

Osmania University
Faculty of Informatics

Master of Computer Applications (MCA)

CBCS (Choice-Based Credit System) Syllabus

Semester III and IV

With effect from the academic year 2025-2026

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



Faculty of Informatics
Osmania University
2025-2026

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

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Dept. of Computer Science & Engg.
University College of Engineering
Osmania University, Hyd-500 007.

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1350
11/12/24

GENERAL COURSE STRUCTURE**Definition of Credit**

Type	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

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

Scheme of Examination

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

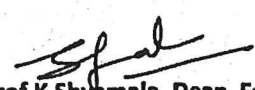
Credit Table R24(2024-2026)

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


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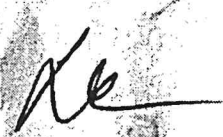
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Master of Computer Applications (MCA)
Semester - III

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


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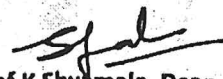
Master of Computer Applications (MCA)
Semester IV

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


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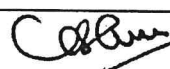
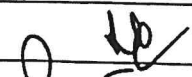
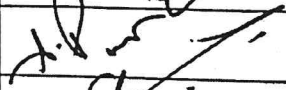
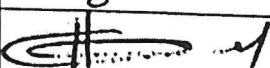
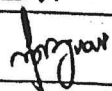

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Semester - III

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SIP321	Summer Internship	-	-	1.5	50	-
TOTAL		20	9	28	305	570

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

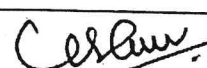
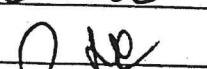
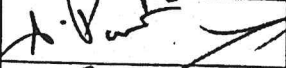
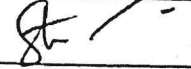
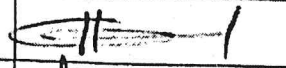
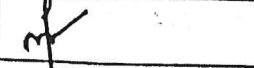

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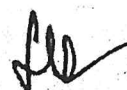

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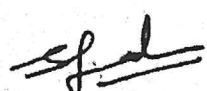
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PCC301	Software Engineering	4 Credits
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Course Objectives

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 architecture
3. Perform software planning in terms of staffing and scheduling
4. Create effective test cases and testing procedures
5. Re-engineer and maintain the developed software systems

Unit I

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

Unit II

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

Unit III

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

Unit IV

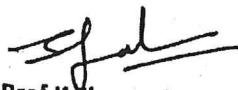
Coding and unit testing - Programming principles and guidelines, incrementally developing code, managing evolving code, unit testing, code inspection, metrics Testing - Testing concepts, testing process, black box testing, white box testing, metrics

Unit V

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


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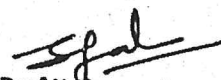
Suggested Readings

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



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PCC302

Computer Networks

4 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

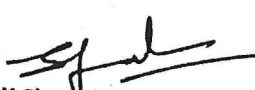
Socket programming - Primitive and advanced system calls, iterative and concurrent client-server programs and Application layer - Domain Name Space (DNS), SMTP, FTP, HTTP

Suggested Readings

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


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PCC303

Artificial Intelligence

4 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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


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Unit III

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

Unit IV

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

Unit V

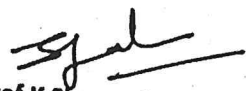
Advanced knowledge representation techniques - Case grammars, semantic web
Natural language processing - Introduction, sentence analysis phases, grammars and parsers, types of parsers, semantic analysis, universal networking knowledge.

Suggested Readings

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


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PCC 304

Full Stack Web Development 4 Credits

Course Objectives

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

Course Outcomes

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

Unit I

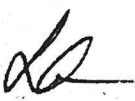
Web development basics - HTML and web servers, shell, UNIX CLI, version control using Git and GitHub, HTML, CSS

Unit II

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

Unit III

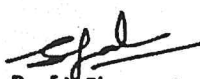
React JS - Introduction to React, Router and single-page applications, React forms, flow architecture, introduction to Redux, advanced Redux, client-server communication



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Unit IV

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

Unit V

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

Suggested Readings

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


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PROFESSIONAL ELECTIVE – I**PEC 311****Digital Forensics****3 Credits****Course Objectives**

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

Course Outcomes

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

Unit I

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

Unit II

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

Unit III

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


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Unit IV

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

Unit V

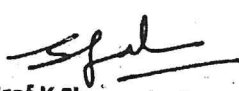
Current computer forensics tools - Software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions Email investigations - Investigating email crime and violations, understanding email servers, specialized email forensics tools

Suggested Readings

1. Warren G. Kruse II and Jay G. Heiser, *Computer Forensics: Incident Response Essentials*, Addison Wesley, 2002
2. Nelson, B., Phillips, A., Enfinger, F., Stuart, C., *Guide to Computer Forensics and Investigations*, 2nd Edition, Thomson Course Technology, 2006.
3. Vacca, J., *Computer Forensics: Computer Crime Scene Investigation*, 2nd Edition, Charles River Media, 2005.


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PROFESSIONAL ELECTIVE - I

PEC 312

Distributed Systems

3 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Suggested Readings

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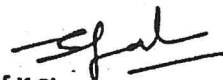
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1. Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems*, PHI, 2nd Edition, 2009.
2. R. Hill, L. Hirsch, P. Lake, S. Moshiri, *Guide to Cloud Computing, Principles and Practice*, Springer, 2013.
3. R. Buyyn, J. Borberg, A. Goscinski, *Cloud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



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PROFESSIONAL ELECTIVE – I

PEC 313	Internet of Things	3 Credits
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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 Prototyping the physical design - Laser cutting, 3D printing, CNC milling Techniques for writing. embedded C code - Integer data types in C, manipulating bits using AND, OR, XOR, NOT, reading and writing from I/O ports, Simple embedded C programs - LED blinking, control of motor using switch, temperature sensor with Arduino board.

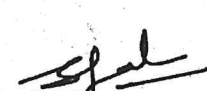
Unit IV

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


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Unit V

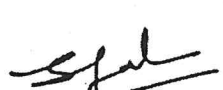
Security and Privacy in the IoT: Security Issues in IoT, Cloud and Fog Computing, IoT practice.

Suggested Readings

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


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PROFESSIONAL ELECTIVE – I

PEC 314	Image Processing	3 Credits
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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.

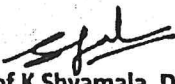
Unit IV

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.


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Suggested Readings

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

PROFESSIONAL ELECTIVE – I

PEC 315	Dev Ops Methodology	3 Credits
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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, micro services and data tier, DevOps, architecture and resilience.

Unit III

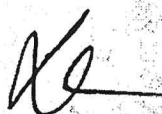
Introduction to project management - source code management, roles and code, source code management system and migrations, shared authentication, hosted Git servers, different Git server implementations, Docker intermission, Gerrit and the pull request model.

Unit IV

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

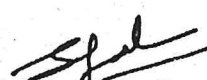
Unit V

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



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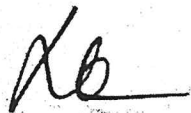
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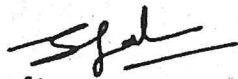
Suggested Reading

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

Suggested Reading

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


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PROFESSIONAL ELECTIVE – II

PEC321

Network Security

3 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

PKI interface - Digital certificates, certifying authorities, POP key interface, system security using firewalls and VPNs
Smart cards - Application security using smart cards, zero knowledge protocols and their use in smart cards, attacks on smart cards

Unit V

Applications - Kerberos, web security protocols SSL, IPSec, electronic payments, e-cash, secure electronic transaction SET, micro payments
Case studies of enterprise security - .NET, J2EE

Suggested Readings

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

PROFESSIONAL ELECTIVE – II

PEC 322

Optimization Techniques

3 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

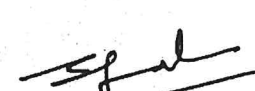

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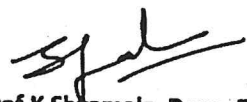
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Suggested Readings

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


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PROFESSIONAL ELECTIVE - II

PEC 323

Deep Learning

3 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

Unit II

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

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

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

Unit III

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

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

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

Unit IV

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

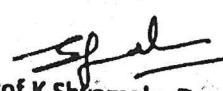

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PROFESSIONAL ELECTIVE - II**PEC 323****Deep Learning****3 Credits****Course Objectives**

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

Course Outcomes

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

Unit I

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

Unit II

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

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

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

Unit III

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

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

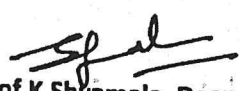
Attention mechanisms - Attention mechanism, sequence to sequence with attention mechanism, transformer

Unit IV

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


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Unit V

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

Suggested Readings

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


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PROFESSIONAL ELECTIVE - II

PEC324

Information Retrieval Systems

3 Credits

Course Objectives

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

Course Outcomes

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

Unit I

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

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

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

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

Unit II

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

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

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

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

Unit III

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

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

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

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

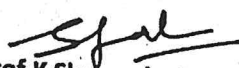

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Unit IV

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

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

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

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

Unit V

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

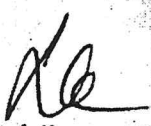
Web search basics: Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling.

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

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

Suggested Readings

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



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Professional Elective - II

PEC325	Data Visualization	3 Credits
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Course Objectives

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

Course Outcomes

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

Unit I

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

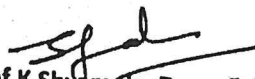
Unit II

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

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


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Unit III

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

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

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

Unit IV

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

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

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

Unit V

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

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

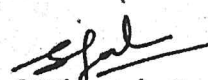
Suggested Readings

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



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LCC351**Network Programming Lab****1.5 Credits****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

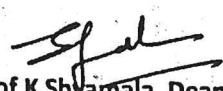
Lab Programs

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


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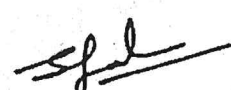
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8. Connection-oriented iterative case server - Server changes the case of the string sent by the client and returns it
9. Connection-oriented iterative server - Server calculates net salary using basic, hra, da, pt, epf, where $\text{net-salary} =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



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LCC352**Software Engineering Lab****1.5 Credits****Course Objectives**

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

Course Outcomes

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

Content

Phases in software development project - Overview, need, coverage of topics

Requirement engineering tasks - Assigning tasks

System analysis - Requirement analysis, SRS

Function-oriented diagrams - DFD, structured chart

User's view analysis - Use case diagram

Structural view diagrams - Class diagram, object diagram

Behavioral view diagrams - Sequence diagram, collaboration diagram

Behavioral view diagrams continued - State-chart diagram, activity diagram

Implementation view diagram - Component diagram

Environmental view diagram - Deployment diagram

Testing - Unit testing, integration testing using testing tools

UML Diagrams to be Drawn for the Following Systems

ATM application

Library management system

Railway reservation system

E-commerce system

Banking system

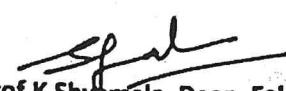


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Case Study Tasks**Task 1 – Domain Analysis**

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

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

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

Task 2 – Software Crisis Scenario

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

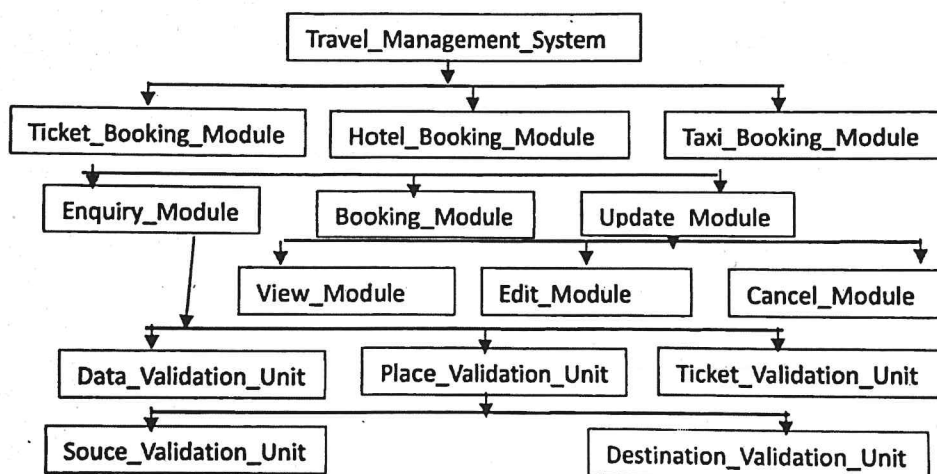
Problem - Analyse software crisis in given scenarios

Scenario A - Railway reservation system crashed after initial success

Scenario B - Delay in autopilot software integration for satellite

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

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

Task 3 – Integration Testing Scenarios

Background - Integration testing using stubs and drivers

Scenario - Travel Management System (TMS) with Ticket_Booking_Module, Hotel_Booking_Module, Taxi_Booking_Module

Sub-modules - Enquiry_Module, Booking_Module, Update_Module

Validation units - Date_Validation_Unit, Ticket_Validation_Unit, Place_Validation_Unit

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

1. Ticket_Validation_Unit not completed, top-down integration testing
2. Update_Module not completed, bottom-up integration testing
3. Taxi_Booking_Module not completed, top-down integration testing

Task 4 – Performance Testing

Background - Performance testing types - load testing, stress testing, endurance testing, spike testing
Problem - Identify appropriate performance testing category for the following

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

Task 5 – Regression Testing

Background - Software enhancement and testing strategy

Problem - Travel Management System upgraded based on customer feedback

Task - Choose correct testing approach

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

Task 6 – Metrics and Productivity

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

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

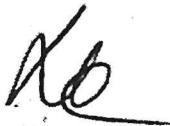
Problem - Online loan system with Car_Loan_Module and House_Loan_Module

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

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

Task - Identify incorrect metric-related statement

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

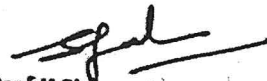


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LCC353

Full Stack Web Development Lab

1.5 Credits

Course Objectives

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

Course Outcomes

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

Unit I – Web Development Basics

Create a basic personal portfolio webpage using HTML and CSS

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

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

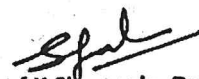
Design a simple HTML form and style it using CSS

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

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


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Unit II – Frontend Development

- Write a JavaScript program to validate form inputs such as email and password
- Demonstrate object-oriented principles in JavaScript with classes and inheritance
- Create a web page that uses AJAX to fetch JSON data from a dummy API and display it dynamically
- Build a basic jQuery-based image slider with event handling
- Create a dynamic to-do list using jQuery UI components
- Parse and display JSON data using JavaScript in a formatted table

Unit III – React JS

- Set up a React project using create-react-app and build a simple Hello World app
- Create a single-page application using React Router with at least three navigable pages
- Build a contact form in React with controlled components and form validation
- Implement a Redux store to manage global state in a shopping cart app
- Use React lifecycle methods or hooks to fetch data from an external API and render it
- Create a client-server interaction using React frontend and dummy JSON server backend

Unit IV – Java Web Development

- Write a Java program demonstrating basic OOP principles such as inheritance, polymorphism, and encapsulation
- Build a simple Java MVC application using Servlets and JSP
- Create a RESTful web service using Spring Boot to handle CRUD operations for a User entity
- Design a web-based login form using Spring MVC and validate credentials
- Use Maven to manage dependencies and build a Spring Boot project
- Implement exception handling and logging in a Spring Boot REST API

Unit V – Databases and Deployment

- Design a normalized relational schema for a student-course enrollment system
- Write SQL queries to perform CRUD operations on a sample database
- Integrate Spring JDBC to fetch data from a MySQL or PostgreSQL database
- Build a mini-project that stores form data into a database and retrieves it dynamically
- Deploy a full-stack Java and React application to Heroku or a cloud server
- Demonstrate the use of agile tools like Trello or GitHub Projects for managing sprints and tasks

Master of Computer Applications (MCA)

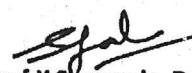
Semester IV

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



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Professional Elective-III

PEC411

IoT Security

3 Credits

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

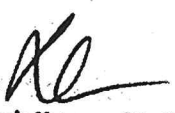
Unit I – Fundamentals of IoT and Security

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

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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. B. Russell and D. Van Duren – *Practical Internet of Things Security*, Packet Publishing, 2016
2. Fei Hu – *Security and Privacy in Internet of Things (IoT): Models, Algorithms, Implementations*, CRC Press, 2016
3. Narayanan et al. – *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, 2016



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Professional Elective-III

PEC412

Generative AI

3 Credits

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

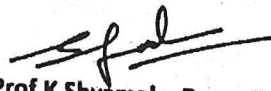
Unit III – Generation of Images

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


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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 Reading

1. David Foster, *Generative Deep Learning*, O'Reilly Books, 2024
2. Altaf Rehmani, *Generative AI for Everyone*, BlueRose One, 2024
3. Denis Rothman, *Transformers for Natural Language Processing and Computer Vision*, 3rd Edition, Packt Books, 2024

Web Links

1. https://onlinecourses.swayam2.ac.in/imb24_mg116/preview
2. <https://www.simplilearn.com/tutorials/generative-ai-tutorial>

PEC-413

Cloud Computing

3 Credits

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

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. Bigdata portability issues and programming model case study
5. Discuss the enterprise architecture and its related information

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

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

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

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

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

1. Sandeep Bhowmik, *Cloud Computing*, Cambridge University Press, 2017
2. Gautam Shroff, *Enterprise Cloud Computing: Technology, Architecture, Applications*, Cambridge University Press, 2016
3. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *Distributed and Cloud Computing from Parallel Processing to the Internet of Things*, Elsevier, 2012

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Professional Elective-III

PEC414

Natural Language Processing

3 Credits

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

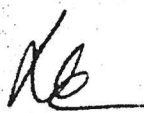
Evaluation measures, Markov models - Hidden Markov models, use of HMMs, general form of an HMM, part-of-speech tagging

Unit V

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

Suggested Readings

1. Christopher D. Manning, Hinrich Schütze, *Foundations of Statistical Natural Language Processing*, MIT Press, 1999
2. James Allan, *Natural Language Understanding*, Pearson Education, 1994
3. Tanveer Siddiqui, U.S. Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press, 2008

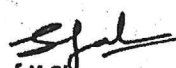

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Professional Elective-III

PEC415

Blockchain Technologies

3 Credits

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

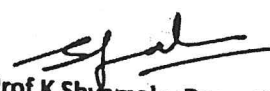
Bitcoin Mining and Anonymity: Bitcoin mining - The task of Bitcoin miners, mining hardware, mining pools, mining incentives and strategies; Bitcoin and anonymity - Anonymity basics, mixing, Zerocoin, Zerocash, Applications of blockchain technologies



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Suggested Readings

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton Press, 2016
2. Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, O'Reilly, 2nd Edition, 2017


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Professional Elective-IV

PEC421

Software Quality and Testing

3 Credits

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



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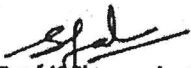
Suggested Readings

1. Daniel Galin, *Software Quality Assurance – From Theory to Implementation*, Pearson Education, 2004
2. Mordechai Ben-Menachem, Garry S. Marliss, *Software Quality – Producing Practical, Consistent Software*, BS Publications, 2014
3. William E. Perry, *Effective Methods for Software Testing*, 3rd Edition, Wiley, 2007.
4. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing, Principles and Practices*, Pearson Education, 2006
5. Dr. K.V.K.K. Prasad, *Software Testing Tools*, Wiley Publishers, 2004.


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Professional Elective-IV

PEC422

Big Data Analytics

3 Credits

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

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data model, document data model, graph databases

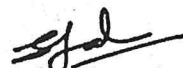
Other aspects - Schema-less databases, materialized views, CAP theorem

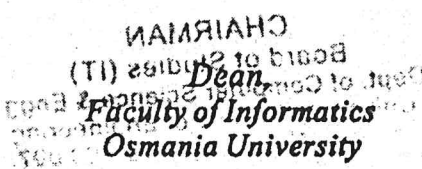
Suggested Readings

1. *BIG DATA Black Book*, Dream Tech Press, 2016.
2. Seema Acharya, Subhasini Chellappan, *Big Data and Analytics*, Wiley Publications, 2016
3. Nathan Marz, James Warren, *Big Data: Principles and Best Practices of Scalable Real-Time Systems*, 2010


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Professional Elective-IV

PEC423

Database Security

3 Credits

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

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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. Silvano Castano, *Database Security*, Pearson Education, ACM Press, 1995.
2. Alfred Basta, Melissa Zgola, *Database Security*, Cengage Learning, 2011
3. Hassan Afyouni, *Database Security and Auditing: Protecting Data Integrity and Accessibility*, Thomson, 1st Edition, 2006.

Web Links

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


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Professional Elective-IV

PEC 424

UI/UX

3 Credits

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. *Rex Hartson & Pardha Pyla, The UX Book: Agile UX Design for a Quality User Experience, 2nd Edition, Morgan Kaufmann, 2018*

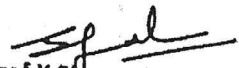

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Professional Elective-IV

PEC 425

AUGMENTED REALITY AND VIRTUAL REALITY

3 Credits

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

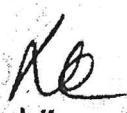
Course Outcomes

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

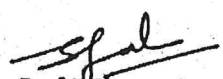
Unit I – Introduction to Augmented Reality

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


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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 andvection

Interaction - Motor programs and remapping, locomotion, social interaction

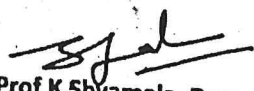
Audio - Physics of sound, physiology of human hearing, auditory perception, auditory rendering

Suggested Readings

1. *Augmented Reality: Principles & Practice*, Schmalstieg and Hollerer, Pearson Education India, 1st Edition, 2016, ISBN-10: 9332578494
2. *Virtual Reality*, Steven M. LaValle, Cambridge University Press, 2016


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OPEN ELECTIVE

OE431

Professional Ethics

2 Credits

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

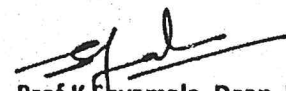
Nature and functions of accounting, important branches of accounting, accounting and law
Bar and bench relations


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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. Myneni S.R., *Professional Ethics, Accountancy for Lawyers and Bench-Bar Relation*, Asia Law House, 2020
2. Pooja Agarwal, *Professional Ethics, Accountancy for Lawyers and Bench-Bar Relation*, Asia Law House, 2022


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Open Elective

OE 432

Constitution of India

2 Credits

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

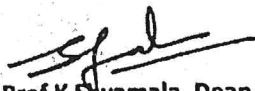
Unit IV – Local Administration

District administration, municipal corporation, Zila Panchayat

Unit V – Election Commission

Role and functioning, chief election commissioner, state election commission


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Suggested Readings

1. Rajeev Bhargava, *Ethics and Politics of the Indian Constitution*, Oxford University Press, New Delhi, 2008
2. B.L. Fadia, *The Constitution of India*, Sahitya Bhawan, New Edition, 2017
3. D.D. Basu, *Introduction to the Constitution of India*, Lexis Nexis, Twenty-Third Edition, 2018



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Open Elective

OE 433

Disaster Management

2 Credits

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, tsunamis, 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


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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. Publications of National Disaster Management Authority NDMA on various templates and guidelines for disaster management
2. Bhandani R.K., *An Overview on Natural and Man-Made Disasters and Their Reduction*, CSIR, New Delhi
3. Srivastava H.N., Gupta G.D., *Management of Natural Disasters in Developing Countries*, Daya Publishers, Delhi, 2006
4. Alexander David, *Natural Disasters*, Kluwer Academic, London, 2018
5. Ghosh G.K., *Disaster Management*, A P H Publishing Corporation, 2006.
6. Murthy D.B.N., *Disaster Management: Text and Case Studies*, 2007.

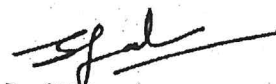


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Open Elective

OE 434	Organization Behaviour	2 Credits
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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

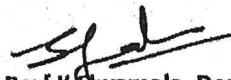
Unit II – Decision Making and Negotiations

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


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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

S.No.	Author	Titles	Publisher	Year/edition
1	Stephen P Robbins, Timothy & Neharika	Organizational Behaviour	Pearson	2022/18 th edition
2	K.Aswathapa	Organizational Behaviour	Himalaya Publishers	2015/ 12 th edition
3	Fred Luthans	Organizational Behaviour	Emerald Publishers	2020/ 14 th edition
4	L M Prasad	Organizational Behaviour	Sultan chand & Sons	2024
5	Harold Koontz, Heinz Weihrich	<i>Essentials of Management</i>	McGraw Hill Education	9th Edition, 2015
6	Curtis W. Cook, Phillip L. Hunsaker	<i>Management and Organizational Behavior</i>	McGraw-Hill	3rd Edition, 2010

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Open Elective

OE 435

Intellectual Property and Cyber Law

2 Credits

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

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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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Open Elective

OE 436

Environmental Science

2 Credits

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

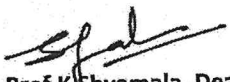

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Unit III – Environmental Pollution and Problems

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.

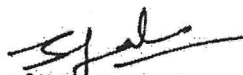


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Proj 401

Project Work

12 Credits

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
13. Apply learned skills to solve practical database-related tasks


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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-

I. 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.

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