

Osmania University  
Faculty of Informatics

# Master of Computer Applications (MCA)

CBCS (Choice-Based Credit System) Syllabus

Semester III and IV

With effect from the academic year 2025-2026

Under R24 Academic Regulations  
(Applicable to Students Admitted  
from the Academic Year 2024-2026)



Faculty of Informatics  
Osmania University  
2025-2026

Dr. L.K. Suresh Kumar, CBoS, Fol.

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Board of Studies (IT)  
Dept. of Computer Science & Engg.  
University College of Engineering  
Osmania University, Hyd-500 007.

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Faculty of Informatics  
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## GENERAL COURSE STRUCTURE

## Definition of Credit

| Type                             | Credit     |
|----------------------------------|------------|
| 1 Hr. Lecture (L)<br>per week    | 1 Credit   |
| 1 Hr. Tutorial (T)<br>per week   | 1 Credit   |
| 1 Hr. Practical (P)<br>per week  | 0.5 Credit |
| 2 Hours Practical(P)<br>per week | 1 Credit   |

## Abbreviation and Definition

| Abbreviations | Definitions                    |
|---------------|--------------------------------|
| PCC           | Professional Core Course       |
| PEC           | Professional Elective Course   |
| MGC           | Management Course              |
| LCC           | Laboratory Core Course         |
| CIE           | Continuous Internal Evaluation |
| SEE           | Semester End Evaluation        |
| L             | Lecture Hours/Week             |
| T             | Tutorial Hours/Week            |
| P             | Practical Hours/Week           |
| Cr            | Credits                        |

## Scheme of Examination

|            | CIE-Marks | SEE-Marks | CIE-Duration | SEE-Duration |
|------------|-----------|-----------|--------------|--------------|
| Theory     | 30        | 70        | 1 hr         | 3hrs         |
| Practical  | 25        | 50        | 2 hr         | 3hrs         |
| Internship | 50        | -         | 3hrs         | -            |
| Project    | 50        | 100       | 3hrs         | 3hrs         |

## Credit Table R24(2024-2026)

| Semester | Credits |
|----------|---------|
| I        | 28.5    |
| II       | 28.5    |
| III      | 28      |
| IV       | 20      |
| Total    | 105     |

  
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**Master of Computer Applications (MCA)**  
**Semester - III**

| Course Code              | Course Title                      | L  | P | Credits | CIE Marks | SEE Marks |
|--------------------------|-----------------------------------|----|---|---------|-----------|-----------|
| THEORY                   |                                   |    |   |         |           |           |
| PCC 301                  | Software Engineering              | 4  | - | 4       | 30        | 70        |
| PCC 302                  | Computer Networks                 | 4  | - | 4       | 30        | 70        |
| PCC 303                  | Artificial Intelligence           | 4  | - | 4       | 30        | 70        |
| PCC 304                  | Full Stack Development            | 4  | - | 4       | 30        | 70        |
| PROFESSIONAL ELECTIVE-I  |                                   |    |   |         |           |           |
| PEC 311                  | Digital Forensics                 | 3  | - | 3       | 30        | 70        |
| PEC 312                  | Distributed Systems               |    |   |         |           |           |
| PEC 313                  | Internet of Things                |    |   |         |           |           |
| PEC 314                  | Image Processing                  |    |   |         |           |           |
| PEC 315                  | Dev Ops Methodology               |    |   |         |           |           |
| PROFESSIONAL ELECTIVE-II |                                   |    |   |         |           |           |
| PEC 321                  | Network Security                  | 3  | - | 3       | 30        | 70        |
| PEC 322                  | Optimization Techniques           |    |   |         |           |           |
| PEC 323                  | Deep Learning                     |    |   |         |           |           |
| PEC 324                  | Information Retrieval System      |    |   |         |           |           |
| PEC 325                  | Data Visualization                |    |   |         |           |           |
| PRACTICALS               |                                   |    |   |         |           |           |
| LCC351                   | Computer Networks Laboratory      | -  | 3 | 1.5     | 25        | 50        |
| LCC352                   | Software Engineering Laboratory   | -  | 3 | 1.5     | 25        | 50        |
| LCC353                   | Full Stack Development Laboratory | -  | 3 | 1.5     | 25        | 50        |
| SIP321                   | Summer Internship                 | -  | - | 1.5     | 50        | -         |
| TOTAL                    |                                   | 20 | 9 | 28      | 305       | 570       |

  
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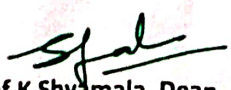
**Master of Computer Applications (MCA)  
Semester IV**

| Course Code               | Course Title                          | L | P  | Credits | CIE Marks | SEE Marks |
|---------------------------|---------------------------------------|---|----|---------|-----------|-----------|
| THEORY                    |                                       |   |    |         |           |           |
| PROFESSIONAL ELECTIVE-III |                                       |   |    |         |           |           |
| PEC411                    | IoT Security                          | 3 | -  | 3       | 30        | 70        |
| PEC412                    | Generative AI                         |   |    |         |           |           |
| PEC413                    | Cloud Computing                       |   |    |         |           |           |
| PEC414                    | Natural Language Processing           |   |    |         |           |           |
| PEC415                    | Block Chain Technologies              |   |    |         |           |           |
| PROFESSIONAL ELECTIVE-IV  |                                       |   |    |         |           |           |
| PEC421                    | Software Quality and Testing          | 3 | -  | 3       | 30        | 70        |
| PEC422                    | Big Data Analytics                    |   |    |         |           |           |
| PEC423                    | Database Security                     |   |    |         |           |           |
| PEC424                    | UI/UX                                 |   |    |         |           |           |
| PEC425                    | Augmented Reality and Virtual Reality |   |    |         |           |           |
| OPEN ELECTIVE             |                                       |   |    |         |           |           |
| OE431                     | Professional Ethics                   | 2 | -  | 2       | 30        | 70        |
| OE432                     | Constitution of India                 |   |    |         |           |           |
| OE433                     | Disaster Management                   |   |    |         |           |           |
| OE434                     | Organization Behaviour                |   |    |         |           |           |
| OE435                     | Intellectual Property and Cyber Law   |   |    |         |           |           |
| OE436                     | Environmental Science                 |   |    |         |           |           |
| PRACTICALS                |                                       |   |    |         |           |           |
| Proj401                   | Project Work                          | - | 24 | 12      | 50        | 100       |
| TOTAL                     |                                       | 8 | 24 | 20      | 140       | 310       |

  
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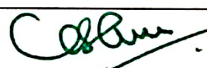
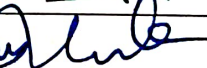
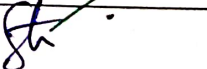
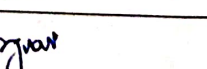
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## Master of Computer Applications (MCA)

## Semester - III

| Course Code              | Course Title                      | L  | P | Credits | CIE Marks | SEE Marks |
|--------------------------|-----------------------------------|----|---|---------|-----------|-----------|
| THEORY                   |                                   |    |   |         |           |           |
| PCC 301                  | Software Engineering              | 4  | - | 4       | 30        | 70        |
| PCC 302                  | Computer Networks                 | 4  | - | 4       | 30        | 70        |
| PCC 303                  | Artificial Intelligence           | 4  | - | 4       | 30        | 70        |
| PCC 304                  | Full Stack Development            | 4  | - | 4       | 30        | 70        |
| PROFESSIONAL ELECTIVE-I  |                                   |    |   |         |           |           |
| PEC 311                  | Digital Forensics                 | 3  | - | 3       | 30        | 70        |
| PEC 312                  | Distributed Systems               |    |   |         |           |           |
| PEC 313                  | Internet of Things                |    |   |         |           |           |
| PEC 314                  | Image Processing                  |    |   |         |           |           |
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| PEC 324                  | Information Retrieval System      |    |   |         |           |           |
| PEC 325                  | Data Visualization                |    |   |         |           |           |
| PRACTICALS               |                                   |    |   |         |           |           |
| LCC351                   | Computer Networks Laboratory      | -  | 3 | 1.5     | 25        | 50        |
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| LCC353                   | Full Stack Development Laboratory | -  | 3 | 1.5     | 25        | 50        |
| SIP321                   | Summer Internship                 | -  | - | 1.5     | 50        | -         |
| TOTAL                    |                                   | 20 | 9 | 28      | 305       | 570       |

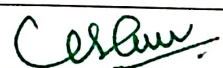
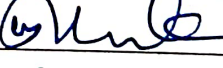
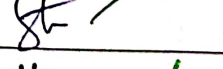
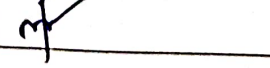
| S. No. | Name of the Member                                       | Signature                                                                             |
|--------|----------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1      | The Dean,<br>Faculty of Engineering, OU                  |  |
| 2      | The Dean,<br>Faculty of Management, OU                   |  |
| 3      | The Dean,<br>Faculty of Commerce, OU                     |  |
| 4      | The CBoS in CSE, OU                                      |  |
| 5      | The CBoS in Informatics, OU                              |  |
| 6      | The Chairperson,<br>Board of Studies in Commerce, OU     |  |
| 7      | Dr.B.Sujatha, Asst. Professor<br>Dept. of CSE, UCE, OU   |  |
| 8      | Dr.M.A.Hameed, Asst. Professor<br>Dept. of CSE, UCE, OU  |  |
| 9      | Mrs.E.Pragnavi, Asst. Professor<br>Dept. of CSE, UCE, OU |  |



## Master of Computer Applications (MCA)

## Semester IV

| Course Code               | Course Title                          | L | P  | Credits | CIE Marks | SEE Marks |
|---------------------------|---------------------------------------|---|----|---------|-----------|-----------|
| THEORY                    |                                       |   |    |         |           |           |
| PROFESSIONAL ELECTIVE-III |                                       |   |    |         |           |           |
| PEC411                    | IoT Security                          | 3 | -  | 3       | 30        | 70        |
| PEC412                    | Generative AI                         |   |    |         |           |           |
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| PRACTICALS                |                                       |   |    |         |           |           |
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| 3      | The Dean,<br>Faculty of Commerce, OU                     |  |
| 4      | The CBoS in CSE, OU                                      |  |
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PCC301

Software Engineering

4 Credits

**Course Objectives**

1. Learn the software problem and address it through various software processes
2. Study the Software Requirements Specification (SRS) and software architecture
3. Understand planning and designing a software project
4. Comprehend testing strategies and recognize the need for performing testing
5. Learn how to carry out reengineering and maintain the system

**Course Outcomes**

1. Apply software processes to solve real-world software problems
2. Create SRS documents and design suitable software architecture
3. Perform software planning in terms of staffing and scheduling
4. Create effective test cases and testing procedures
5. Re-engineer and maintain the developed software systems

**Unit I**

The software problem - Cost, schedule and quality, scale and change , Software processes - Process and project, component software processes Software development process models, Project management process

**Unit II**

Software requirements analysis and specification - Value of a good SRS, requirements process, requirements specification, functional specification with use cases, other approaches for analysis Software architecture - Role of software architecture views, component and connector view, architectural styles for C&C view, documenting architecture design, evaluating architectures

**Unit III**

Planning software project - Effort estimation, project schedule and staffing, quality planning, risk management planning, project monitoring plan, detailed scheduling Design - Design concepts, function-oriented design, object-oriented design, detailed design, verification, metrics

**Unit IV**

Coding and unit testing - Programming principles and guidelines, incrementally developing code, managing evolving code, unit testing, code inspection, metrics Testing - Testing concepts, testing process, black box testing, white box testing, metrics

**Unit V**

Maintenance and re-engineering - Software maintenance, supportability, reengineering, business process reengineering, software reengineering, reverse engineering, restructuring, forward engineering, economics of reengineering Software process improvement - Introduction, SPI process, CMMI, PCMM, other SPI frameworks, SPI return on investment, SPI trends



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Prof K Shyamala, Dean, FoI

Dean,  
Faculty of Informatics  
Osmania University  
Hyd-500 007.

**Suggested Readings**

1. Pankaj Jalote, *Software Engineering – A Precise Approach*, Wiley India, 2010
2. Roger S. Pressman, *Software Engineering – A Practitioner's Approach*, 7<sup>th</sup> Edition, McGraw Hill, 2010
3. Deepak Jain, *Software Engineering*, Oxford University Press, 2008
4. Rajib Mall, *Fundamentals of Software Engineering*, 4<sup>th</sup> Edition, PHI Learning, 2014
5. Ian Sommerville, *Software Engineering*, 10<sup>th</sup> Edition, Addison Wesley, 2015



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**Course Objectives**

1. Comprehend the fundamentals of computer networks
2. Learn the aspects relevant to physical and data-link layer
3. Understand network layer and its significance and functionality
4. Study transport layer and its operations
5. Learn the protocols implemented at application layer

**Course Outcomes**

1. Elaborate the network model
2. Analyse the transmission media and functions of data-link layer
3. Create routing tables based on DVR and LSR
4. Distinguish the functions of TCP and UDP protocols
5. Design the application layer protocols

**Unit I**

Data communications - Components, direction of data flow, networks, components and categories, types of connections, topologies, protocols and standards, ISO/OSI model, TCP/IP  
Transmission media - Coaxial cable, fiber optics, line coding, modems, RS232 interfacing

**Unit II**

Data link layer - Error detection and correction, CRC, Hamming code, flow control and error control, stop and wait protocol, sliding window protocol, go back-N ARQ, selective repeat ARQ  
MAC layer - LAN, pure and slotted ALOHA, Ethernet IEEE 802.3, LAN Ethernet efficiency calculation, bridges, ARP, RARP

**Unit III**

Network layer - Distance vector routing, link state routing, IPv4 addressing, subnetting, CIDR, introduction to IPv6 and Protocols - ICMP, IGMP, OSPF, BGP

**Unit IV**

Transport layer - Services of transport layer, multiplexing, Transmission Control Protocol (TCP), congestion control, timer management, Quality of Service (QoS), User Datagram Protocol (UDP)

**Unit V**

Socket programming - Primitive and advanced system calls, iterative and concurrent client-server programs and Application layer - Domain Name Space (DNS), SMTP, FTP, HTTP

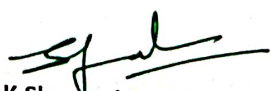
**Suggested Readings**

1. Andrew S. Tanenbaum, *Computer Networks*, Pearson Education, Fourth Edition, 2008
2. Behrouz A. Forouzan, *Data Communication and Networking*, Tata McGraw-Hill, 2009
3. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach Featuring the Internet*, Pearson Education, 2006
4. W. Richard Stevens, *Unix Network Programming*, PHI, 2003

  
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PCC303

Artificial Intelligence

4 Credits

**Course Objectives**

1. To introduce the fundamental concepts of Artificial Intelligence, problem-solving techniques, and heuristic-based search strategies
2. To provide a strong foundation in logic-based reasoning, logic programming, and knowledge representation methods
3. To explore expert systems, their architecture, and methods for handling uncertainty using probabilistic reasoning models
4. To understand core machine learning paradigms, including supervised, unsupervised learning, and artificial neural networks
5. To introduce advanced knowledge representation and processing techniques, including case grammars, semantic web, and natural language processing

**Course Outcomes**

1. Analyze AI systems using state-space representations, search algorithms, and game playing strategies like alpha-beta pruning
2. Apply propositional and predicate logic for reasoning and demonstrate knowledge representation using semantic networks and frames
3. Design and evaluate expert systems and apply uncertainty reasoning techniques like Bayesian networks and Dempster-Shafer theory
4. Distinguish between machine learning models and develop basic ANN models for classification, clustering, and pattern recognition tasks
5. Apply techniques of advanced knowledge representation and natural language processing for understanding and modeling human language

**Unit I**

Introduction - History, intelligent systems, foundations of AI, sub-areas of AI, applications, problem solving State-space search and control strategies - Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening, A\*, constraint Satisfaction Game playing - Bounded look-ahead strategy and use of evaluation functions, alpha-beta pruning.

**Unit II**

Logic concepts and logic programming - Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic, logic programming Knowledge representation - Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames

  
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**Unit III**

Expert system and applications - Introduction, phases in building expert systems, expert system architecture, expert systems vs traditional systems, truth maintenance systems, application of expert systems, list of shells and tools. Uncertainty measure - Probability theory - Introduction, probability theory, Bayesian belief networks, certainty factor theory, Dempster-Shafer theory

**Unit IV**

Machine-learning paradigms - Introduction, machine learning systems, supervised and unsupervised learning, inductive learning, learning decision trees, deductive learning, clustering, support vector machines. Artificial neural networks - Introduction, artificial neural networks, single-layer feed-forward networks, multi-layer feed-forward networks, radial-basis function networks, design issues of artificial neural networks, recurrent networks

**Unit V**

Advanced knowledge representation techniques - Case grammars, semantic web  
Natural language processing - Introduction, sentence analysis phases, grammars and parsers, types of parsers, semantic analysis, universal networking knowledge.

**Suggested Readings**

1. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning, 2011
2. Russell, Norvig, *Artificial Intelligence – A Modern Approach*, Pearson Education, 2<sup>nd</sup> Edition, 2004
3. Rich, Knight, Nair, *Artificial Intelligence*, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2009



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**Course Objectives**

1. To introduce the foundational concepts of web development, including HTML, CSS, and version control.
2. To develop interactive frontend applications using JavaScript, jQuery, and AJAX, and to manage data with JSON
3. To impart practical knowledge of building single-page applications using React and Redux architecture
4. To train students in backend development using Java programming, Spring framework, and RESTful API design
5. To provide an understanding of relational databases, SQL, Spring JDBC, and cloud deployment strategies in agile environments

**Course Outcomes**

1. Demonstrate proficiency in creating web pages using HTML, CSS, and version control systems like GitHub
2. Apply JavaScript and jQuery concepts to create dynamic user interfaces and manage asynchronous data exchange
3. Develop and manage frontend applications using React, React Router, and Redux for efficient client-server communication
4. Build secure and scalable backend applications using Java, Spring MVC, and RESTful services
5. Design and deploy full-stack applications with normalized relational databases and cloud-based deployment practices

**Unit I**

Web development basics - HTML and web servers, shell, UNIX CLI, version control using Git and GitHub, HTML, CSS

**Unit II**

Frontend development - JavaScript basics, OOPS aspects of JavaScript, memory usage and functions in JavaScript, AJAX for data exchange with server, jQuery framework, jQuery events, UI components, JSON data format

**Unit III**

React JS - Introduction to React, Router and single-page applications, React forms, flow architecture, introduction to Redux, advanced Redux, client-server communication

  
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**Unit IV**

Java web development - Java programming basics, Model View Controller (MVC) pattern, MVC architecture using Spring, RESTful API using Spring framework, building an application using Maven

**Unit V**

Databases and deployment - Relational schemas and normalization, Structured Query Language (SQL), data persistence using Spring JDBC, agile development principles, deploying applications in cloud

**Suggested Readings**

1. Jon Duckett , "*Web Design with HTML, CSS, JavaScript and jQuery Set*", Wiley Publications, 2014
2. Nicholas C. Zakas, "*Professional JavaScript for Web Developers*", Wiley Publications, 2012.
3. Robin Nixon, "*Learning PHP, MySQL, JavaScript, CSS and HTML5: A Step-by-Step Guide to Creating Dynamic Websites*", Oielly, 7<sup>th</sup> Edition, 2025
4. Azat Mardan , "*Full Stack JavaScript: Learn Backbone.js, Node.js and Mongo DB*" , Apress, 2018.

## PROFESSIONAL ELECTIVE – I

PEC 311

Digital Forensics

3 Credits

## Course Objectives

1. To introduce the fundamentals of computer forensics, its benefits, and legal aspects related to cybercrime and digital evidence
2. To provide knowledge on corporate investigation procedures and the tools used in digital evidence recovery
3. To train students in data acquisition methods, validation of digital evidence, and use of specialized tools
4. To develop skills for processing digital crime scenes, securing and preserving electronic evidence, and reviewing forensic cases
5. To explore current computer forensics tools, email investigation techniques, and handling of data-hiding and remote acquisition challenges

## Course Outcomes

1. Understand core concepts of computer forensics and identify legal and ethical issues in handling digital evidence
2. Apply structured approaches for conducting high-tech investigations and use data recovery tools effectively
3. Acquire and validate digital evidence from various storage systems using appropriate forensic acquisition techniques
4. Secure and analyse digital crime scenes and handle evidence in compliance with forensic best practices
5. Use modern forensic tools for analysis, investigate email-based crimes, and address data-hiding and remote access challenges

## Unit I

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

## Unit II

Understanding computing investigations - Procedure for corporate high-tech investigations, understanding data recovery workstation and software, conducting an investigation

## Unit III

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 acquisition tools



#### Unit IV

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

#### Unit V

Current computer forensics tools - Software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions Email investigations - Investigating email crime and violations, understanding email servers, specialized email forensics tools

#### Suggested Readings

1. Warren G. Kruse II and Jay 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*, 2<sup>nd</sup> Edition, Thomson Course Technology, 2006.
3. Vacca, J., *Computer Forensics: Computer Crime Scene Investigation*, 2<sup>nd</sup> Edition, Charles River Media, 2005.



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## PROFESSIONAL ELECTIVE – I

|         |                     |           |
|---------|---------------------|-----------|
| PEC 312 | Distributed Systems | 3 Credits |
|---------|---------------------|-----------|

## Course Objectives

1. Understand the architecture, processes and communication of distributed system
2. Learn the naming and synchronization strategies
3. Study fault tolerance, and distributed object-based system
4. Learn distributed file system and distributed web-based system
5. Comprehend the distributed coordination-based system and map reduce

## Course Outcomes

1. Explain the architecture, processes and communication of distributed system
2. Elaborate the naming and synchronization strategies
3. Describe the fault tolerance and distributed object-based system
4. Discuss the distributed file system and distributed web-based system
5. Explain distributed coordination-based system and map reduce

## Unit I

Introduction - Goals and types of distributed systems Architectures - Architectural styles, system architectures, architectures versus middleware, self-management in distributed systems. Processes - Threads, virtualization, clients, servers, code migration. Communication - Fundamentals, remote procedure call, message-oriented communication, stream-oriented communication, multicast communication

## Unit II

Naming - Names, identifiers and addresses, flat naming, structured naming, attribute-based naming Synchronization - Clock synchronization, logical clocks, mutual exclusion, global positioning of nodes, election algorithms, Consistency and replication - Introduction, data-centric consistency models, client-centric consistency models, replica management, consistency protocols.

## Unit III

Fault tolerance - Introduction to fault tolerance, process resilience, reliable client-server Communication, reliable group communication, distributed commit and recovery . Distributed object-based systems - Architecture, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security

## Unit IV

Distributed file systems - Architecture, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security. Distributed web-based systems - Architecture, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security

## Unit V

Distributed coordination-based systems - Introduction to coordination models, architecture, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security Map-reduce - Example, scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce, Mapreduce.net, Pig and Hive

## Suggested Readings

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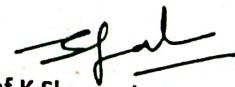


1. Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems*, PHI, 2<sup>nd</sup> Edition, 2009.
2. R. Hill, L. Hirsch, P. Lake, S. Moshiri, *Guide to Cloud Computing, Principles and Practice*, Springer, 2013.
3. R. Buyya, J. Borberg, A. Goscinski, *Cloud Computing – Principles and Paradigms*, Wiley, 2013.



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## PROFESSIONAL ELECTIVE – I

PEC 313

Internet of Things

3 Credits

## Course Objectives

1. Discuss fundamentals of IoT and its applications and requisite infrastructure
2. Describe internet principles and communication technologies relevant to IoT
3. Discuss hardware and software aspects of designing an IoT system
4. Describe concepts of cloud computing and data analytics
5. Discuss business models and manufacturing strategies of IoT products

## Course Outcomes

1. Understand the various applications of IoT and other enabling technologies
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product

## Unit I

Introduction to Internet of Things (IoT) – Characteristics of IoT. IoT architecture and components . protocols and programming framework for IoT. IoT Applications.

## Unit II

Internet principles and communication technology - Internet communications overview, IP, TCP, IP protocol suite, UDP, IP addresses, DNS, static and dynamic IP addresses, MAC addresses, TCP and UDP ports, application layer protocols HTTP and HTTPS, cost versus ease of production, prototypes and production, open-source versus closed-source.

## Unit III

Prototyping and programming for IoT - Prototyping embedded devices, sensors, actuators, microcontrollers, SoC, choosing a platform, prototyping hardware platforms, Arduino, Raspberry Pi Prototyping the physical design - Laser cutting, 3D printing, CNC milling Techniques for writing. embedded C code - Integer data types in C, manipulating bits using AND, OR, XOR, NOT, reading and writing from I/O ports, Simple embedded C programs - LED blinking, control of motor using switch, temperature sensor with Arduino board.

## Unit IV

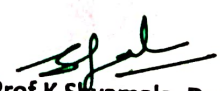
IoT product manufacturing - From prototype to reality, business model for IoT product manufacturing, business model canvas, funding an IoT startup, mass manufacturing, designing kits, designing PCB, 3D printing, certification, scaling up software. Ethical issues in IoT - Privacy, control, environment, solutions to ethical issues.



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Unit V

Security and Privacy in the IoT: Security Issues in IoT, Cloud and Fog Computing, IoT practice.

Suggested Readings

1. *Designing the Internet of Things*, Adrian McEwen, Hakim Cassimally, Wiley India Publishers, 2013.
2. Kamlesh Lakhawani, Hemant Kumar Gianey, Joseph Kofi Wireko, " *Internet of Things (IOT)*, BPB Publications, 2020.
3. Simon Cirani, Gianluigi Ferrari et al, " *Internet of Things*" Wiley Publishers, 2020



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**PROFESSIONAL ELECTIVE – I****PEC 314****Image Processing****3 Credits****Course Objectives**

1. Understand image processing fundamentals
2. Understand image transforms
3. Understand image enhancement
4. Understand image restoration and feature extraction
5. Understand image reconstruction

**Course Outcomes**

1. Learn image processing fundamentals
2. Learn image transforms
3. Learn image enhancement
4. Learn image restoration and feature extraction
5. Learn image reconstruction

**Unit I**

Fundamentals - Need for digital image processing, fundamental steps in digital image processing, elements of visual perception, image sensing and acquisition, image sampling and quantization, imaging geometry, discrete image mathematical characterization

**Unit II**

Image transforms - Two-dimensional Fourier transform, properties, fast Fourier transform, inverse FFT, discrete cosine transform, Karhunen-Loeve (KL) transform, discrete short time Fourier transform, wavelet transform, discrete wavelet transform, application of wavelet transform in compression

**Unit III**

Image enhancement - Spatial domain - Basic relationship between pixels, basic gray level transformations, histogram processing, smoothing spatial filters, sharpening spatial filters  
Frequency domain - Smoothing frequency domain filters, sharpening frequency domain filters, homomorphic filtering.

**Unit IV**

Image restoration - Overview of degradation models, unconstrained and constrained restorations, inverse filtering, Wiener filter. Feature extraction - Detection of discontinuities, edge linking and boundary detection, thresholding, edge-based segmentation, region-based segmentation, matching, advanced optimal border and surface detection, use of motion in segmentation, Image morphology - Boundary descriptors, regional descriptors

**Unit V**

Image reconstruction from projections - Need for reconstruction, Radon transform, back projection operator, projection theorem, inverse Radon transform.



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**Suggested Readings**

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson Education, 2<sup>nd</sup> Edition, 2011.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson Education, 2003
3. B. Chanda and D. Dutta Majumder, *Digital Image Processing and Analysis*, Prentice Hall of India, 2011.
4. William K. Pratt, *Digital Image Processing*, John Wiley & Sons, 2<sup>nd</sup> Edition, 2013.

  
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## PROFESSIONAL ELECTIVE – I

PEC 315

Dev Ops Methodology

3 Credits

## Course Objectives

1. To describe the agile relationship between development and IT operations
2. To know the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability
3. To explore project management tools and system integration
4. To impart testing tools, automation, and deployment of the system

## Course Outcomes

1. Explore various components of Dev Ops environment
2. Identify software development models and architectures of Dev Ops
3. Apply different project management models
4. Investigate different Dev Ops software development models, integration, collaborate and adopt Dev Ops in real-time projects
5. Assess various Dev Ops practices, testing and code deployment tools

## Unit I

Introduction to Dev Ops - Introduction, agile development model, Dev Ops and ITIL, Dev Ops process and continuous delivery, release management, Scrum, Kanban, delivery pipeline and identifying bottlenecks.

## Unit II

Software development models and DevOps - DevOps lifecycle for business agility, DevOps and continuous testing, DevOps influence on architecture - Introducing software architecture, monolithic scenario, architecture rules of thumb, separation of concerns, handling database migrations, micro services and data tier, DevOps, architecture and resilience.

## Unit III

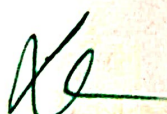
Introduction to project management - source code management, roles and code, source code management system and migrations, shared authentication, hosted Git servers, different Git server implementations, Docker intermission, Gerrit and the pull request model.

## Unit IV

Integrating the system - Build systems, Jenkins build server, managing build dependencies, Jenkins plugins, file system layout, the host server, build slaves, software on the host, triggers, job chaining and build pipelines, build servers and infrastructure as code, building by dependency order, build phases, alternative build servers and collating quality measures.

## Unit V

Testing tools and deployment - Various types of testing, automation of testing, Selenium - Introduction, Selenium features, JavaScript testing, testing backend integration points, test-driven development, REPL-driven development. Deployment of the system - Deployment systems, virtualization stacks, code execution at the client, Puppet master and agents, Ansible Deployment tools - Chef, SaltStack, Docker



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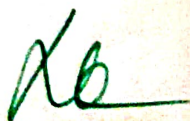
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**Suggested Reading**

1. Joakim Verona, *Practical DevOps*, Packt Publishing, 2016
2. Deepak Gaikwad, Viral Thakkar, *DevOps Tools from Practitioner's Viewpoint*, Wiley Publications, 2019.
3. Len Bass, Ingo Weber, Liming Zhu, *DevOps: A Software Architect's Perspective*, Addison Wesley, 2015.



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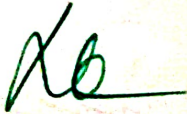
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1. Joakim Verona, *Practical DevOps*, Packt Publishing, 2016
2. Deepak Gaikwad, Viral Thakkar, *DevOps Tools from Practitioner's Viewpoint*, Wiley Publications, 2019.
3. Len Bass, Ingo Weber, Liming Zhu, *DevOps: A Software Architect's Perspective*, Addison Wesley, 2015.

  
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## PROFESSIONAL ELECTIVE – II

|        |                  |           |
|--------|------------------|-----------|
| PEC321 | Network Security | 3 Credits |
|--------|------------------|-----------|

## Course Objectives

1. Understand the significant aspects of network security
2. Comprehend secret and public key cryptography
3. Learn hash functions and digital signatures
4. Study the digital signatures and smart cards
5. Comprehend the applications of network security

## Course Outcomes

1. Explain the fundamentals of network security
2. Elaborate the concepts of secret and public key cryptography
3. Elucidate the hash functions and digital signatures
4. Describe the digital signatures and smart cards
5. Explain the applications of network security

## Unit I

Introduction - Attributes of security, integrity, authenticity, non-repudiation, confidentiality, authorization, anonymity. Types of attacks - DoS, IP spoofing, replay, man-in-the-middle attacks  
General threats to computer network - Worms, viruses and trojans

## Unit II

Secret key cryptography - DES, Triple DES, AES, key distribution, attacks, Public key cryptography - RSA, ECC, key exchange using Diffie-Hellman, Java cryptography extensions and attacks.

## Unit III

Integrity, authentication and non-repudiation - Hash function MD5 and SHA5, message authentication code MAC, digital signature using RSA and DSA and biometric authentication.

## Unit IV

PKI interface - Digital certificates, certifying authorities, POP key interface, system security using firewalls and VPNs

Smart cards - Application security using smart cards, zero knowledge protocols and their use in smart cards, attacks on smart cards

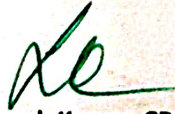
## Unit V

Applications - Kerberos, web security protocols SSL, IPSec, electronic payments, e-cash, secure electronic transaction SET, micro payments

Case studies of enterprise security - .NET, J2EE

## Suggested Readings

1. William Stallings, *Cryptography and Network Security*, 7<sup>th</sup> Edition, Pearson, 2018.
2. Behrouz A. Forouzan, *Cryptography and Network Security*, TMH, 2009
3. Joseph Migga Kizza, *A Guide to Computer Network Security*, Springer, 2024.
4. Dario Catalano, *Contemporary Cryptology*, Springer, 2010

  
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**PROFESSIONAL ELECTIVE – II****PEC 322****Optimization Techniques****3 Credits****Course Objectives**

1. Understand the optimization basics
2. Understand optimization using calculus
3. Understand dynamic programming and its applications
4. Understand integer programming
5. Understand advanced optimization techniques

**Course Outcomes**

1. Learn the optimization basics
2. Learn optimization using calculus
3. Learn dynamic programming and its applications
4. Learn integer programming
5. Learn advanced optimization techniques

**Unit I**

Introduction and basic concepts - Historical development, engineering applications of optimization, art of modeling, objective function, constraints and constraint surface, formulation of design problems as optimization problems using classical and advanced techniques

**Unit II**

Optimization using calculus - Stationary points, functions of single and two variables, global optimum, convexity and concavity of functions of one and two variables, optimization of functions of one variable and multiple variables, gradient vectors  
Optimization of function of multiple variables subject to equality constraints - Lagrangian function, Hessian matrix formulation, eigen values, Kuhn-Tucker conditions, examples

**Unit III**

Dynamic programming - Sequential optimization, representation of multistage decision process, types of multistage decision problems, concept of sub-optimization and the principle of optimality, recursive equations using forward and backward recursions, computational procedure in dynamic programming and Dynamic programming types - Discrete versus continuous dynamic programming, multiple state variables, curse of dimensionality in dynamic programming

**Unit IV**

Dynamic programming applications - Problem formulation and application in design of continuous beam, optimal geometric layout of a truss, water allocation as a sequential process, capacity expansion, reservoir operation. Integer programming - Integer linear programming, concept of cutting plane method, mixed integer programming and solution with examples.

**Unit V**

Advanced topics in optimization - Piecewise linear approximation of a nonlinear function, multi-objective optimization using weighted and constrained methods, multi-level optimization, direct and indirect search methods. Evolutionary algorithms for optimization and search and applications.

  
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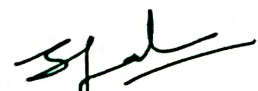
**Suggested Readings**

1. S.S. Rao, *Engineering Optimization: Theory and Practice*, New Age International, New Delhi, 2000
2. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 1990
3. H.A. Taha, *Operations Research: An Introduction*, 5<sup>th</sup> Edition, Macmillan, New York, 2013.
4. K. Deb, *Optimization for Engineering Design: Algorithms and Examples*, Prentice-Hall of India, New Delhi, 2012.
5. K. Srinivasa Raju and D. Nagesh Kumar, *Multicriterion Analysis in Engineering and Management*, PHI Learning, New Delhi, 2010



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## PROFESSIONAL ELECTIVE - II

PEC 323

Deep Learning

3 Credits

## Course Objectives

1. Learn deep learning basics and optimization algorithms
2. Understand deep learning computation, CNNs and modern CNNs
3. Study recurrent neural networks and their modern versions
4. Learn computer vision basics
5. Comprehend GANs

## Course Outcomes

1. To Understand the deep learning basics and optimization algorithms
2. To apply deep learning computations and modern CNNs
3. Analyse the recurrent neural networks and their modern versions
4. Understand the concepts of GANs

## Unit I

Introduction - Linear regression, multilayer perceptrons, model selection, underfitting and overfitting, weight decay, dropout, forward propagation, backward propagation and computational graphs, numerical stability and initialization, considering the environment, predicting house prices on Kaggle  
Optimization algorithms - Optimization and deep learning, convexity, gradient descent, momentum, Adagrad, RMSProp, Adadelta, Adam, learning rate scheduling

## Unit II

Deep learning computation - Layers and blocks, parameter management, deferred initialization, custom layers, file I/O, GPUs.

Convolutional neural networks - convolutions for images, padding and stride, multiple input and output channels, pooling, convolutional neural networks using LeNet

Modern convolutional neural networks - Deep convolutional neural networks using AlexNet, networks using blocks with VGG, networks with parallel concatenations using GoogleNet, batch normalization, residual networks using ResNet, densely connected networks using DenseNet

## Unit III

Recurrent neural networks - Sequence models, text processing, language models and the dataset, recurrent neural networks, back propagation through time

Modern recurrent neural networks - Gated recurrent units GRU, long short-term memory, deep recurrent neural networks, bidirectional recurrent neural networks, machine translation and the dataset, encoder-decoder architecture, sequence to sequence

Attention mechanisms - Attention mechanism, sequence to sequence with attention mechanism, transformer

## Unit IV

Computer vision - Image augmentation, fine tuning, object detection and bounding boxes, anchor boxes, multiscale object detection, object detection dataset, single shot multibox detection SSD, region-based CNNs R-CNNs, semantic segmentation and the dataset, transposed convolution, fully convolutional networks FCN, neural style transfer, image classification using CIFAR-10 on Kaggle, dog breed identification using ImageNet dogs on Kaggle



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**PROFESSIONAL ELECTIVE - II****PEC 323****Deep Learning****3 Credits****Course Objectives**

1. Learn deep learning basics and optimization algorithms
2. Understand deep learning computation, CNNs and modern CNNs
3. Study recurrent neural networks and their modern versions
4. Learn computer vision basics
5. Comprehend GANs

**Course Outcomes**

1. To Understand the deep learning basics and optimization algorithms
2. To apply deep learning computations and modern CNNs
3. Analyse the recurrent neural networks and their modern versions
4. Understand the concepts of GANs

**Unit I**

Introduction - Linear regression, multilayer perceptrons, model selection, underfitting and overfitting, weight decay, dropout, forward propagation, backward propagation and computational graphs, numerical stability and initialization, considering the environment, predicting house prices on Kaggle  
 Optimization algorithms - Optimization and deep learning, convexity, gradient descent, momentum, Adagrad, RMSProp, Adadelta, Adam, learning rate scheduling

**Unit II**

Deep learning computation - Layers and blocks, parameter management, deferred initialization, custom layers, file I/O, GPUs.

Convolutional neural networks - convolutions for images, padding and stride, multiple input and output channels, pooling, convolutional neural networks using LeNet

Modern convolutional neural networks - Deep convolutional neural networks using AlexNet, networks using blocks with VGG, networks with parallel concatenations using GoogleNet, batch normalization, residual networks using ResNet, densely connected networks using DenseNet

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Modern recurrent neural networks - Gated recurrent units GRU, long short-term memory, deep recurrent neural networks, bidirectional recurrent neural networks, machine translation and the dataset, encoder-decoder architecture, sequence to sequence

Attention mechanisms - Attention mechanism, sequence to sequence with attention mechanism, transformer

**Unit IV**

Computer vision - Image augmentation, fine tuning, object detection and bounding boxes, anchor boxes, multiscale object detection, object detection dataset, single shot multibox detection SSD, region-based CNNs R-CNNs, semantic segmentation and the dataset, transposed convolution, fully convolutional networks FCN, neural style transfer, image classification using CIFAR-10 on Kaggle, dog breed identification using ImageNet dogs on Kaggle

  
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**Unit V**

Generative adversarial networks - Generative adversarial networks, deep convolutional generative adversarial networks, Tools for deep learning - Using Jupyter, using Amazon Sagemaker, using AWS EC2 instances, using Google Colab, selecting servers and GPUs

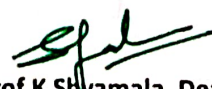
**Suggested Readings**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.
2. Zhang, Aston, et al., *Dive into Deep Learning*, 2020.



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## PROFESSIONAL ELECTIVE - II

|        |                               |           |
|--------|-------------------------------|-----------|
| PEC324 | Information Retrieval Systems | 3 Credits |
|--------|-------------------------------|-----------|

## Course Objectives

1. To understand indexing and querying in information retrieval systems
2. To learn the different models for information retrieval
3. To expose the students to text classification and clustering
4. To learn about web searching

## Course Outcomes

1. Able to Understand the algorithms and techniques for information retrieval like document indexing and retrieval and query processing.
2. Able to Quantitatively evaluate information retrieval systems.
3. Able to Classify and cluster documents.
4. Able to Understand the practical aspects of information retrieval such as those in web search engines

## Unit I

**Boolean Retrieval:** Building an inverted index, processing Boolean queries, the extended Boolean model versus ranked retrieval.

**The term vocabulary and postings lists:** Document delineation and character sequence decoding, determining the vocabulary of terms, faster postings list intersection via skip pointers, Positional postings, and Phrase queries.

**Dictionaries and tolerant retrieval:** Search structures for dictionaries, Wildcard queries, spelling correction.

**Index Construction:** Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, dynamic indexing and Other types of indexes.

## Unit II

**Index Compression:** Statistical properties of terms in information retrieval, Dictionary Compression and Posting file compression.

**Scoring, term weighting and the vector space model:** Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, and Variant tf-idf functions.

**Computing scores in a complete search system:** Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.

**Evaluation in information retrieval:** Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

## Unit III

**Relevance feedback and query expansion:** Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

**XML retrieval:** Basic XML concepts, Challenges in XML retrieval, a vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

**Probabilistic information retrieval:** Basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

**Language models for information retrieval:** Language models, the query likelihood model.

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## Unit IV

**Text classification and Naive Bayes:** The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection.

**Vector space classification:** Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbour, Linear versus nonlinear classifiers.

**Flat clustering:** Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means.

**Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

## Unit V

**Matrix decompositions and latent semantic indexing:** Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

**Web search basics:** Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling.

**Web crawling and Indexes:** Overview, Crawling, Distributing indexes, Connectivity servers.

**Link analysis:** The Web as a graph, Page Rank, Hubs and Authorities.

## Suggested Readings

1. Soumen Chakrabarti, *Mining the Web: Discovering Knowledge from Hypertext Data*, Morgan-Kaufmann Publishers, 2002
2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, *An Introduction to Information Retrieval*, Cambridge University Press, 2009



## Professional Elective - II

|        |                    |           |
|--------|--------------------|-----------|
| PEC325 | Data Visualization | 3 Credits |
|--------|--------------------|-----------|

## Course Objectives

1. To understand various types of graphs for data visualization
2. To learn data visualization through graph representation
3. To explore multidimensional scaling techniques
4. To learn data visualization via kernel machines
5. To know about parallel coordinates, notations, and applications

## Course Outcomes

1. Know the historical development and evolution of data visualization techniques
2. Analyze and visualize high-dimensional datasets using appropriate techniques
3. Visualize large multidimensional datasets using appropriate methods
4. Create insightful visual representations for diverse types of data
5. Visualizations promote collaboration and interdisciplinary communication by providing a shared understanding of data among team members

## Unit I

Introduction - Brief history of data visualization, Different types of graphs for data visualization - Line charts, bar charts, scatter plots, pie charts, column charts, tree map charts, heat-map charts, Pareto charts, geo charts, waterfall charts , Good graphics - Static graphics, static visualizations versus interactive visualizations

## Unit II

Data visualization through graph representations - Data and graphs, graph layout techniques, force-directed techniques, multidimensional scaling, pulling under constraints model, graph-theoretic graphics

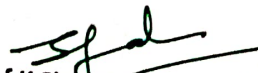
High-dimensional data visualization - Univariate analysis, visualizing data in one dimension, multivariate analysis, visualizing data in two dimensions, multivariate data glyphs principles and practice, linked views for visual exploration, linked data views, visualizing trees and forests



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**Unit III**

Multidimensional scaling - Multiple line graphs, permutation matrix, survey plot, scatter plot matrix, parallel coordinates, tree maps, principal component analysis PCA, Sammon's mapping, Self-Organizing Maps (SOM)

Comparison of visualization techniques - Huge multidimensional data visualization, multivariate visualization by density estimation, structured sets of graphs, structural adaptive smoothing by propagation, separation methods

Smoothing techniques for visualization - Exponential smoothing, moving average smoothing, double exponential smoothing and Holt-Winters smoothing

**Unit IV**

Data visualization via kernel machines - Kernel machines in the framework of an RKHS, Kernel Principal Component Analysis (KPCA), computation of KPCA, kernel canonical correlation analysis, kernel cluster analysis, visualizing cluster analysis

Visualization and finite mixture models - Flexible method of modeling, brief history, formulation of mixture distribution

Visualizing contingency tables - Mosaic displays for n-way tables, fourfold display, mosaic plots and variants

**Unit V**

Parallel coordinates - Scenarios, components of a parallel coordinate plot, interpreting parallel coordinate plots, advantages of parallel coordinate plots, comparison with other visualization techniques

Visualization, exploration and classification of high-dimensional data - Notations, data matrix preparation, heatmaps, clustering, comparing clusterings with Rand Index, properties, applications, matrix visualization, visualization in Bayesian data analysis

**Suggested Readings**

1. Chun-houh Chen, *Handbook of Data Visualization*, 2008
2. Matthew Ward, Georges Grinstein, Daniel Keim, *Interactive Data Visualization: Foundations, Techniques, Applications*, 2010.
3. Robert Spence, *Information Visualization – Design for Interaction*, Pearson Education, 2<sup>nd</sup> Edition, 2007
4. Alexandru C. Telea, *Data Visualization: Principles and Practice*, A. K. Peters Ltd, 2008



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**Course Objectives**

1. Understand basic commands of networks
2. Learn socket program implementation
3. Understand connection-oriented socket programs
4. Learn connectionless socket programs
5. Understand DNS implementation

**Course Outcomes**

1. Execute basic commands of networks
2. Implement socket program implementation
3. Execute connection-oriented socket programs
4. Implement connectionless socket programs
5. Execute DNS implementation

**Lab Programs**

Programs are to be implemented using any programming language such as Python, C, C++, or Java

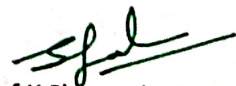
1. Understanding and using of commands - ifconfig, netstat, ping, arp, telnet, ftp, finger, trace route, whois
2. Socket programming - Implementation of connection-oriented service using standard ports
3. Socket programming - Implementation of connectionless service using standard ports
4. Connection-oriented iterative server - Echo server, date and time server, character generation using user-defined ports
5. Connectionless iterative server - Echo server, date and time server, character generation using user-defined ports
6. Connection-oriented concurrent server - Echo server, date and time server, character generation using user-defined ports
7. Connection-oriented iterative server - Server reverses the string sent by the client and sends it back

8. Connection-oriented iterative case server - Server changes the case of the string sent by the client and returns it
9. Connection-oriented iterative server - Server calculates net salary using basic, hra, da, pt, epf, where  $\text{net-salary} = \text{basic} + \text{hra} + \text{da} - \text{pt} - \text{epf}$
10. File access using sockets
11. Remote command execution using sockets
12. Implementation of DNS



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**Course Objectives**

1. Learn use case diagram
2. Learn class and object diagram
3. Understand sequence and collaboration diagrams
4. Study state-chart and activity diagrams
5. Comprehend component and deployment diagrams

**Course Outcomes**

1. Apply use case diagram
2. Apply class and object diagram
3. Apply sequence and collaboration diagrams
4. Apply state-chart and activity diagrams
5. Apply component and deployment diagrams

**Content**

Phases in software development project - Overview, need, coverage of topics  
Requirement engineering tasks - Assigning tasks  
System analysis - Requirement analysis, SRS  
Function-oriented diagrams - DFD, structured chart  
User's view analysis - Use case diagram  
Structural view diagrams - Class diagram, object diagram  
Behavioral view diagrams - Sequence diagram, collaboration diagram  
Behavioral view diagrams continued - State-chart diagram, activity diagram  
Implementation view diagram - Component diagram  
Environmental view diagram - Deployment diagram  
Testing - Unit testing, integration testing using testing tools

**UML Diagrams to be Drawn for the Following Systems**

ATM application  
Library management system  
Railway reservation system  
E-commerce system  
Banking system



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**Case Study Tasks****Task 1 – Domain Analysis**

Background - Software plays a critical role across domains such as healthcare, airlines, banking, insurance, retail, education

Problem - Identify areas or systems in each domain where software has been extensively leveraged

Domains - Healthcare, airlines, banking and insurance, retail, education

**Task 2 – Software Crisis Scenario**

Background - Historical software development challenges, lack of discipline, emergence of software crisis

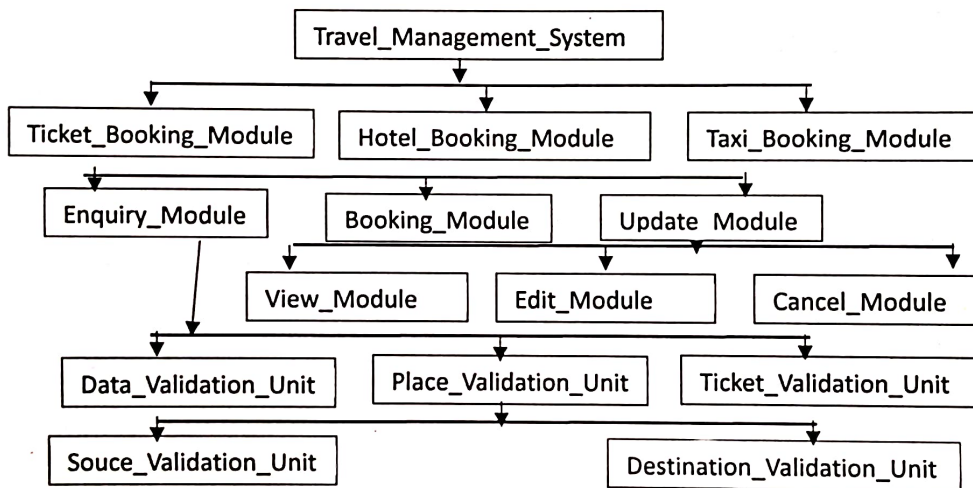
Problem - Analyse software crisis in given scenarios

Scenario A - Railway reservation system crashed after initial success

Scenario B - Delay in autopilot software integration for satellite

Scenario C - Financial system delivered with defect too complex to identify

Task - Identify appropriate software crisis issues - time slippage, cost slippage, intractable error, failure at customer site

**Task 3 – Integration Testing Scenarios**

Background - Integration testing using stubs and drivers

Scenario - Travel Management System (TMS) with Ticket\_Booking\_Module, Hotel\_Booking\_Module, Taxi\_Booking\_Module

Sub-modules - Enquiry\_Module, Booking\_Module, Update\_Module

Validation units - Date\_Validation\_Unit, Ticket\_Validation\_Unit, Place\_Validation\_Unit

Tasks - Identify use of stubs and drivers in the following situations

1. Ticket\_Validation\_Unit not completed, top-down integration testing
2. Update\_Module not completed, bottom-up integration testing
3. Taxi\_Booking\_Module not completed, top-down integration testing



#### Task 4 – Performance Testing

Background - Performance testing types - load testing, stress testing, endurance testing, spike testing

Problem - Identify appropriate performance testing category for the following

1. Endurance testing - Orbit control system of spacecraft required to work for 8 years
2. Load testing - Objective test tool to support 2000 concurrent users at GEC Infosys
3. Stress testing - University result portal crashed on result announcement
4. Spike testing - News website crashed due to sudden surge in traffic during terrorist attack

#### Task 5 – Regression Testing

Background - Software enhancement and testing strategy

Problem - Travel Management System upgraded based on customer feedback

Task - Choose correct testing approach

Options - Integration testing and quick system testing, regression testing, sanity testing only, no testing required

#### Task 6 – Metrics and Productivity

Background - Software metrics - size, effort, defect, schedule

Derived metrics - Productivity = size / effort, Quality = defects / size

Problem - Online loan system with Car\_Loan\_Module and House\_Loan\_Module

Developer 1 - Mike, 2000 LOC, 100 hours, 5 defects

Developer 2 - John, 3000 LOC, 200 hours, 6 defects

Task - Identify incorrect metric-related statement

Options - John's quality is better than Mike, John's productivity is more than Mike, John introduced more defects than Mike, John's effort is more than Mike



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Osmania University

LCC353

Full Stack Web Development Lab

1.5 Credits

**Course Objectives**

1. To develop hands-on proficiency in using HTML, CSS, and Git for structuring and managing web development projects
2. To enable students to create dynamic and interactive front-end applications using JavaScript, AJAX, jQuery, and JSON
3. To build single-page applications and manage frontend state using React and Redux frameworks
4. To design and implement Java-based backend applications using Spring MVC and RESTful services
5. To integrate databases with backend applications using SQL and Spring JDBC and deploy them on cloud platforms using agile principles

**Course Outcomes**

1. Design and deploy structured web pages with styling and version control using Git and GitHub
2. Implement dynamic client-side interactivity and asynchronous data exchange using JavaScript and jQuery
3. Develop and manage scalable React applications with routing, form handling, and Redux integration
4. Create backend services using Java and Spring Boot, following MVC and RESTful architecture
5. Connect applications to relational databases and deploy full-stack solutions using cloud and agile methodologies

**Unit I – Web Development Basics**

Create a basic personal portfolio webpage using HTML and CSS

Write UNIX shell commands to navigate directories, create files, and manipulate text using cat, grep, and awk

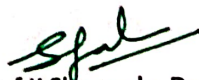
Initialize a Git repository, commit changes, and push a project to GitHub

Design a simple HTML form and style it using CSS

Use CLI tools to manage file permissions and run a shell script to automate backups

Clone a remote repository from GitHub, make changes, and submit a pull request

  
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**Unit II – Frontend Development**

Write a JavaScript program to validate form inputs such as email and password

Demonstrate object-oriented principles in JavaScript with classes and inheritance

Create a web page that uses AJAX to fetch JSON data from a dummy API and display it dynamically

Build a basic jQuery-based image slider with event handling

Create a dynamic to-do list using jQuery UI components

Parse and display JSON data using JavaScript in a formatted table

**Unit III – React JS**

Set up a React project using create-react-app and build a simple Hello World app

Create a single-page application using React Router with at least three navigable pages

Build a contact form in React with controlled components and form validation

Implement a Redux store to manage global state in a shopping cart app

Use React lifecycle methods or hooks to fetch data from an external API and render it

Create a client-server interaction using React frontend and dummy JSON server backend

**Unit IV – Java Web Development**

Write a Java program demonstrating basic OOP principles such as inheritance, polymorphism, and encapsulation

Build a simple Java MVC application using Servlets and JSP

Create a RESTful web service using Spring Boot to handle CRUD operations for a User entity

Design a web-based login form using Spring MVC and validate credentials

Use Maven to manage dependencies and build a Spring Boot project

Implement exception handling and logging in a Spring Boot REST API

**Unit V – Databases and Deployment**

Design a normalized relational schema for a student-course enrollment system

Write SQL queries to perform CRUD operations on a sample database

Integrate Spring JDBC to fetch data from a MySQL or PostgreSQL database

Build a mini-project that stores form data into a database and retrieves it dynamically

Deploy a full-stack Java and React application to Heroku or a cloud server

Demonstrate the use of agile tools like Trello or GitHub Projects for managing sprints and tasks

  
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