

OMEGA INSTITUTE OF SCIENCE AND TECHNOLOGY(A)

College Code: 2144

UGC- AUTONOMOUS, Accredited by NAAC
(Approved by AICTE & Affiliated to Osmania University)
Sy. No:7, Edulabad, Ghatkesar, Medchal- Malkajgiri- 501301

MASTER OF COMPUTER APPLICATIONS

(MCA)

SEMESTER III AND IV

With effect from Academic Year: 2026-2027

Under R24 Academic Regulations (III & IV Semester)



DEPARTMENT OF COMPUTER APPLICATIONS

ACADEMIC YEAR: 2026-2027

SEMESTER III & IV

Website: <https://omist.ac.in>

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MASTER OF COMPUTER APPLICATIONS (MCA)

Semester III

GENERAL COURSE STRUCTURE

Definition of Credit

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical(P) per week	1 Credit

Abbreviation and Definition	
Abbreviation	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	SEE-Duration
Theory	30	70	1hr	3hrs
Practical	25	50	2hrs	3hrs
Internship	50	-	3hrs	
Project	50	100	3hrs	3hrs

Credits table R24(2025-2027)

Semester	Credits
I	28.5
II	28.5
III	28
IV	20
TOTAL	105

Faculty of Informatics
Omega Institute of Science and Technology (A)
OM-R24: (2024-2026)

MASTER OF COMPUTER APPLICATIONS(MCA)

Semester- III

Course Code	Course Title	L	P	Credits	CIE Marks	SEE Marks
THEORY						
OMPCC301	Software Engineering	4	-	4	30	70
OMPCC302	Computer Networks	4	-	4	30	70
OMPCC303	Artificial Intelligence	4	-	4	30	70
OMPCC304	Full Stack Development	4	-	4	30	70
PROFESSIONAL ELECTIVE-I						
OMPEC311	Digital Forensics	3	-	3	30	70
OMPEC312	Distributed Systems					
OMPEC313	Internet o Things					
OMPEC314	Image Processing					
OMPEC315	Dev Ops Methodology					
PROFESSIONAL ELECTIVE-II						
OMPEC321	Networks Security	3	-	3	30	70
OMPEC322	Optimization Techniques					
OMPEC323	Deep Learning					
OMPEC324	Information Retrieval System					
OMPEC325	Data Visualization					
PRACTICALS						
OMLCC351	Computer Networks Laboratory	-	3	1.5	25	50
OMLCC352	Software Engineering Laboratory	-	3	1.5	25	50
OMLCC353	Full Stack Development Laboratory	-	3	1.5	25	50
OMSIP321	Summer Internship	20	-	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						
OMPEC411	IoT Security	3	-	3	30	70
OMPEC412	Generative AI					
OMPEC413	Cloud Computing					
OMPEC414	Natural Language Processing					
OMPEC415	Block Chain Technologies					
PROFESSIONAL ELECTIVE-IV						
OMPEC421	Software Quality and Testing	3	-	3	30	70
OMPEC422	Big Data Analytics					
OMPEC423	Database Security					
OMPEC424	UI/UX					
OMPEC425	Augmented Reality and Virtual Reality					
OPEN ELECTIVE						
OMOE431	Professional Ethics	2	-	2	30	70
OMOE432	Constitution of India					
OMOE433	Disaster Management					
OMOE434	Organizational Behaviour					
OMOE435	Intellectual Property and Cyber Law					
OMOE436	Environmental Science					
PRACTICALS						
OMProj401	Project Work	-	24	12	50	100
TOTAL		8	24	20	140	310

OM -R24PCC301

Software Engineering

Credit: 4	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 architectures.
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

Suggested Readings

1. Pankaj Jalote, Software Engineering: With Open Source and GenAI, Wiley India, 2nd Edition, 2024
2. Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, McGraw Hill, 9th Edition, 2023
3. Deepak Jain, Software Engineering: Principles and Practices, Oxford University Press, 2014
4. Rajib Mall, Fundamentals of Software Engineering, PHI Learning, 5th Edition, 2018
5. Ian Sommerville, Software Engineering, Pearson, 10th Global Edition, 2016


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OM -R24PCC302

Computer Networks

Credit:4	CIE:30	SEE:70	Hrs./ Week: 3L+1T
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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, Nick Feamster, and David J. Wetherall, Computer Networks, Pearson, 6th Edition, 2026
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, 6th Edition, McGraw Hill, 2022
3. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson, 9th Edition, 2025
4. W. Richard Stevens, Bill Fenner, and Andrew M. Rudoff, UNIX Network Programming, Volume 1: The Sockets Networking API, 3rd Edition, Addison-Wesley / PHI, 2003.

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OM -R24PCC303

Artificial Intelligence

Credit:4	CIE:30	SEE:70	Hrs./ Week: 3L+
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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 Knowledge representation - Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames

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, 2nd Edition, Cengage Learning, 2022
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition / Global Edition, 2020
3. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, McGraw Hill Higher Education, 3rd/4th Edition, McGraw Hill / MedTech, 2024


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OM -R24PCC304

Full Stack Web Development

Credit: 4	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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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

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. Nicholas C. Zakas, Professional JavaScript for Web Developers, Wrox / Wiley, 5th Edition, 2023
2. Robin Nixon, Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to reating Dynamic Websites, O'Reilly, 7th Edition, 2025
3. Azat Mardan, Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB, Apress, 2nd Edition, 2018
4. Juha Hinkula, Full Stack Development with Spring Boot 3 and React: Build modern web applications using the power of Java, React, and TypeScript, Packt Publishing, 4th Edition, 2023



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OM -R24PCC311

Digital Forensics

Credit: 4	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 analyze 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

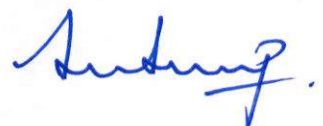
1. Bill Nelson, Amelia Phillips, and Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning, 6th Edition, 2018
2. Nelson, B., Phillips, A., Steuart, C., Guide to Computer Forensics and Investigations, Cengage Learning, 7th Edition, 2024
3. Vacca, J., Computer Forensics: Computer Crime Scene Investigation, Charles River Media, 3rd Edition, 2010
4. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, Academic Press, 3rd Edition, 2011
5. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Syngress, 2nd Edition, 2015


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OM -R24PCC312

Distributed Systems

Credit: 4	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 1

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 to Lorange, 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

1. George Coulouris et al., Distributed Systems: Concepts and Design, Pearson, 5th Edition - Indian Reprints
2. Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems, distributed-systems.net, 4th Edition, 2023


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OM-R24PCC313

Internet of Things

Credit: 4	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 Proto typing 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, 3Dprinting, certification, scaling up software. Ethical issues in IoT - Privacy, control, environment, solutions to ethical issues.

Unit V

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

Suggested Readings

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 1st Edition - Revised Printing, 2015 / 2020
2. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, 2nd Edition, 2020
3. Sudip Misra, Anandrup Mukherjee, and Arijit Roy, Introduction to IoT, Cambridge University Press, 1st Edition, 2021



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~~OM-R24PCC314~~

~~Image Processing~~

Credit: 4	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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.

Suggested Readings

- 1 Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson, 4th Edition / Updated Version, 2018
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education / PHI, 1st Edition (Reprint), 2015
3. Wilhelm Burger and Mark J. Burge, Digital Image Processing: An Algorithmic Introduction, Springer, 3rd Edition, 2022
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2nd Edition, 2022


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OM -R24PCC315

Dev Ops Methodology

Credit: 3	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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, microservices 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, Salt Stack, Docker

Suggested Reading

1. Joakim Verona, Practical DevOps, Packt Publishing, 2nd Edition, 2018
2. Gene Kim, Jez Humble, Patrick Debois, John Willis, and Nicole Forsgren, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, IT Revolution Press, 2nd Edition, 2021
3. James Turnbull, The Docker Book: Containerization is the new virtualization, Turnbull Press, 1st Edition, 2018


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OM -R24PCC321

Network Security

Credit: 3	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 smartcards, 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: Principles and Practice, Pearson, 8th Edition, 2024
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, McGraw Hill Education, 3rd Edition, 2015.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: Private Communication in a Public World, Pearson, 3rd Edition, 2022
4. Mark Stamp, Information Security: Principles and Practice, Wiley, 3rd Edition, 2021

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OM -R24PCC322

Optimization Techniques

Credit: 3	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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.

Suggested Readings

1. Singiresu S. Rao, Nitin Kumar, and D. Sumitha, Engineering Optimization: Theory and Practice, Wiley India, 5th Edition / Indian Adaptation, 2023
2. Hamdy A. Taha, Operations Research: An Introduction, Pearson, 10th Global Edition, 2017
3. G. Hadley, *Linear Programming*, Narosa Publishing House, 1st Edition (Reprint), 2002
4. H.A. Taha, *Operations Research: An Introduction*, Pearson Education, 11th Edition, 2022
5. Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, McGraw-Hill Education, 11th Edition, 2021

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Sudhakar

OM -R24PCC323

Deep Learning

Credit: 3	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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. Analyze the recurrent neural networks and their modern versions
4. Understand the concepts of GANs

Unit I

Introduction - Linear regression, multilayer perceptron's, 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, Aagard, RMS Prop, Ad delta, 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 multibook 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.

Unit V

Generative adversarial networks - Generative adversarial networks, deep convolutional generative adversarial networks, Tools for deep learning - Using Jupyter, using Amazon S3, using AWS EC2 instances, using Google Colab, selecting servers and GPUs

Suggested Readings

1. .Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, Cambridge University Press, 1st Edition, 2023
2. François Chollet and Matthew Watson, Deep Learning with Python, Manning Publications, 3rd Edition, 2025.
3. Sebastian Raschka, Yuxi (Hayden) Liu, and Vahid Mirjalili, Machine Learning with PyTorch and Scikit-Learn, Packt Publishing, 1st Edition, 2022

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OM -R24PCC324

Information Retrieval Systems

Credit: 3	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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 list: 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.

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 neighbor, 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. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search, ACM Press / Addison-Wesley, 2nd Edition, 2011
2. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press, Online & Updated Print Edition, 2009.



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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.

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 clustering's with Rand Index, properties, applications, matrix visualization, visualization in Bayesian data analysis

Suggested Readings

1. Scott Murray, Interactive Data Visualization for the Web: An Introduction to Designing with D3, O'Reilly, 2nd Edition, 2017
2. Andy Kirk, Data Visualization: A Handbook for Data Driven Design, SAGE Publications, 2nd Edition, 2019
3. Matthew O. Ward, Georges Grinstein, and Daniel Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications*, A K Peters / CRC Press, 2nd Edition, 2015
4. Robert Spence, Information Visualization: Design for Interaction, Springer, 3rd Edition, 2014
5. Alexandru C. Telea, Data Visualization: Principles and Practice, A K Peters / CRC Press, 2nd Edition, 2014

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OM -R24LCC351

Network Programming Lab

Credit: 1.5	CIE: 30	SEE: 70	Hrs./ 3L+1T	Week:
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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

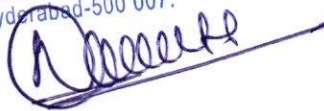
8. Connection-oriented iterative ense server - Server changes the case of the string sent by the client and returns it
9. Connection-oriented iterative server - Server calculates net salary using basic, hra, da, pt, epf, where $\text{net-salary} = \text{basic} + \text{hra} + \text{da} + \text{pt} + \text{epf}$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

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OM -R24LCC352

SoftwareEngineering Lab

Credit: 1.5	CIE: 30	SEE: 70		Hrs./ 3L+1T	Week:
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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

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 - analyze software crisis in given scenarios

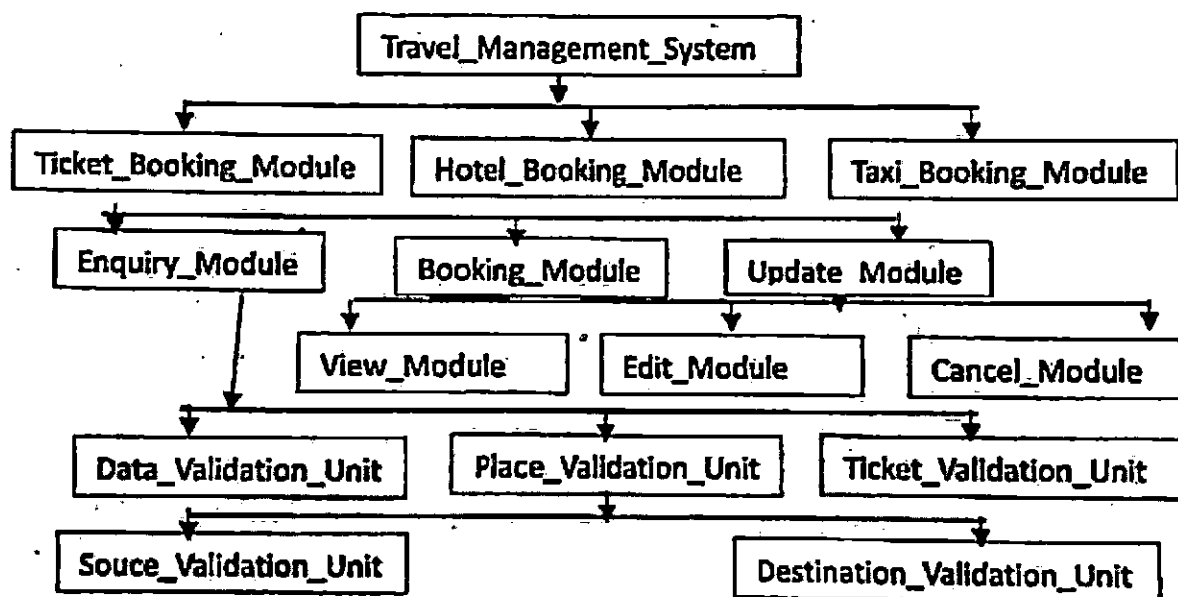
Scenario A - Railway reservation system crashed after initial success

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 loanModule 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

OM -R24LCC353 Full Stack Web Development Lab

Credit: 1.5	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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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

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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MASTER OF COMPUTER APPLICATIONS (MCA)

Semester IV – Professional Electives, Open Electives & Project Work

Faculty of Informatics
Omega Institute of Science and Technology (A)
OM-R24: (2024-2026)

MASTER OF COMPUTER APPLICATIONS(MCA)

Semester- IV

Course Code	Course Title	L	P	Credits	CIE Marks	SEE Marks
THEORY						
PROFESSIONAL ELECTIVE-III						
OMPEC411	IoT Security	3	-	3	30	70
OMPEC412	Generative AI					
OMPEC413	Cloud Computing					
OMPEC414	Natural Language Processing					
OMPEC415	Block Chain Technologies					
PROFESSIONAL ELECTIVE-IV						
OMPEC421	Software Quality and Testing	3	-	3	30	70
OMPEC422	Big Data Analytics					
OMPEC423	Database Security					
OMPEC424	UI/UX					
OMPEC425	Augmented Reality and Virtual Reality					
OPEN ELECTIVE						
OMOE431	Professional Ethics	2	-	2	30	70
OMOE432	Constitution of India					
OMOE433	Disaster Management					
OMOE434	Organizational Behaviour					
OMOE435	Intellectual Property and Cyber Law					
OMOE436	Environmental Science					
PRACTICALS						
OMProj401	Project Work	-	24	12	50	100
TOTAL		8	24	20	140	310

MASTER OF COMPUTER APPLICATIONS (MCA)

Semester IV – Professional Electives, Open Electives & Project Work

OM -R24PEC411

IoT Security

Credit: 3	CIE: 30	SEE: 70		Hrs./ 3L+1T	Week:
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Course Objectives

1. Understand the fundamentals of IoT security, its importance, and methods to prevent unauthorized access to sensor data
2. Study cyber-physical systems, their vulnerabilities, encryption techniques, and consensus algorithms applicable in IoT
3. Learn about IoT-specific security engineering principles including hardware security, elliptic curve cryptography, and blockchain integration
4. Analyze privacy concerns and networking protocols related to IoT and explore cryptographic mechanisms for data security
5. Explore authentication mechanisms, secure communication layers, smart contract execution, and data analytics in IoT

Course Outcomes

1. Describe IoT fundamentals, explain security needs, differentiate between IoT and embedded devices, and analyze threats such as unauthorized sensor access
2. Identify key security concerns in cyber-physical systems, apply encryption and hashing methods, and evaluate consensus mechanisms for scalability
3. Implement security measures using hardware cryptographic tools, Merkle trees, zero-knowledge proofs, and blockchain, and distinguish analog vs digital data
4. Explain privacy preservation methods, secure networking functions, and utilize cryptocurrency mechanisms for real-time IoT communication
5. Apply authentication techniques, manage secure IoT layers, analyze P2P and smart contract networks, and perform basic data analytics for trustworthy IoT systems.

Unit I - Fundamentals of IoT and Security

Fundamentals of IoT and security and its need, prevent unauthorized access to sensor data, block ciphers, introduction to blockchain, introduction to IoT devices, IoT security requirements, M2M security, message integrity, handling faults and adversaries, differences among IoT devices, computers, and embedded devices

Unit II - IoT and Cyber-Physical Systems

RFID security, authenticated encryption, Byzantine Generals problem, sensors and actuators in IoT, IoT security vulnerabilities, attacks and countermeasures, cyber-physical object security, hash functions, consensus algorithms and their scalability problems, accelerometer, photoresistor, buttons

Unit III - Security Engineering for IoT Development

Hardware security, Merkle trees and elliptic curve digital signatures, verifiable random functions, zero-knowledge systems, motor, LED, vibrator, IoT security lifecycle, front-end system privacy protection, management, secure IoT data, public-key cryptography PKI, blockchain, the challenges and solutions, analog signal vs digital.

Unit IV - Data Privacy and Networking

Data privacy, networking function security, tree signature algorithms, proof of work, proof of stake, networking in IoT, device authentication in IoT, user authentication in IoT, IoT networking protocols, cryptocurrencies, alternatives to Bitcoin consensus, Bitcoin scripting language and their use, real-time communication.

Unit V - Authentication Techniques and Secure Layers

Introduction to authentication techniques, secure IoT lower layers, Bitcoin P2P network, Ethereum and smart contracts, bandwidth efficiency, data trustworthiness in IoT, secure IoT higher layers, distributed consensus, smart contract languages and verification challenges, data analytics in IoT, simple data analyzing methods.

Suggested Readings

1. Brian Russell & Drew Van Duren, Practical Internet of Things Security, Packt Publishing, Second Edition 2023
2. Arshdeep Bahga & Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, second edition 2023.


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OM -R24PEC412

Generative AI

Credit: 3	CIE: 30	SEE: 70		Hrs./ Week: 3L+1T
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Course Objectives

1. To understand the challenges of generative modeling
2. To learn about the generative models for text
3. To study the different image generative models
4. To outline the different models for generating painting and music
5. To understand open-source models for generating text, image, music

Course Outcomes

1. List the challenges of generative modeling
2. Illustrate the generative models for text
3. Describe the different image generative models
4. Outline the different models for generating painting and music
5. Summarize open-source models for generating text, image, music

Unit I - Introduction to Gen AI

Historical overview of generative modeling, difference between generative AI and discriminative modeling, importance of generative models in AI, types of generative models, GANs, VAEs, autoregressive models, vector quantized diffusion models. Probabilistic modeling and generative process, challenges of generative modeling, future of generative AI, ethical aspects of AI, responsible AI, use cases.

Unit II - Generative Models for Text

Language models basics, building blocks of language models, transformer architecture, encoder and decoder, attention mechanisms, generation of text, models like BERT and GPT, exploring ChatGPT Prompt engineering - Designing prompts, revising prompts using reinforcement learning from human feedback RLHF, retrieval augmented generation, multimodal LLM, issues of LLM.

Unit III - Generation of Images

Introduction to generative adversarial networks, adversarial training process, Nash equilibrium, variational autoencoders, encoder-decoder architectures, transformer-based image generation.

CLIP, visual transformers ViT, DALL-E 2, DALL-E 3, GPT-4V, issues of image generation models.

Unit IV - Generation of Painting and Music

Variants of GAN, types of GAN, cyclic GAN, using cyclic GAN to generate paintings.

Neural style transfer, style transfer techniques. Music generation - Music generating RNN, MuseGAN. Autonomous agents - Deep Q algorithm, actor-critic network.

Unit V - Open-Source Models and Deployment

Training and fine tuning of generative models, GPT-4 All, transfer learning and pretrained models, training vision models Tools and platforms - Google Copilot, programming LLM, LangChain, LLaMA, Hugging Face Programming for TimeSformer, deployment of generative models

Suggested Readings

1. Chip Huyen ,AI Engineering: Building Applications with Foundation Models,O'Reilly Media,First Edition,2025.
2. Denis Rothman, Transformers for Natural Language Processing and Computer Vision, 3rd Edition, Packt Books, 2024.
3. Altaf Rehman Generative AI for Everyone BlueRose Publisher First Edition 2024.
4. Denis Rothman Transformers for Natural Language Processing and Computer Vision Packt Publishing Third Edition 2024.
5. Andriy Burkov The Hundred-Page Language Models Book Andriy Burkov Publishing First Edition 2024

Web Links

1. https://onlinecourses.swayam2.ac.in/imb24_mgl16/preview


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OM -R24PEC413

Cloud Computing

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the cloud computing services including resource virtualization
2. Study the scaling, planning and file system and storage
3. Understand database technology and security issues
4. Comprehend portability issues and programming model case study
5. Learn the enterprise architecture and its related information

Course Outcomes

1. Elaborate the cloud computing services and resource virtualization
2. Explain the scaling, planning and file system and storage
3. Describe the database technology and security issues
4. Elucidate portability issues and programming model case study
5. Discuss the enterprise architecture and its related information

Unit I

Introduction - Benefits and challenges, cloud computing services, resource virtualization, resource pooling, sharing and provisioning, Case study - IaaS, PaaS, SaaS

Unit II

Scaling in the cloud - Capacity planning, load balancing, file system and storage, containers.

Unit III

Multi-tenant software - Data in cloud, database technology, content delivery network, Security - Security reference model, security issues, privacy and compliance issues.

Unit IV

Portability and interoperability - Issues in cloud portability, cloud management, programming model case study: Cloud services - Overview of popular cloud services.

Unit V

Enterprise architecture - Service-oriented architecture SOA, enterprise software, enterprise custom applications, workflow and business processes, enterprise analytics and search, enterprise cloud computing ecosystem

Suggested Readings

1. Dan C. Marinescu Cloud Computing: Theory and Practice Morgan Kaufmann Second Edition 2017.
2. Kris Jamsa Cloud Computing Jones & Bartlett Learning Second Edition Year: 2019.
3. Gautam Shroff, Enterprise Cloud Computing: Technology, Architecture, Applications, Cambridge University Press, 2016

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OM -R24PEC414 *Natural Language Processing*

Credit: 3	CIE: 30	SEE: 70		Hrs./ 3L+1T	Week:
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Course Objectives

1. Learn elementary probability and information theory
2. Study the linguistic essentials
3. Comprehend statistical inference and word sense disambiguation
4. Understand evaluation measures and Markov models
5. Learn probabilistic context-free grammars

Course Outcomes

1. Explain elementary probability and information theory
2. Discuss the linguistic essentials
3. Describe statistical inference and word sense disambiguation
4. Elaborate evaluation measures and Markov models
5. Elucidate probabilistic context-free grammars

Unit I

Introduction of elementary probability theory, essential information theory, Linguistic essentials - Corpus-based work, collocations.

Unit II

Statistical inference - Bins, forming equivalence classes, reliability versus discrimination, N-gram models - Building n-gram models, an information theoretic approach.

Unit III

Word sense disambiguation - Methodological preliminaries, supervised and unsupervised learning, pseudo words, upper and lower bounds on performance, supervised disambiguation, Bayesian classification

Unit IV

Evaluation measures, Markov models - Hidden Markov models, use of HMMs, general form of an HMM, part-of-speech tagging

Unit V

Probabilistic context-free grammars – Introduction Clustering and information retrieval - Background, the vector space model

Suggested Readings

1. Daniel Jurafsky & James H. Martin Speech and Language Processing Daniel Jurafsky, James H. Martin, publisher Pearson, 3rd 2025.
2. Lewis Tunstall, Leandro von Werra & Thomas Wolf, Natural Language Processing with Transformers, Publisher: O'Reilly Media, 1st Edition 2022.
3. Denis Rothman Transformers for Natural Language Processing and Computer Vision, Packt Publishing, 3rd Edition, Year: 2024
4. Sebastian Raschka, Build a Large Language Model (From Scratch), Sebastian Raschka, Manning Publications 1st Edition 2024.

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OM -R24PEC415

Blockchain Technologies

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the basic concept of cryptographic hash functions and hash pointers
2. Study elliptic curve digital signature algorithm
3. Provide a technical overview of decentralized digital currencies like Bitcoin and their broader economic, legal and financial context
4. Gain insight into the working of the Bitcoin network and wallet
5. Comprehend Bitcoin mining and distributed consensus for reliability

Course Outcomes

1. Learn the basics of hash functions
2. Learn the importance of digital signature
3. Understand the structure of a blockchain
4. Learn different ways of storing Bitcoin keys and associated security measures
5. Learn how Bitcoin relies on mining and consensus mechanisms

Unit I

Introduction to Cryptography: Cryptographic hash functions, SHA-256, hash pointers and data structures, Merkle tree.

Unit II

Digital Signatures: Elliptic curve digital signature algorithm ECDSA, public keys as identities, a simple cryptocurrency

Unit III

Bitcoin Mechanics and Consensus: Centralization versus decentralization, distributed consensus, consensus without identity using a blockchain, incentives and proof of work

Mechanics of Bitcoin - Bitcoin transactions, Bitcoin scripts, applications of Bitcoin scripts, Bitcoin blocks, the Bitcoin network

Unit IV

Storage and Usage of Bitcoins: Simple local storage, hot and cold storage, splitting and sharing keys, online wallets and exchanges, payment services, transaction fees, currency exchange markets

Unit V

Bitcoin Mining and Anonymity: Bitcoin mining - The task of Bitcoin miners, mining hardware, mining pools, mining incentives and strategies; Bitcoin and anonymity - Anonymity basics, mixing, Zerocoin, Zerocash, Applications of blockchain technologies

Suggested Readings

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder
Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction Publisher:
Princeton University Press Second Edition 2024.
2. Andreas M. Antonopoulos, Mastering Bitcoin: Programming the Open Blockchain, Andreas
M. Antonopoulos, Publisher: O'Reilly Media, Third Edition, 2024.
3. Imran Bashir Mastering Blockchain, Imran Bashir, Packt Publishing, Fourth Edition, 2023.
4. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel
Drescher, Apress, Second Edition, 2024.

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M -R24PEC421

Software Quality and Testing

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the essentials of software quality
2. Study methods to integrate software quality activities in the project
3. Understand the software quality metrics
4. Learn building software testing strategy
5. Comprehend testing various artifacts of a software project

Course Outcomes

1. Explain the essentials of software quality
2. Elaborate the methods to integrate software quality activities in the project
3. Describe the software quality metrics
4. Discuss building software testing strategy
5. Perform testing various artifacts of a software project

Unit I

Software Quality Fundamentals: The software quality challenge, introduction to software quality factors, Components of the software quality assurance system - Overview, development and quality plans.

Unit II

Integration of Quality Activities: Integrating quality activities in the project life cycle, assuring the quality of software maintenance components, CASE tools and their effect on software quality, Supporting quality infrastructure - Procedure and work instructions, supporting quality devices, configuration management, documentation control, project progress control.

Unit III

Quality Metrics and Standards: Software quality metrics, costs of software quality, Quality management standards - ISO 9000 and companion ISO standards, CMM, CMMI, PCMM, Malcolm Baldrige, 3 Sigma, 6 Sigma, SQA project process standards - IEEE software engineering standards

Unit IV

Software Testing Strategy: Building a software testing strategy, establishing a software testing methodology, determining software testing techniques

Eleven-step software testing process overview - Assess project management development estimate and status, develop test plan, requirements phase testing, design phase testing, program phase testing, execute test and record results, acceptance test, report test results, test software changes, evaluate test effectiveness

Unit V

Testing in Diverse Environments: Testing client/server systems, testing adequacy of system documentation, testing web-based systems, testing off-the-shelf software, testing in a multiplatform environment, testing security, testing a data warehouse

Creating test documentation, software testing tools, taxonomy of testing tools, methodology to evaluate automated testing tools

Examples of tools - LoadRunner, WinRunner, Rational testing tools, Java testing tools, JMetra, JUnit, Cactus.

Suggested Readings

1. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fifth Edition, 2023
2. Aditya P. Mathur, Foundations of Software Testing, Pearson, Second Edition, 2018.


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OM -R24PEC422

Big Data Analytics

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Understand big data fundamentals
2. Understand Hadoop ecosystem
3. Understand MapReduce and HBase fundamentals
4. Understand database concepts related to big data
5. Understand NoSQL fundamentals

Course Outcomes

1. Learn how to handle big data
2. Learn Hadoop ecosystem
3. Learn MapReduce and HBase fundamentals
4. Learn database concepts related to big data
5. Learn NoSQL fundamentals

Unit I

Big Data Overview and Technologies: Getting an overview of big data - Introduction to big data, structuring big data, types of data, elements of big data, big data analytics, advantages of big data analytics. Introducing technologies for handling big data - Distributed and parallel computing for big data, cloud computing and big data, features of cloud computing, cloud deployment models, cloud services for big data, cloud providers in big data market.

Unit II

Hadoop Ecosystem and Components: Understanding Hadoop ecosystem - Introducing Hadoop, HDFS and MapReduce, Hadoop functions, Hadoop ecosystem Hadoop distributed file system - HDFS architecture, concept of blocks in HDFS architecture, name nodes and data nodes, features of HDFS, MapReduce. Introducing HBase - HBase architecture, regions, storing big data with HBase, combining HBase and HDFS, features of HBase Other ecosystem components - Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie

Unit III

MapReduce and Big Data Stack: Understanding MapReduce fundamentals - The MapReduce framework, features of MapReduce, working of MapReduce, techniques to optimize MapReduce jobs, hardware and network topology, synchronization, file system, uses of MapReduce

Role of HBase in big data processing - Characteristics of HBase

Understanding big data technology foundations - Big data stack, data sources layer, ingestion layer, storage layer, physical infrastructure layer, platform management layer, security layer, monitoring layer, visualization layer.

Unit IV

Databases and Data Warehouses: Storing data in databases and data warehouses - RDBMS and big data, issues with relational model, non-relational database, issues with non-relational database, polyglot persistence, integrating big data with traditional data warehouse, big data analysis and data warehouse

Unit V

NoSQL Data Management: NoSQL data management - Introduction to NoSQL, characteristics of NoSQL, history of NoSQL, Types of NoSQL data models - Key-value data model, column-oriented data model, document data model, graph databases Other aspects - Schema-less databases, materialized views, CAP theorem

Suggested Readings

- 1 Seema Acharya & Subhasini Chellappan, Big Data and Analytics, Publisher: Wiley India, Second Edition, 2023.
2. Judith Hurwitz, Alan Nugent, Fern Halper & Marcia Kaufman, Big Data For Dummies, Wiley, Second Edition, 2021.
3. Jules S. Damji, Brooke Wenig, Tathagata Das & Denny Lee, Learning Spark: Lightning-Fast Data Analytics, O'Reilly Media, Second Edition, 2020.

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OM -R24PEC423

Database Security

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. To understand the security of databases
2. To learn the design techniques of database security
3. To study techniques for secure software development
4. To gain knowledge of securing databases against intrusions
5. To learn about different security frameworks and their role in database protection

Course Outcomes

1. Identify and understand security threats in database systems
2. Explain the concepts and security mechanisms in the protection of data
3. Design and implement secure database systems
4. Demonstrate a disaster recovery strategy for retrieving database assets post-incident
5. Apply different techniques for detecting intrusions in database systems

Unit I

Introduction and Security Models I: Introduction to database security - Problems in database security, controls, conclusions

Security models - Access matrix model, Take-Grant model, Acten model, PN model, Hartson and Hsiao's model, Fernandez's model, Bussolati and Martella's model for distributed databases.

Unit II

Security Models II and Mechanisms: Security models - Bell and LaPadula's model, Biba's model, Dion's model, Sea View model, Jajodia and Sandhu's model, lattice model for flow control

Security mechanisms - User identification and authentication, memory protection, resource protection, control flow mechanisms, isolation, security functionalities in operating systems, trusted computer systems, evaluation criteria.

Unit III

Security Software Design: Security software design - Methodological approach, secure operating system design, secure DBMS design, security packages, database security design.

Unit IV

Statistical Protection and Intrusion Detection: Statistical database protection - Statistical concepts and definitions, types of attacks, inference controls, evaluation criteria for control comparison

Intrusion detection systems - IDES system, RETISS system, ASES system, discovery.

Unit V

Models for New Generation Database Systems: Protection models - Frame-based systems, object-oriented systems, SORION model, Orion model, Jajodia and Kogan's model, active databases
Conclusions

Suggested Readings

1. Carlos Coronel & Steven Morris, Database Systems: Design, Implementation and Management, Cengage Learning, 14th Edition, 2022.
2. Peter Rob & Carlos Coronel Database Systems: Design, Implementation and Management, Cengage Learning, Latest Edition Year: 2022.
3. Paul Bois, MySQL, Addison-Wesley Professional, 5th Edition, 2019

Web Links

1. <http://nptel.ac.in/courses/106106093/>
2. <http://www.nptelvideos.in/2012/11/database-management-system.html>

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OM -R24PEC424

UI/UX

Credit: 3	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. To introduce the User Experience lifecycle and human-centered design process.
2. To provide skills in user research, requirement gathering, and modeling.
3. To develop competency in interaction design, conceptual modeling, and navigation.
4. To enable creation of wireframes, prototypes, and UX specifications.
5. To evaluate designs through usability testing and iterative refinement.

Course Outcomes

1. Understand and apply the UX process based on real-world contexts.
2. Conduct user research and define user needs and goals.
3. Create user models, task flows, and conceptual designs.
4. Develop and refine interface designs using prototyping techniques.
5. Plan and conduct usability testing and accessibility analysis.

Unit I

Introduction to UX and the UX Life cycle: UX vs usability, User-centered design, Overview of the UX lifecycle, Agile UX, Principles of interaction design, Contextual inquiry.

Unit II

User Research and Requirements Modeling: Planning user research, Contextual inquiry in depth, User analysis, Personas and scenarios, Work activity affinity diagrams, Requirements extraction

Unit III

UX Design and Conceptual Modeling: Design space and design thinking, Task analysis, Conceptual design, Navigation design, Interaction design, Design patterns

Unit IV

Prototyping and UX Design Artifacts: Low-fidelity prototyping, Storyboards, Wireframes, UX specifications, Screen design guidelines, Agile design documentation

Unit V

UX Evaluation and Usability Testing: UX goals and metrics, Planning usability tests, Conducting and analyzing usability tests, Heuristic evaluation, Accessibility considerations

Suggested Readings

1. Jenifer Tidwell, Charles Brewer & Aynne Valencia, Designing Interfaces: Patterns for Effective Interaction Design, O'Reilly Media, 3rd Edition, 2020.
2. Rex Hartson & Pardha S. Pyla, The UX Book: Agile UX Design for a Quality User Experience, Morgan Kaufmann (Elsevier), 2nd Edition, 2018.

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OM-R24PEC425 Augmented Reality and Virtual Reality

Credit: 3	CIE: 30	SEE: 70		Hrs./ 3L+1T	Week:
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Course Objectives

1. Understand the fundamental concepts of Augmented Reality including its definition, historical evolution, display types, and tracking technologies
2. Explore computer vision techniques, interaction models, and software architectures relevant to Augmented Reality applications
3. Comprehend the foundational principles of Virtual Reality including its geometry, perception, and the behavior of light and optics in virtual spaces
4. Analyze human visual physiology and visual rendering techniques critical for immersive VR experiences
5. Study motion dynamics, interaction paradigms, and audio processing to create realistic virtual environments and enhance user engagement

Course Outcomes

1. Define augmented reality, explain its evolution, and distinguish its components such as multimodal displays and tracking systems
2. Apply computer vision techniques, interaction modalities, and architectural models to build AR-based solutions
3. Explain the concepts of virtual reality geometry, user perception, and optical mechanisms used in visual simulation
4. Evaluate visual rendering approaches in VR and relate them to the human visual system for optimizing realism and performance
5. Demonstrate understanding of motion handling, social and motor interactions, and auditory perception in designing fully immersive VR systems

Unit I - Introduction to Augmented Reality

Augmented reality - Defining augmented reality, history of augmented reality, examples, related fields Displays - Multimodal displays, visual perception, requirements and characteristics, spatial display model, visual displays Tracking - Tracking, calibration and registration, coordinate systems, characteristics of tracking technology, stationary tracking systems, mobile sensors

Unit II - Computer Vision and Software for AR

Computer vision for augmented reality - Marker tracking, multiple-camera infrared tracking, natural feature tracking by detection, outdoor tracking Interaction - Output modalities, input modalities, tangible interfaces, virtual user interfaces on real surfaces, augmented paper, multi-view interfaces, haptic interaction Software architectures - AR application requirements, software engineering requirements, distributed object systems, dataflow, scene graphs

Unit III - Introduction to Virtual Reality and Visual Geometry

Virtual reality - Defining virtual reality, history of VR, human physiology and perception. Geometry of virtual worlds - Geometric models, axis-angle representations of rotation, viewing transformations. Light and optics - Basic behaviour of light, lenses, optical aberrations, the human eye, cameras, displays.

Unit IV - Human Vision and Visual Rendering

Physiology of human vision - From the cornea to photoreceptors, from photoreceptors to the visual cortex, eye movements, implications for VR. Visual perception - Perception of depth, perception of motion, perception of color. Visual rendering - Ray tracing and shading models, rasterization, correcting optical distortions, improving latency and frame rates, immersive photos and videos.

Unit V - Motion, Interaction, and Audio in VR

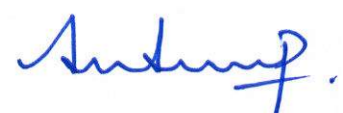
Motion in real and virtual worlds - Velocities and accelerations, the vestibular system, physics in the virtual world, mismatched motion and vacation. Interaction - Motor programs and remapping, locomotion, social interaction. Audio - Physics of sound, physiology of human hearing, auditory perception, auditory rendering.

Suggested Readings

1. Bernard Marr, Extended Reality in Practice: 100+ Amazing Ways Virtual, Augmented and Mixed Reality Are Changing Business and Society, Wiley, 1st Edition, 2021.
2. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors, Edition: 2nd Edition, 2017
3. Jonathan Linowes, Augmented Reality for Developers, Jonathan Linowes, Packt Publishing, 1st Edition 2017.


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OM -R24OE431

Professional Ethics

Credit: 2	CIE: 30	SEE: 70		Hrs./ 3L+1T	Week:
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Course Objectives

1. Learn the developments of legal profession in India
2. Study the seven lamps of advocacy
3. Understand disciplinary proceedings
4. Comprehend the accountancy for lawyers
5. Gain insights into safety and risk

Course Outcomes

1. Explain the developments of legal profession in India
2. Describe the seven lamps of advocacy
3. Elaborate disciplinary proceedings
4. Elucidate the accountancy for lawyers
5. Discuss insights into safety and risk

Unit I - Development of Legal Profession

Development of legal profession in India, Advocates Act 1961, right to practice as a right or privilege, constitutional guarantee under Article 19(1)(g) and its scope. Enrolment and practice, regulation governing enrolment and practice, practice of law, solicitors firm, elements of advocacy.

Unit II - Seven Lamps of Advocacy and Ethics

Seven lamps of advocacy, advocates' duties towards public, clients, court, other advocates, and legal aid Bar Council code of ethics.

Unit III - Disciplinary Proceedings

Disciplinary proceedings, professional misconduct, disqualifications. Functions of Bar Council of India and State Bar Councils in disciplinary matters. Disciplinary committees - Powers and functions, disqualification and removal from rolls.

Unit IV - Accountancy for Lawyers

Nature and functions of accounting, important branches of accounting, accounting and law

Bar and bench relations

Unit V - Safety and Risk in Legal Profession

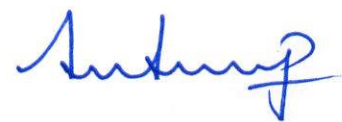
Assessment of safety and risk, risk-benefit analysis and reducing risk, respect for authority, collective bargaining, confidentiality

Conflicts of interest, occupational crime, professional rights, employee rights, intellectual property rights IPR, discrimination

Suggested Readings

1. Pooja Agarwal, Professional Ethics, Accountancy for Lawyers and Bench-Bar Relations, Pooja Agarwal, Asia Law House, 2024 Edition.
2. Dr. Kailash Rai, Professional Ethics, Accountancy for Lawyers and Bench-Bar Relations, Central Law Publications (CLP), Edition 2023.
3. Dr. J. P. Sirohi, Professional Ethics, Accountancy for Lawyers and Bench-Bar Relations, Allahabad Law Agency Latest Revised Edition, 2023.
4. Bare Act, The Constitution of India, Universal LexisNexis / Eastern Book Company, 2025 Edition.


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OM -R24OE432

Constitution of India

Credit: 2	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the basics of the constitution
2. Understand the structure of the union government
3. Comprehend the state government structure
4. Gain insights into local administration
5. Study about the election commission

Course Outcomes

1. Explain the basics of the constitution
2. Elucidate the structure of the union government
3. Elaborate the state government structure
4. Describe the local administration
5. Discuss the election commission

Unit I - The Constitution: Introduction

The history of the making of the Indian Constitution, preamble and the basic structure and its interpretation, fundamental rights and duties and their interpretation, state policy principles.

Unit II - Union Government

Structure of the Indian Union, president - role and power, prime minister and council of ministers, Lok Sabha and Rajya Sabha.

Unit III - State Government

Governor - role and power, chief minister and council of ministers, state secretariat.

Unit IV - Local Administration

District administration, municipal corporation, Zila Panchayat.

Unit V - Election Commission

Role and functioning, chief election commissioner, state election commission.

Suggested Readings

1. D.D. Basu / Durga Das Basu, Introduction to the Constitution of India, LexisNexis, 28th Edition, 2026.
2. Subhash C. Kashyap , Our Constitution: An Introduction to India's Constitution and Constitutional Law, 5th Edition , 2025. , National Book Trust, India.
3. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, Twenty-Third Edition, 2018

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OM -R24OE433

Disaster Management

Credit: 2	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. To learn about various types of natural and man-made disasters
2. To know pre- and post-disaster management for some of the disasters
3. To know about various information and organizations in disaster management in India
4. To get exposed to technological tools and their role in disaster management

Course Outcomes

1. Acquainted with basic information on various types of disasters
2. Knowing the precautions and awareness regarding various disasters
3. Decide first action to be taken under various disasters
4. Familiarized with organizations in India which are dealing with disasters
5. Able to select IT tools to help in disaster management

Unit I - Understanding Disaster

Concept and definitions of disaster, hazard, vulnerability, risk, capacity, disaster and development, disaster management.

Unit II - Types, Trends, Causes, Consequences and Control of Disasters

Geological disasters - Earthquakes, landslides, tsunami, mining. Hydro-meteorological disasters - Floods, cyclones, lightning, thunderstorms, hailstorms, avalanches, droughts, cold and heat waves. Biological disasters - Epidemics, pest attacks, forest fires. Technological disasters - Chemical, industrial, radiological, nuclear. Man-made disasters - Building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemical and biological disasters. Global disaster trends, emerging risks of disasters, climate change and urban disasters.

Unit III - Disaster Management Cycle and Framework

Disaster management cycle, paradigm shift in disaster management. Pre-disaster - Risk assessment and analysis, risk mapping, zonation and microzonation, prevention and mitigation of disasters, early warning system, preparedness, capacity development, awareness. During disaster - Evacuation, disaster communication, search and rescue, emergency operation centre, incident command system, relief and rehabilitation. Post-disaster - Damage and needs assessment, restoration of critical infrastructure, early recovery, reconstruction and redevelopment. Frameworks - IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit IV - Disaster Management in India

Disaster profile of India, mega disasters of India and lessons learnt. Disaster Management Act 2005, institutional and financial mechanism, National policy on disaster management, national guidelines and plans on disaster management, Role of government - Local, state, national, Role of non-government and inter-governmental agencies

Unit V - Applications of Science and Technology for Disaster Management

Geo-informatics in disaster management - Remote sensing RS, geographic information system GIS, global positioning system GPS Disaster communication system - Early warning and its dissemination Land use planning and development regulations, disaster-safe designs and constructions, structural and non-structural mitigation of disasters, Science and technology institutions for disaster management in India

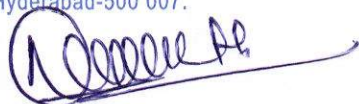
Suggested Readings

1. H.N. Srivastava & G.D. Gupta, Management of Natural Disasters in Developing Countries, 2018 Daya Publishing House listing, 2006.
2. David Alexander, Natural Disasters, 2018 Routledge edition.
3. R.K. Bhandani, An Overview on Natural and Man-Made Disasters and Their Reduction, CSIR, New Delhi..


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OM -R24OE434

Organizations Behaviour

Credit: 2	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn management process and functions
2. Study decision making and negotiations
3. Comprehend psychological contract
4. Understand models of organization behavior
5. Gain insights into organization design

Course Outcomes

1. Explain management process and functions
2. Discuss decision making and negotiations
3. Describe psychological contract
4. Elaborate models of organization behavior
5. Elucidate the organization design

Unit I - Management Process and Functions

Scientific and modern management, 3D model of managerial behavior, MBO, MBWA, line and staff, The Peter's Principle, Parkinson's Law. Approaches to organization structure-management - Classical, human relations, systems and contingency approaches, Hawthorne's experiments, human engineering.

Unit II - Decision Making and Negotiations

Approaches to decision making - Rational, behavioral, practical, personal, Open and closed models of decision making, Types and steps in planning, Authority, responsibility, centralization, Decentralization, recentralization, Bureaucracy.

Unit III - Psychological Contract and Motivation

Personality traits, Big Five personality traits, MBTI inventory, Process of perception, perceptual distortions and errors, Kelly's personal construct theory, Motivation - Content theories: Maslow, Alderfer, Herzberg, McClelland, Process theories: Vroom, Porter and Lawler, equity theory, goal theory, attribution theory

Unit IV - Organizational Behavior Models and Group Dynamics

Models of organization behavior - Autocratic, custodial, supportive, collegial, system models, Transactional analysis, Johari window, Group dynamics - Typology of groups, conflicts in groups, Nature of conflict, reactions to conflict, model of conflict Leadership - Trait and behavioral approaches, managerial grid, path-goal theory, Vroom's decision tree approach, Hersey and Blanchard model.

Unit V - Organization Design and Emerging Aspects

Organization design, organization culture, organization climate, Stress management and counseling, management of change, organization development, Communication, emerging aspects of organizational behavior.

Suggested Readings

1. Stephen P Robbins, Timothy & Neharika, Organizational Behaviour, Pearson, 2022/18th edition
2. K. Aswathapa, Organizational Behaviour, Himalaya Publishers, 2015/12th edition
3. Fred Luthans, Organizational Behaviour, Emerald Publishers, 2020/14th edition
4. L M Prasad, Organizational Behaviour, Sultan Chand & Sons, 2024
5. Harold Koontz, Heinz Weihrich, Essentials of Management, McGraw Hill Education, 9th Edition, 2015
6. Curtis W. Cook, Phillip L. Hunsaker, Management and Organizational Behavior, McGraw-Hill, 3rd Edition, 2010

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OM -R24OE435 Intellectual Property and Cyber Law

Credit: 2	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the fundamentals of intellectual property
2. Study the basics of international instruments of IPR
3. Understand the laws concerning copyright in India
4. Comprehend the IP in trademarks
5. Gain insights into the concept of patent

Course Outcomes

1. Explain the fundamentals of intellectual property
2. Elaborate the basics of international instruments of IPR
3. Describe the laws concerning copyright in India
4. Discuss the IP in trademarks
5. Explain the concept of patent

Unit I - Fundamentals of Intellectual Property

Meaning, nature, classification and protection of intellectual property, Main forms of intellectual property - Copyright, trademarks, patents, designs industrial and layout, geographical indications, plant varieties protection, biotechnology.

Unit II - International Instruments of IPR

Introduction to leading international instruments concerning intellectual property rights, The Berne Convention, Universal Copyright Convention, the Paris Union, Patent Cooperation Treaty, The World Intellectual Property Organization WIPO, the UNESCO, International trade agreements concerning IPR - WTO, TRIPS.

Unit III - Law of Copyright in India

The Copyright Act 1957, historical evolution, meaning of copyright, Copyright in literary, dramatic, musical works, computer programs, cinematograph films. Neighboring rights - Rights of performers and broadcasters. Ownership and assignment of copyright, author's special rights, Notion of infringement, criteria of infringement in films, literary and dramatic works Authorities under the Act, remedies for infringement.

Unit IV - Trademarks and Design Protection

Intellectual property in trademarks, rationale for protection, The Trade Marks Act 1999, Definition of trademark, distinction between trademark and property mark, Registration, passing off, infringement of trademark, criteria of infringement, remedies, The Designs Act 2000 - Definition and characteristics of design, law in India, protection and rights of design holders, copyright in design, registration, remedies for infringement.

Unit V - Patent Law and Protection

Concept of patent, historical overview of patents law in India, Patentable inventions, kinds of patents, procedure for obtaining a patent, The Patents Act 1970, rights and obligations of a patentee, term of patent protection, Use and exercise of rights, exclusive marketing rights, right to secrecy, Notion of abuse of patent rights, infringement of patent rights and remedies.

Suggested Readings

1. P. Narayanan, Patent Law, Eastern Law House, 1995
2. S.K. Roy Chowdhary and Others, Law of Trademark, Copyrights, Patents and Designs, Kamal Law House, 1999
3. Dr. G.B. Reddy, Intellectual Property Rights and the Law, 5th Edition, Gogia Law Agency, 2005


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OM -R24OE436

Environment Science

Credit: 2	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. Learn the scope and importance of environmental studies
2. Study about the environment and natural resources
3. Understand the environmental pollution
4. Comprehend the regional and sectoral issues concerning environment
5. Gain insights into social issues and the environment

Course Outcomes

1. Explain the scope and importance of environmental studies
2. Elaborate the environment and natural resources
3. Describe the environmental pollution
4. Discuss the regional and sectoral issues concerning environment
5. Explain the social issues and the environment

Unit I - Environmental Studies and Biodiversity

Environmental studies - Introduction, definition, scope and importance, basic principles of ecosystem functioning

Concept of ecosystem - Structure and functioning of ecosystem, introduction and characteristic features, structure and functions of different ecosystems

Biodiversity and its conservation - Introduction, bio-geographical classification of India, value of biodiversity - consumptive and productive use, social, ethical and optional values

Levels of biodiversity - Global, national and local

Hotspots of biodiversity, threats to biodiversity, endangered and endemic species of India

Conservation of biodiversity - In-situ and ex-situ conservation

Unit II - Environmental and Natural Resources, Valuation and Economics

Forest resources - Use and over-exploitation, deforestation, timber extraction, mining and dams, effects on forests and tribal people

Water resources - Use and over-utilization of surface and ground water, floods, droughts, conflicts over water, dams and their impacts

Food resources - World food problems, changes due to agriculture and overgrazing, effects of modern agriculture, fertilizer and pesticide issues, water logging and salinity

Environmental valuation - Welfare measures and environmental values, definition and classification of environmental values, valuation methods

Environmental economics - Economic approach to preservation and conservation, property rights and externalities, management of natural resources

Unit III - Environmental Pollution and Problems

Environmental pollution - Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution.

Environmental problems in India - Effects of human activities on quality of life, water and river pollution, ground water depletion, wasteland reclamation.

Unit IV - Regional and Sectoral Environmental Issues

Regional and sectoral issues - Urbanization, agroforestry, dry lands, goods and services, mountain development, river basin water resources management, sustainable tourism, coastal zone management

Environment and development - Economy and environment interaction, state of the environment, economics of development, preservation and conservation

Sustainability - Theory and practice, equitable use of resources, sustainable lifestyles, role of individuals in pollution prevention

Human population and environment - Population growth, environmental impacts, human rights

Unit V - Social Issues and Environmental Policy

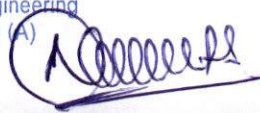
Social issues and environment - Sustainable development, resettlement and rehabilitation, associated problems and concerns Environmental ethics - Issues and possible solutions, consumerism and waste products, public awareness Sustainable resources management, design of environmental policy - Direct government regulation, command and control instruments

Suggested Readings

1. B. Sudhakara Reddy, T. Sivaji Rao, U. Tataji, K. Purushottam Reddy, An Introduction to Environmental Studies, Maruti Publications
2. C. Manohar Chary, P. Jayaram Reddy, Principles of Environmental Studies, B.S. Publications, Hyderabad, 2019.
3. Y. Anjaneyulu, Introduction to Environmental Science, B.S. Publications, Hyderabad, 2017.


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OM -R24PROJ401

Project Work

Credit: 12	CIE: 30	SEE: 70	Hrs./ Week: 3L+1T
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Course Objectives

1. To enable students to undertake independent, in-depth study of a real-world problem and propose practical software or system-based solutions
2. To apply knowledge and skills acquired from various courses to design, develop, test and deploy a complete application or solution
3. To encourage systematic project planning, progress tracking and professional project documentation
4. To enhance skills in technical writing and oral presentation through seminars, reports and viva-voce
5. To prepare students for professional roles by cultivating self-discipline, time management and problem-solving abilities

Course Outcomes

1. Identify and define a project problem, prepare a detailed synopsis and plan its execution using appropriate tools and methodologies
2. Conduct literature review and feasibility analysis to propose effective and innovative technical solutions
3. Design and implement a functional software system or application demonstrating sound engineering practices
4. Present technical content clearly and confidently in both written reports and oral presentations
5. Demonstrate project management skills, professional ethics and the ability to work independently with accountability
6. Enhance previous knowledge of database systems, deepen understanding of theoretical and practical aspects of database technologies, and show the need for distributed database technology to address deficiencies in centralized systems
7. Expose active and emerging research issues in distributed database systems and application development
8. Apply theory to practice by building and delivering a distributed database query engine subject to remote web service calls

9. Familiarize with current models, technologies and approaches to building distributed database systems and services
10. Develop practical skills in selecting and applying suitable methods for specific cases in distributed database design and application
11. Be aware of current research directions and their potential outcomes
12. Conduct independent research on relevant topics, identify primary references, analyze them and draw meaningful conclusions

Project Implementation Guidelines

Project Duration – 15 weeks

Project Guide – One faculty guide per student

By Week 2 – Project Synopsis Submission

Content – Problem definition, scope of the problem, plan of action

By Week 8 – Project Seminar Presentation

Coverage – Analysis, design, implementation aspects of the project

Final Evaluation (End Semester)

University Viva-Voce – Mandatory appearance required

Evaluation – As per University Rules and Regulations book

Internal Evaluation (CIE) Guidelines

A committee comprising two faculty members and the project guide will evaluate and award CIE marks. Evaluation is based on the following:

1. Submission of a one-page synopsis for notice board display
2. 20-minute project seminar presentation followed by 10-minute discussion
3. Submission of a complete technical write-up

The project seminar must include the following components:

- Problem definition and specification
- Literature survey and familiarity with research journals
- Broad understanding of available techniques and tools for problem-solving
- Planning and scheduling of work, bar (activity) chart preparation, oral and written presentation

The department will appoint a project coordinator who will coordinate the following:

- Re-grouping of students – deletion of internship candidates from groups made as part of project work
- Re-Allotment of internship students to project guides
- Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 2nd week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

WEB RESOURCES:

1. https://swayam.gov.in/nc_details/NPTEL
2. <https://fossee.in/>
3. <https://nmeict.ac.in/>
4. <https://delnet.in/index.html>
5. <https://ocw.mit.edu/>
6. <https://online.stanford.edu/>
7. <https://github.com/>
8. https://www.ndl.iitkgp.ac.in/ndl_he
9. <https://www.salesforce.com/in/>
10. <https://www.osmania.ac.in/faculties.php>


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