Harcourt Butler Technical University, Kanpur

Department of Computer Science and Engineering

Syllabus

For

M. Tech. (Computer Science & Engineering)

(Effective from the Session: 2022-23)

Course structure and evaluation scheme for M. Tech Computer Science & Engineering (Effective from the Session: 2022-23)

SEMESTER –I

S.No.	Course Type	Course Code	Course Title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	ECS501	Foundation of Computer Science	4(3-0-2)	15	20	15	50	50	100
2.	PCC	ECS503	Advanced Algorithms	4(3-0-2)	15	20	15	50	50	100
3.	PCC	ECS 505	Professional Aspects in Software Engineering	3(3-0-0)	30	20	-	50	50	100
4.	PCC	ECS 507	Research Methodology	3(3-0-0)	30	20	-	50	50	100
5.	PCC	ECS	Departmental Elective I	3(3-0-0)	30	20	-	50	50	100
Total Credits				**17**						

SEMESTER –II

S.No.	Course Type	Course Code	Course Title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	ECS 502	Artificial Intelligence	4(3-0-2)	15	20	15	50	50	100
2.	PCC	ECS 504	Computer Networks & Security	4(3-0-2)	15	20	15	50	50	100
3.	PCC	ECS 506	Advanced Databases	3(3-0-0)	30	20	-	50	50	100
4.	PEC		Departmental Elective II	3(3-0-0)	30	20	-	50	50	100
5.	PEC		Departmental Elective III	3(3-0-0)	30	20	-	50	50	100

SEMESTER –III

S.No.	Course Type	Course Code	Course Title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	ECS601	Soft Computing	3(3-0-0)	30	20	-	50	50	100
2.	PCC	ECS	Department Elective IV	3(3-0-0)	30	20	-	50	50	100
3.	PCC	ECS	Department Elective V	3(3-0-0)	30	20	-	50	50	100
4.	PCC	ECS603	Seminar	2(0-0-4)	-	50	-	50	50	100
5.	PCC	ECS605	Minor Dissertation	3(3-0-6)	-	50	-	50	50	100
Total Credits				**14**						

SEMESTER –IV

S.No.	Course Type	Course Code	Course Title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	ECS602	Dissertation	12(0-0-24)	-	5-	-	50	50	100
Total Credits				**12**						

List of Departmental Electives

	BASKET 1	BASKET 2	BASKET 3	BASKET 4	BASKET 5
Departmental Elective I	Data Science ECS-511	Data Warehousing & Data Mining ECS-513	Multimedia Systems ECS-515	Wireless & Mobile Networks ECS-517	Modeling and Simulation ECS-519
Departmental Elective II	Cloud Computing ECS- 512	Software Requirements Engineering and Risk Management ECS- 514	Digital Image Processing ECS- 516	Storage Area Network ECS- 518	Real-Time Systems ECS- 520
Departmental Elective III	Machine Learning ECS-522	Software Project Planning & Management ECS-524	Digital Forensics ECS-526	High-Performance Networking ECS-528	Embedded Systems ECS-530
Departmental Elective IV	Internet of Things (IoT) ECS-611	Software Testing & Auditing ECS-613	Computer Vision ECS-615	Sensor Network ECS-617	Robotics ECS-619
Departmental Elective V	Big Data Analytics ECS-621	Software Metrics & Quality Assurance ECS-623	Bioinformatics ECS-625	Optical Networks ECS-627	Mobile Application Development ECS-629

FOUNDATION OF COMPUTER SCIENCE (ECS-501)

C (L T P)
4 (3-0-2)

COURSE OBJECTIVES:

- Review of core concepts of computer science.
- To provide theoretical and conceptual knowledge to the student to make their foundation for further learning and research.

Course Content:

Unit-1: Data Structure
List, Stack, Queue, Tree, Hash Table, Graph,

Unit-2: PARADIGMS OF PROGRAMMING LANGUAGES
Imperative Programming Languages: Procedural Vs Object Oriented Paradigm, Declarative Programming: Functional and Logical Programming Languages, Hybrid Paradigm of Programming, Aspect Oriented Programming

Unit-3: **Operating System**
Scheduling Algorithm, Synchronization Technique, Paging and Segmentation, Virtual Memory.

Unit-4: Automata Theory
Finite Automata, Regular Expression, Context Free Grammar, Push Down Automata.

Unit-5: **Database System**
Concepts and Architecture; Data Model; Normalization; SQL Advanced Transaction Processing, Deadlock and Concurrency Control.

Text and References Books:

1. Hopcroft & Ullman, "Introduction to Automata Theory, Languages, and Computation", Narosa Publishing House, 2008.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Addison Wesley, 1983.

LAB-1: FOUNDATION OF COMPUTER SCIENCE (ECS-551)

Laboratory experiments are based on theory contents (total 10 experiments).

Course Outcomes:

1. To understand the proof of correctness and running time of the algorithms for the classic problems in various domains
2. To be able to know the concepts of the algorithms and to know the efficiency of the algorithms.
3. to understand the fundamentals of operating systems and advanced topics.
4. To understand various categories of Programming Languages and their design principles.
5. To understand the theoretical aspects of computation.
6. To learn the design of complex databases through normalization and tackle issues like synchronization.

ADVANCED ALGORITHM (ECS-503)

C (L T P)
4 (3-0-2)

Course Content:

Unit-1: Algorithm Fundamentals

Basic Concept, Analysis of Algorithm, Growth of Functions, Master's Theorem. Analysis of algorithms for classic problems in various domains.

Unit-2: Randomized Algorithm

Introduction to Probabilistic Analysis and Randomized Algorithms.

Unit-3: Advance Design and Analysis Techniques:

Dynamic Programming, Greedy Algorithms, Branch and bound, Back Tracking.

Unit-4: Computational Geometry

Introduction to Computational Geometry, NP-Completeness. Introduction to Approximation Algorithms

Unit-5: Parallel Algorithm

Performance Measures of Parallel Algorithms, Parallel Merging/Sorting Algorithms on CREW/EREW, and Parallel searching algorithms.

Text and References Books:

1. Coreman, Rivest, Lisserson, "Algorithm", PHI, 2009.
2. Basse, "Computer Algorithms: Introduction to Design & Analysis", Addison Wesley, 2002.
3. Horowitz, Sahani, and Rajasekaran "Fundamental of Computer Algorithms", Universities Press, 2019.

LAB-II: ADVANCED ALGORITHMS (ECS-552)

Laboratory experiments are based on theory contents (total 10 experiments).

Course Outcomes:

1. Understand and apply mathematical preliminaries to the analysis and design of various types of algorithms.
2. Understand and apply the probabilistic analysis and randomized algorithms.
3. Apply various algorithmic strategies and paradigms to model engineering problems.
4. Understand NP completeness-related issues and approximation to np-complete problems.
5. Understand and apply the parallel algorithms in various research problems.

ADVANCED SOFTWARE ENGINEERING (ECS-505)

C (L T P)
3 (3-0-0)

Course Objectives

- The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing, and quality management of large software development projects.
- Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management, and UML diagrams

Course Content:

Unit-1

Introduction to Software Engineering: Defining the problem, identifying resources, identifying tools. Process models: The waterfall model, incremental process models, evolutionary process models, and the unified process. Agile Methodology- Scrum and XP.

Software Project Management: Software Project Planning and its characteristics, Types of metrics, Effort Estimation- FP, LOC, FP vs. LOC, Helstead's Software Engineering Measures, Cyclomatic Complexity. Schedule & Cost Estimation Models- Activity Networks-PERT/CPM, COCOMO-I, COCOMO-II, Risk Assessment- Probability Matrix, Risk Management.

Unit-2

Object Oriented Software Engineering Object-oriented methodologies. Unified Modeling Language, Use Case Centric Development, Structural and Behavioral Modeling, User Interface design, Component and Deployment Diagrams, Design Principles, and Patterns.

Unit-3

Component-Based Software Engineering: CBSE process, Domain engineering, Component-based development, Classifying and retrieving components, and economics of CBSE. Client/Server Software Engineering: Structure of client/server systems, Software engineering for Client/Server systems, Analysis modeling issues, Design for Client/Server systems, Testing issues

Unit-4

Web Engineering: Attributes Of web-based applications, the WebE process, and a framework for WebE. Formulating, and analyzing web-based systems, designing and testing for web-based applications, and Management issues.

Unit-5

Software Quality: CASE tools, metrics, Standards, Certification, and Assessment. TQM, Bootstrap methodology, The SPICE project, ISO-IEC 15504, SEI-CMM, Six Sigma Concept for Software Quality. Computer-Aided Software Engineering: Building Blocks for CASE, taxonomy Of CASE tools, integrated CASE environments, Integration architecture, and CASE repository.

Text and References Books:

1. Sommerville, "Software Engineering, 9th ed.", Addison Wesley Professional, 2010, ISBN-13: 978-0137035151
2. Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill,2019.
3. K. K. Agrawal and Yogesh Singh, Software Engineering New Age Publishing, 2007.
4. Object-Oriented Software Engineering Practical software development using UML and Java by Timothy C. Lethbridge & Robert Langaniere Mcgraw-Hill Co, 2004.
5. Priestley, Object Oriented Design Using UML, Mcgraw Hill Co, 2005.

Course Outcomes:

1. The ability to analyze and implement solutions to complex problems involving computer applications and networks
2. Ability to translate end-user requirements into system and software requirements, using e.g., UML, and structure the requirements in a Software Requirements Document (SRD).
3. Identify and apply appropriate software architectures and patterns to carry out the high-level design of a system and be able to critically compare alternative choices.
4. Will have experience and/or awareness of testing problems and will be able to develop a simple testing report
5. A solid understanding of the methods of modern software engineering

RESEARCH METHODOLOGY (ECS-507)

C (L T P)
3 (3-0-0)

Course Content:

Unit-1
Defining research and research problems, classification of research; Scientific explanation, and social science/management research; Review of Literature. Research questions; Research framework; Hypotheses formulat1on, Research Variable

Unit-2
Research design formulations; Classification of research design - exploratory research design; descriptive research design. Causal & experimental research design. Measurement and scaling; Scales of measurement s, Comparative and non-comparative scaling techniques; research framework; hypothesis formulation, sample research proposal preparation/ case studies.

Unit-3
Tools of data collection; Questionnaire design- process and structure; Reliability and validity. Sampling design and procedure; Classification of sampling techniques, Sample size

Unit-4
Overview of statistical techniques for data analysis – descriptive, statistics, theoretical distribution, central limit theorem testing of hypothesis, regression analysis, correlation analysis, inferencing, non-parametric statistics and test, analysis of variance CANOVA), experimental design, response surface methodology univariate and multivariate analysis of statistical data

Unit-5
Ethical issues in Research: Academic Integrity Report, Report writing, and use of plagiarism check, citation ethics, etc. Use of Computer software for Data Analysis & Reporting: Report compilation, Overview of Software like MS word, MS Excel, MS PowerPoint, Latex, SPSS etc.

Text and References Books:

1. L. Research Methodology by C.R. Kothari, New age International, New Delhi. (Major contents of unit 1- IV available), 2015.
2. Statistical Methods by S. P. Gupta, S. Chand & Sons, 2014.
3. Fundamentals of Statistics by D. N. Elhance, KITAB MAHAL ALLAHABAD, 2021.
4. Fundamentals of applied statistics b) S.C. Gupta & V.K. Kapoor, S. Chand & Sons, 2020.
5. Research Methodology by R. Paneer shelvarn. PHI publications, 2014.
6. Research Methodology: A step-by-step Guide for Beginners by Ranjit Kumar, Sage Publication (I) P. Ltd- New Delhi 4th edition, 2017.

DATA SCIENCE (ECS-511)

C (L T P)
3 (3-0-0)

Course Content:

Unit 1
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications, Mathematical Foundations for Data Science: linear algebra; Analytical and numerical solutions of linear equations; Mathematical structures, concepts, and notations used in discrete mathematics. Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics; Concepts of statistics in solving problems arising in data science.

Unit 2
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit 3
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit 4
Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Unit 5
Pandas and NumPy: NumPy Basics - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; Pandas - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing.

Text and References Books:

1. R. V. Hogg, J. W. McKean and A. Craig, Introduction to Mathematical Statistics, 8th Ed., Pearson Education India, 2019.
2. Avrim Blum, John Hopcroft, Ravindran Kannan, “Foundations of Data Science”, Cambridge University Press, 2020.
3. Ani Adhikari and John DeNero, ‘Computational and Inferential Thinking: The Foundations of Data Sciene’ , GitBook, 2019.
4. Python For Data Analysis (O Reilly, Wes Mckinney), 2012.

Course Outcomes:

1. Understand the core concepts and methods in data science.
2. Understand the issues and challenges in data collection, storage, and management.
3. Understand and apply various techniques for data analysis.
4. Understand various data visualization techniques.
5. Understand Learn Python programming tools for data science.

DATA WAREHOUSING & DATA MINING (ECS-513)

C (L T P)
3 (3-0-0)

Course Content:

Unit 1
Data Warehousing and Business Analysis: - Data warehousing Components, Building a Data warehouse, Mapping the Data Warehouse to a Multiprocessor Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup, and Transformation Tools, Metadata reporting, Query tools and Applications, Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

Unit 2
Data Mining: - Data Mining Functionalities – Data Preprocessing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization, and Concept Hierarchy Generation.
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.

Unit 3
Classification and Prediction: - Issues Regarding Classification and Prediction, Classification by Decision Tree Introduction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation, 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.

Unit 4
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.

Unit 5
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 and References Books:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” Second Edition, 2006.
2. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill Edition, Tenth Reprint 2007.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, 2006.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education, 2007.
5. Soman K.P., Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.
6. Daniel T. Larose, “Data Mining Methods and Models”, Wile-Interscience, 2006.

Course Outcomes:

1. Understand the importance of abstraction of Knowledge from unstructured sources. (Understand)
2. Use of data pre-processing, cleaning, transformation, and integration for knowledge discovery and data mining principles. (Apply)
3. Understand classification and prediction in the areas of machine learning algorithms that underpin the knowledge discovery. (Understand)
4. Design data mining and data warehousing systems and solutions to meet user requirements and specifications. (Apply, Analyze)
5. Use of multidimensional and web mining as techniques for extracting knowledge from a data warehouse. (Apply, Evaluate)

MULTIMEDIA SYSTEMS (ECS-515)

C (L T P)
3 (3-0-0)

Course Content:

Unit 1

Introduction: Concept of Multimedia, Media & data stream, main properties of multimedia system, Data stream characteristics for continuous media, Multimedia Applications, Hardware Software requirements, Storage Technologies: RAID, Optical Media.

Unit 1

Components of multimedia and file formats: Text, Basic sound concepts, MIDI, Speech, Basic concept of Images, Graphics format, Basic concepts of Video & animation, Conventional system, Computer based animation, Authoring Tools, Categories of Authoring Tools. Latest Web technologies, such as XML, X3D and Semantic Web.

Unit 2

Compression Techniques: Lossless and Lossy compression, Run length coding, Statistical Coding, Transform Coding, JPEG, MPEG, Text compression using static Huffman technique, Dynamic Huffman Technique, Arithmetic Technique.

Unit 1

Multimedia Communication: Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter – Fixed playout and Adaptive playout – Recovering from packet loss – RTSP — Multimedia Communication Standards – RTP/RTCP – SIP and H.263. Multimedia servers, databases and content management; Multimedia information system and applications.

Unit 1

Wireless Multimedia Communication: End to End QoS provisioning in Wireless Multimedia Networks – Adaptive Framework – MAC layer QoS enhancements in Wireless Networks – A Hybrid MAC protocol for 10 Multimedia Traffic – Call Admission Control in Wireless Multimedia Networks – A Global QoS Management for Wireless Networks.

Text and References Books:

1. David Hillman, "Multimedia Technology & Applications", Galgotia Publications, 2000
2. Nigel Chapman & Jenny Chapman, "Digital Multimedia", Wiley Publications, 2000
3. D.P. Mukherjee, "Fundamentals of Computer Graphics and Multimedia", PHI, 2001
4. Nalin K Sharda, 'Multimedia Information Networking', Prentice Hall of India, 1999
5. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, 'Multimedia Wireless Networks: Technologies, Standards and QoS', Prentice Hall, 2003.
6. Ellen Kayata Wesel, 'Wireless Multimedia Communications: Networking Video, Voice and Data', Addision Wesley, 1998

Course Outcome:

1. Students will work with all aspects of images, videos and animation.
2. Define the basic concepts of image / video coding technology and compression standards
3. Describe the fundamentals of multimedia content, description and presentation.
4. Design the fundamentals of multimedia communication.
5. Explain the concept of wireless multimedia communication.

WIRELESS AND MOBILE NETWORKS (ECS-517)

C (L T P)
3 (3-0-0)

Course Content:

Unit-1: Introduction

Wireless and Mobile Networks: History of different types of wireless technologies, Facts, Statistics, and Trends, Wireless Transmission: Signals, Antennas, Coding, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Introduction to Cellular systems, satellite systems, broadcast systems, Introduction to wireless LANs and technologies like Wi-Fi (IEEE 802.11), WiMAX (IEEE 802.16), Low-rate wireless personal area networks (IEEE 802.15), Bluetooth, Zigbee, LoRA and others.

Unit-2: Cellular Network Foundations

Theoretical foundations in the core principles of modern cellular systems, Network planning techniques, Connectivity requirements analysis, Design of resource allocation mechanisms, Power control for fixed-rate and rate-adaptive systems. Wireless Medium Access Control: Common Problems, SDMA, FDMA, TDMA, CDMA. Wireless Telecommunications Systems: GSM, DECT, TETRA, UMTS, IMT-2000, LTE.

Unit-3: Mobile Network Layer

Issues and Problems of IP in Wireless Networks, Principles behind Mobile IP, Security issues and DHCP, Routing in Ad-hoc Networks and Wireless Sensor Networks: Need for routing and routing classifications, Table Driven Routing Protocols, Source Initiated On-Demand Routing Protocols, Hybrid Protocols – Zone Routing, Basic network performance metrics for evaluating and maintaining Quality of Service (QoS), Concepts and background to distinguish among various performance metrics for different wireless/mobile infrastructures.

Unit-4: Mobile Transport Layer

Effects of mobility and wireless transmissions on reliable transport protocols such as TCP, Support for Mobility: File Systems, databases, WWW and Mobility, WAP, Application layer for mobile networks, Traditional TCP-Congestion Control, Slow start, Fast retransmit/fast recovery, Implications of mobility, Classical TCP, Indirect TCP, Snooping TCP, Mobile TCP, Transmission/time out freezing and advancements.

Unit-5: Advanced Wireless Networks

Architecture and applications of Cellular, LTE, and 3G/4G/5G Systems, Wireless Broadband Networks-3G, Harmonized 3G, 3G CDMA, Smart Phones and 3G Evolution, 4G Vision, 4G features and challenges, Applications of 4G, 4G Technologies, 5G Wireless technologies, VANET: Connected and autonomous cars, Drone networking.

Text and References Books:

1. J. Schiller, Mobile Communications, 2nd edition, Addison Wesley, 2008
2. Wireless Communications and Networks, William Stallings, 2nd edition, Prentice Hall, 2018.

3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.
4. Anurag Kumar, D. Manjunath, Joy Kuri, Wireless Networking, First Edition, Elsevier 2011.
5. Simon Haykin, Michael Moher, David Koilpillai, Modern Wireless Communications, First Edition, Pearson Education 2013

Course Outcomes:

1. Understand various wireless LAN and Mobile Technologies available in the Mobile industry.
2. Understand the theoretical foundation and core principles of Wireless and Mobile Networks.
3. Study the issues and challenges in Mobile routing and various related protocols.
4. Study the issues and challenges in the mobile transport layer and various related protocols.
5. To get aware of state of art and latest industry standards in Wireless Mobile Networks.

MODELING AND SIMULATION (ECS-519)

C (L T P)
3 (3-0-0)

Course Content:

Unit-1: Introduction

Systems and system environment, Components of a system, Static and Dynamic systems, Discrete and continuous systems, Model of a system, Types of Models, Art and science of the modeling process, Simulation methods and Principles, Continuous, Discrete-Event and other System Simulation Techniques, Advantages and disadvantages of Simulation, Simulation examples: Simulation of queuing systems.

Unit-2: Physical Modeling

Identify the key parameters of a model, estimate model outcomes, Dimensions analysis, Dimensionless grouping of input and output variables to find empirical relations, similarity criteria and their application to physical models, Modeling of System with Known Structure, Deterministic model, State Space Model, Transfer functions block diagram and sub-systems, Modeling for control.

Unit-3: Random Processes and Queuing Models

Random process, Discrete/continuous time processes, Markovian property, Markov chain, State Transition Diagrams, Birth-death process, Little's theorem, Introduction to Queues and Random Noise, Random Variates Generation, Sensitivity Analysis, Steady state analysis of M/M/1 model; multi-server models, M/G/1 and other queuing models, Burke's theorem, a network of queues, Jackson theorem.

Unit-4: Model Performance

Probability density and distribution functions, Location, scale and shape parameters, discrete and continuous probability distributions; Inverse transform method, composition and acceptance-rejection methods, efficiency and quality measures, Measures of performance and their estimation, Output analysis for terminating and steady-state simulations, Verification, Calibration, Validation and Optimization of models via Simulation.

Unit-5: Simulation, Analysis and Viewing Tools

General structure and features of a simulation tool, Study of MATLAB as a simulation tool to describe the system syntax, define elementary representations, functions etc., Explain programming and the scripting process, e.g., relational operations, logical representations, condition statements, loops, etc., Create tabular and graphical and multidimensional visualization results. Various important tool boxes of MATLAB.

Text and References Books:

1. Law, A.M. and Kelton, W.D., "Simulation, Modeling and Analysis", 3rd Ed., Tata McGraw-Hill, 2003.
2. Banks, J., Carson, L.S., Nelson, B.L. and Nicol, D.M., "Discrete Event System Simulation", 4th Ed., Pearson Education, 2009.
3. Alberto Leon-Garcia, "Probability and Random Processes for Electrical Engineers", 2nd Ed., Pearson Education, 1998.
4. Network Simulation: SimEvent tool box in MATLAB, general features of network simulation packages, case study of OMNET++/ns2/ns3/NetSim, 2008.

ARTIFICIAL INTELLIGENCE (ECS-502)

C (L T P)
4 (3-0-2)

Course Content:

Unit-1: Introduction

Introduction to Artificial Intelligence, Various approaches to AI, Simulation of sophisticated & Intelligent Behavior, Intelligent Agents, Knowledge and its role in AI, Representing problems in state space, Heuristic algorithm versus solution guaranteed algorithms, Informed versus uninformed search, Production System Model, Soft computing versus Hard computing.

Unit-2: AI-based Solution Strategies

Depth First Search and Breadth First Search, Heuristic Search Techniques: Hill Climbing, Best First search, A* Algorithm, Branch and Bound, Cryptarithmatic Problem, Means-End Analysis, Problem Reduction Technique, AND-OR Graphs, AO* Algorithm, Game Playing: MINMAX Search, Alpha-Beta Pruning.

Unit-3: Knowledge Representation and Reasoning

Propositional Logic, First Order Predicate Logic, Inference System in Propositional and Predicate Logic, Horn Clauses, Forward & Backward Deduction, Resolution Refutation, Reasoning under Uncertainty Associative Network, Semantic Networks, Conceptual Dependencies, Frames, Scripts, Case Grammar Theory.

Unit-4: AI Applications

Understanding Natural Languages, Various Approaches of NLP, Parsing techniques, Context free and transformational grammars, Transition nets, Augmented transition nets, Fillmore's grammars, Grammar free analyzers, Sentence generation, and translation, Introduction to Pattern Recognition, Machine Learning, Perception, Object Identification, Speech Recognition etc.

Unit-5: Expert Systems

Architecture of Expert System, Expert System Shell, Explanation System, Knowledge Acquisition System, Case study of Existing Expert Systems like DENDRAL, MYCIN, Development of a small Expert System using programming Languages and tools like LISP, PROLOG, JESS, Python.

Text and References Books:

1. N. J. Nilsson, “Artificial Intelligence: A New Synthesis”, Elsevier Publications, 1998.
2. Rich & Knight, “Artificial Intelligence”, McGraw-Hill Publication, 2017.
3. D. W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI., 1990
4. Winston, “LISP Programming”, Addison Wesley, 2015.
5. Marcellous, “Expert System Programming”, PHI, 2018

Course Outcomes:

1. Understanding different types of AI agents (Understand).
2. Understand and apply various AI search algorithms (Understand, Apply).
3. Understand and apply the fundamentals of knowledge representation and reasoning process (Understand, Apply)
4. Apply AI concepts in a different domain (Apply)
5. Build simple knowledge-based AI/Expert systems using languages like LISP, Prolog, and AI tools like JESS. (Apply)

CRYPTOGRAPHY AND NETWORK SECURITY (ECS-504)

C (L T P)
4 (3-0-2)

Course Content:

Unit-1:
Introduction to security attacks, services and mechanisms, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard (DES), strength of DES, differential and linear cryptanalysis of DES, block cipher modes of operations, triple DES, key distribution.

Unit-2:
Introduction to prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm.

Unit-3:
Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, message digest algorithm, Secure hash algorithm (SHA). Digital Signatures: Digital Signatures, digital signature standards (DSS), digital signature algorithm.

Unit-4:
Authentication Applications: Kerberos and X.509, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit-5:
IP Security: Architecture, Authentication header, encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, System Security: Intruders, Viruses and related threats, firewall.

Text Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Fourth Edition, Pearson, 2006.
2. Atul Kahate,"Cryptography and Network Security", Third Edition, Mc. Graw Hill, 2014.
3. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag, 2001.
4. Bruce Schiener, "Applied Cryptography", Second Edition, Wiley, 2015.

Reference Books:

1. Oded Goldreich ,"Foundations of Cryptography", Cambridge University Press, 2001.
2. Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone, "A Handbook of Applied Cryptography", CRC Press, 1996.
3. Wembo Mao, "Modern Cryptography: Theory and Practice", Pearson Education, 2003.

Course Outcomes:

1. Understand and deploy cryptographic techniques to secure data in networks. (Understand, Apply)
2. Analyze the vulnerabilities in any computing system and design a security solution. (Apply, Analyze)
3. Understand and use standard algorithms for confidentiality, integrity, and authenticity. (Understand, Apply)
4. Apply various key distribution and management schemes in the network system. (Apply)
5. Apply security protocols in various IT applications. (Apply)

ADVANCED DATABASES (ECS-506)

C(L-T-P)
3(3-0-0)

Course Content:

Unit-1

Database System Applications Purpose of Database Systems, View of Data – Data Abstraction, Instances and Schemas, Data Models – the ER Model, Relational Model, Languages – DDL, DML, Transaction Management, Data Storage, Database Architecture, Database Users and Administrators, ER Model- ER Diagrams, Basic SQL Queries, Nested Queries, Complex Integrity Constraints in SQL, Triggers.

Unit-2

Relational Model: Introduction to the Relational Model – Integrity Constraints Over Relations, Enforcing Integrity constraints, Querying relational data, Logical database Design, Introduction to Schema Refinement – Functional Dependencies, Normal Forms – FIRST, SECOND, THIRD Normal forms, BCNF, Properties of Decompositions- Loss less- join Decomposition, Multi-valued Dependencies, FOURTH Normal Form, Join, Dependencies, FIFTH Normal form.

Unit-3

Transaction Management: The ACID Properties, Transactions and Schedules, Deadlocks, Concurrency Control: Serializability, and recoverability, Introduction to Lock Management, Lock Crash recovery: Introduction to Crash recovery.

Unit-4

Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Clustered Indexes, Primary and Secondary Indexes, Index data Structures, Hash-Based Indexing, Tree based Indexing, Storing data: Disks and Files: -The Memory Hierarchy

Unit-5

Distributed databases: Introduction to distributed databases, Distributed DBMS architectures, storing data in a distributed DBMS, Distributed catalog management, Distributed query processing Updating distributed data, Distributed transactions, Distributed concurrency control, and Distributed Recovery.

Text and Reference books:

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, TMH, 3rd Edition, 2003.
2. Database System Concepts, A. Silberschatz, H.F. Korth, S. Sudarshan, McGraw hill, VI editions, 2006.
3. Fundamentals of Database Systems 5th edition. Ramez Elmasri, Shamkant B.Navathe, Pearson Education, 2008.
4. Introduction to Database Systems, C. J. Date, Pearson Education, 8th Edition, 2003
5. Database Management System Oracle SQL and PL/SQL, P. K. Dass Gupta, PHI, e-book, 2013.
6. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning, 2008.

Course Outcomes:

1. Understand database systems, create ER models and write queries using relational algebra and SQL (understand, apply, analyze)
2. Create databases using Relational Model and normalizing databases to suitable normal forms (apply, analyze and create)
3. Understand the concept of transactions and concurrent transactions (understand, apply)
4. Understand and apply the data storage and indexing methods and study memory hierarchy (understand, apply, analyze)
5. Analyze various types of databases including distributed database environments (apply, analyze)

CLOUD COMPUTING (ECS-512)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1: Overview of Computing Paradigm
Recent trends in Computing Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing.

Introduction to Cloud Computing Cloud Computing (NIST Model) Introduction to Cloud Computing, Benefits of Cloud Computing.

Unit-2: Cloud Computing Architecture
Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community cloud.

Unit-3: Infrastructure as a Service (IaaS)
IaaS, virtualization, Different approaches to virtualization, Machine Image, Virtual Machine (VM) Resource Virtualization Server, Storage, Network Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service).

Platform as a Service (PaaS) PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management Computation Storage, SaaS, Web services.

Unit-4: Service Management in Cloud Computing
Service Level Agreements (SLAs), Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously Managing Data Looking at Data, Scalability & Cloud Services Database & Data Stores in Cloud Large Scale Data Processing

Unit-5: Cloud Security
Infrastructure Security Network level security, Host level security, Application-level security Data security and Storage Data privacy and security Issues, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud.

Text and Reference books:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Course Outcomes

1. Understand various basic concepts related to cloud computing technologies. (Understand)
2. Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS. (Understand)
3. Apply the underlying principle of cloud virtualization, cloud storage, data management and data visualization. (Apply)
4. Use different cloud service management terminologies. (Apply)
5. Design and deploy cloud computing security and risk measures (Analyze)

SOFTWARE REQUIREMENTS ENGINEERING AND RISK MANAGEMENT (ECS-514)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1: Introduction
Software Engineering Processes, Definition, Role, and Importance of Requirements Engineering, Requirements Engineering Activities and Processes, Types of Requirements (Functional vs. Non-Functional), Techniques for Writing High-Quality Requirements, Requirements Inception, Elicitation, Evaluation, and Documentation, Software Requirements Specification (SRS) Documentation Standards and Templates.

Unit-2: Requirements Analysis, Modeling, and Specification
Description vs. Specification, Modeling Techniques and Diagrammatic Notations, Domain Modeling, Use Case Modeling and Scenario Descriptions, UML Modeling, Analysis for Understanding the Domain and Requirements, and Formal Specification.

Unit-3: Requirements Verification and Validation
Requirements Verification vs. Validation, Techniques for Inspection, Verification, and Validation, Detection of Conflicts, Inconsistencies, and Completeness, Quality Assurance for Requirements.

Unit-4: Requirements Evolution and Management
Requirements Traceability, Priorities, Changes, Baselines, Reusing Requirements, foundation used to systematically establish, define, and manage the requirements for large, complex, and changing software-intensive systems from technical, organizational, and management perspectives.

Unit-5: Advanced Topics
Hazard Analysis and Safety-Critical System Requirements, Threat Modeling and Security-Critical System Requirements, Tool Support for Requirements Engineering, Open Research Problems in Requirements Engineering.

Text and Reference Books:

1. Requirements Engineering Fundamentals: A Study Guide for the Certified Professional for Requirements Engineering Exam - Foundation Level by Chris Rupp and Klaus Pohl, 2nd Edition, IREB Compliant, 2015.
2. Requirements Engineering by Jeremy Dick, Elizabeth Hull, and Ken Jackson, 4th Edition, Springer Publications, 2017.
3. Software Engineering: A Practitioner's Approach By Roger S. Pressman and Bruce Maxim McGraw-Hill Higher International; ISBN-10: 1259872971; ISBN-13: 978-1259872976, 9th Edition, 2014.
4. Software Engineering (10th Edition) by Ian Sommerville, Pearson; ISBN-10: 0133943038; ISBN-13: 978-0133943030, 2017.

Course Outcomes:

1. Understand the role of, and need for, requirements engineering and requirements elicitation, evaluation, documentation, and quality assurance.

2. Understand, prepare and use effective visual models, diagrams and notations in requirements analysis.
3. Describe and participate in requirements verification, validation, and traceability activities.
4. Prepare well-organized and maintainable software requirements documentation that can be reviewed, corrected, and (eventually) accepted by clients and stakeholders.
5. Create awareness about the latest and advanced tools and techniques of software requirements engineering.

DIGITAL IMAGE PROCESSING (ECS-516)

C(L T P)
3 (3-0-0)

Prerequisite: Fundamental knowledge of Computer Graphics, Linear Algebra, and Calculus.

Course Content:

Unit-1: Digital Image Fundamentals
Introduction to Digital Image Processing and its components, Image Sensing and Acquisition, Sampling and Quantization, Relationships between pixels, Two-dimensional mathematical preliminaries, Image transforms – DFT, DCT.

Unit-2: Image Enhancement
Spatial Domain transforms: Gray level transformations, Histogram processing, Frequency Domain transforms: Fourier Transform, Smoothening and Sharpening, Spatial Filtering, Frequency Domain Filters – Gaussian Lowpass and High pass Filters, Ideal, Butterworth, and Homomorphic Filtering.

Unit-3: Image Restoration
Image Restoration – degradation model, Properties, Noise models, Mean Filters, Order Statistics Adaptive filters, Band reject Filters, Band-pass Filters, Inverse Filtering, Wiener filtering.

Unit-4: Image Segmentation
Point detection, Edge detection, Edge linking, and boundary detection, Hough Transform, Similarity-based segmentation – Thresholding, Region growing, Region splitting and merging, Morphological processing-Erosion and Dilation, Opening, Closing, Boundary Extraction, Convex Hull, Thinning, Thickening.

Unit-5: Image Representation and Description
Image Understanding techniques- Boundary-based, Region-based, Topological Attributes, Geometric Attributes Description Boundary-based Description, Region-based Description.
Image processing research-based case study.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010
2. Digital Image Processing and Computer Vision, R.J. Schalkoff Published by: John Wiley and Sons, NY, 1989.
3. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
2. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
3. D, E. Dudgeon, and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, Digital Image Processing John Wiley, New York, 2002.

Online Source:

1. https://in.coursera.org/specializations/image-processing
2. https://www.udemy.com/topic/image-processing/

3. https://onlinecourses.nptel.ac.in/noc19_ee55/preview
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/digital-image-processing

Course Outcomes (COs):

To explain the fundamentals of Image processing in terms of various research application-based components and to develop an understanding of various tools applied in different image processing fields.

At the end of this course, students should be able to:

CO1	**Analyze and apply** the sampling and quantization techniques for the conversion of an analog image into digital form.	Analyze and apply	K3
CO2	**Understand and apply** the concept of Image enhancement in both spatial and transform domains using various techniques.	Understand and apply	K1, K2
CO3	**Analyze and evaluate** the effects of various filters to restore the image degraded under a noisy environment.	Analyze and evaluate	K3, K4
CO4	**Understand and apply** different techniques for image segmentation and morphological operations to improve image quality.	Understand and apply	K1, K2
CO5	**Analysis** of various image representation and description methods and a brief discussion on tools and techniques in multidisciplinary research fields.	Analysis	K3

K1-Understand, K2-Apply, K3-Analyse, K4-Evaluate,

STORAGE AREA NETWORKS (ECS 518)

C(L T P)
3 (3-0-0)

Course Content:

Unit 1

Introduction to evolution of storage architecture, key data centre elements, virtualization, and Cloud Computing. Key data centre elements – Host (or compute), connectivity, storage, and application in both classic and virtual environments. RAID implementations, techniques, and levels along with the impact of RAID on application performance. Components of intelligent storage systems and virtual storage provisioning and intelligent storage system implementations.

Unit 2

Storage Networking Technologies and Virtualization: Fibre Channel SAN components, connectivity options, and topologies including access protection mechanism 'zoning", FC protocol stack, addressing and operations, SAN-based virtualization and VSAN technology, iSCSI and FCIP protocols for storage access over IP network, Converged protocol FCoE and its components, Network Attached Storage (NAS) - components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.

Unit 3

Backup, Archive, and Replication: Information availability and business continuity solutions in both virtualized and non-virtualized environments. Business continuity terminologies, planning and solutions, Clustering and multipathing architecture to avoid single points of failure, Backup and recovery - methods, targets and topologies, Data deduplication and backup in virtualized environment, Fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection.

Unit 4

Cloud Computing Characteristics and benefits: Business drivers, definition, essential characteristics, and phases of journey to the Cloud., Business drivers for Cloud computing, Definition of Cloud computing, Characteristics of Cloud computing, Steps involved in transitioning from Classic data centre to Cloud computing environment Services and deployment models, Cloud infrastructure components, Cloud migration considerations.

Unit 5

Securing and Managing Storage Infrastructure: Framework and domains of storage security along with covering security. Implementation at storage networking. Security threats, and countermeasures in various domains Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle management (ILM) and storage tiering, Cloud service management activities

Text and Reference Books:

1. G. Somasundaram, A. Shrivastava, EMC Corporation: Information Storage and Management, 1st Edition, Wiley Publishing, 2009.
2. Clark Tom, Storage Virtualization, Addison Wesley Publishing Company, 2016.
3. Robert Spalding, Storage Networks: The Complete Reference, 1st Edition, TMH, 2003.

4. Meeta Gupta: Storage Area Network Fundamentals, 2nd Edition, Pearson Education Limited, 2002.

Course Outcomes:

1. Identify key challenges in managing information and analyze different storage networking technologies and virtualization (analyze, evaluate)
2. Explain components and the implementation of NAS (understand, apply)
3. Describe CAS architecture and types of archives and forms of virtualization (understand, apply)
4. Illustrate the storage infrastructure and management activities (evaluate)
5. Implementation of storage mechanism, understanding security threats and countermeasures (understand, apply)

REAL-TIME SYSTEMS (ECS-520)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1: Introduction

Definition, Issues in Real-Time Computing, Structure of a Real Time System, RTS Examples, Characterizing Real-Time System and Tasks, Performance Measures for RTS, Estimating Program Run Time.

Unit-2: Real-Time Scheduling

Common Approaches to Real-Time Scheduling Algorithms, Allowing for Precedence Constraints, Offline Versus Online Scheduling, and Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

Unit-3: Resources Access Control

Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance, and Priority-Ceiling Protocols, Use of Priority-Ceiling Protocol in Dynamic n-Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects, Real-Time Databases

Unit-4: Real Time Communication

Network Topologies, Protocols, Real Time Communication over LAN and Internet, Routing, Resource Reservation, Traffic Shaping and Policing, Quality of Service Model.

Unit -5: Fault Tolerance Techniques

Introduction, What causes Failure, Fault types, Fault detection, Fault and error containment, Redundancy, Data Diversity, Reversal Checks, Malicious or Byzantine Failure, Integrated Failure Handling.

Text and Reference Books:

1. Real-Time Systems by Jane W. S. Liu, Pearson Education Publication, 2000.
2. Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, JohnWiley Publications. 2002.
3. Real-Time Systems, C.M. Krishna, Kang G. Shin, McGraw Hill.2017.
4. Real-Time Systems: Theory and Practice by Rajib Mall, Pearson.2006.

Course Outcomes:

1. Understand the characteristics of Real-Time Systems and their applications in various fields,
   (Understand)
2. Understand various Scheduling Algorithms for real-time systems and apply the appropriate oneto prepare a feasible Schedule for a given task set. (Understand, Apply)
3. Apply precedence constraints and mutual exclusion constraints to a given Real-Time Schedule.(Apply)
4. Understand Distributed and Network related issues for Distributed Real-Time Systems.(Understand)
5. Understand various causes of Failures and Faults in Real-Time Systems and appreciate various techniques to avoid these faults and failures.

MACHINE LEARNING (ECS-522)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1
Introduction, Learning Paradigms, Ingredients of Learning, Designing a Learning System, The Concept Learning

Unit-2
Linear Regression: Single Variable and Multivariate, Cost Function, Parameter Learning: Gradient Descent and Analytical, Polynomial Regression, Logistic Regression Model, Regularization

Unit-3
Instance based Learning: K-Nearest Neighbor Learning, Decision Tree Learning, Multiclass Classification, Evaluation of Hypothesis, Comparing Learning Algorithms

Unit-4
Neural Networks, Perceptron, Multilayer Perceptron, Introduction to Deep Learning, Bayesian Learning, EM Algorithm, HMM

Unit-5
Support Vector Machine, Kernel Machines, Unsupervised Learning: Clustering, Dimensionality Reduction, Reinforcement Learning, Q Learning

Text and References Books:

1. Tom. M. Mitchell, Machine Learning, McGraw Hill International Edition, 2017.
2. Pattern Classification - Duda, Hart and Stork (DHS), 2006.
3. Ethern Alpaydin, Introduction to Machine Learning. Eastern Economy Edition, Prentice Hall of India, 2015.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag. 2016
5. The Elements of Statistical Learning - Hastie, Tibshirani, Friedman (HTF) 2017.

Course Outcomes:

1. Learn the Machine Learning problems, and various paradigms to solve them
2. Understand Linear Regression and approaches to optimize a cost function
3. Apply and analyze various algorithms of KNN, Decision Tree based learning
4. Analyze the concept of neural networks for learning linear and non-linear activation functions.
5. Learn the concepts in Bayesian analysis from probability models and methods
6. Apply and analyze various algorithms for SVM, Reinforcement Learning, and Clustering,

DIGITAL FORENSICS (ECS-526)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1
Evidential potential of digital devices: closed vs. open systems, evaluating digital evidence potential- Device handling: seizure issues, device identification, networked devices and contamination. Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations)

Unit-2
Digital forensics examination principles: Previewing, imaging, continuity, hashing and evidence locations- Seven element security model- developmental model of digital systems audit and logs- Evidence interpretation: Data content and context.

Unit-3
Live Data collection and investigating windows environment: windows Registry analysis, Gathering Tools to create a response toolkit (Built in tools like netstat, cmd.exe, nbtstat, arp, md5sum, regdmp, etc and tools available as freeware like Fport, Pslist etc), Obtaining volatile Data (tools like coffee, Helix can be used) Computer forensics in windows environment, Log analysis and event viewer, File auditing, identifying rogue machines, hidden files and unauthorized access points

Unit-4
Live Data collection and investigating Unix/Linux environment: /Proc file system overview, Gathering Tools to create a response toolkit (Built-in tools like losetup, Vnode, netstat, df, md5sum, strace etc and tools available as freeware like Encase, Carbonite etc). Handling Investigations in Unix/Linux Environment: Log Analysis (Network, host, user logging details), Recording incident time/date stamps, Identifying rogue processes, unauthorized access points, unauthorized user/group accounts,

Unit-5
Forensic Tools and Report Generation: Recovery of Deleted files in windows and Unix, Analyzing network traffic, sniffers, Ethical Hacking, Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap, Netscan etc. Password recovery (tools like John the ripper, L0phtcrack, and THC-Hydra), Mobile forensic tools and analysis of called data record Template for computer forensic reports

Text and References Books:

1. Incident Response & Computer Forensics. Mandia, k, Prosise, c, Pepe, m. 2nd edition. TataMcGraw Hill, 2003.
2. Guide to Computer Forensics and Investigations, 2nd edition, Bill Nelson, Amelia Phillips, Frank Enfinger, and Chris Steuart, Thomson Learning, 2009.
3. Digital Evidence and Computer Crime, 2nd Edition, Eoghan Casey , academic Press File System Forensic Analysis by Brian Carrier , addition Wesley, 2011.
4. Windows Forensic Analysis DVD Toolkit (Book with DVD-ROM), Harlan Carvey, syngress Publication, 2007.
5. EnCE: The Official EnCase Certified Examiner Study Guide, 2nd Edition, Steve Bunting,

sybex Publication, 2004.

Course Outcomes:

1. To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
2. To understand how to examine digital evidences such as the data acquisition, identification analysis.
3. Know how to apply forensic analysis in Windows environment to recover important evidence for identifying computer crime.
4. Know how to apply forensic analysis in Linux/Unix environment to recover important evidence for identifying computer crime.
5. To be well-trained as next-generation computer crime investigators.

HIGH-PERFORMANCE NETWORKING (ECS-528)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1: Introduction

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET, DWDM, DSL, ISDN, BISDN,ATM.

Unit-2: MULTIMEDIA NETWORKING APPLICATIONS

Streaming stored Audio and Video, Best effort service, protocols for real-time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP, differentiated services.

Unit-3: ADVANCED NETWORKS CONCEPTS

VPN, Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS-based VPN, overlay networks-P2P connections.

Unit-4: TRAFFIC MODELLING

Little's theorem, Need for modeling, Poisson modeling and its failure, Non - Poisson models, and Network performance evaluation.

Unit-5: NETWORK SECURITY AND MANAGEMENT

Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and: firewalls – attacks and counter measures, security in many layers. Infrastructure for network management, The internet standard management framework, SMI, MIB, SNMP, Security and administration, ASN.1

REFERENCES:

Text Books

1. J.F. Kurose & K.W. Ross,"Computer Networking- A top down approach featuring the internet", Pearson, 2nd edition, 2003.
2. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
3. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint 2002.

Reference Books

1. Aunurag kumar, D. MAnjunath, Joy kuri, "Communication Networking", Morgan Kaufmann Publishers, 1ed 2004.
2. Hersent Gurle & petit, "IP Telephony, packet Pored Multimedia communication Systems",Pearson education 2003.
3. Fred Halsall and Lingana Gouda Kulkarni,"Computer Networking and the Internet" fifth edition, Pearson education, 2005.

Course Outcomes:

1. To develop a comprehensive understanding of multimedia networking
2. To study the types of VPN
3. Understand tunneling protocols for security
4. To apply network security in many layers
5. Understand and implement network management

EMBEDDED SYSTEMS(ECS-530)

C(L T P)
3 (3-0-0)

Course Content:

Unit-1
Introduction to Embedded Systems: Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

Unit-2
Embedded Networking: Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter-Integrated Circuits (I2C) –the need for device drivers.

Unit-3
Embedded Firmware Development Environment: Embedded Product Development Life Cycle objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object-oriented Model.

Unit-4
RTOS-Based Embedded System Design: Introduction to basic concepts of RTOS Task, process & threads, interrupt routines in RTOS, Multiprocessing, and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter-process Communication.

Unit-5
Embedded System Application Development: Design issues and techniques Case Study of Washing Machine- Automotive Application- Smart card System Application.

Text and References Books:

1. Wayne Wolf, 'Computers as Components: Principles of Embedded Computer System Design', Elsevier, 2006.
2. Michael J. Pont, 'Embedded C', Pearson Education, 2007.
3. Steve Heath, 'Embedded System Design', Elsevier, 2005.
4. Muhammed Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems', Pearson Education, Second edition, 2007.

Course Outcomes:

1. Understand the basics of embedded systems and their structural units.
2. Analyze the embedded system specification and develop software programs.
3. Evaluate the requirements of the programming embedded systems and related software architecture.
4. Understand the RTOS-based embedded system design.
5. Understand all the applications of the embedded system and design issues.