

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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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	1 hr	3hrs
Practical	25	50	2 hr	3hrs
Internship	50	-	3hrs	-
Project	50	100	3hrs	3hrs

Credit Table R24(2024-2026)

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


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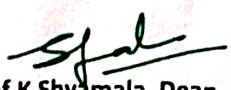
**Master of Computer Applications (MCA)
Semester IV**

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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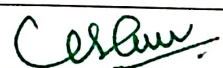
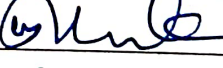
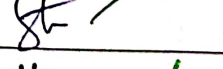
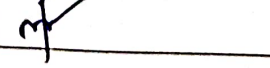

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OE436	Environmental Science					
PRACTICALS						
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TOTAL		8	24	20	140	310

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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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_mgl16/preview
2. <https://www.simplilearn.com/tutorials/generative-ai-tutorial>

Professional Elective-III

PEC413	Cloud Computing	3 Credits
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Course Objectives

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

Course Outcomes

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

Unit I

Introduction - Benefits and challenges, cloud computing services, resource virtualization, resource pooling, sharing and provisioning

Case study - IaaS, PaaS, SaaS

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Suggested Readings

1. 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

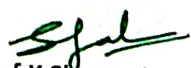
Suggested Readings

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

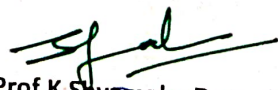


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Suggested Readings

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
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Course Objectives

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

Course Outcomes

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

Unit I

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

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

Unit II

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

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

Unit III

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

Unit IV

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

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

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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

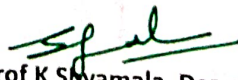
1. *Rex Hartson & Pardha Pyla, The UX Book: Agile UX Design for a Quality User Experience, 2nd Edition, Morgan Kaufmann, 2018*


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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 and vection

Interaction - Motor programs and remapping, locomotion, social interaction

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

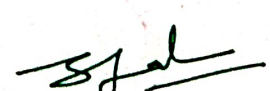
Suggested Readings

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

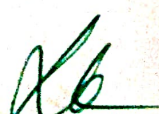
Unit V – Safety and Risk in Legal Profession

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

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

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

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

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.
