 questions in all. The first question will be compulsory covering the entire syllabus and consisting of 4 short answers type questions of 3.5 marks each. In addition to that, 8 questions have to be set consisting of 2 questions from each unit. A candidate is required to attempt five questions in all, selecting one question from each unit and the compulsory question No. 1. All questions carry equal marks.*

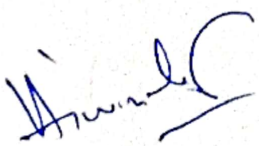
Pre-requisites: Basic knowledge of computer, Programming Skills and Innovative assessment.

Syllabus

Unit I

Introduction to Software Engineering: Software Engineering, Software Development Life Cycle Phases, Software Characteristics, Software Engineering Paradigms: Classical and Iterative Waterfall Model, Prototyping Model, Incremental Model, Spiral Model, Selection of Life Cycle Model, Agile Model, Version Control System and distributed Version Control System, Git Repository.

Software Project Management: Software Project Management Plan , Metrics for Project Size estimation- Lines of Code, Function Point Metric, Software Cost estimation - COCOMO, Project Scheduling, Personnel Planning , Organization and Team Structures, Software Configuration Management (SCM), Software Risks, Software Risk Management. **Project Evaluation and Estimation:** Cost-Benefit analysis, cash flow forecasting, cost benefit evaluation techniques, Selection of an appropriate project.



Unit II

Software Requirements: Functional and non-functional Requirements, User and interface requirements, Software Requirement Specification (SRS), Requirement Engineering Process.
Problem Analysis: Structured Analysis, Data Flow Diagrams (DFD), Decision Tables, Decision Trees, Data Dictionary, Structured Charts, Object Oriented Analysis, System Models: Context Models, Data Modeling, Behavioral Modeling, Object Models, Structured Models.
Software Design: Software Design Fundamentals, Design Principles, Function-Oriented Software Design, Object Modeling using UML, Object- Orientation Concepts, UML, UML Diagrams, Use Case Model, Class Diagrams, Interaction Diagrams, Activity Diagrams, State Chart diagram. Object Oriented Software Development, User Interface Design.

Unit III

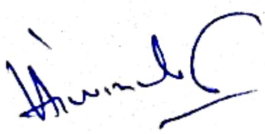
Software Testing Basics, Test Case Design, Software Testing Strategies, The V-Model of Software Testing, Levels of Software Testing- Unit Testing, Integration Testing-Top down Integration Testing and Bottom-up Integration Testing, Regression Testing, Smoke Testing, System Testing- Recovery Testing, Security Testing, Stress Testing, Performance Testing, Acceptance Testing- Alpha Testing, Beta Testing, Software Test Report (STR), Software Testing Tools, Static and Dynamic Testing tools.
Software Testing Methods: Black Box Testing Methods: Equivalence class partitioning, Boundary-value analysis, Error guessing, graph- based testing methods, White Box Testing Methods: Statement coverage, Condition coverage, Path testing, Data flow testing. Object Oriented Testing, Web Testing, GUI testing.

Unit IV

Software Quality: Software Quality Concepts, ISO 9126 Quality Factors, McCall's Quality Factors, Software Quality Assurance (SQA) Activities, Software Reviews-Walkthroughs, Formal Technical Review (FTR), Defect Amplification Model, ISO 9000 series Quality Standards, Capability Maturity Model (CMM), product versus process quality management, techniques to enhance software quality. Software Reliability, Software Maintenance, Reverse Engineering, Software Reuse, Software Engineering Emerging Trends: Client Server software, Service Oriented Architecture, Software as service.
Computer Aided Software Engineering (CASE): CASE Environment, advantages of CASE, CASE support in Software Life Cycle, Characteristics of CASE tools.

Recommended Books/Sources:

1. Rajib Mall, Fundamentals of Software Engineering, PHI Learning Pvt. Ltd., Third Edition, 2009.
2. Bob Hughes, Mike Cotrell, Rajib Mall, Software Project Management, McGraw Hill Education (India) Pvt. Ltd., Sixth Edition, 2018.
3. K. K. Aggarwal & Yogesh Singh, Software Engineering Programs Documentation Operating Procedures, A New Age International Publishers, Third Edition, 2007.



4. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publications, Third Edition, 2007.
5. Roger S. Pressman, Software Engineering A Practitioner's Approach, McGraw Hill International Edition
6. Simon Bennett, Steve McRobb and Ray Farmer,Object- Oriented System Analysis and Design using UML, McGraw Hill Education India Pvt. Ltd., Second Edition, 2015.
7. Renu Rajani & Pradeep Oak, Software Testing Effective Methods Tools and Techniques, McGraw Hill Education Pvt. Limited, Second Edition, 2018.
8. Nina S. Godbole, Software Quality Assurance Principles and Practice, Narosa Publications, 2011.
9. Yogesh Singh, Software Testing, Cambridge University Press, 2016.
10. James F. Peters, Witold Pedrycz, Software Engineering: an Engineering Approach, Wiley, 2014.

PPD-103(III) DATA MINING AND APPLICATIONS

(Departmental Elective Course)

General Course Information:

Course Code: PPD-103(III) Course Credits: 4.0 Type: Elective Course Contact Hours: 4 hours/week (4 Lectures) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** **Internal Examination (30 Marks):** *Two minor tests each of 20 marks will be conducted. The highest marks obtained by a student in any of the two minor examinations will be considered, Class Performance will be measured through percentage of lectures attended (4 marks) , Assignment, quiz etc. (6 marks)* **External End semester examination (70 marks)** *The Examiner is required to set 9 questions in all. The first question will be compulsory covering the entire syllabus and consisting of 4 short answers type questions of 3.5 marks each. In addition to that, 8 questions have to be set consisting of 2 questions from each unit. A candidate is required to attempt five questions in all, selecting one question from each unit and the compulsory question No. 1. All questions carry equal marks.*

Pre-requisites: A strong foundation in Computer Science fundamentals. Prior knowledge of database systems and basic data structures, linear algebra, and optimization techniques. Knowledge of programming languages such as Python, R, or Java for data analysis.

Syllabus

Unit I

Introduction to data mining, data preprocessing, Technologies used for data mining, Data mining functionalities- Cluster analysis, Association analysis, classification and prediction, characterization and discrimination, outlier analysis, Major issues in data mining.

Unit II

Data mining: Data mining and knowledge discovery. Kinds of Applications targeted in Data mining and Case studies such as data mining in health care management, data mining in banks, data mining in insurance, data mining in cyber security etc.

Unit III

Mining Associations and Correlations: Mining Frequent Patterns, Associations and Correlations, Frequent Itemset Mining using Apriori Algorithm, Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods.

Unit IV

Classification : classification and general approach to classification, Decision tree induction, Bayesian classification, classification by back propagation, K-nearest neighbor classifier, Support Vector Machine (SVM), Key metrics: accuracy, precision, recall ,F1-score.

Cluster analysis: K-mean clustering, hierarchical clustering, Knowledge of data mining tools.

Recommended Books/Sources:

1. Data Mining Concepts & Techniques, Jiawei Han & Micheline Kamber- 4th edition, 2022, Morgan Kaufmann.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, 2006 Springer
3. "Data Mining and Analysis: Fundamental Concepts and Algorithms" – Mohammed J. Zaki, Wagner Meira Jr., 2014, Cambridge University Press.
4. Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Wojciech Samek, Grégoire Montavon,2019, Springer
5. Privacy-Preserving Data Mining, Models and Algorithms, Charu C. Aggarwal, Philip S. Yu, 2008, Springer
6. Deep Learning for Data Mining: A Practitioner's Approach, Gopinath Rebala, Ajay Ravi, Sanjay Churiwala, 2019, Springer
7. Data Mining and Machine Learning in Cybersecurity, Sumeet Dua, Xian Du,2016, CRC Press.
8. Automated Machine Learning: Methods, Systems, Challenges" – Frank Hutter, Lars Kotthoff, Joaquin Vanschoren, 2019, Springer

PPD-103 (IV) SOFT COMPUTING CONCEPTS AND TECHNIQUES

(Departmental Elective Course)

General Course Information:

Course Code: PPD-103 (IV) Course Credits: 4.0 Type: Elective Course Contact Hours: 4 hours/week (4 Lectures) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** **Internal Examination (30 Marks):** *Two minor tests each of 20 marks will be conducted. The highest marks obtained by a student in any of the two minor examinations will be considered, Class Performance will be measured through percentage of lectures attended (4 marks) , Assignment, quiz etc. (6 marks)* **External End semester examination (70 marks)** *The Examiner is required to set 9 questions in all. The first question will be compulsory covering the entire syllabus and consisting of 4 short answers type questions of 3.5 marks each. In addition to that, 8 questions have to be set consisting of 2 questions from each unit. A candidate is required to attempt five questions in all, selecting one question from each unit and the compulsory question No. 1. All questions carry equal marks.*

Pre-requisites: Basic knowledge of Probability Theory, Set Theory, programming skills and Data Structure and Computer Algorithms

Syllabus

Unit I

introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of soft computing techniques.

Fuzzy sets: Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterization, Derivatives of parameterized MFs, Fuzzy numbers, Extension principal and fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Fuzzy reasoning, and compositional rule of inference

Unit II

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Characteristics of neural networks, Learning methods, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem.

14/7/25

Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm. Applications of ANNs to solve some real-life problems.

Unit III

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.

Unit IV

Fundamentals of Deep Networks: Deep Learning, common architecture principles of Deep Networks, building blocks of deep networks.

Major Architectures of Deep Networks: Unsupervised Pretrained Networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks and Recursive neural Networks.

Software and Tools to be learnt: MATLAB toolboxes on global optimization, neural networks and fuzzy logic, R Programming, Hadoop, Spark, GALIB 247 and KEEL

Recommended Books/Sources:

1. David.E. Goldberg, Genetic Algorithms in Search, Optimization and machine learning, Addison Wesley, 1999.
2. Zbigniew Michalewicz, Genetic algorithms +Data Structures = Evolution Programs, Springers-Verlag, 1999.
3. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007.
6. J.-S. R. Jang, C.-T. Sun, and E. Mizutani Neuro-Fuzzy and soft Computing, , PHI Learning, 2009.
7. Rajasekaran, and G. A. Vijayalakshmi PaiNeural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, S, Prentice Hall of India, 2007.
8. D. K. PratiharSoft Computing, , Narosa, 2008.
9. Simon Haykin, Neural Networks and Learning Machines, (3rd Edn.), , PHI Learning, 2011.
10. Collelo, Lament, VeldhnizerEvolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), (Springer).

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