ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B. TECH.(COMPUTER ENGINEERING) SCHEME OF EXAMINATION & SYLLABUS 2023-24

COMPUTER SCIENCE AND ENGINEERING

SEMESTER VII

Sr. No	Course Category	Course Code	Course Title	Hours per Week			Credits	Maximum Marks				Minimum Passing Marks	No of Hours for ESE
				L	T	P		Mid Semester Examination	Continual Assessment	End Sem Examination	Total		
1	PCC	23CE701T	Compiler Construction	4	-	-	4	15	15	70	100	45	3
2	PCC	23CE701P	Compiler Construction Lab	-	-	2	1	-	25	25	50	25	1.5
3	PEC	23CE702T	Program l Elective - IV	4	-	-	4	15	15	70	100	45	3
4	PEC	23CE702P	Program Elective - IV Lab	-	-	2	1	-	25	25	50	25	1.5
5	PEC	23CE703T	Program Elective - V	4	-	-	4	15	15	70	100	45	3
6	ELC	23CE704P	Project - II	-	-	8	4	-	50	50	100	45	-
7	ELC	23CE705P	Summer / Winter Internship*	-	-	-	2	-	50	-	50	25	-
8	MDM	23CE731M	MDM – V (Refer MDM Basket)	3	-	-	3	15	15	70	100	45	-
			Total	15	-	12	23	60	210	380	650	-	-

*** Summer / Winter Internship (Evaluation of Four weeks Internship Completion till 6th Semester)**

23CE702T	Program Elective - IV
23CE702T(i)	IOT and Its Applications
23CE702T(ii)	Fundamentals of Virtual and Augmented Reality
23CE702T(iii)	Cryptography and Network Security

23CE702P	Program Elective – IV lab
23CE702P(i)	IOT and Its Applications Lab
23CE702P(ii)	Fundamentals of Virtual and Augmented Reality Lab
23CE702P(iii)	Cryptography and Network Security Lab

Multidisciplinary Minor - V	
23CE731M	Advanced Data Analytics

23CE703T	Program Elective - V
23CE703T(i)	Ad Hoc and Sensor Networks
23CE703T(ii)	Deep Learning
23CE703T(iii)	Real Time Operating System

Open Elective - III	
23CE761O	Cyber Security and Ethics

		July 2026	NEP 1.0	Applicable for 2026-27
Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23CE701T	Compiler Construction	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Develop a strong foundation in compiler design principles and modern compiler architectures. 2. Apply compiler construction techniques using standard tools and frameworks. 3. Utilize code generation and optimization techniques for efficient software systems.	**Students will be able to** 1. Explore the structure and phases of modern compiler systems. 2. Apply lexical and syntax analysis techniques for parser construction. 3. Construct intermediate representations using syntax-directed translation techniques. 4. Evaluate runtime management and code generation strategies for efficient execution. 5. Analyze code optimization techniques and emerging trends in compiler design.

Unit I	**[10 Hrs.]**
Introduction to Compiling and Lexical Analysis: Introduction to language translators, phases of a compiler, grouping of phases, compiler construction tools, bootstrapping, overview of modern compiler frameworks such as low-level virtual machine (LLVM) and GNU compiler collection (GCC), basics of just-in-time (JIT) and cross compilation. Role of lexical analyzer, input buffering, tokens and lexical errors, finite automata, regular expressions, lexical analyzer generation using LEX/FLEX, overview of tokenization in modern language processing systems.	
Unit II	**[12 Hrs.]**
Syntax Analysis: Role of parser, context-free grammars, parse trees, ambiguity, elimination of left recursion, left factoring, recursive descent parsing, predictive parsing, LL (1) parsing. bottom-up parsing, shift-reduce parsing, operator precedence parsing, LR, SLR, canonical LR, and LALR parsers, error recovery techniques, parser generation using YACC/BISON, overview of parsing in modern programming languages, domain-specific languages (DSLs).	
Unit III	**[10 Hrs.]**
Intermediate Code Generation: Syntax-directed definitions, translation schemes, semantic analysis, symbol table management, type checking, and declarations. Intermediate code generation: syntax trees, directed acyclic graphs (DAGs), postfix notation, three-address code, quadruples, triples, translation of expressions and control statements, overview of LLVM intermediate representation, java virtual machine (JVM) bytecode, intermediate representations used in modern virtual machines.	
Unit IV	**[08 Hrs.]**
Code Generation: Issues in code generation, runtime storage organization, activation records, parameter passing, stack and heap allocation, basic blocks and flow graphs, next-use information, register allocation and assignment. code generation from DAGs, instruction selection, simple code generation algorithms, machine-independent and machine-dependent code generation, introduction to parallel and graphics processing unit (GPU)-aware compilation techniques.	
Unit V	**[08 Hrs.]**
Code Optimization and Emerging Trends: Sources of optimization, machine-independent and machine-dependent optimization, peephole optimization, optimization of basic blocks, loop optimization, global data flow analysis, and efficient data flow algorithms. Emerging trends: profile-guided optimization, compiler support for artificial intelligence (AI) frameworks, heterogeneous computing, security-aware compilation.	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Compilers: Principles, Techniques, and Tools	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman	Second	Addison-Wesley
2	Engineering a Compiler	Keith D. Cooper	Second	Morgan Kaufmann

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Compiler Writing	Paul G. Sorenson	First	McGraw-Hill Publication
2	Writing Compilers and Interpreters: A Software Engineering Approach	Ronald Mak	Third	Wiley Publication

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23CE701P	Compiler Construction Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended to 1. Develop practical understanding of compiler phases and translation techniques. 2. Apply lexical, syntax, and semantic analysis using standard compiler tools. 3. Implement intermediate code generation and optimization techniques.	**Students will be able to** 1 Design and implement lexical analyzers using finite automata and LEX tools. 2 Construct predictive and bottom-up parsers for syntax analysis. 3 Apply YACC/BISON tools for parser generation and translation. 4 Generate intermediate code and perform semantic analysis. 5 Develop a compiler prototype integrating major compilation phases.

Experiment No.	Title of the Experiment
1	Implementation of character set validation and token recognition.
2	Design of lexical analyzers using regular expressions and finite automata.
3	Implementation of lexical analyzer using the LEX/FLEX tool.
4	Implementation of FIRST and FOLLOW computation for Context-Free Grammars (CFGs).
5	Implementation of LL(1) predictive parsing and parsing table construction.
6	Implementation of a syntax analyzer using shift-reduce parsing and the YACC/BISON tool.
7	Implementation of syntax-directed translation and intermediate code generation.
8	Implementation of code generation and optimization techniques.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Compilers: Principles, Techniques, and Tools	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman	Second	Addison-Wesley
2	Engineering a Compiler	Keith D. Cooper	Second	Morgan Kaufmann

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Compiler Writing	Paul G. Sorenson	First	McGraw-Hill Publication
2	Writing Compilers and Interpreters: A Software Engineering Approach	Ronald Mak	Third	Wiley Publication

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23CE702T(i)	PE– IV IoT and Its Applications	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. To study architecture of IoT. 2. To learn the concept of Machine to Machine to IoT. 3. To understand the concept of IoT Connectivity technologies.	**Students will be able to** 1. Understand the concept of Internet of things with architecture 2. Remember the application of Internet of things. 3. Differentiate the connectivity technologies. 4. Explain IoT processing technologies with Data formats. 5. Analyze the Precursor Technologies for different application.

Unit I **[9 Hrs]**

Internet of Things – Precedence of IoT-Wireless Sensor Network, Machine-2-Machine. Evolution of IoT-IoT vs M2M, IoT vs WoT. IoT networking Components, Addressing Strategies in IoT -Address management class, Addressing During Node mobility. OSI Model.

[9 Hrs]

Unit II

Introduction to Internet of Things (IoT):Definition, Characteristic of IoT, Architecture, Vision, Trend in Adaptation of IoT, Technical Building block. Physical Design of IoT: Interoperability of IoT Devices, Sensor and Actuators, Need of analog/ Digital Conversion. Logical Design of IoT: IoT functional block, Iot Enabling technologies, IoT level and Development template, Application in IoT.

[9 Hrs]

Unit III

Machine-to-machine to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit IV **[9 Hrs]**

IoT Processing Technologies: Data Format – Structured data, Unstructured Data, Importance of Processing in IoT, Processing Topologies-On-site, Off-site. IoT Device Design and Selection Consideration. IoT Connectivity Technologies- IEEE 802.15.4, Zigbee, LoRa, Wi-Fi, Bluetooth. IOT Data and BigData, Challenges of IOT analytics applications, cloud based IOT platform, IaaS, PaaS and SaaS paradigms, Requirements of IOT BigData Analytics, Function.

Unit V

[9 Hrs]

IoT Communication Technologies- Constrained nodes, Constrained networks, Types of Constrained Devices, Low Power and lossy networks. Infrastructure Protocol – Ipv7,LOADng, RPL, QUIC, NanoP, CCN. Data Protocol – MQTT, MQTT-SN, CoAP. Agricultural IoT, Vehicular IoT and Healthcare IoT.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to IOT	Sudip Misra, Anandarup, Arjit Roy		Cambridge University Press
2	Building blocks for IOT Analytics	John Soldatos		River Publishers

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Getting Started with the Internet of Things	Cuno Pfister	1st	Shroff
2	Internet of Things	Shriram K Vasudevan, Abhishek S Nagarajan,RMDSundaram	2nd	Wiley

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23CE702T(ii)	PE – IV Fundamentals of Virtual and Augmented Reality	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR 2. Review the Virtual Environment 3. Use of various types of Hardware and Software in Virtual Reality systems 4. Simulate and Apply Virtual/Augmented Reality to varieties of Applications	**Students will be able to** 1. Understand Fundamental of Computer Vision, Computer Graphics Techniques and applications of VR/AR. 2. Understand Geometric Modeling Techniques 3. Understand The Virtual Environment 4. Analyze And Evaluate VR/AR Technologies 5. Apply Various Types Of Hardware And Software In Virtual Reality System

Unit I	**[9 Hrs]**
Introduction to Virtual Reality (VR): Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark	
Unit II	**[10 Hrs]**
Computer Graphics and Geometric Modelling: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference. Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.	
Unit III	**[10 Hrs]**
Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices**)** **Generic VR system**: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system **Physical Simulation:** Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft	
Unit IV	**[7 Hrs]**
Augmented Reality (AR): Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, enhancing interactivity in AR Environments, Evaluating AR systems	
Unit V	**[9 Hrs]**
Development Tools and Frameworks: **Human factors**: Introduction, the eye, the ear, the somatic senses **Hardware**: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems **Software**: Introduction, Modelling virtual world, Physical simulation, VR toolkits, VRML AR / VR Application	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Virtual Reality	GrigoreBurdea and Philippe Coiffet	5th edition	Wiley-IEEE Press
2	Augmented Reality: Principles and Practices	Schmalstieg, D., Höllerer, T., (2016)	2nd edition	Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Designing Virtual Systems: The Structured Approach	Gerard Jounghyun Kim,	2005	Springer

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23CE702T(iii)	PE – IV Cryptography and Network Security	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. To develop the student's ability to understand the concept of security goals in the various applications. 2. To provide the students with some fundamental cryptographic mathematics used in various symmetric and asymmetric key cryptography. 3. To develop the student's ability to analyze the cryptographic algorithms. 4. To familiarize the student with the need of security management in computer network related applications.	**Students will be able to** 1. Acquire knowledge about security goals, background of cryptographic mathematics and identification of its application. 2. Understand, analyze and implement the symmetric key algorithm. 3. Acquire knowledge about the background of mathematics of asymmetric 4. Analyze the concept of message integrity and the algorithms for checking the integrity of data. 5. Understand various network security techniques to protect against the threats in the networks.

Unit I	**[9 Hrs]**
Introduction, Terminology, Attacks, Security goals, Model for network security, Substitution & Transposition techniques, Mathematics for cryptography: Modular arithmetic, Euclidean, Extended Euclidean algorithm.	
Unit II	**[9 Hrs]**
Symmetric Key Cryptography: Introduction, Block Cipher principles, Data Encryption Standard (DES0, Triple DES, Attacks on DES, Blowfish, Advanced Encryption Standard (AES), Stream Cipher principles: RC4.	
Unit III	**[9 Hrs]**
Asymmetric Key Cryptography: Euler's Totient function, Fermat's & Euler's Theorem, Chinese Remainder Theorem (CRT), RSA, Elliptic Curve Cryptography (ECC), Digital Signature.	
Unit IV	**[9 Hrs]**
Key Management & Authentication: Introduction, Kerberos, Key Management Protocol: Diffie Hellman Key Exchange Algorithm, Digital Certificate: X.509 certificate, Hash Function: Introduction to SHA-1, SHA-256, MD5.	
Unit V	**[9 Hrs]**
Network Security: Firewalls & its principal design, Electronic Payment types: E-cash, chip card transaction & attacks, IDS, Software vulnerability: Phishing attack, Buffer overflow, Types of Intruders & its detection: virus, worms and trojan& its countermeasures.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Cryptography and Network Security: Principles and Standards	William Stallings	7th Edition	Prentice Hall India
2	Network Security and Cryptography	Bernard Menezes	1st Edition	Cengage Learning

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Network Security,The Complete Reference	Robert Bragge, Mark Rhodes, Heithstraggberg	1st Edition	McGraw-Hill
2	Cryptography and Network Security	Behrouz A. Forouzan	2nd Edition	McGraw-Hill
3	Applied Cryptography	Bruce Schneier	2nd Edition	John Wiley

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23CE702P(iii)	PE– IV Cryptography and Network Security Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended 1. To understand basics of Cryptography and Network Security. 2. To be able to secure a message over insecure channel by various means. 3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.	**Students will be able to** 1. Interpret security fundamentals and implement the cipher techniques. 2. Analyze and implement the key management and key distribution techniques. 3. Demonstrate the techniques to ensure data security and integrity.

Expt. No.	Title of the experiment
1	Implement Substitution Cipher techniques
2	Implement Transposition Cipher techniques
3	Implement Euclid's algorithm and Extended Euclid Algorithm
4	Implement the following regarding modern block cipher components: 1. WAP a program that splits an n-bit word into two words, each of n/2 bits. 2. WAP that combines two n/2 bits words into n-bit word. 3. WAP that swaps the left and right halves of an n- bit word. 4. WAP that circular- shifts an n-bit word k bits to the left or right based on the first parameter passed to the routine. 5. WAP to show the mapping for straight n x m P-box. 6. WAP to find the order of the permutation group and key size for n x m transposition and substitution block cipher method.
5	To explore Triple DES using virtual lab.
6	To perform round key transformation & Key Expansion process for AES-128 version symmetric key cryptography algorithm.
7	To understand the implementation of Asymmetric key cryptographic algorithm using RSA algorithm & Euler's Totient Function.
8	Implement Mathematical theorems related to Asymmetric Key Cryptography: Fermat's Little Theorem and Chinese Remainder Theorem.
9	Implementation of Cryptographic Hash function using SHA-1 hashing algorithm.
10	To understand the creation of session key using Diffie-Hellman Key Exchange algorithm.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Cryptography and Network Security: Principles and Standards	William Stallings	7th Edition	Prentice Hall India
2	Network Security and Cryptography	Bernard Menezes	1st Edition	Cengage Learning

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Network Security, The Complete Reference	Robert Bragge, Mark Rhodes, Heithstraggberg	1st Edition	McGraw-Hill
2	Cryptography and Network Security	Behrouz A. Forouzan	2nd Edition	McGraw-Hill
3	Applied Cryptography	Bruce Schneier	2nd Edition	John Wiley

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23CE703T(i)	PE–V Ad Hoc and Sensor Networks	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
This course is intended 1. To comprehensively understand the Infrastructure less networks and importance in the future directions for wireless communications	**Students will be able to** 1. Classify wireless Networks and Identify issues in MAC layer Protocols. 2. Evaluate Routing Protocols for Ad Hoc Networks 3. Interpret Challenges and Issues in Ad Hoc Network over traditional Networks 4. Examine Ad Hoc Networks Applications 5. Gain a comprehensive understanding of Quality of Service (QoS) principles in ad hoc networks, including the challenges and issues involved in providing QoS.

Unit I **[8Hrs]**

Introduction – Fundamentals of Wireless Networks, Wireless Internet, What Are Ad Hoc Networks?, MAC Layer Protocols for Ad Hoc Wireless Networks – Introduction, Important Issues and the Need for Medium Access Control, Classification of MAC Protocols

Unit II **[8Hrs]**

Routing Protocols for Ad Hoc Wireless Networks – Introduction, Design Issues of Routing Protocols for Ad Hoc Networks, Classification of Routing Protocols, Proactive Routing Protocols, Reactive Routing Protocols, Hybrid Routing Protocols.

Unit III **[9Hrs]**

Multicast Routing Protocols for Mobile Ad Hoc Networks – Introduction, Issues in Designing a Multicast Routing Protocol, Classification of Multicast Routing Protocols, Multicast Ad Hoc On-Demand Distance Vector (MAODV), Mesh-Based Routing Protocols, Source Routing-Based Multicast Protocol (SRMP), Multicasting with Quality-of-Service (QoS) Guarantees, Energy-Efficient Multicast Routing Protocols, Application Dependent Multicast Routing

Unit IV **[10Hrs]**

Transport Protocols for Ad Hoc Networks – Introduction, Transmission Control Protocol's (TCP's) Challenges and Design Issues in Ad Hoc Networks, TCP Performance over that of Mobile Ad Hoc Networks (MANETs), Ad Hoc Transport Protocols, Application Controlled Transport Protocol (ACTP)

Unit V **[10Hrs]**

Quality of Services (QoS) in Ad Hoc Networks – Introduction to QoS, Issues and Challenges involved in Providing QoS,Energy Management System in Ad Hoc Wireless Networks – Introduction, Energy Efficient Routing Protocols, Transmission Power Management Schemes, Transmission Power Control,Applications and Recent Developments in Ad Hoc Networks – Introduction, Typical Application, Application Opportunities, Challenges, Highlights of the Most Recent Development in the field

Text Books

S.N	Title	Authors	Edition	Publisher
1	Ad Hoc Mobile Wireless Networks, Principles, Protocols, and Applications	Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa	Special Indian Edition	Auerbach Publications

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Mobile Communication	Jochen Schiller	4th Edition	Pearson Education
2	Ad Hoc And Sensor Networks: Theory And Applications	Carlos De Morais Cordeiro, Dharma Prakash Agrawal	2nd Edition	World Scientific

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits		Evaluation		
						MSE	CA	ESE	Total
23CE703T(ii)	PE – V Deep Learning	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. To Learn the foundations of Deep Learning and its applications in real world 2. To Learn how to implement, train and evaluate deep neural networks 3. To Learn various deep neural networks architectures such as CNNs, RNNs, LSTM, and their applications	**Students will be able to** 1. Describe the biological inspiration, fundamental concepts of neural networks, and core principles of deep learning. 2. Design and train neural network architectures for prediction and classification tasks. 3. Apply CNNs and RNNs for computer vision and sequence modeling problems. 4. Analyze and compare sequence modeling architectures including RNN, LSTM, GRU, and Transformers for solving sequential learning problems. 5. Evaluate and apply deep learning techniques to address complex real-world problems across diverse application domains.

Unit I	**[10 Hrs]**
Fundamentals of Deep Learning and Neural Networks- Introduction to AI, Machine Learning, and Deep Learning; Human Brain and Biological Neuron; Artificial Neuron Model; Neural Network Components (weights, bias, threshold); Learning paradigms – supervised, unsupervised, reinforcement learning; Neural Network architectures and taxonomy; Activation functions (Sigmoid, Tanh, ReLU, Leaky ReLU, SoftMax),Applications of Deep Learning.	
Unit II	**[10 Hrs]**
Feed Forward Neural Networks and Training Methods - Hebbian Learning; Perceptron Learning Algorithm; Delta Rule; Multilayer Perceptron (MLP); Backpropagation Algorithm; Associative Memory Networks; Adaptive Resonance Theory.	
Unit III	**[10 Hrs]**
Convolutional Neural Networks and Computer Vision- Introduction to CNN; Convolution and Pooling Operations; Deep CNN architectures – LeNet, AlexNet, VGG, ResNet, EfficientNet; Image preprocessing and augmentation; Transfer Learning; Feature Extraction; Object Detection basics (YOLO overview); CNN Visualization and Explainable AI methods (Grad-CAM).	
Unit IV	**[10 Hrs]**
Sequence Models and Transformer Architectures- Recurrent Neural Networks (RNN); Backpropagation Through Time; LSTM and GRU; Bidirectional RNN/LSTM; Sequence Modeling; Attention Mechanism; Transformer Architecture; NLP applications.	
Unit V	**[8 Hrs]**
Applications: Case studies on applications of Deep Learning in Predictions and Classification applications, Computer vision, speech recognition and natural language processing.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Deep Learning	Ian Goodfellow, Yoshua Bengio and Aaron Courville	2016	MIT Press
2	Neural Networks and Deep Learning	Charu C. Aggarwal	2018	Springer
3	Deep Learning	M. Gopal	2022	Pearson education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Deep Learning- From Logical Calculus to AI	Sandro Skansi	2018	Springer
2	Artificial Neural Networks	Yegnanarayana, B.	2009	PHI Learning Pvt. Ltd
3	Deep Learning	A.Das,S.Goswami,P. Mitra,A, Chakrabarti	2022	Pearson education
4	Introduction of Artificial neural networks.	Jecek Zurada	1992	PHI

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits		Evaluation		
						MSE	CA	ESE	Total
23CE703T(iii)	PE – V Real time Operating System	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. Developing knowledge of real-time operating system concepts, characteristics, and performance evaluation techniques. 2. Applying RTOS features and embedded software architectures for real-time and embedded system applications. 3. Analyzing scheduling and fault tolerance techniques for developing reliable real-time systems.	**Students will be able to** 1. Analyze the fundamentals, characteristics, and performance measures of real-time operating systems. 2. Apply RTOS features and services to solve real-time system problems. 3. Design embedded software architectures and select appropriate scheduling algorithms for real-time applications. 4. Evaluate real-time database concepts including transaction management, concurrency control, and disk scheduling techniques. 5. Develop fault-tolerant real-time systems using fault detection, containment, recovery, and redundancy techniques.

Unit I	**[10Hrs]**
Unit I: Fundamentals of Real-Time Operating System : Introduction to Real-Time Systems and RTOS, characteristics and classification of real-time systems (Hard, Soft and Firm Real-Time Systems), architecture and components of RTOS, task management and process states, applications of RTOS in embedded, automotive, healthcare and industrial systems	
Unit II	**[9 Hrs]**
RTOS Services and Embedded System Design :RTOS kernel structure, tasks and threads, context switching, inter-process communication, synchronization mechanisms, interrupt handling, memory management, embedded software architectures, and modern RTOS platforms including FreeRTOS, Zephyr RTOS, RT Linux, VxWorks and µC/OS-II for embedded and IoT applications	
Unit III	**[9 Hrs]**
Embedded software and Task Scheduling: Examples of embedded system their characteristics and their typical hardware components embedded software architectures Scheduling algorithms: round robin, round robin with interrupts, function queue scheduling real time operating system selection, CPU scheduling algorithms: Rate monotonic, EDF, MLF. ,Priority Scheduling, Priority Ceiling and Priority inheritance **Real time operating system**: Tasks and task states, shared data and reentrancy semaphores and shared data, use of semaphores Protecting shared data.	
Unit IV	**[9 Hrs]**
Real Time Databases: Real time v/s general purpose databases main memory databases transaction priorities transaction aborts concurrency control issues: pessimistic concurrency control and optimistic concurrency control Disk scheduling algorithms	
Unit V	**[8 Hrs]**
Fault Tolerance and Safety-Critical Systems: Fault tolerant real-time systems, causes and types of faults, fault detection and recovery mechanisms, hardware and software redundancy techniques, data diversity and reliability enhancement, safety-critical real-time systems, reliability and availability concepts, and applications of RTOS in aerospace, automotive and medical systems.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	An Embedded Software Primer	David E. Simon	1st Edition	Pearson
2	Embedded system: Architecture Programming and Design	Raj kamal	2nd Edition	TMH

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Real Time Systems	C.M. Krishna and Kang G. Shin	1st Edition	McGraw-Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23CE731M	Advanced Data Analytics	3	-	-	3	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Describe advanced data analytics workflows and architectures. 2. Apply preprocessing, visualization, and feature engineering techniques to datasets. 3. Analyze datasets using statistical and machine learning methods. 4. Develop predictive models for data-driven applications. 5. Examine emerging trends and ethical practices in analytics.	**Students will be able to** 1. Illustrate advanced data analytics workflows and applications. 2. Apply advanced preprocessing and visualization techniques on real-life datasets. 3. Experiment with various datasets using statistical and machine learning approaches. 4. Develop predictive analytical models for real-world applications. 5. Classify various emerging analytics technologies and intelligent decision systems.

Unit I: Advanced Analytics Foundations and Applications	**[08 Hrs.]**
Review of Data Analytics lifecycle and CRISP-DM methodology, Advanced analytics architecture and modern data ecosystem, Data Warehouses and Data Lakes, Predictive and Prescriptive Analytics concepts, Real-time and Stream Analytics overview, Data-driven decision systems, Analytics applications in healthcare, finance, manufacturing, education, and governance.	
Unit II: Data Preparation and Feature Engineering	**[10 Hrs.]**
Advanced data acquisition using APIs and streaming sources, Data integration and transformation techniques, Handling missing, noisy, and imbalanced datasets, Outlier detection methods, Feature selection and feature engineering, Dimensionality reduction concepts: PCA basics, Automated preprocessing pipelines using Pandas, NumPy, and Scikit-learn.	
Unit III: Statistical Analytics and Visual Intelligence	**[08 Hrs.]**
Inferential statistics and hypothesis testing basics, Correlation and regression analysis, Exploratory Data Analysis (EDA), Time-series analysis fundamentals, Advanced data visualization principles, Heatmaps and correlation visualization, Interactive dashboards and storytelling with data, Visualization using Matplotlib, Seaborn, and Power BI/Tableau.	
Unit IV: Deep Learning and Predictive Analytics	**[10 Hrs.]**
Advanced predictive analytics concepts, Introduction to Deep Learning for Data Analytics, Artificial Neural Networks (ANN), Deep Neural Networks (DNN), Fundamentals of Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN), Auto encoders, Time-series and sequential data analytics, Model optimization and hyperparameter tuning basics, Model evaluation metrics: Precision, Recall, F1-score, ROC-AUC, Use of DL frameworks in scientific analysis of data	
Unit V: Emerging Trends and Multidisciplinary Analytics Workflows	**[09 Hrs.]**
Multidisciplinary applications of Data Analytics in healthcare, finance, education, and manufacturing, Analytics workflow: data acquisition, preprocessing, visualization, modeling, and decision support, Cloud and IoT-based analytics overview, Dashboard-driven analytics systems, Emerging trends in analytics: Generative AI, Explainable AI (XAI), Agentic AI, and AutoML concepts, Case studies: healthcare prediction, fraud detection, smart traffic analytics, predictive maintenance, and social media analytics	

Text Books/ Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Data Science for Business	Foster Provost, Tom Fawcett	2nd	O'Reilly Media
2	Python for Data Analysis	Wes McKinney	3rd	O'Reilly Media
3	Introduction to Machine Learning with Python	Andreas Müller, Sarah Guido	2nd	O'Reilly Media
4	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber, Jian Pei	4th	Morgan Kaufmann