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VEER NARMAD SOUTH GUJARAT UNIVERSITY

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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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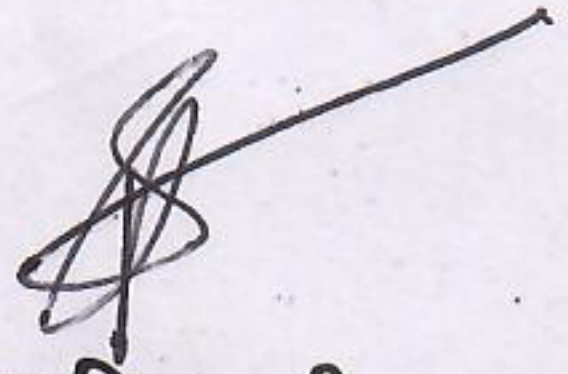
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પરીપત્ર

The University Grants Commission (Minimum Standards and Procedures for Award of Ph.D. Degree) Regulations, 2022 ની જોગવાઈઓને અનુરૂપ પીએચ.ડી. કોર્ષવર્કના અભ્યાસક્રમને અદ્યતન કરવા અંગે કોમ્પ્યુટર સાયન્સ વિષયની RESEARCH AND RECOGNITION COMMITTEE ધ્વારા તૈયાર કરેલ આ સાથે સામેલ અભ્યાસક્રમને એકેડેમિક કાઉન્સિલે તેની તા.૦૯/૦૭/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંક (૭૭) થી નીચે મુજબ મંજૂર કરેલ છે. તદ્દનુસાર ઘટતી કાર્યવાહી કરવાની જાણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૯/૦૭/૨૦૨૫ ની સભાનો ઠરાવ ક્રમાંક : (૭૭)

:: આથી ઠરાવવામાં આવે છે કે, કોમ્પ્યુટર સાયન્સ વિષયની RESEARCH AND RECOGNITION COMMITTEE ની સભાએ તૈયાર કરેલ અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.


કુલ સચિવ વતી

ક્રમાંક : પીએચ.ડી./કોર્ષવર્ક/૧૯૦૪૬/૨૦૨૫

તા.૧૯/૦૭/૨૦૨૫

પ્રતિ,
૧. તમામ કોલેજના આચાર્યશ્રીઓ, યુનિવર્સિટીના વિવિધ વિભાગોના વડાશ્રીઓ, યુનિવર્સિટી પરિસરના સ્વનિર્ભર અભ્યાસક્રમોના કો-ઓર્ડિનેટરશ્રીઓ, તમામ પીએચ.ડી.ના માર્ગદર્શક શિક્ષકશ્રીઓ તરફ જાણ તથા અમલ કરવા સારૂ...

૨. યુનિવર્સિટીના તમામ વહીવટી વિભાગોના વડાશ્રીઓ તરફ જાણ તથા જરૂરી કાર્યવાહી અંગે...

Veer Narmad South Gujarat University, Surat
Ph.D. Coursework
Computer Science
Effective From June 2025

Name of Programme	Ph.D Coursework								
Program Outcomes	<p>PO1 : Fundamental Knowledge Enrichment Program trains students with the core computer science and Information Technology (IT) knowledge domains. It also makes research scholars capable of using core concepts in the conceptualization of domain-specific research.</p> <p>PO2 : Critical Thinking Development Critically apply theories, methodologies, and knowledge to address fundamental questions in their primary area of study.</p> <p>PO3 : Knowledge and Intellectual Abilities The knowledge, intellectual abilities, and techniques to carry out excellent research.</p> <p>PO4 : Advanced Tools Usage The program teaches the researchers to apply the advanced tools to solve research problems.</p> <p>PO5 : Research governance and organization The knowledge of the standards, requirements and professional conduct that are needed for the effective management of research.</p> <p>PO6 : Undertake Research Projects Develop skills to lead research projects within specified limits and participate constructively in more complex interdisciplinary research projects.</p> <p>PO7 : General Competence Train researchers to conduct their research in accordance with recognized ethical standards for research.</p>								
Program Specific Outcomes	<p>PSO1 : Develop and strengthen the fundamental core concepts that are required to solve research problems.</p> <p>PSO2 : Develop skills that needs independent logical and analytical thinking to solve research problems.</p> <p>PSO3 : Nurture the researchers to investigate for the design and development of a workable solution for a research problem.</p> <p>PSO4 : Train researchers for self-learning and performing challenging problem solution in their research area.</p> <p>PSO5 : Train researchers to use recent computer science and application domain specific knowledge in their research problem.</p> <p>PSO6 : Train researchers to take-up the real-world challenges to develop workable solution to a domain specific research problem.</p> <p>PSO7 : Inculcate the passion for continuous learning and doing research for making a successful professional career.</p>								
Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	PO1								
	PO2								
	PO3								
	PO4								
	PO5								

		PO6							
		PO7							
Paper No	Subject	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks	
		Theory			Duration	Marks			
I	Research Methodology	4		4	3 Hrs.	50	50	100	
Electives	(Select any two courses)								
II	Machine Learning	4		4	3 Hrs.	50	50	100	
III	BlockChain Technology	4		4	3 Hrs.	50	50	100	
IV	Advanced Web Technology (Open Source)	4		4	3 Hrs.	50	50	100	
V	Data Management	4		4	3 Hrs.	50	50	100	
VI	Digital Image Processing	4		4	3 Hrs.	50	50	100	
VII	Advanced Object-Oriented Paradigm : A Multi Language and Database Perspective	4		4	3 Hrs.	50	50	100	
	Total			12					

Course Title	Research Methodology							
Credit	4							
Review / Revision	June 2025							
Course Outcome	CO1: Discuss different methodologies and techniques used in research work. CO2: Explain basic computer skills necessary for the conduct of research. CO3: Assess the basic function and working of programming and analytical software used in research. CO4: Propose the required numerical skills necessary to carry out research. CO5: Organize and conduct research in an organized and ethical manner.							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							
Course Content	<p>UNIT 1: Research Philosophy</p> 1.1 Meaning and objectives of research 1.2 Motivation in research 1.3 Types of research 1.4 Research methods VS Research methodology, 1.5 How research is done 1.6 Criteria of good research 1.7 Defining a research problem 1.8 Selection of a research problem 1.9 Research design and its need <p>UNIT 2: Data and Data Analysis</p> 2.1 Type of data, 2.1.1 Primary and Secondary data 2.1.2 Data Collection Methods 2.1.3 Data Visualization 2.2 data collection methods 2.3 Descriptive Statistics : 2.2.1 Measure of central tendency, 2.2.1 Measure of dispersion, 2.2.3 Measure of Asymmetry, 2.3.4 Correlation and Regression <p>Unit 3: Hypothesis Testing</p> 3.1 Introduction to Testing of Hypothesis 3.2 Understanding parametric and nonparametric tests 3.3 Parametric tests 3.3.1 Testing of Means 3.3.2 Testing of Differences between Means 3.3.3 Testing of Two related Samples 3.3.4 Testing for comparing two variance 3.4 Chi-square test <p>UNIT 4: Research Reporting</p> 4.1 Report writing 4.2 Significance of report writing 4.3 Steps in report writing 4.4 Layout of research figures, tables, graphs, references, foot notes etc. 4.5 Presentation of research 4.6 Art of writing a good research paper							

	<p>4.7 Selection of a journal for paper publication</p> <p>UNIT 5: Research Metrics and Tools</p> <p>5.1 Ethical Issues in research and reporting research</p> <p>5.2 Research Metrics</p> <p>5.2.1 Research Databases</p> <p>5.2.1. Citation databases: Web of Science, Scopus, etc.</p> <p>5.4.2 Research Metrics: Impact Factor, Cite Score. Metrics: h-index, i10 index etc</p> <p>5.3 Use of tools / techniques for Research</p> <p>5.3.1 Methods to search required information effectively</p> <p>5.3.2 Reference Management Software like Zotero/Mendeley</p> <p>5.3.3 Software for paper formatting like LaTeX/MSOffice</p> <p>5.3.4 Software for detection of Plagiarism Turnitin, Urkund</p>
Reference Books	<ol style="list-style-type: none"> 1. Kothari, C. R., Research Methodology -methods and techniques, 2nd Edition,Wishwa Prakashjan, Newdelhi. 1999. 2. Berny, H. Durston, M. Poole, "Thesis and Assignment writing", Wiley Eastern Ltd, ND, 3. Misra, R P, Research Methodology - A Hand Book , Concept publishing Company, New Delhi, 1988. 4. Y. Kirani Singh, B.B. Chaudhuri, Matlab Programming,PHI EEE, 2007 5. Amos Gilat, MATLAB An introduction with applications, Wiley India Edition, 6. John H. Mathews, Kurtis D. Fink, Numerical Methods using MATLAB, Fourth Edition, PHI EEE 7. Alasdair Mc Andrew, Introduction to Digital Image Processing with MATLAB, Cengage Learning 8. Python Data Science Handbook: Essential Tools for Working with Data, Jake VanderPlas, 1 January 2016,O'Relly Media,ISBN : 978-1491912058 9. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools Davy Cielen et.al. , 1 January 2016,dreamtech,ISBN: 978-1633430037 10. Python: The Complete Reference Paperback – 20 March, Martin C. Brown (Author), 2018 <p>Additional Reading</p> <ol style="list-style-type: none"> 1. Anthony, M., Graziano, A. M. and Raulin, M. L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.

Paper – II : Machine Learning

Course Title	Machine Learning							
Credit	4							
Review / Revision	June 2025							
Course Outcome	<p>CO1: By the end of the course the students will be able to understand the concepts of Machine Learning</p> <p>CO2: By the end of the course the students will be able to apply various machine learning techniques to real problem</p> <p>CO3: By the end of the course, the students will be able to analyze ML algorithms problem solving</p> <p>CO4: The students will be able to determine the best suitable algorithm for after proper analysis of the problem statement and dataset.</p> <p>CO5 : At the end of the course students will be able to develop a new algorithm for solving research problem based on the ML</p>							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							
Course Content	<p>Unit 1 : Introduction</p> <p>1.1. Definition of Machine Learning</p> <p>1.2 Types of Machine Learning : Supervised , Unsupervised and Semi-supervised</p> <p>1.3 Model training and Performance Evaluation</p> <p>1.5 Model Selection</p> <p>1.6 Data Visualization</p> <p>1.7 Data Wrangling</p> <p>Unit 2 : Supervised Learning</p> <p>2.1 Supervised Learning : Classification and Regression</p> <p>2.2 Regression Methods</p> <p>2.3 Classification Algorithms</p> <p>2.4 Ensemble Algorithm</p> <p>Unit 3 : Neural Network</p> <p>3.1 Introduction to Neural Network</p> <p>3.2 Architecture of Neural Network</p> <p>3.3 Feedforward network and Backpropagation</p> <p>3.4 Convolution Neural Network</p> <p>3.5 Recurrent Neural Network</p> <p>Unit 4 : Unsupervised Learning</p> <p>4.1 Introduction to Unsupervised learning</p> <p>4.2 Clustering Algorithms</p> <p>4.3 Association Rule Learning Algorithm</p>							
Reference Books	<ol style="list-style-type: none"> 1. “Machine Learning” by Tom M. Mitchell, McGraw Hill 2. “Understanding Machine Learning” by Shai Shalev-Shwartz, Shai Ben-David 3. “Machine Learning” by Anuradha Srinivasaraghavan, Vincy Joseph 4. “Machine Learning using Python” by U Dinesh Kumar Manaranjan Pradhan 5. “Real-World Machine Learning” by Henrik Brink, Joseph Richards, Mark Fetherolf 6. “Python Machine Learning” by Sebastian Raschka and Vahid Mirjalili 7. “Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems” by Aurelien Geron 8. “Machine Learning in Action” by Peter Harrington 9. “Introduction to Machine Learning with Python : A Guide for Data Scientists” by 							

	Andreas C. Muller, Sarah Guido
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Paper – III : BlockChain Technology

Course Title	BlockChain Technology							
Credit	4							
Review / Revision	June 2025							
Course Outcome	<p>CO1: Students will be able to Understand Blockchain Technology.</p> <p>CO2: Students will learn Importance of Security and Consensus in Blockchain.</p> <p>CO3: Students will be able to Develop a Blockchain base applications for a specific domain.</p> <p>CO4. Expose the students to various sectors where Blockchain Technology can be implemented and how It will bring the transformation.</p> <p>CO5: Explain students about concept of Hyperledger, web 3.0 and Smart Contracts using Soidity.</p>							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							
Course Content	<p>UNIT 1 Blockchain Architecture & Protocol Design</p> <p>1.1 Evolution of Blockchain</p> <p>1.2 Consensus Mechanisms: PoW, PoS, DPoS, PBFT, etc.</p> <p>1.3 Block Structure & Chain Management</p> <p>1.4 Smart Contracts & Virtual Machines (EVM, WASM)</p> <p>1.5 Gas, Fees, and Incentive Structures</p> <p>UNIT 2 Smart Contract Development & Security</p> <p>2.1 Writing Smart Contracts in Solidity or Vyper</p> <p>2.2 ERC Standards (ERC-20, ERC-721, ERC-1155)</p> <p>2.3 Contract Deployment on Testnets</p> <p>2.4 Common Vulnerabilities</p> <p>2.5 Security Tools (MythX, Slither, OpenZeppelin)</p> <p>UNIT 3 Advanced Cryptography & Zero-Knowledge Proofs</p> <p>3.1 Merkle Trees & Merkle Patricia Trees</p> <p>3.2 zk-SNARKs, zk-STARKs, Bulletproofs</p> <p>3.3 Identity Management & Privacy (ZK-ID, Tornado Cash)</p> <p>3.4 Homomorphic Encryption & Threshold Signatures</p> <p>3.5 Use of Cryptographic Primitives in Layer-2s</p> <p>UNIT 4 Layer-2 Scaling, Interoperability & Cross-Chain Systems</p> <p>4.1 Rollups (Optimistic vs. zkRollups)</p> <p>4.2 State Channels & Plasma</p> <p>4.3 Cross-Chain Bridges (Axelar, Wormhole, LayerZero)</p> <p>4.4 Interoperability Protocols (IBC, Polkadot, Cosmos)</p> <p>4.5 MEV & Flashbots</p> <p>UNIT 5 Real-World Use Cases & Enterprise Blockchain</p> <p>5.1 DeFi Architecture (DEXs, Lending, Stablecoins)</p> <p>5.2 DAOs, Governance Protocols</p> <p>5.3 CBDCs & Government Use Cases</p>							

	<p>5.4 Supply Chain & IoT Integration</p> <p>5.5 Enterprise Solutions (Hyperledger, Corda, Quorum)</p>
Reference Books	<ol style="list-style-type: none"> 1. The Blockchain Developer. A practical Guide for Designing, implementing, Publishing, Testing and SecllrIng Distributed Blockchain-based Projects-Elad Elrom, Apress 2. Mastering Bitcoin : Programming the open Blockchain, Andreas M. Antonopoulos, O'REILLY 3. The Book of satoshi :The collected writings of Bitcoin creator, Phil Champagne, E53 Publishing LIC 4. Blockchain ; The Blockchain for beginners guide to Blockchain technology and leveraging Blockchain programming, Josh Thompson, Create Space independent Publishing Platform 5. "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Imran Bashir, Second Edition, Packt Publishing, 2018 6. "Block chain: The Block chain for Beginners-Gulde to Blockchaln Technology and Leveraging Block Chain Programming", Josh Thompsons 7. "Block chain: Blueprint for a New Economy", Melanie swan, O'Reilly, 2015

Paper – IV : Advanced Web Technology (Open Source)

Course Title	Advanced Web Technology (Open Source)							
Credit	4							
Review / Revision	June 2025							
Course Outcome	<p>CO1: Explain researchers the Advanced aspects of the Web based Technology.</p> <p>CO2: Train various web technologies like Java, Microsoft .NET and Open-Source PHP in the aspects of Performance, Security, System Resource Requirement etc.</p> <p>CO3: Train various advanced web technologies like Swing, Silverlight, AJAX, JQuery, MVC etc.</p> <p>CO4: Explain and train researchers to deal with possible problems & their solutions while developing websites.</p> <p>CO5: Expose the researchers with the analysis and development process of Websites and recent trends in Markup Languages.</p>							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							

<p>Course Content</p>	<p>UNIT 1: Web Architecture and Protocols</p> <ol style="list-style-type: none"> 1.1. Client-server model and its variations (REST, GraphQL, WebSockets) 1.2. HTTP/2 and HTTP/3 protocols 1.3. Security protocols: TLS, SSL, OAuth, OpenID, JWT 1.4. Web caching techniques (CDN, reverse proxy, etc.) 1.5. API Development: RESTful and GraphQL <p>UNIT 2: Web Application Development and Web Performance Optimization</p> <ol style="list-style-type: none"> 2.1 Progressive Web Apps (PWAs) 2.2 Microservices Architecture and its applications 2.3 Real-time application development using WebSockets 2.4 Docker, Kubernetes, and containerization in web applications 2.5 Analyze and improve website performance metrics. 2.6 Techniques like code minification, image optimization, caching, and lazy loading. 2.7 Explore tools for performance testing and profiling. <p>UNIT 3: Open Source Software Development</p> <ol style="list-style-type: none"> 3.1 Introduction to Open Source concepts 3.2 Contributions to Open Source projects (GitHub, GitLab) 3.3 Open-source licenses and legal considerations (MIT, GPL, Apache) 3.4 Open-source software communities and governance models 3.5 Examples of significant open-source projects (Linux, Apache, Docker) <p>UNIT 4: Advanced Web Technologies & Security</p> <ol style="list-style-type: none"> 4.1 WebAssembly (Wasm) 4.2 Web Performance Optimization Techniques (Lazy loading, caching strategies) 4.3 Browser Developer Tools for debugging and performance analysis 4.4 Web Application Security (OWASP Top 10, SQL Injection, XSS, CSRF) 4.5 Security best practices for frontend and backend development 4.6 SSL/TLS encryption, HTTP security headers 4.7 Secure Authentication Mechanisms (OAuth, JWT) 4.8 Security auditing tools (Burp Suite, OWASP ZAP) <p>UNIT 5 : Research and Emerging Trends</p> <ol style="list-style-type: none"> 5.1 Current research in Web Technology 5.2 Future trends in Web Development (Quantum Web, AI-driven Web) 5.3 Web3 technologies and their impact on the internet
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. "Web Application Architecture: Principles, Protocols and Practices" – Leon Shklar, Richard Rosen, Wiley, ISBN: 978-0470518601, 2009 2. "Designing Data-Intensive Applications" – Martin Kleppmann, O'Reilly Media, ISBN: 978-1449373320, 2017 3. "Web Security, Privacy & Commerce" – Simson Garfinkel, Gene Spafford, O'Reilly Media, ISBN: 978-0596000455, 2001 4. "Foundations of Security: What Every Programmer Needs to Know" – Neil Daswani, Christoph Kern, Anita Kesavan, Apress, ISBN: 978-1590597842, 2007 5. "Building Microservices: Designing Fine-Grained Systems" – Sam Newman, O'Reilly Media, ISBN: 978-1491950352, 2015 6. "Kubernetes: Up and Running" – Kelsey Hightower, Brendan Burns, Joe Beda, O'Reilly Media, ISBN: 978-1491935670, 2017 7. "Docker Deep Dive" – Nigel Poulton, Leanpub, ISBN: 978-1521822807, 2017 8. "WebAssembly in Action" – Gerard Gallant, Manning Publications, ISBN: 978-1617295744, 2020 9. "Open Source Licensing: Software Freedom and Intellectual Property Law" –

Paper – V : Data Management

Course Title	Data Management							
Credit	4							
Review / Revision	June 2025							
Course Outcome	<p>CO1 : Articulate the principles of Database Management Systems. CO2 : To demonstrate the differences between RDBMS and distributed database. CO3: Outline the essential features and elements NOSQL databases. CO4 : To grasp and apply the concepts of query optimization and transaction management.</p>							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
Course Content	<p>UNIT 1: Data Management & Distributed Data Storage</p> <p>1.1. RDBMS vs. Distributed Databases 1.2. Distributed Database Model and Architecture 1.3. Need for Distributed Databases 1.4. Key Principles: Transparency, Scalability, Fault Tolerance</p> <p>UNIT 2: Data Distribution and Replication</p>							

	<p>2.1. Data Fragmentation and Partitioning 2.1.1.Fragmentation (Horizontal, Vertical, and Hybrid) 2.1.2.Data Sharding 2.1.3.Partitioning Strategies and Performance Considerations</p> <p>2.2. Data Replication 2.2.1.Alternative Design Strategies for Replication 2.2.2.Eventual Consistency vs. Strong Consistency 2.2.3.Conflict Resolution in Distributed Replication</p> <p>UNIT 3: Query Processing & Query Optimization</p> <p>3.1. Query Processing in Centralized database 3.2. Distributed Query Processing 3.2.1.Query Decomposition 3.2.2.Data Localization 3.2.3.Global Query Optimization 3.2.4.Distributed Query Execution</p> <p>3.3. Query Optimization for Centralized database 3.3.1.Query processing Cost for relational algebra operations selection, join & sort operation 3.3.2.Cost Based Optimization with Equivalence Rule 3.3.3.Heuristic Optimization</p> <p>3.4. Query Optimization for distributed database 3.4.1.Cost Models for Distributed Queries 3.4.2.Query Optimization Techniques 3.4.3.Join Algorithms in Distributed Databases</p> <p>UNIT 4: Distributed Transaction Control</p> <p>4.1. Transactions in distributed Systems 4.2. ACID vs. BASE Properties 4.3. Concurrency control in distributed Systems 4.4. CAP Theorem: Consistency, Availability, and Partition Tolerance</p> <p>UNIT 5: Distributed Storage Systems – Case Study</p> <p>5.1. NoSQL database 5.2. Cloud-Based Distributed Databases</p>
Reference Books	<ol style="list-style-type: none"> 1. Database System Concepts, H. F. Korth, S. Sudarshan, A. Silberschatz, McGraw Hil Database System Concepts , H. F. Korth, S. Sudarshan, A. Silberschatz, McGraw Hill 2. Principles of Distributed Database Systems, M. Tamer Özsu • Patrick Valduriez, Springer 3. DISTRIBUTED DATABASE MANAGEMENT SYSTEMS - A Practical Approach, SAEED K. RAHIMI, FRANK S. HAUG, Wiley 4. Distributed Database Systems, Chanda Ray, Pearson Publication
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	50% Internal assessment 50% External Assessment

Paper VI : Digital Image Processing

Course Title	Digital Image Processing							
Credit	4							
Review / Revision	June 2025							
Course Outcome	CO1: Explain the fundamentals of digital image and its processing. CO2: Perform image enhancement techniques in spatial and frequency domain. CO3: Explain the mathematical modelling of image restoration and compression. CO4: Apply the concept of image segmentation. CO5: Describe object detection and recognition techniques. CO6: Implement Computer Vision using OpenCV python							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							
	CO6							
Course Content	UNIT 1: Digital Image Fundamentals 1.1. Elements of Visual Perception 1.2. Image Sensing and Acquisition 1.3. Image Sampling and Quantization							

	<p>1.4. Relationships between pixels - Basic Relationship among pixels-neighbor, connectivity, regions, boundaries, distance measures</p> <p>1.5. colour models</p> <p>UNIT 2: Image Enhancement and Image Transformation</p> <p>2.1 Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering</p> <p>2.2 Frequency Domain: 2D Fourier Transform – Smoothing and Sharpening frequency domain filters.</p> <p>2.3 Introduction to the Fourier Transform,</p> <p>2.4 The Discrete Fourier Transform,</p> <p>2.5 Properties of the Two - Dimensional Fourier Transform,</p> <p>2.6 The fast Fourier Transform</p> <p>UNIT 3: Image Restoration, Segmentation and Compression</p> <p>3.1 Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.</p> <p>3.2 Segmentation: Edge detection Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation.</p> <p>3.3 Compression: Fundamentals – Image Compression models – Error Free Compression – Lossy compression– Image Compression standards</p> <p>UNIT 4: Image Representation, Recognition and Colour Processing</p> <p>4.1 Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number –</p> <p>4.2 Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture -</p> <p>4.3 Patterns and Pattern classes -</p> <p>4.4 Recognition based on matching.</p> <p>4.5 Color fundamentals, Color models, The RGB, CMY, CMYK, HSI model, Pseudo color Image processing, Color Transformations, Smoothing and sharpening, Color segmentation</p> <p>UNIT 5: Computer Vision using OpenCV python</p> <p>5.1 Object Detection and Counting</p> <p>5.2 Image Capturing with camera</p> <p>5.3 Object Segmentation</p> <p>5.4 Object Classification</p> <p>5.5 Object Size Measurement</p> <p>5.6 Object Detection from video</p> <p>5.7 Color Detection</p>
Reference Books	<ol style="list-style-type: none"> 1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018. 2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011. 3. Sandipan Dey, “Image Processing Masterclass with Python”, BPB publication, 2021 4. Ravishankar Chityala, Sridevi Pudipeddi, “Image Processing and Acquisition using Python”, CRC press publication, 2021.

	5. Kenneth Dowson - Howe, "A practical introduction to Computer Vision with OpenCV", Willey , 2014 6. R. Szeleski,"Computer Vision: Algorithms & Applications", Springer, 2010 7. S. Sridhar "Digital Image Processing", oxford press, 2013
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Paper VII : Advanced Object-Oriented Paradigm : A Multi Language and Database Perspective

Course Title	Advanced Object-Oriented Paradigm : A Multi Language and Database Perspective							
Credit	4							
Review / Revision	June 2025							
Course Outcome	CO1: The researcher will get an insight into the principles of Object- Oriented Problem solving and programming. CO2: The researcher will be able to compare the object-oriented features of at least three programming languages. CO3: The researcher will be able to compare and implement advanced object-oriented features like generic programming across at least three programming languages. CO4: The researcher will be able to understand and study the object- oriented features incorporated in various Database Management Systems. CO5: The researcher will be able to do gap analysis and proceed further in Research area of Object-Oriented Methodology and Data Management.							
Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							

Course Content	<p>UNIT 1: Object Oriented Foundation</p> <ul style="list-style-type: none"> 1.1 Advanced Encapsulation, Inheritance (single/multiple), Polymorphism, Abstraction 1.2 Object model comparison: C++ (static), Java/C# (managed runtime) 1.3 Interfaces vs abstract classes (Java & C#), pure virtual functions (C++) 1.4 Composition vs Inheritance: design trade-offs 1.5 Type safety and language differences in polymorphism 1.6 Introduction to Object-Oriented Analysis & Design 1.7 Introduction to Object-Oriented Database Management Systems <p>UNIT 2: Advanced OOP features in Different Languages</p> <ul style="list-style-type: none"> 2.1 C++: Virtual functions, multiple inheritance, RTTI, smart pointers, STL 2.2 Java: JVM object model, annotations, generics, garbage collection 2.3 C#: Properties, Delegates, Events, LINQ, async/await 2.4 Exception handling comparison 2.5 Object serialization (binary/XML/JSON) in all three languages 2.6 Persistence 2.7 Genericity <p>UNIT 3: Design Patterns</p> <ul style="list-style-type: none"> 3.1 Design principles: SOLID, DRY, KISS, GRASP 3.2 UML for class, sequence, and state diagrams 3.3 Key patterns: <ul style="list-style-type: none"> 3.3.1 Creational: Singleton, Factory, Builder 3.3.2 Structural: Adapter, Composite, Decorator 3.3.3 Behavioral: Observer, Command, Strategy 3.4 Pattern implementation in C++, Java, and C# <p>UNIT 4: Object Relational Mapping and Database Integration</p> <ul style="list-style-type: none"> 4.1 Object-Relational Mapping (ORM) principles and challenges 4.2 ORM tools and techniques: <ul style="list-style-type: none"> 4.2.1 Java: Hibernate (JPA basics) 4.2.2 C#: Entity Framework Core 4.2.3 C++: Custom mapping techniques or lightweight ORMs Like ODB 4.3 Class-table mapping, annotations/data attributes, lazy loading 4.4 Transactions and cascading behaviours <p>UNIT 5 : Case Study Analysis</p> <ul style="list-style-type: none"> 5.1 Implement core Patterns, ORM and Layered architecture 5.2 Real World source code case study analysis
Reference Books	<ul style="list-style-type: none"> 1. The C++ Programming Language, Stroustrup, Addison Wesley 2. The Complete Reference C++, Schildt, Tata McGraw Hill 3. Java- The Complete Reference, Patrick Naughton, Tata McGraw Hill 4. Object-Oriented Analysis and Design with Applications, Grady Booch, Addison-Wesley (3rd Edition)

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| | <ol style="list-style-type: none">5. C# 10 and .NET 6 – Modern Cross-Platform Development, Mark J. Price, Packt Publishing (2021)6. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides (GoF), Addison-Wesley7. Pattern-Oriented Software Architecture, Volume 1: A System of Patterns, Frank Buschmann et al., Wiley8. Pro C# 9 with .NET 5, Andrew Troelsen, Philip Japikse, Apress9. Programming Entity Framework Core, Julie Lerman, O'Reilly Media10. ODB C++ ORM Documentation, Code Synthesis Tools |
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