Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's

Sharad Institute of Technology College of Engineering

(An Autonomous Institute)

NBA Accredited, Accredited by NAAC 'A' Grade, ISO 9001:2015 Certified

Department: Computer Science Engineering **Rev:** Course Structure/01/NEP/2023-24

Class: Final.Year. B.Tech **Semester:** VII

Sr No	Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
				L	T	P	Total Hrs.	CA1	CA2	MSE	ESE	Total	
1	23CS4701	PCC	Deep Learning	3	-	-	3	10	10	30	50	100	3
2	23CS4702	PCC	Research Methodology	3	-	-	3	10	10	30	50	100	3
3	23CS4703	PEC	Program Elective Courses-IV	3	-	-	3	10	10	30	50	100	3
4	23CS4704	PEC	Program Elective Courses-V	3	-	-	3	10	10	30	50	100	3
5	23CS4705	PCC	Deep Learning Laboratory	-	-	2	2	15	15	-	20	50	1
6	23CS4706	VSEC	Full Stack Development Laboratory	-	-	2	2	15	15	-	20	50	1
7	23CS4707	VSEC	Object Oriented Modelling & Design Laboratory	-	-	2	2	15	15	-	20	50	1
8	23CS4708	PROJ	Capstone Project-II	-	-	4	4	25	25	-	50	100	2
9	23CS4709	HSMC	Values & Ethics	2	-	-	2	25	25	-	-	50	Audit
9	23CSMDXX	MDM	Multidisciplinary Minor	3	-	-	3	10	10	30	50	100	3
Total				**17**	**-**	**10**	**27**	**145**	**145**	**150**	**360**	**800**	**20**

Multidisciplinary Minor-

Basket	Agriculture (Basket A)	Management (Basket B)	Healthcare (Basket C)
Course Code, Name	IoT for Agriculture (23CSMDA5)	Engineering Management Accounting (23CSMDB5)	Biomedical Instrumentation and Devices (23CSMDC5)

Program Elective Course IV-

23CS4703A) Computer Vision
23CS4703B) Cloud Storage Technologies
23CS4703C) Quantum Computing
23CS4703D) Game Theory

Program Elective Course V-

23CS4704A) Big Data Analytics
23CS4704B) Security & Privacy in Cloud
23CS4704C) Block chain Technologies
23CS4704 D) Cognitive Science

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23CS4701	PCC	Deep Learning	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture:3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Linear Algebra, Basics of Classical Computing

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline the fundamentals of deep learning.
CO2	Demonstrate deep learning models using regularization and convolution operations
CO3	Examine the working of Convolution Neural Networks and RNN in decision making.
CO4	Analyze sequential data to build recurrent and recursive models.
CO5	Analyze architecture of Recursive Neural Networks and Long Short-Term Memory.
CO6	Explain the applications of Auto encoders.

Course Contents:

Unit 1: Deep Learning Fundamentals What is Deep Learning, Artificial Neural Network, Perceptron, Multilayer Perceptron, Neural Network, Activation Function, Loss Function, Gradient Descent Method, Chain Rule, Backpropagation, Vanishing Gradient Problem.	[6]
Unit 2: Optimization & Regularization Techniques Overfitting, L1 & L2 Regularization, Dropout, Regularization, Optimizer, Batch Normalization, Weight Initialization, Hyperparameter Tuning	[6]
Unit 3: Convolution neural networks Introduction to CNNs, Convolution Operation- Filters, stride, padding, Pooling Layers, Fully-Connected Layer, Image Data Augmentation, CNN Architectures- LeNet, AlexNet, VGG16.	[6]

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Unit 4: Sequence Modeling I Introduction to Sequential Data, Recurrent Neural Networks (RNN), Structure of RNN, Variable-Length Input, Weight & Bias, Types of RNN, Vanishing Gradient Problem in RNN.	[6]
Unit 5: Sequence Modeling II LSTM, Long Short-Term Memory Dependencies, Standard RNN, BPTT in LSTM, LSTM Applications and Challenges, Deep Reinforcement Learning.	[6]
Unit 6: Autoencoders Attention Mechanism, Transformers, Autoencoders, Generative Models.	[6]

Text Books/Reference Books: -

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT Press, 2016.
3. Deep Learning" – Ian Goodfellow, YoshuaBengio, Aaron Courville

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23CS4702	PCC	Research Methodology	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture:3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the need of research
CO2	Classify different types of research
CO3	Interpret the importance of Literature survey
CO4	Construct a research report in different phases
CO5	Illustrate the importance of research ethics
CO6	Make a use of different ICT Tools for research

Course Contents:

Unit 1 -Introduction to Research The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, Research process, outcomes, application of Research, Meaning and types of Research	[6]
Unit 2 -Types of Research Types of research, pure and applied research, qualitative and quantitative. Research Design: Meaning, need, Casual research Design, Components of research design, and Features of good Research design. Experiments, surveys and case study Research design.	[6]
Unit 3-Literature Survey Importance of literature survey, planning a literature search, Identifying key concepts and key words, locating relevant literature, Reliability of a source.	[6]
Unit 4-Research Report Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Components of thesis and dissertations. Referencing styles and bibliography.	[6]

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Unit 5- Ethics in Research Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher.	[6]
Unit 6- ICT Tools for Research Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools. Web search: Introduction to Internet, use of Internet and WWW, using search engines and advanced search tools	[6]
Text Books: 1. C.R.Kothari,—Research Methodology: Methods and Techniques New Age International,2013. 2. Deepak Chawla Neena Sondhi, —Research Methodology concepts and cases Vikas, New Delhi,2011.	
Reference Books: 1. Panneerselvam R, "Research Methodology", PHI, New Delhi,2013. 2. Taylor, Bill, "Research Methodology", PHI, New Delhi,2006.	

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Program Elective Course IV

23CS4703A	**PEC**	**Computer Vision**	**3-0-0**	**3 Credits**

Teaching Scheme	Evaluation Scheme
Lecture:3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain fundamental concepts of image processing.
CO2	Illustrate fundamental image processing techniques required for computer vision.
CO3	Outline shape analysis and Implement boundary-tracking techniques.
CO4	Apply Hough Transform for line, circle, and ellipse detections.
CO5	Apply 3D vision techniques and Implement motion related techniques.
CO6	Develop applications using computer vision techniques.

Course Contents:

Unit 1: Introduction to Computer Vision Definition and applications of computer vision, Historical background and development, Importance and relevance in modern technology.	[6]
Unit 2: Image Processing Foundations Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.	[6]
Unit 3: Shapes And Regions Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.	[6]

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Unit 4: Hough Transform Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.	[6]
Unit 5: 3D Vision and Motion Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – Optical flow – layered motion.	[6]
Unit 6: Applications Applications Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating Pedestrians.	[6]

Reference/Text books: -

1. D. L. Baggio et al., —Mastering OpenCV with Practical Computer Vision Projectsl, Packt Publishing, 2012.
2. E. R. Davies, —Computer & Machine Visionl, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing imagesl, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Visionl, Third Edition, Academic Press, 2012.
5. R. Szeliski, —Computer Vision: Algorithms and Applicationsl, Springer 2011.
6. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inferencel, Cambridge University Press, 2012.

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Program Elective Course IV

23CS4703B	**PEC**	**Cloud Storage Technologies**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Basics of cloud computing

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the evolution and architecture of traditional and cloud storage systems.
CO2	Apply storage virtualization and management techniques in cloud environments.
CO3	Develop and test applications using public cloud storage platforms and APIs.
CO4	Analyze access control, and compliance mechanisms.
CO5	Analyze data protection with various mechanisms.
CO6	Evaluate performance and emerging trends in cloud-based storage solutions.

Course Contents:

Unit 1: Introduction to Storage Systems Basics of data storage: primary, secondary, and tertiary storage, Traditional storage systems: DAS, NAS, SAN, Introduction to RAID: Levels, configuration, and performance impact, Evolution of storage systems and need for cloud storage, Overview of storage networking and file systems. Cloud services and cloud deployment models, Comparison of traditional and enterprise storage.	[6]
Unit 2: Storage Virtualization & Management Virtualization concepts in cloud and storage, Storage virtualization techniques (thin provisioning, pooling, tiering), Hypervisor-level storage management (VMware, Hyper-V, KVM), Storage provisioning and capacity planning, Storage orchestration and automation, Introduction to Software-Defined Storage (SDS), Orchestration tools: OpenStack Cinder, Kubernetes CSI basics	[6]

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Unit 3: Cloud Storage Platforms and Access Methods Amazon S3, Google Cloud Storage, Azure Blob Storage: Architecture & features, RESTful APIs for cloud storage access, Authentication mechanisms: API keys, OAuth, SDKs (Python/Java/Node.js) for programmatic access, Use cases: Backup, file sharing, media hosting, data lakes	[6]
Unit 4: Data Management and Security in cloud Data availability, durability, and replication, Backup- Access control and Identity Management, deduplication, snapshots, versioning,	[6]
Unit 5: Data Security in Cloud Data encryption and key management, Access control, IAM(Access control and Identity Management), compliance standards (GDPR, HIPAA), Disaster recovery and business continuity Threats to cloud storage: Data breaches, ransom ware, insider threats	[6]
Unit 6: Performance Optimization and Emerging Trends Performance metrics: IOPS, throughput, latency, Monitoring and tuning storage performance, Storage cost optimization techniques, Emerging trends: Edge storage, Multi-cloud storage, Serverless storage, Introduction to distributed file systems (Ceph, HDFS), Overview of container storage in Kubernetes environments.	[6]
Reference Books: 1. Cloud Storage Forensics" – Darren Quick, Syngress 2. "Cloud Computing: Concepts, Technology & Architecture" – Thomas Erl 3. Amazon, Google, and Azure Cloud Storage Official Docs 4. "Designing Data-Intensive Applications" by Martin Kleppmann – O'Reilly	

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Program Elective Course IV

23CS4703C	PEC	Quantum Computing	3-0-0	3 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Mathematical maturity, Linear Algebra, Basics of Classical Computing

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand fundamental principles of quantum mechanics applicable to computing.
CO2	Rephrase quantum information using qubits, and apply quantum gates and circuits.
CO3	Compare between classical and quantum paradigms and interpret the power of quantum parallelism.
CO4	Make use of quantum algorithms like Deutsch, Grover's, and Shor's at a conceptual level.
CO5	Identify physical realization and limitations of quantum computers.
CO6	Classify ethical, societal, and cryptographic implications of quantum technologies.

Course Contents:

Unit 1: Introduction to Quantum Computing Differences between classical and quantum computing, quantum parallelism, real-world motivation (encryption, simulation, optimization)	[6]
Unit 2: Mathematical Preliminaries Linear algebra, complex numbers, Dirac notation, tensor products, quantum state representation	[6]
Unit 3: Quantum Mechanics for Computing Qubits, superposition, entanglement, measurement postulates, Bloch sphere	[6]
Unit 4: Quantum Gates and Circuits Quantum gates (Pauli, Hadamard, CNOT), quantum circuits, reversible computing, Deutsch-Jozsa Algorithm	[6]

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Unit 5: Quantum Algorithms Grover's algorithm (search), Shor's algorithm (factoring) – high-level ideas and implications	[6]
Unit 6: Hardware, Challenges, and Future Scope Quantum hardware overview (IBM Q, Google Sycamore), quantum decoherence, quantum error correction, quantum supremacy, ethical and cryptographic implications	[6]

Reference Books: -

1. Quantum Computation and Quantum Information – Michael A. Nielsen and Isaac L. Chuang
2. Quantum Computing for Everyone – Chris Bernhardt
3. An Introduction to Quantum Computing – Phillip Kaye, Raymond Laflamme, Michele Mosca

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Program Elective Course IV

23CS4703D	**PEC**	**Game Theory**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Knowledge of probability theory, discrete mathematics, and algorithm design.

Course Outcomes: At the end of the course, students will be able to:

CO1	Illustrate basic concept of game theory.
CO2	Outline Artificial Intelligence (AI) methods and describe their foundations
CO3	Construct equilibrium notions such as Nash equilibrium, subgame perfection, correlated equilibrium, evolutionary stability, and refinements
CO4	Analyze strategic situations and represent them formally as games in normal form, extensive form, and coalitional form (e.g., zero-sum, nonzero-sum, cooperative)
CO5	Construct concrete applications in economics (auctions, oligopolies, contracts), political science, biology (evolutionary games), computer science (security, ML), etc
CO6	Solve simple games using various techniques" (e.g., backward induction, elimination of dominated strategies, subgame perfect equilibrium, mixed strategies, Shapley value, core)

Course Contents:

Unit 1: Introduction Making rational choices: basics of Games, strategy, preferences, payoffs, Mathematical basics, Game theory, Rational Choice, Basic solution concepts-non-cooperative versus cooperative games, Basic computational issues, finding equilibria and learning in games. Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets.)	[6]
Unit 2: Games With Perfect Information Games with Perfect Information, Strategic games , prisoner's dilemma, matching pennies, Nash equilibria, theory and illustrations, Cournot's and Bertrand's models of oligopoly, auctions ,mixed strategy equilibrium ,zerosum games , Extensive Games with Perfect Information ,repeated games (prisoner's dilemma)-sub game perfect	[6]

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Information-Nash equilibrium, computational issues.	
Unit 3: Games With Imperfect Information Bayesian Games, Motivational Examples, General Definitions, Information aspects Illustrations, Extensive Games with Imperfect, Information, Strategies, Nash Equilibrium ,Beliefs and sequential equilibrium ,Illustrations ,Repeated Games, The Prisoner's Dilemma ,The Bargaining	[6]
Unit 4: Non-Cooperative Game Theory Non-cooperative Game Theory, Self-interested agents, Games in normal form Analyzing games: from optimality to equilibrium, Computing Solution Concepts of Normal, Form Games, Computing Nash equilibria of two-player, zero-sum games Computing Nash equilibria of two-player, general sum games , Identifying dominated strategies	[6]
Unit 5: Aggregating Preferences Social Choice, Formal Model ,Voting ,Existence of social functions ,Ranking systems ,Protocols for Strategic Agents:	[6]
Unit 6: Mechanism Design Mechanism design with unrestricted preferences, Efficient mechanisms, Vickrey and VCG mechanisms (shortest paths),Combinatorial auctions ,profit maximization Computational applications of mechanism design, applications in Computer Science ,Google's sponsored search, eBay auctions, K-armed bandits.	[6]

Text Books: -

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2004.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors), Algorithmic Game Theory. Cambridge University Press, 2007.

Reference Books: -

1. A. Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
2. YoavSoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, GameTheoretic, andLogical Foundations, Cambridge University Press 2008.
3. Zhu Han, DusitNiyati, WalidSaad, Tamer Basar and Are Hjorungnes, "Game Theory in Wirelessand Communication Networks", Cambridge University Press, 2012.
4. Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific

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Program Elective Course V

23CS4704A	PEC	Big Data Analytics	3-0-0	3 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Basic data science and visualization, python programming.

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the fundamentals of Big Data and its ecosystem.
CO2	Illustrate the process and flow of Big Data Analytics.
CO3	Apply Hadoop architecture and its components in Big Data applications.
CO4	Select Hive and Pig programming tools for data processing.
CO5	Analyze NoSQL data stores and perform CRUD operations in HBase.
CO6	Determine data analytics tasks using Apache Spark framework.

Course Contents:

Unit 1: Introduction To Big Data Introduction to Big Data: Definition, Characteristics, Types of Digital Data: Structured, Semi-structured, Unstructured. Challenges of conventional System, Evolution of Big Data, Applications and Challenges of Big Data, Traditional vs. Big Data systems, Role of Data Analyst.	[6]
Unit 2: Data Analytics Process Introduction to Big data Analytics, Classification of Analytics, Terminologies used in Big Data Environment, Analytics flow for Big Data, Big Data Stack.	[6]
Unit 3: Big Data Technology: Hadoop Introduction to Hadoop: Architecture, Components. HDFS (Hadoop Distributed File System): Features, Architecture, Blocks, NameNode, DataNode. MapReduce Programming Model. YARN (Yet Another Resource Negotiator). Hadoop Ecosystem Tools Overview: Pig, Hive, Sqoop, Flume, Zookeeper, HBase	[6]

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Unit 4: Data Processing Using Hive and Pig Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). Introduction to Pig: What is Pig, Anatomy of Pig, Pig on Hadoop, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function.	[6]
Unit 5: NoSQL and HBase Introduction to NoSQL: Types (Key-value, Column-family, Document, Graph). Differences between RDBMS and NoSQL. Introduction to HBase: Architecture, Data Model, CRUD operations in HBase, HBase vs HDFS.	[6]
Unit 6: Data Analytics with Spark Apache Spark Overview: Architecture, Components, RDDs (Resilient Distributed Datasets), Spark SQL, Creating Data Frames: Data Frames Operations, Dataset Operations, Spark real time use cases: Data Analytics Project architecture and use cases.	[6]

Textbooks: -

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2004.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors), Algorithmic Game Theory. Cambridge University Press, 2007.

Reference Books:-

1. A. Dixit and S. Skeath, Games of Strategy, Second Edition. W Norton & Co Inc, 2004.
2. Yoav Soham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game Theoretic, and Logical Foundations, Cambridge University Press 2008.
3. Zhu Han, Dusit Niyati, Walid Saad, Tamer Basar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012.
4. Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific

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Program Elective Course V

23CS4704B	**PEC**	**Security & Privacy in Cloud**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Cloud basics, networking and privacy.

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain cloud security and cryptographic foundations
CO2	Understand secure cloud architectures and data protection strategies
CO3	Apply identity and access management techniques
CO4	Apply cloud security design patterns to mitigate risks
CO5	Make use of monitoring, auditing, and privacy in cloud systems
CO6	Analyze the privacy issues in could environment

Course Contents:

Unit 1: Fundamentals Of Cloud Security Concepts Overview of cloud security- Security Services – Confidentiality, Integrity, Authentication, Non-repudiation, Access Control – Basic of cryptography – Conventional and public-key cryptography, hash functions, authentication, and digital signatures.	[6]
Unit 2: Security Design and Architecture for Cloud Security design principles for Cloud Computing – Comprehensive data protection – End-to-end access control – Common attack vectors and threats – Network and Storage – Secure Isolation Strategies – Virtualization strategies – Inter-tenant network segmentation strategies – Data Protection strategies: Data retention, deletion and	[6]

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archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key	
Unit 3: Access Control & Identity Management Access control requirements for Cloud infrastructure - User identification – Authentication and Authorization – Roles-based Access Aontrol – Multi Factor Authentication – Single Sign-On Identity Federation – Identity Providers And Service Consumers- Storage And Network Access Control Options – OS Hardening and Minimization – Verified And Measured Boot – Intruder Detection and Prevention.	[6]
Unit 4: Cloud Security Design Patterns Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.	[6]
Unit 5: Monitoring, Auditing and Management Proactive activity monitoring – Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges – Events and alerts – Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.	[6]
Unit 6: Privacy In Cloud What Is Privacy, What Is the Data Life Cycle, What Are the Key, Privacy Concerns in the Cloud, Who Is Responsible for Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	[6]

Text Books:

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:", Wiley 2013
2. Dave shackleford, "Virtualization Security", SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011

Reference Books:

1. Mark C. Chu-Carroll —Code in the Cloudll,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. ThamaraiSelvi

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Program Elective Course V

23CS4704C	PEC	Block chain Technologies	3-0-0	3 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Basic knowledge of Computer Networks and Cryptography.

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the foundational concepts of blockchain and its evolution beyond cryptocurrencies.
CO2	Outline core components like hashing, Merkle trees, consensus mechanisms, and smart contracts.
CO3	Apply the working of platforms like Bitcoin, Ethereum, and Hyperledger.
CO4	Analyze the security issues, vulnerabilities, and mitigation strategies in blockchain environments.
CO5	Evaluate real-world applications of blockchain across various domains like supply chain, finance, and identity.
CO6	Explain, regulatory, and ethical considerations in blockchain deployment.

Course Contents:

Unit 1: Introduction to Blockchain Definition, history and evolution, types of blockchain (public, private, consortium), key properties: decentralization, transparency, immutability, use cases	[6]
Unit 2: Cryptographic Foundations Hash functions (SHA-256), public-key cryptography, digital signatures, Merkle trees, hash pointers	[6]
Unit 3: Consensus Mechanisms Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), comparison and trade-offs	[6]

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Unit 4: Blockchain Platforms Overview of Bitcoin architecture, Ethereum architecture and smart contracts (conceptual), permissioned platforms (Hyperledger Fabric)	[6]
Unit 5: Security and Attacks 51% attack, Sybil attack, replay attack, double spending, scalability issues, Layer-2 solutions (e.g., Lightning Network)	[6]
Unit 6: Applications and Legal Aspects Use cases: supply chain, e-governance, healthcare, identity; regulatory frameworks (GDPR, Indian context), blockchain and data privacy	[6]
Reference Books:- 1. Mastering Blockchain – Imran Bashir 2. Bitcoin and Cryptocurrency Technologies – Arvind Narayanan et al. 3. Blockchain Basics – Daniel Drescher	

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Program Elective Course V

23CS4704D	**PEC**	**Cognitive Sciences**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Mathematics, Computer science, Psychology, Linguistics, and Philosophy

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the underlying theory behind cognition.
CO2	Outline the cognition elements computationally.
CO3	Illustrate mathematical functions through WebPPL.
CO4	Develop applications using cognitive inference model.
CO5	Develop applications using cognitive learning model.
CO6	Apply critical and adaptive thinking to solve complex, real-world problems involving uncertainty and change.

Course Contents:

Unit 1: Philosophy, Psychology and Neuroscience Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.	[6]
Unit 2: Computational Intelligence Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.	[6]
Unit 3: Probabilistic Programming Language WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation –	[6]

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Coroutines: Functions that receive continuations –Enumeration	
Unit 4: Inference Models Of Cognition Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference	[6]
Unit 5: Learning Models Of Cognition Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.	[6]
Unit 6: Future Skills Critical thinking – Adaptive thinking – Cognitive Load Management – Design Thinking – Virtual Collaboration and Cultural Sensitivity. Case Study: Social Cognition and Artificial Intelligence.	[6]

Text Books: -

1. Vijay V Raghavan, Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
3. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences",The MIT Press, 1999.
4. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

Reference Books: -

1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

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23CS4705	PCC	Deep Learning Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA I: 15 Marks CA II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Linear Algebra, Basics of Classical Computing

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline the fundamentals of deep learning.
CO2	Demonstrate deep learning models using regularization and convolution operations
CO3	Examine the working of Convolution Neural Networks and RNN in decision making.
CO4	Analyze sequential data to build recurrent and recursive models.
CO5	Analyze architecture of Recursive Neural Networks and Long Short-Term Memory.
CO6	Explain the applications of Auto encoders.

Experiment List:

1. Implement a single-layer perceptron for binary classification.
2. Train a basic MLP on the MNIST dataset.
3. Build a CNN for CIFAR-10 or MNIST image classification.
4. Use VGG16, ResNet50, or MobileNet for image classification.
5. Improve CNN accuracy using techniques like rotation, flipping, zooming.
6. Implement RNN/LSTM to predict the next word or character.
7. Train LSTM on IMDB movie review dataset for sentiment classification.
8. Implement a basic autoencoder and visualize compressed features.
9. Generate synthetic images using a basic GAN.
10. Detect objects in images using pre-trained YOLO/SSD models.

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23CS4706	VSEC	Full Stack Development Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA I: 15 Marks CA II: 15 Marks End Semester Exam: 20 Marks

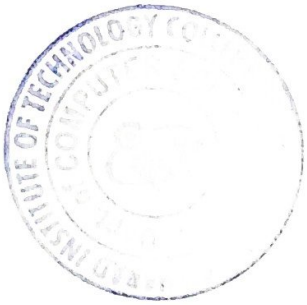
Pre-Requisites: Web Technology

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the fundamental concepts of HTML and CSS.
CO2	Examine the concepts of Javascript.
CO3	Make use of basics of React JS concepts.
CO4	Make use of basics of React JS concepts.
CO5	Develop web-based application using effective database access.

Experiment List:

1. Write a program to create a simple webpage using HTML.
2. Write a program to create a website using HTML CSS and JavaScript?
3. Write a program to build a Chat module using HTML CSS and JavaScript?
4. Write a program to create a simple calculator Application using React JS
5. Write a program to create a Voting Application using React JS
6. Write a program to create and Build a Password Strength Check using Jquery.
7. Develop web-based application using suitable client side and server side code.
8. Create a project on Grocery delivery application.
9. Develop student application using MongoDB database.
10. Develop application and deploy on cloud.



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23CS4707	VSEC	Object Oriented Modelling & Design Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA I: 15 Marks CA II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Mega Project, Mini Project.

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify and classify object-oriented concepts such as classes, objects, inheritance, polymorphism, and encapsulation to model real-world problems.
CO2	Analyze user requirements and construct appropriate UML diagrams (use case, class, sequence, activity, and state diagrams) for system design.
CO3	Design object-oriented systems by applying design principles and implement reusable solutions using relevant design patterns.
CO4	Evaluate existing software systems using object-oriented metrics and principles, and recommend improvements through refactoring and reverse engineering.

Experiment List:

1. Analyze Library Management System or Online Shopping System and identify potential classes, attributes, and methods. Create a class diagram.
2. Create a Use Case diagram for a real-world system.
3. Model a system using Class and Object diagrams for Hospital Management System and Show relationships like inheritance, association, and aggregation.
4. Draw sequence diagrams to represent object interactions over time. Online Food Ordering System - order flow from user to restaurant.
5. Use activity diagrams for workflow modeling and state diagrams for object states. Student Registration System, Lifecycle of a Book in a Library.
6. Implement SOLID principles in a small software module using python. Employee Management System with Interface Segregation & Single Responsibility.
7. Demonstrate code reuse and dynamic method binding for implementation of Inheritance and Polymorphism such as Shape class hierarchy (Circle, Rectangle, Triangle).
8. Analyze final year mega project and generate all the types of diagrams.

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23CS4708	PROJ	Capstone Project-II	0-0-4	2 Credits

Teaching Scheme	Evaluation Scheme
Practical: 4 hrs/week	CA I: 25 Marks CA II: 25 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Knowledge of Core Computer science Engineering Subjects.

Course Outcomes: At the end of the course, students will be able to:

CO1	Basic Knowledge of Core Computer science Engineering Subjects.
CO2	Analyze and optimize solutions to real life problems with individual and team work through modern tool usage.
CO3	Improve professional ethics and communication skill and engage with environment sustainability to build lifelong learning attitude.

Experiment List:

At the end of semester student have to submit project phase-2 report for POE

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23CS4709	HSMC	Values & Ethics	2-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA-I:25 Marks CA-II: 25 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Interpret the principles of ethics and human values by examining their influence on personal behavior, public conduct, and value formation through family, society, and education.
CO2	Demonstrate improved attitude, morals, aptitude, and integrity in contributing positively to society
CO3	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO4	Explain the significance of value inputs in a classroom and start applying them in their life and profession.
CO5	Analyze publication ethics and misconduct to ensure adherence to ethical standards, authorship guidelines, and responsible research dissemination.
CO6	Evaluate the role of ethics, professional values, and gender sensitization in promoting responsible and equitable conduct in engineering and public life.

Course Contents:

Unit 1 Ethics and Human Interface Ethics and Human Interface, Essence, determinants and consequences of Ethics in human actions; Dimensions of ethics; ethics in private and public relationships Human Values – lessons from the lives and teachings of great leaders, reformers and administrators, Role of family, society in inculcating values, role of educational institutions in inculcating values.	[4]
Unit 2: Attitude, Morals, Aptitude, Integrity towards Society Attitude: content, structure, function, Attitude and its influence and relation with thought and behavior, Aptitude and foundational values towards society , integrity, impartiality and non-partisanship, objectivity, dedication towards society, empathy, tolerance and compassion intelligence-concepts, and their utilities and application.	[4]
Unit 3:Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body', Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal	[4]

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of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya, Understanding harmony in the Family.	
Unit 4: Value Education: Need, Guidelines, content and process for Value Education, Self-Exploration–; Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	[4]
Unit 5: Publication Ethics Publication Ethics: Introduction, Scope & importance, Best practices/standards initiatives & Guidelines: COPE, WAME, etc., Conflict of Interest, Publication Misconduct: definition, concept, problems that lead to unethical behavior & Vice versa, Violation of Publication Ethics, Authorship & Contributor ship, Identification of Publication misconduct, complaints & appeals, Predatory publishers & Journals.	[4]
Unit 6: Ethics and Gender Sensitization Ethics - Meaning, Importance, & Types of Ethics, Values and Attitudes of Professional Engineers, Seven Principles of Public Life. Gender Sensitization: Introduction, Sex vs. Gender, Social construction of Gender, Gender Roles, Gender Stereotypes, Ending violence against girls/ women: Advancing safety and rights, Gender Equality.	[4]

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
3. Neeraj Kumar, "Lexicon for Ethics, Integrity & Aptitude", Chronicle Publication, 2016.
4. Santosh Ajmera, Nand Kishor Reddi, "Ethics - Integrity and Aptitude", Tata Mc Graw Hill Publication, 2014.
5. M. Karthikeyan"Ethics, Integrity and Aptitude", Tata Mc Graw Hill Publication, 2015.
6. Dr. Vara Lakshmi G, Dr. R V Anuradha, "Gender Sensitization", Neelkamal Publications.

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.
2. A N Tripathy, 2003, Human Values, New Age International Publishers.
3. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press.
4. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
5. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

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Multidisciplinary Minor V

23CSMDA5	MDM	IoT for Agriculture	3-0-0	3 Credit

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Agriculture Informatics, Internet- of- Things

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the fundamentals of IoT and its relevance to modern agricultural practices.
CO2	Apply appropriate sensors and actuators for monitoring and automating agricultural parameters.
CO3	Analyze the suitability of various IoT hardware and communication protocols for agricultural applications.
CO4	Design a basic IoT-based data management system using cloud platforms for agricultural monitoring.
CO5	Evaluate different IoT applications in agriculture and their impact on productivity and sustainability.
CO6	Develop innovative IoT-based solutions by integrating knowledge from real-world case studies and emerging technologies in agriculture.

Course Contents:

Unit 1: Introduction to IoT and Smart Agriculture Basics of IoT: Definitions, architecture, and components, Importance and scope of IoT in agriculture, Challenges in traditional agriculture systems, Overview of smart agriculture applications, Role of wireless communication in agriculture, Case studies of IoT adoption in Indian and global agriculture.	[6]
Unit 2: Sensors and Actuators in Agriculture Types of sensors used in agriculture: soil moisture, temperature, humidity, pH, light, etc, Actuators: pumps, valves, motors, etc, Sensor integration and interfacing with	[6]

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microcontrollers, Data acquisition and pre-processing, Power management in field-deployed sensors, Calibration and maintenance of sensors.	
Unit 3: IoT Devices and Communication Protocols Microcontrollers and boards (Arduino, Raspberry Pi, ESP32, etc.), Communication protocols: Wi-Fi, LoRa, Zigbee, Bluetooth, NB-IoT, LPWAN and its significance in agriculture, Data transmission techniques for rural areas, Cloud connectivity options, Security considerations in IoT communications.	[6]
Unit 4: Data Management and Cloud Platforms Data collection, storage, and management, Real-time and batch processing of agricultural data, Introduction to cloud platforms: AWS IoT, ThingSpeak, Google Firebase, Dashboard development and visualization tools, Basics of analytics and decision-making, Privacy and data security.	[6]
Unit 5: IoT Applications in Agriculture Smart irrigation systems, Crop monitoring and disease detection, Precision farming and yield prediction, Livestock monitoring using IoT, Greenhouse automation, Use of drones and mobile robots in agriculture.	[6]
Unit 6: Agricultural IOT successful IoT implementations in agriculture, National and international projects (e.g., Digital India, Smart Villages), Open-source IoT tools and kits, DIY projects and lab-based implementation ideas, Challenges and ethical issues in agricultural IoT, Future trends: AI + IoT (AIoT), edge computing, blockchain in agriculture.	[6]
Text Books: 1. Internet of Things: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti 2. Internet of Things (IoT): Principles and Paradigms by Rajkumar Buyya et al.	

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Multidisciplinary Minor V

23CSMDB5	**MDM**	**Engineering Management Accounting**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Engineering Economics

Course Outcomes: At the end of the course, students will be able to:

CO1	Recall and describe the fundamental concepts and scope of management accounting.
CO2	Explain the structure and components of financial statements and interpret their use in decision-making.
CO3	Apply appropriate financial ratios to evaluate a firm's financial performance.
CO4	Analyze the components of working capital and prepare fund flow statements to assess liquidity and operations.
CO5	Evaluate various types of budgets for effective profit planning and organizational control.
CO6	Construct costing models using marginal costing, absorption costing, and cost-volume-profit (CVP) analysis for managerial decision-making.

Course Contents:

Unit 1: Introduction to Management Accounting- Meaning and Definition of Management Accounting, Nature and Scope of Management Accounting, Objectives and Functions of Management Accounting, Role of Management Accounting in Decision-Making, Management Accounting v/s Financial Accounting v/s Cost Accounting, Tools and Techniques of Management Accounting, Limitations of Management Accounting.	[6]
Unit 2: Financial Statements & Analysis Meaning and Types of Financial Statements (Balance Sheet, P&L), Objectives of Financial Statement Analysis, Limitations of Financial Statements ,Methods of	[6]

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Analysis, Comparative Statement, Common Size Statement, Trend Analysis. Interpretation of Financial Statements, Practical Problems on Comparative & Common Size Statements.	
Unit 3: Ratio Analysis Meaning and Importance of Ratio Analysis, Classification of Ratios, Liquidity Ratios: Current Ratio, Quick Ratio, Solvency Ratios: Debt-Equity, Interest Coverage, Profitability Ratios: Gross Profit, Net Profit, Return on Capital, Turnover Ratios: Inventory, Debtors, Creditors Turnover, Advantages and Limitations of Ratio Analysis, Practical Problems on Ratio Calculation and Interpretation.	[6]
Unit 4: Working Capital & Fund Flow- Meaning and Importance of Working Capital, Determinants of Working Capital, Classification of Activities: Operating, Investing, Financing, Format of Cash Flow Statement, Working Capital Forecasting and Planning, Sources and Applications of Working Capital, Fund Flow Statement:--Statement of Changes in Working Capital, Funds from Operations, Preparation of Fund Flow Statement, Difference Between Fund Flow and Cash Flow, Direct Method v/s Indirect Method, Practical Problems on Cash Flow Statement.	[6]
Unit 5: Budgeting for Profit Planning & Control – Meaning of Budget & budgetary control, Objectives, Merits & Limitations, Types of Budgets – Production, Sales, Cash and Master Budget. Fixed & flexible budgeting, Capital Budgeting, Performances Budgeting responsibility accounting.	[6]
Unit 6: Marginal Costing, Absorption Costing & CVP- Meaning and Concepts:--Marginal Costing, Absorption Costing, Difference Between the Two Contribution, P/V Ratio, Break-Even Point (BEP), Margin of Safety, Cost-Volume-Profit (CVP) Analysis, Applications of Marginal Costing in Decision-Making:--Make or Buy, Product Mix Decisions, Accepting Special Orders, Shut Down or Continue, Advantages and Limitations of Marginal Costing, Numerical Problems on BEP, CVP Analysis, Variance Analysis- Material, Labour & Overheads Variance, Advantages & limitations, MIS.	[6]

Reference/Textbooks: -

1. Khan, M.Y. & Jain, P.K., *Management Accounting*, Tata McGraw Hill.
2. Maheshwari, S.N. & Maheshwari, S.K., *Management Accounting*, Vikas Publishing House.

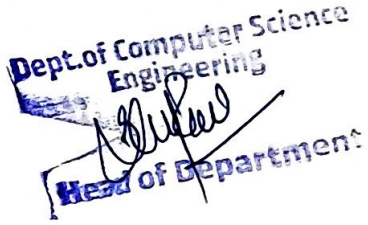
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3. Kaplan, R.S. & Atkinson, A.A., *Advanced Management Accounting*, Pearson Education.
4. Jawahar Lal & Srivastava, S., *Cost and Management Accounting*, Tata McGraw Hill.
5. Reddy, T.S. & Reddy, Y.H.P., *Cost and Management Accounting*, Margham Publications.





Multidisciplinary Minor V

23CSMDC5	**MDM**	**Biomedical Instrumentation and Devices**	**3-0-0**	**3 Credit**

Teaching Scheme	**Evaluation Scheme**
Lecture: 3 hrs/week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre- Requisites: Healthcare Cybersecurity and Privacy

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe the components of biomedical instruments and their role in signal acquisition.
CO2	Explain the working of biomedical sensors and their applications in physiological monitoring.
CO3	Analyze the operation and applications of cardiovascular and respiratory instruments.
CO4	Understand the principles behind medical imaging and diagnostic equipment.
CO5	Evaluate therapeutic and assistive medical devices and their impact on patient care.
CO6	Examine modern innovations and case studies in the design and deployment of biomedical devices.

Course Contents:

Unit 1: Fundamentals of Biomedical Instrumentation Introduction to biomedical engineering and instrumentation, Classification of biomedical instruments, General block diagram of a medical instrument, Bio-signals: types and characteristics (ECG, EEG, EMG, etc.), Safety standards and electrical hazards in biomedical devices.	[6]
Unit 2: Sensors and Transducers in Healthcare Basic concepts of sensors and transducers, Types: temperature, pressure, displacement, flow, pH, biochemical, Biomedical sensors: ECG, EEG, EMG, blood pressure, SPO2, glucose, Smart sensors and wearable biosensors,	[6]

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Signal conditioning and calibration.	
Unit 3: Cardiovascular and Respiratory Devices Electrocardiograph (ECG) and Holter monitor, Blood pressure measurement instruments (manual and digital), Pulse oximeter and plethysmograph, Spirometer and respiratory monitoring systems, Defibrillator and pacemaker basics.	[6]
Unit 4: Imaging and Diagnostic Instruments X-ray machines, CT scanners, MRI systems (overview), Ultrasound imaging systems Endoscopy and laparoscopic instruments, Automated analysers and diagnostic lab equipment, Advances in portable and point-of-care diagnostic tools.	[6]
Unit 5: Therapeutic and Assistive Devices Infusion and syringe pumps, Dialysis machines, Ventilators and anaesthesia machines, Assistive devices: hearing aids, prosthetics, orthotics, Robotic surgery systems and rehabilitation devices.	[6]
Unit 6: Innovation, Design, and Case Studies Medical device design process and lifecycle, Biocompatibility and material selection Internet of Medical Things (IoMT), Regulatory bodies: FDA, CDSCO, CE marking, Case studies: innovations in biomedical devices and startups in India.	[6]

Reference/Textbooks: -

1. Biomedical Instrumentation and Measurements – Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
2. Principles of Medical Electronics and Biomedical Instrumentation – C. Raja Rao & S. K. Guha
3. Introduction to Biomedical Equipment Technology – Joseph J. Carr & John M. Brown

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