B.Tech. Sem-V (Computer Science and Engineering-Major)

Sr. No.	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				TH	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	BOS
1	PCC-VI	Database management System	BCSE5T15	3	-	-	3	3	70	30	45	-	-	-	CS
2	PCC-VI	Database management System Lab	BCSE5P15	-	-	2	1	-	-	-	-	25	25	25	CS
3	PCC-VII	Computer Network	BCSE5T16	3	-	-	3	3	70	30	45	-	-	-	CS
4	PCC-VII	Computer Network Lab	BCSE5P16	-	-	2	1	-	-	-	-	25	25	25	CS
5	PCC-VIII	Theory of Computation	BCSE5T17	2	-	-	2	3	70	30	45	-	-	-	CS
6	PEC-I	Elective – I (Refer Elective Basket)	BCSE5T18	3	-	-	3	3	70	30	45	-	-	-	CS
7	PEC-I	Elective – I	BCSE5P18	-	-	2	1	-	-	-	-	25	25	25	CS
8	MDM-III	Refer MDM-III Basker	BMD5T19	3	-	-	3	3	70	30	45	-	-	-	CS
9	MDM-III	Refer MDM-III Basker	BMD5P19	-	-	2	1	-	-	-	-	25	25	25	CS
10	OE-III	Refer Open Elective Basket	BOE5T03	2	-	-	2	3	70	30	45	-	-	-	
Total				16	-	08	20		420	180		100	100		

(Dr. Ravindra Jogekar)

6/5/26
Dr. A. N. Thakare

6/5/26
(A. M. Kuthe)

6/5/26
Dr Debdatta Mallick

Dr. V. P. Balpande

Program Electives - I

Code	PEC-I
BCSE5T18.1	Parallel Computer Architecture and Programming
BCSE5P18.1	Parallel Computer Architecture and Programming Lab
BCSE5T18.2	Cyber Security
BCSE5P18.2	Cyber Security Lab
BCSE5T18.3	AI & Machine Learning
BCSE5P18.2	AI & Machine Learning Lab

MDM-III

Sr. No	Code	Name of Subject
1	BMD5T19.1	Embedded systems for IOT
2	BMD5T19.2	Basic VLSI Design

Open Elective-III (T)

Sr. No	Code	Name of Subject
1	BOE5T03.1	Data Visualization Techniques
2	BOE5T03.2	Data Science
3	BOE5T03.3	DataBase Management System

B.Tech. Sem-VI (Computer Science and Engineering- Major)

Sr. No.	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				TH	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	BOS
1	PCC-IX	Software Engineering ~~Project Management Testing~~	BCSE6T20	3	-	-	3	3	70	30	45	-	-	-	CS
2	PCC-X	Design and Analysis of Algorithm	BCSE6T21	2	-	-	2	3	70	30	45	-	-	-	CS
3	PCC-X	Design and Analysis of Algorithm Lab	BCSE6P21	-	-	2	1	-	-	-	-	25	25	25	CS
4	PCC-XI	Compiler Design	BCSE6T22	3	-	-	3	3	70	30	45	-	-	-	CS
5	PEC-II	Elective – II (Refer Basket for Elective)	BCSE6T23	3	-	-	3	3	70	30	45	-	-	-	CS
6	PEC-II	Elective – II	BCSE6P23	-	-	2	1	-	-	-	-	25	25	25	CS
7	PEC-III	Elective – III (Refer Basket for Elective)	BCSE6T24	3	-	-	3	3	70	30	45	-	-	-	CS
8	MDM-IV	Refer MDM-IV Basket	BMD6T25	2	-	-	2	3	70	30	45	-	-	-	CS
9	SEC-II	Refer to SEC Basket	BSE6P02	-	-	4	2	-	-	-	-	50	50	50	CS
Total				16	-	8	20		420	180		75	125		

Dr. V. P. Balpande

Dr. Ravindra Jogekar

SATkurs

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(A. M. Kuthe)

6/5/26
Dr Amrita Thalare

6/5/26
Dr Ankit Malik

Program Electives

Code	PEC-II	Code	PEC-III
BCSE6T23.1	Responsible AI	BCSE6T24.1	GPU Computing
BCSE6T23.2	Natural Language Processing	BCSE6T24.2	Blockchain Technologies
BCSE6T23.3	Data Visualization Techniques	BCSE6T24.3	Generative AI

Note : PEC-III – MOOCS 12 Week Course Approved by BoS

MDM-IV

S. No	Code	Name of Subject
1	BMD5T19.1	Data Science for IOT
2	BMD5T19.2	Digital VLSI Design

SEC Basket

S.No.	Course code	Course Name
1	BSE6P02.2	Android App Development
2	BSE6P02.2	Cloud Infrastructure & DevOps

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Fifth Semester B. Tech. (Computer Science and Engineering)

PCC-VI Database Management System (TH)	
Total Credits: 03T	**Subject Code:** BCSE5T15
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 2 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-VI	**BoS :** CS

Course Objectives	
1	To Understand the basic concepts and the applications of database systems
2	To Master the basics of SQL and construct queries using SQL
3	To understand the relational database design principles
4	To become familiar with the basic issues of transaction processing and concurrency control

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Demonstrate the basic elements of a relational database management system and Ability to identify the data models for relevant problems.
CO2	Understand query languages and relational operators
CO3	Apply normalization for the development of application softwares
CO4	Implement transaction management concept
CO5	Learn and implement query optimisation

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Database System			
Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models –Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base Architecture – Storage Manager – the Query Processor. Data base design and ER diagrams – ER Model - Entities, Attributes and Entity sets – Relationships and Relationship sets – ER Design Issues – Concept Design – Conceptual Design for University Enterprise. Introduction to the Relational Model – Structure – Database Schema, Keys – Schema Diagram	8	-	1
UNIT 2: Relational Query Languages, Relational Operations			
Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus. Overview of the SQL Query Language – Basic Structure of SQL Queries, Set Operations, Aggregate Functions – GROUPBY – HAVING, Nested Sub queries, Views, Triggers	7	-	2
UNIT 3: Normalization			
Normalization – Introduction, Non loss decomposition and functional dependencies, First, Second,and third normal forms – dependency preservation, Boyee/Codd normal form.Higher Normal Forms - Introduction, Multi-valued dependencies and Fourth normal form, Join dependencies and Fifth normal form	6	-	3
UNIT 4: Transaction Concept			
Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions –Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation-Based Protocols –Multiple Granularity.	7	-	4
UNIT 5:File organization			
Various kinds of indexes. Query Processing – Measures of query cost - Selection operation – Projection operation, - Join operation – set operation and aggregate operation – Relational Query Optimization – Transacting SQL queries – Estimating the cost –Equivalence Rules.	8	-	5

Text Books:
1 Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition 2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.
Reference Books:
1. Fundamentals of Database Systems, Elmasri Navathe Pearson Education. 2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight 3. Edition for UNIT III.Apress, 1st Edition, 2017. 4. Mastering Blockchain, Imran Bashir, Packt Publishing, 3rd Edition, 2020.

Fifth Semester B. Tech. (Computer Science and Engineering)

PCC-VII – Computer Network	
Total Credits: 03T	**Subject Code: BCSE5T16**
Teaching Scheme :	**Examination Scheme :**
Lectures: 03 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 02 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-VII	**BoS :** CS

Course Objectives	
1	To understand the fundamentals of computer networks, TCP/IP & OSI model.
2	To analyze Data link layer Issues, Protocols.
3	To explain Network layer Protocols, IP addressing.
4	To identify end to end communication & various things in Transport layer.
5	To describe various user services in a network.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Understand basics of Computer Networks and Reference Models.
CO2	Understand the Data link Layer Concepts
CO3	Know allotment of IP addresses, best routing path calculations in network.
CO4	Analyze TCP,UDP working and know how to handle congestion
CO5	Get an idea of various things in Application Layer

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A/P	CO
Unit 1			
Introduction: Network, Uses of Networks, Types of Networks, Reference Models: TCP/IP Model, The OSI Model, Comparison of the OSI and TCP/IP reference model. Physical Layer: Guided transmission media, Wireless transmission media.	7		1

Unit 2			
Data Link Layer: Design issues, Error Detection & Correction, Elementary Data Link Layer Protocols, Sliding window protocols Multiple Access Protocols - ALOHA, CSMA,CSMA/CD, CSMA/CA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer.	7	-	2
Unit 3			
Network Layer: Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Path Vector Routing, Hierarchical Routing; Congestion control algorithms, IP addresses, CIDR, Subnetting, SuperNetting, IPv4, Packet Fragmentation, IPv6 Protocol, Transition from IPv4 to IPv6, ARP, RARP.	9	-	3
Unit 4			
Transport Layer: Services provided to the upper layers elements of transport protocol addressing connection establishment, Connection release, Error Control & Flow Control, Crash Recovery. The Internet Transport Protocols: UDP, Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Sliding Window, The TCP Congestion Control Algorithm.	8	-	4
Unit 5			
Application Layer: Introduction, providing services, Applications layer paradigms: Client server model, HTTP, Email, WWW, TELNET, DNS.	5	-	5

Text Books:
1. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
2. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
Reference Books:
1. An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Education. 2. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning. 3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education

Fifth Semester B. Tech. (Computer Science and Engineering)

PCC-VIII - THEORY OF COMPUTATION (TH)	
Total Credits: 02 T	**Subject Code:** BCSE5T17
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 2 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-VIII	**BoS :** CS

Course Objectives	
1	To understand the **fundamental concepts of automata, formal languages, and computation theory.**
2	To study and analyze different **models of computation such as Finite Automata, Pushdown Automata, and Turing Machines.**
3	To understand the **relationship between formal languages, grammars, and automata.**
4	To analyze the **computational power and limitations of different computational models.**

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Understand and apply the concepts of finite automata** for recognizing regular languages and converting between NFA and DFA.
CO2	**Analyze regular expressions and regular grammars** and perform interconversion between regular expressions, finite automata, and grammars.
CO3	**Design context-free grammars and pushdown automata** and understand their equivalence in recognizing context-free languages.
CO4	Understand and apply the **concepts** of Turing Machines and their role in defining computability and undecidable problems and computational limitations including concepts such as Post Correspondence Problem and recursive function theory.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction			
Strings, Alphabet, Language, Operations, Finite state machine, definitions, Finite automation model, Acceptance of strings and languages, Non Deterministic Finite Automation, Deterministic Finite Automation, Equivalence between NFA and DFA. Conversion	7	-	1

of NFA into DFA, Minimization of FSM, Equivalence between two FSM's. Moore and Melay machines			
UNIT 2: Regular sets, Regular expressions			
Regular sets, Regular expressions, Identify rules, Manipulation of regular expressions. Equivalence between RE and FA, Inter conversion, Pumping lemma, Closure properties of regular sets (proofs not required), Regular grammars, Right linear and left linear grammars, Equivalence between regular linear grammar and F.A. inter conversion between RE and RG.	8	-	2
UNIT 3: Context free grammar			
Context free grammar, Derivation trees, Chomsky Normal Form, Greibach Normal Form, Push Down Automata, Definition, Model, acceptance of CFL, Equivalence of CFL and PDA , Interconversion, enumeration of properties of CFL.	7	-	3
UNIT 4: Turing Machine			
Turing Machine, Definition, Model, Design of TM, Universal Turing Machine Computable functions, Recursive enumerable language, Church's hypothesis, Counter machine, Types of TM's Undecidability: Properties of recursive & non-recursive enumerable languages, Universal Turing Machine, Post-correspondence problem, Introduction to recursive function theory.	7	-	4
Text Books:			
1.Introduction to Automata Theory, Languages and Computation by Hopcraft H. E. & Ulman			
2.Introduction to Languages and the Theory of Automata by John C. Martin			
3. Theory of Computation by Mishra and Chandrashekharan			
Reference Books:			
1. An Introduction to Formal Languages and Automata – by Peter Linz, Jones & Bartlett Learning.			
2. Automata Theory and Formal Languages, PHI Learning.			

Fifth Semester B. Tech. (Computer Engineering)

PEC-I– Parallel Computer Architecture and Programming	
Total Credits: 03T	**Subject Code: BCSE5T18.1**
Teaching Scheme :	**Examination Scheme :**
Lectures: 03 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 02 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-I	**BoS :** CS

Course Objectives	
1	To develop structural intuition of how the hardware and the software work, starting from simple systems to complex shared resource architectures.
2	Get a broad understanding of parallel computer architecture and different models for parallel computing
3	To understand concepts related to memory consistency models, cache coherence, interconnection networks, and latency tolerating techniques
4	To know about current practical implementations of parallel architectures
5	To learn how to design parallel programs and how to evaluate their execution.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Have an understanding of parallel algorithms, analysis and architectures.
CO2	Be able to reason about ways to parallelize a problem
CO3	Design and analyze the algorithms that execute efficiently on parallel computers
CO4	Design and analyse the Mesh based architecture
CO5	Ability to do the parallel programming

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A/P	CO
Unit 1			
Introduction & Technique of Parallelism: Trends towards parallel computing, parallelism in Uniprocessor systems, Architectural classification schemes, Amdahl's law, Moore's law, Principles of Scalable Performance, Parallel Processing in Memory, Parallel Algorithms, Parallel Algorithm Complexity, Models of Parallel Processing, Cache coherence, Cache coherence Protocols.	7		1
Unit 2			
Pipeline & Vector Processing: Conditions of Parallelism: Data & Resource dependencies, Program flow mechanisms: Control-flow .vs. Data flow computers Principle of pipelining and vector processing: principles of linear pipelining, classification of pipeline processors. General pipelines and reservation tables. Instruction and arithmetic pipelines, vector processing, architecture of Cray –1, Pipeline hazards,VLIW computers, Array Processing.	7	-	2
Unit 3			
Parallel Models: PRAM and Basic Algorithms, Data Broadcasting, Parallel Prefix Computation, Shared- Memory Algorithms, Parallel Selection Algorithm, Circuit-Level Examples, Tree-Structured Dictionary Machine, Parallel Prefix Networks, Sorting and routing on a 2D Mesh or Torus, Types of Data Routing Operations, Greedy Routing Algorithms	7	-	3
Unit 4			
Mesh-Based Architectures: 2 D Mesh Algorithms, Other Mesh-Related Architectures, Meshes of Trees, Low-Diameter Architectures, Hyper-cubes and Their Algorithms, Sorting and Routing on Hypercubes, Bitonic Sorting on a Hypercube, Dimension-Order Routing, Broadcasting on a Hypercube, Other Hypercubic architectures, Butterfly and Permutation Networks, Plus-or-Minus- 2'Network, The Cube-Connected Cycles Network, Shuffle and Shuffle–Exchange Networks, A Sampler	8	-	4
Unit 5			
Multiprocessor Architecture and Programming: Emulation and Scheduling, Emulations among Architectures, Distributed Shared Memory, Data Storage, Input, and Output, Multithreading and Latency Hiding, Parallel I/O Technology, Defect-Level Methods, Fault-Level Methods, Error-Level Methods, Parallel Programming Parallel Operating Systems, Parallel File Systems.		-	5

Text Books:

1. Computer Architecture & Parallel processing - Kai Hwang 7 Briggs.(MGH).
2. Parallel Computers: Arch.&Prog., Rajaraman& Siva Ram Murthy, PHI.

Reference Books:

1. Parallel Computer 2 –Arch..&Algo., Adam Hilger, R.W. Hockney, C.R. Jesshope.
2. Advanced Computer Architecture with Parallel Programming", K. Hwang, MGH.
3. Parallel computing- Theory and practice - Michael J Quinn- Mc Graw Hill

Fifth Semester B. Tech. (Computer Science and Engineering)

PEC-I Cyber Security(Th)	
Total Credits: 03	**Subject Code:BCSE5T18.2**
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 3 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-I	**BoS :** CS

	Course Objectives
1	Introduce the fundamentals of Cybercrime and its legal perspectives with respect to India.
2	Acquaint the student with various types of attacks and Cyber offenses.
3	Make the student aware of crimes related to wireless devices.
4	Familiarize the student with tools and other possible vulnerabilities that assist in performing crimes and of the consequences of Cybercrimes.
5	Design solutions and system components that meet specified needs while considering public health, safety, and culture.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Explain the types of Cybercrimes happening all around.
CO2	Select tools and practices that boost up the crime rate.
CO3	Demonstrate the vulnerabilities of Botnets and cloud to.
CO4	Demonstrate the contribution of key loggers, password crackers, viruses and worms towards enabling the possibilities of Cybercrime.
CO5	Assess the seriousness of the security problems faced by the organizations.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A/P	CO

Unit I: Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.	7	-	1
Unit II: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	7	-	2
Unit III: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.	7	-	3
Unit IV: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.	7	-	4
Unit V: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.	7	-	5

Text Books:
1.**Nina Godbole and Sunil Belapure, Cyber Security:** Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1/e, Wiley INDIA, 2011. 2. **James Graham, Richard Howard and Ryan Otson:** Cyber Security Essentials, 1/e, CRC Press, 2011. 3. **Chwan-Hwa(John) Wu,J.DavidIrwin:**Introduction to Cyber Security, 1/e, CRC Press T&F Group, 2.
Reference Books:

Text Books:
1.**Nina Godbole and Sunil Belapure, Cyber Security:** Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1/e, Wiley INDIA, 2011. 2. **James Graham, Richard Howard and Ryan Otson:**Cyber Security Essentials, 1/e, CRC Press, 2011. 3. **Chwan-Hwa(John) Wu,J.DavidIrwin:** Introduction to Cyber Security, 1/e, CRC Press T&F Group, 2.

Fifth Semester B. Tech. (Computer Science and Engineering)

PEC-IArtificial Intelligence & Machine Learning (TH)	
Total Credits: 03T	**Subject Code:** ~~BCSE518T.3~~ BCSE5T18.3
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-I	**BoS :** CS

Course Objectives	
1	Understand fundamental concepts of Artificial Intelligence and Machine Learning
2	Learn key algorithms used in ML.
3	Apply AI techniques to real-world problem
4	Develop basic ML models using tools

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Understand core AI and ML concepts
CO2	Apply ML algorithms to datasets
CO3	Perform data preprocessing and exploratory data analysis
CO4	Evaluate model performance using appropriate metrics
CO5	Develop basic AI-based applications using Python

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to AI & ML			
Introduction to Artificial Intelligence and its applications,History and evolution of AI,Types of AI (Narrow, General, Super AI),Introduction to Machine Learning Types of ML:Supervised Learning,Unsupervised Learning,Reinforcement Learning,AI vs ML vs Deep Learning Applications in healthcare, finance, and industry.	7	-	1
UNIT 2: Data Preprocessing & Exploratory Data Analysis (EDA)			
Data collection and datasets, Data cleaning:,Handling missing values, Outlier detection, Feature selection and feature engineering, Data normalization and scaling, Exploratory Data Analysis (EDA):,Visualization techniques,Correlation analysis,Train-test split.	8	-	2
UNIT 3: Supervised Learning Algorithms			
Regression:Linear Regression ,Multiple Regression, Classification: Logistic Regression,K-Nearest Neighbors (KNN),Decision Trees,Naïve Bayes,Model evaluation:Confusion Matrix,Accuracy, Precision, Recall, F1-score,Overfitting and Underfitting	7	-	3
UNIT 4: Unsupervised Learning			
Clustering:K-Means Clustering,Hierarchical Clustering Dimensionality Reduction:Principal Component Analysis (PCA),Association Rule Learning (basic concept).	7		4
UNIT 5: Introduction to Advanced AI Concepts			
Basics of Neural Networks,Introduction to Deep Learning, Overview of Natural Language Processing (NLP) , Introduction to Computer Vision , Ethical issues in AI, Future trends in AI	7	-	5
Text Books:			
1. Machine Learning by Tom M. Mitchell			
2. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig			
3. Hands-On Machine Learning with Scikit-Learn & TensorFlow by Aurélien Géron			
Reference Books:			
1. Deep Learning by AIan Goodfellow, Yoshua Bengio, Aaron Courville			
2. Pattern Recognition and Machine Learning by Christopher M. Bishop			

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Fifth Semester B. Tech. (Computer Science and Engineering)

MDM III: Embedded System for IOT	
Total Credits: 03T	**Subject Code: BMD5T19.1**
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : MDM-III	**BoS :** CS

Course Objectives	
1	To introduce students to fundamental concepts of embedded systems and IoT architecture, including processors, hardware units, and embedded software integration.
2	To provide knowledge of embedded hardware design, System on Chip (SoC), Network on Chip (NoC), and hardware modelling techniques used in IoT systems.
3	To enable students to design and implement IoT applications using Raspberry Pi, sensors, communication protocols, and web technologies for real-world applications.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Explain the concepts, characteristics, and applications of embedded systems and describe the architecture and layers of IoT systems.
CO2	Identify and compare processors, hardware components, and embedded software structures used in IoT-based embedded systems.
CO3	Analyze SoC and NoC architectures, and apply hardware modelling levels for embedded system design and development.
CO4	Describe the architecture, pin configuration, and onboard components of Raspberry Pi, and compare various Raspberry Pi models for IoT applications.
CO5	Interface and program sensors and communication modules (DHT11, PIR, Ultrasonic, GSM, Wi-Fi) with Raspberry Pi for data acquisition and transmission.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Embedded systems for IoT			

Embedded system, Application and characteristics of embedded systems, Overview of processors and hardware unit in an embedded system, Embedded software into a system. Introduction to embedded system design, Block diagram of IoT, Architecture Layers of IoT.	6	-	1
UNIT 2: System On Chip, NoC, Embedded Hardware Modelling and Design			
System on Chip (SoC), Network on Chip (NoC), levels of Hardware Modelling, embedded Hardware design, and development.	8	-	2
UNIT 3: Overview of Raspberry Pi			
Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi , On-board components of Rpi.	7	-	3
UNIT 4:Sensors Interfacing			
Temperature and Humidity Sensor DHT11), Motion Sensor PIR), Obstacle detection using Ultrasonic sensor, etc. Communicating using RPi- GSM interfacing, Accessing on-board Wi-Fi, Connecting Database with RPi	7	-	4
UNIT 5: IoT Design using Raspberry Pi			
IoT Applications based on Pi, LAMP Web-server, GPIO Control over Web Browser, Creating Custom Web Page for LAMP, communicating data using on-board module, Home automation using Pi, Node- RED, MQTT Protocol, Using Node-RED Visual Editor on Rpi	8	-	5

Text Books:

1. Raj Kamal, —Internet of things – Architecture and Design Principles‖ , McGraw Hill Education (India) Pvt. Ltd.

2. Arshadeep Bahga, Vijay Madisetti , —Internet of Things – A Hands on Approach‖ , Universities press

3. Raj Kamal , —Embedded Systems Soc, IoT, AI and Real Time Systems‖, McGraw Hill Education (India) Pvt. Ltd.

Reference Books:

5. Sudip Misra, Anandarup Mukherjee , Arijit Roy ,‖Introduction to IOT –2.

6. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective‖ —, CRC Press, 2012.

7. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things –Key Applications and Protocols‖ —, Wiley, 2012

8. John C. Shovic, —Raspberry Pi IoT Projects: Prototyping Experiments for Makers‖, APress 2016

Fifth Semester B. Tech. (Computer Science and Engineering)

MDM III: Basics VLSI Design	
Total Credits: 03T	**Subject Code: BMD5T19.2**
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : MDM - III	BoS : CS

Course Objectives	
1	To understand VLSI Design flow and technology trends.
2	To realize MOS based circuits using different design styles.
3	To study semiconductor memories using MOS logic.
4	To study adder, multiplier, and shifter circuits for realizing data path design.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Demonstrate a clear understanding of VLSI Design flow, technology trends, scaling and MOSFET models.
CO2	Design and analyze MOS based inverters.
CO3	Understand different MOS circuit design styles.
CO4	Apply design styles for realization of Combinational and Sequential Circuits
CO5	Design adder, multiplier and shifter circuits using MOS logic

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: VLSI Design flow			
VLSI Design Flow: Full custom and Semicustom IC design flow, MOSFET Scaling: Types of scaling, comparison of MOSFET Model levels, MOSFET capacitances, interconnect scaling and crosstalk, Technology Comparison: Comparison of BJT and MOS technologies.	6	-	1
UNIT 2: MOSFET Inverters			

Introduction to MOS inverters: Active and passive load nMOS inverters, CMOS inverter and their comparison. Static Analysis of Resistive nMOS and CMOS Inverters: Calculation of critical, voltages and noise margins, Design of symmetric CMOS inverter Dynamic Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay, Various components of power dissipation in CMOS circuits.	8	-	2
UNIT 3: MOS Circuit Design styles			
Static: Static CMOS, Pass transistor, Transmission gate, Pseudo NMOS design Styles, Dynamic: C2MOS, Dynamic, Domino, NORA, and Zipper design styles.	7	-	3
UNIT 4: Combinational and Sequential Circuit Realization			
Analysis and design of 2-I/P NAND, 2-I/P NOR and complex Boolean function realisation using equivalent CMOS inverter for simultaneous switching, Complex Boolean function realisation using various design styles, Basic gates and MUX realisation using pass transistor ,and transmission gate logic, SR Latch, JK FF, D FF, 1 Bit Shift Register realisation using CMOS logic.	7	-	4
UNIT 5: Data path Design			
Adder: CLA adder, MODL, Manchester carry chain, High-speed adders: carry skip, carry select and carry save, Multipliers and shifter: Array multiplier and barrel shifter.	8	-	5

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design" Tata McGraw Hill, Revised 4th Edition.
2. John P. Uyemura, "Introduction to VLSI Circuits and Systems", Wiley India Pvt. Ltd.
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition
4. Douglas A Pucknell, Kamran Eshraghian, "Basic VLSI Design", Prentice Hall of India Private Ltd.
5. Ivan Sutherlan and Bob Sproull, "Logical Effort: Designing Fast CMOS Circuits"

Fifth Semester B. Tech. (Computer Science and Engineering)

OE-III – Data Visualization Techniques	
Total Credits: 02	**Subject Code:** BOE5T03.1
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 3 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : OE-III	**BoS :** CS

Course Objectives	
1	Enable the student to tell about data visualization and relevant models, illustrating methods of finding similarity while representing on visualization of data.
2	Familiarize the student to demonstrate on Techniques of spatial and Time oriented data.
3	Explain various methods of Visualization on trees, graphs and networks.
4	Distinguish various Interaction design approaches.
5	Evaluate various data visualization systems and their diverse designs.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Explain the types of Cybercrimes happening all around.
CO2	Select tools and practices that boost up the crime rate.
CO3	Demonstrate the vulnerabilities of Botnets and cloud to.
CO4	Demonstrate the contribution of key loggers, password crackers, viruses and worms towards enabling the possibilities of Cybercrime.
~~CO5~~	~~Assess the seriousness of the security problems faced by the organizations~~.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A/P	CO

Unit I Introduction: What Is Visualization? History of Visualization Relationship between Visualization and Other Fields, The Visualization Process Pseudocode Conventions, The Scatterplot and The Role of the User. Data Foundations Types of Data, Structure within and between Records, Data Preprocessing. Human Perception and Information Processing: What Is Perception? Physiology, Perceptual Processing, Perception in Visualization, Metrics Visualization Foundations The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables Historical Perspective, Taxonomies.	7	-	1
Unit II: Visualization Techniques for Spatial Data: One-Dimensional Data, Two-Dimensional Data, Three-Dimensional Data, Dynamic Data Combining Techniques. Visualization Techniques for Geospatial Data: Visualizing Spatial Data, Visualization of Point Data, Visualization of Line Data, Visualization of Area Data, Other Issues in Geospatial Data Visualization. Visualization Techniques for Time-Oriented Data Introduction, Definitions: Characterizing Time-Oriented Data, Visualizing Time-Oriented Data, Time Bench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data.	7	-	2
Unit III: Visualization Techniques for Multivariate Data Point-Based Techniques, Line-Based Techniques, Region-Based Techniques, Combinations of Techniques. Visualization Techniques for Trees, Graphs, and Networks: Displaying Hierarchical Structures, Displaying Arbitrary Graphs/Networks. Text and Document Visualization Introduction, Levels of Text Representations, The Vector Space Model, Single Document Visualizations, Document Collection Visualizations, Extended Text Visualizations.	7	-	3

Unit IV: Interaction Concepts: Interaction Operators, Interaction Operands and Spaces, A Unified Framework. Interaction Techniques Screen Space, Object Space (D Surfaces), Data Space (Multivariate Data Values), Attribute Space (Properties of Graphical Entities), Data Structure Space (Components of Data Organization), Visualization Structure Space (Components of the Data Visualization). Animating Transformations Interaction Control. Designing Effective Visualizations: Steps in Designing Visualizations, Problems in Designing Effective Visualization.	7	-	4
Unit V: Comparing and Evaluating Visualization Techniques User Tasks, User Characteristics Data Characteristics , Visualization Characteristics, Structures for Evaluating Visualizations Benchmarking Procedures, An Example of Visualization Benchmarking. Visualization Systems Based on Data Type, Systems Based on Analysis Type Text Analysis and Visualization, Modern Integrated Visualization Systems Toolkits Research Directions in Visualization: Issues of Data Issues of Cognition, Perception, and Reasoning, Issues of System Design, Issues of Evaluation, Issues of Hardware Issues of Application.	7	-	4

Text Books:
4. **Ward, Grinstein Keim, Interactive Data Visualization:** Foundations, Techniques, and Applications. Natick: A K Peters, Ltd,2015. 5. **Charu C. Aggarwal, Recommender Systems**: The Textbook, 1/e, Springer, 2016. 6. **Ricci F., Rokach L., Shapira D., Kantor B.P.,** Recommender Systems Handbook, Springer, 2015. 7. **Manouselis N., Drachsler H., Verbert K., Duval E.**, Recommender Systems for Learning, Springer.
Reference Books:
4. **Ward, Grinstein Keim, Interactive Data Visualization:** Foundations, Techniques, and Applications. Natick: A K Peters, Ltd,2015. 5. **Charu C. Aggarwal, Recommender Systems**: The Textbook, 1/e, Springer, 2016. 6. **Ricci F., Rokach L., Shapira D., Kantor B.P.,** Recommender Systems Handbook, Springer, 2015.

Fifth Semester B. Tech. (Computer Science and Engineering)

OE-III – Data Science(Th)	
Total Credits: 02	**Subject Code:** BOE5T03.2
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 3 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category :OE-III	**BoS :** CS

S.N.	Course Objectives
1	To acquire skills in data preparatory and prepossessing steps
2	To learn the tools and packages in Python for data science
3	To acquire knowledge in data interpretation and visualization techniques

Course Outcomes :	
After completing the course, students will be able to	
CO1	Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data science tools
CO2	Apply principles of Data Science to the analysis of business problems.
CO3	Apply ethical practices in everyday business activities and make well -reasoned ethical business and data management decisions
CO4	Demonstrate knowledge of statistical data analysis techniques utilized in business decision making

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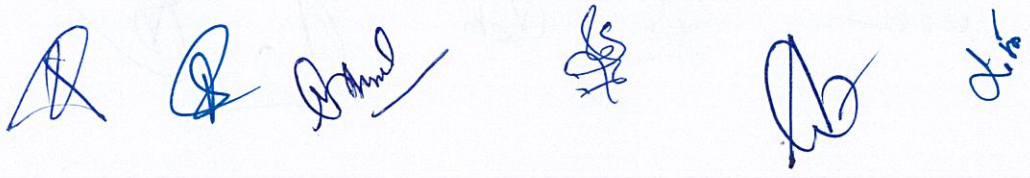
UNIT 1
INTRODUCTION TO DATA SCIENCE: Need for data science benefits and uses facets of data, data science process setting the research goal retrieving data cleansing integrating and transforming data exploratory data analysis build the models presenting and building applications.
UNIT 2
PYTHON FOR DATA HANDLING: Basics of Numpy arrays aggregations computations on arrays comparisons masks boolean logic fancy indexing structured arrays Data manipulation with Pandas data indexing and selection operating on data missing data hierarchical indexing combining datasets – aggregation and grouping – pivot tables.
UNIT 3
PYTHON FOR DATA VISUALIZATION: Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using statsmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh
UNIT 4
ADVANCED DATA ANALYSIS: Decision Trees: What Is a Decision Tree? Entropy, The Entropy of a Partition, Creating a Decision Tree, Random Forests Neural Networks: Perceptron, Feed-Forward Neural Networks, Backpropagation, Example: Defeating a CAPTCHA MapReduce: Why MapReduce? Examples like word count and matrix multiplication

BOOKS
Textbooks: 1. Data Science from Scratch : Joel Grus, O'Reilly Media Inc., ISBN: 9781491901427 2. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. **Reference Books:** 1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016 2. "Practical Data Science", Andreas François Vermeulen APress



Fifth Semester B. Tech. (Computer Science and Engineering)

Open Elective III – Database Management System	
Total Credits: 02T	**Subject Code: BOE5T03.3**
Teaching Scheme :	**Examination Scheme :**
Lectures: 02 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : OE-III	**BoS :** CS

Course Objectives	
1	To introduce the basic concepts, architecture and characteristics of database systems
2	To introduce relational model concepts and PL/SQL programming
3	To introduce relational database design and Normal forms based on functional dependencies
4	To know the fundamental concepts of transaction processing and implementation techniques.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Demonstrate the basic elements of a relational database management system and Ability to identify the data models for relevant problems.
CO2	Ability to use query languages and relational operators
CO3	Apply normalization for the development of application software's
CO4	Ability to design database and manage transaction processing and implementation techniques.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A/P	CO
Unit 1			
Introduction- Purpose of Database System — Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.	6		1
Unit 2			
Relational Model- Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL	6	-	2
Unit 3			
Database Design- Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF	6	-	3
Unit 4			
Transactions- Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods. Data Storage and Indexes, Hashing	6	-	4

Text Books:

1. A. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 5th Ed, Tata McGraw Hill, 2006.

2. C. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th ed, Pearson Education, 2006

Reference Books:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision wesley, 2007

2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003

3. S. K. Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006

Sixth Semester B. Tech. (Computer Science and Engineering)

PCC - IX Software Engineering & Testing ~~and Project Management~~ (TH)	
Total Credits: 03T	**Subject Code:** BCSE6T20
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-IX	**BoS :** CS

	Course Objectives
1	To understand general idea of software engineering
2	To develop skills to design various software process models
3	To develop skills required for software testing and various risk strategies

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Acquire** knowledge of software engineering methods,practices,process models and application
CO2	**Understand** measures metrics and indicators and learn various modeling approach
CO3	**Analyze** and extract requirements for the product and translate these into a documented design using different modelling techniques
CO4	**Learn** software testing methods and types and to know software risk and principles of quality management also reengineering and reverse engineering
CO5	**Apply** software project management principles to plan, schedule, and manage software development projects using techniques such as WBS, resource allocation, and scheduling methods (Gantt, PERT, CPM).

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Software Engineering			

Basics: Introduction to Software Engineering, Software Engineering-A Layered technology,Software Process Models-The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Agile Process Models	7	-	1
UNIT 2: System Modeling and Approaches			
Measures,Metrics and Indicators. System Engineering-Hierarchy,Business Process Engineering System Modeling-Analysis Modeling Approaches, Data Modeling,Scenario based Modeling,Flow Oriented Modeling,Class Based Modeling,Behavioral Model	7	-	2
UNIT 3: Design Engineering Concepts			
Design Engineering Concepts,Design Model, Architectural Design,Cohesion,Coupling,User Interface Analysis and Design.	8	-	3
UNIT 4: Software Testing and Risk			
Unit Testing,Integration Testing,Validation Testing,System Testing,Black Box Testing,White Box Testing, Software Risk, Software Quality Assurance, Software Reengineering and Reverse Engineering	7	-	4
UNIT 5:			
Software Project Management (SPM) -Definition and importance of project management in software development, Role of a project manager, Project planning activities Project Planning and Scheduling - Project scope and feasibility, Work Breakdown Structure (WBS), Resource allocation, Scheduling techniques (Gantt charts, PERT, CPM)	7	-	5

Text Books:

1. Software Engineering-A Practitioner's Approach(Sixth Edition) by Roger Pressman (TMH)
2. Software Engineering(Ninth Edition)-Ian Summerville(Pearson).

Reference Books:

1. Schaum's Outline of Theory and Problems of Software Engineering by David Gustafson(TMH)
2. Software Engineering(Third Edition) by K.K Aggarwal and Yogesh Singh(New Age Publishers)
3. Software Engineering,Theory and Practice (4th Edition) Pfleeger,Atlee(Pearson)

Sixth Semester B. Tech. (Computer Science and Engineering)

PCC - X Design & Analysis of Algorithm (TH)	
Total Credits: 02T	**Subject Code:** BCSE6T21
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 2 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-X	**BoS :** IT

Course Objectives	
1	Analyse the asymptotic performance of algorithm
2	Apply important algorithmic design paradigms and methods of analysis
3	Solve simple to moderately difficult algorithmic problems arising in applications
4	Able to Demonstrate the hardness of simple NP -complete problems

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Illustrate** different approaches for analysis and design of efficient algorithms and Analyze performance of various algorithms using asymptotic notations.
CO2	**Determine** and Apply various divide & conquer strategies and greedy approaches for solving a given computational problem.
CO3	**Demonstrate** and Solve various real time problems using the concepts of dynamic programming.
CO4	**Apply** backtracking and graph traversal techniques to **analyze and solve real-world problems.**

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Algorithms, Asymptotic Analysis, and Sorting Techniques:			
Definition of algorithms and brief explanation about the basic properties of algorithms Recurrence relations, solutions of recurrence relations using technique of characteristic equation, master theorem ,Asymptotic notations of analysis of algorithm, worst case, average case and best case analysis of insertion sort, selection sort and bubble sort, amortized analysis, application of amortized analysis, Bio tonic sorting network.	7	-	1
UNIT 2: Divide and conquer strategies and Greedy Approach:			
Divide and conquer strategies: Binary search, quick sort, merge sort, heap sort, Stressen's matrix multiplication algorithm, min-max algorithm. Greedy Approach: Application to job sequencing with deadlines problem, knapsack problem, optimal merge pattern, Huffman code.	7	-	2
UNIT 3: Dynamic Programming and its Strategies:			
Basic Strategy, Multistage graph (forward and backward approach), Longest Common Sub sequence, matrix chain multiplication, Optimal Binary Search Tree, 0/1 Knapsack problems, Traveling Salesman problem, single source shortest path using Bellman-Ford algorithm, all pair shortest path using Floyd - Warshall algorithm.	8	-	3
UNIT 4: Basic Traversal and Search Techniques and Backtracking			
Basic Traversal and Search Techniques : Breadth first search and depth first search, connected components. Backtracking: Basic strategy, N-Queen Problem and their Analysis (4 & 8-Queen), graph coloring, Hamiltonian cycles .	8	-	4

Text Books:

1. "Introduction to Algorithms", Third Edition, Prentice Hall of India by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.
2. The Design and Analysis of Computer Algorithms", Pearson education by Alfred V. Aho, John E. Hopcraft, Jeffrey D. Ullman.
3. "Fundamentals of Computer Algorithms", Second Edition, University Press By Horowitz, Sahani, Rajasekharam.
4. "Design and Analysis of Algorithms",Pearson Education, II nd Edition, Parag Dave, Himanshu Dave.

Reference Books:
1. Computer Algorithms: Introduction to Design and analysis, 3rd Edition, By Sara Baase and A.V. Gelder Pearson Education.

Sixth Semester B. Tech. (Computer Science and Engineering)

PCC - XI Compiler Design (TH)	
Total Credits: 03T	**Subject Code:** BCSE6T22
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PCC-XI	**BoS :** CS

Course Objectives	
1	Define the different phases of the Compiler and utilities of Automata
2	Understand the concept of syntax and semantic Analysis.
3	Understand the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.
4	Understand the Architecture of computer and its use in designing a compiler.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Define** the compiler along with the phases and Solve LL(1) parser.
CO2	**Understand** the parser and Solve Bottom-up parsers like SLR, CLR, and LALR.
CO3	**Implement** program based on concept of Type Checking, Parameter Passing and Overloading.
CO4	**Implement** the concept of Code Optimizations and Code Generations.
CO5	**Explain** the concepts of Object Oriented in Compilers.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Compiler			

Introduction: Concepts of Compiler, Interpreter, Assembler , Phases of a Compiler , Compiler construction tools(LEX and YACC) , Bootstrapping and cross compilers , Error handling in compiler , Top Down Parsing, FIRST () and FOLLOW(), LL(1) parser.	7	-	1
UNIT 2: Syntax Analysis			
Syntax Analysis (Parser): Bottom-up parsing: Shift-reduce parsing , LR parsing: SLR, CLR, LALR, operator grammars , ambiguity , parser generator ,(yacc, bison).	8	-	2
UNIT 3: Semantic Analysis & Symbol Table			
Semantic Analysis: Attribute Grammar, syntax directed definition, evaluation, and flow of attribute in a syntax tree, Syntax Directed Translation (SDT) . **Symbol Table:** Basic Structure, symbol table attributes and managements, Runtime Environment: Procedure activation, parameter passing, value return ,memory allocation	7	-	3
UNIT 4: Intermediate Code Generation			
Intermediate Code Generation: Translation of different language features, different types of intermediate forms, code improvement (optimization),control flow, Basic blocks and flow graphs, data dependence etc, local optimization, global optimization, peep hole optimization etc.	7	-	4
UNIT 5: Architecture dependent code improvement			
Architecture dependent code improvement: instruction scheduling (for pipelining),loop optimization(for cache memory) etc, Register allocation and target code generation, Advance topics: Type Systems, data abstraction, compilation of object oriented features and non-imperative programming languages.	7	-	5

Text Books:
1. Compilers: Principles, Techniques and Tools, V. Aho,R. Sethi, J.Ullman.
2. Lex and Yaac, Levine R. John, Tony Mason and Doug Brown.
Reference Books:
2. The Design and Evolution of C++,Bjarne Stroustrup.

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective II - Responsible AI (TH)	
Total Credits: 03T	**Subject Code:** BCSE6T23.1
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 2 Hours/Week	University Assessment: 70 Marks
Course Category : PEC - II	**BoS :** CS

Course Objectives	
1	To introduce the fundamental concepts and importance of **Responsible Artificial Intelligence** in modern AI systems.
2	To understand ethical, legal, and societal implications of **Artificial Intelligence** applications.
3	To examine fairness, accountability, transparency, and privacy in AI-driven decision-making systems.
4	To develop the ability to design and evaluate AI systems following responsible and trustworthy AI principles.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Explain** the principles and need for **Responsible Artificial Intelligence.**
CO2	**Identify** ethical risks and societal impacts associated with **Artificial Intelligence** technologies.
CO3	**Apply** fairness, transparency, and accountability principles in AI system design.
CO4	**Evaluate** AI systems for bias, privacy risks, and regulatory compliance.
CO5	**Propose** responsible AI frameworks and governance strategies for real-world applications.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to Responsible AI			
Overview of **Artificial Intelligence** and AI applications, Need for responsible and trustworthy AI, Principles of responsible AI, Social and economic impact of AI, Stakeholders in AI systems.	6	-	1
UNIT 2: Ethics and Bias in AI			
Ethical theories relevant to AI, Algorithmic bias and discrimination, Fairness in machine learning, Case studies of biased AI systems, Techniques for bias detection and mitigation.	8	-	2
UNIT 3: Transparency, Explainability and Accountability			
Explainable AI concepts, Interpretable machine learning models, Accountability in AI decision making, Human oversight and governance mechanisms, Tools for AI transparency.	7	-	3
UNIT 4: Privacy, Security and Data Governance			
Data privacy issues in AI systems, Privacy-preserving AI techniques, Data governance and responsible data usage, AI security risks and adversarial attacks, Regulatory perspectives on AI data usage.	7	-	4
UNIT 5: Policy, Regulation and Responsible AI Frameworks			
Global AI governance initiatives, Responsible AI frameworks and guidelines, Ethical AI in industry and public sector, Risk assessment and impact evaluation, Future trends and challenges in responsible AI.	8	-	5

Text Books:

3. "Artificial Intelligence: A Guide for Thinking Humans", Melanie Mitchell, Farrar Straus and Giroux, 1st Edition, 2019.
4. "Ethics of Artificial Intelligence and Robotics", Vincent C. Müller, Stanford Encyclopedia of Philosophy, Updated Edition, 2021.

Reference Books:

1. "Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig , Pearson Education, 4th Edition, 2020
2. "Weapons of Math Destruction", Cathy O'Neil , Crown Publishing Group, 1st Edition, 2016
3. "Human Compatible: Artificial Intelligence and the Problem of Control", Stuart Russell, Viking Press, 1st Edition, 2019

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective - II Natural Language Processing (TH)	
Total Credits: 03T	**Subject Code:** BCSE6T23.2
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
	University Assessment: 70 Marks
Course Category : PEC-II	**BoS :** CS

Course Objectives	
1	To introduce the basic concepts and applications of Natural Language Processing (NLP)
2	To provide an understanding of the challenges in NLP and their solutions
3	To teach the different techniques and algorithms used in NLP, such as text classification, information retrieval and extraction, syntactic and semantic analysis, and deep learning models
4	To enable students to analyze text data and build NLP models
5	To equip students with the skills to evaluate and compare different NLP techniques and algorithms

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Understand the basic concepts and applications of Natural Language Processing (NLP)
CO2	Identify the challenges in NLP and evaluate the solutions to these challenges
CO3	Analyse and pre-process sext data for NLP tasks
CO4	Apply different NI.P techniques and algorithms such as text classification, information retrieval sad extraction, syntactic and semantic analysis, and deep learning models
CO5	Evaluate and compare different NEP techniques and algorithms using appropriate metric

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction to NLP			
Introduction to NLP: Definition and scope of NLP, Historical overview and applications of NLP, Challenges in NLP and their solutions, Basic concepts in linguistics and language processing. Text preprocessing and normalization.	7	-	1
UNIT 2: Language Models and Text Classification			
Language Models and Text Classification: Language modelling and n-gram models, Classification and categorization of text data, Text classification algorithms such as Naive Bayes, Decision Trees, and Support Vector Machines (SVM), Evaluation measures for text classification.	8	-	2
UNIT 3: Information Retrieval and Extraction			
Information Retrieval and Extraction: Information retrieval models such as vector space model and probabilistic model, Retrieval of relevant documents using query expansion, Named Entity Recognition (NER), Relation Extraction and Open Information Extraction (OIE)	7	-	3
UNIT 4: Syntactic and Semantic Analysis			
Syntactic and Semantic Analysis: Parts of Speech (POS) tagging and parsing, Dependency Parsing. Semantic Analysis and Sentiment Analysis, Word Embedding's and Semantic Similarity	7	-	4
UNIT 5: Advanced Topics in NLP			
Advanced Topics in NLP: Neural Network models for NLP tasks Natural Language Generation (NLG), Dialogue Systems and Chatbots. tasks, Deep Learning models for NLP usks,	7	-	5

Text Books:
5. Speech and Language Processing" by Daniel Jurafsky and James H. Martin 6. Natural Language Processing" by Jacob Eisenstein
Reference Books:
4. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schütze 5. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective - II Data Visualization Techniques (TH)	
Total Credits: 03T	**Subject Code:** BCSE6T23.3
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 2 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-II	**BoS :** CS

Course Objectives	
1	To understand the fundamentals of data visualization and its importance.
2	To learn principles of effective visual design
3	To analyze and visualize complex datasets.
4	To analyze real-world applications, challenges in data visualization.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Identify and recognize visual perception and representation of data.
CO2	Illustrate about projections of different views of objects.
CO3	Apply various Interaction and visualization techniques.
CO4	Analyze various groups for visualization.
CO5	Evaluate visualizations with the help of different visualization techniques.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: Introduction Data Visualization and Fundamentals of Data Analysis			

Introduction: History of Visualization, Relationship between Visualization and Other Fields, The Visualization Process Fundamentals of Data Analysis: Statistical foundations for Data Analysis, Types of data, Descriptive Statistics, Correlation and covariance, Linear Regression, Statistical Hypothesis Generation and Testing,	6	-	CO1
UNIT 2: Data Manipulation, Visualization Foundations and Techniques			
Numpy array: Creating Numpy arrays; various data types of Numpy arrays, indexing and slicing, swapping axes, transposing arrays, data processing using Numpy arrays. Data Structures in Pandas: Series, DataFrame, Index objects, Loading data into Pandas data frame The Visualization Process in Detail: Semiology of Graphical Symbols, The Eight Visual Variables,	9	-	CO2
UNIT 3: Visualization Classification and Representations			
Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.	8	-	CO3
UNIT 4: Visualization Techniques for Trees, Graphs, and Networks			
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.	6	-	CO4
UNIT 5: Plotting and Visualization			
Using Matplotlib to plot data: figures, subplots, markings, color and line styles, labels and legends, Plotting functions in Pandas: Line, bar, Scatter plots, histograms, stacked bars, Heatmap, 3D Plotting, interactive plotting using Bokeh and Plotly.	7	-	CO5

Text Books:

7. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition,A K Peters, Ltd 2015.
8. McKinney W. Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython, 2nd edition, O'Reilly Media, 2018.
9. Molin S. Hands-On Data Analysis with Pandas, Packt Publishing, 2019.

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Reference Books:

1. Tamara Munzner,Visualization Analysis & Design ,1st edition,AK Peters Visualization Series 2014
2. Scott Murray,Interactive Data Visualization for the Web ,2nd Edition, 2017

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective III - GPU Computing	
Total Credits: 03T	**Subject Code:** BCSE6T24.1
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-III	**BoS :** CS

S.N.	Course Objectives
1	To understand the architecture and working principles of GPU computing.
2	To learn parallel programming models and GPU programming using CUDA/OpenCL.
3	To develop and optimize parallel algorithms for high-performance computing applications.

Course Outcomes :	
After completing the course, students will be able to	
CO1	Understand GPU architecture and parallel computing concepts.
CO2	Develop GPU programs using CUDA/OpenCL frameworks.
CO3	Apply parallel programming techniques for performance improvement.
CO4	Analyze and optimize GPU-based applications.
CO5	Design efficient solutions for real-world problems using GPU computing.

UNIT 1
INTRODUCTION OF PARALLEL COMPUTING AND EVOLUTION OF GPU ARCHITECTURES: Review of Traditional Computer Architecture, Heterogeneous Parallel Computing, Architecture of a Modern GPU, Need of More Speed or Parallelism, Speeding Up Real Applications, Parallel Programming Languages and Models. Evolution Of GPU Architectures: Evolution of Graphics Pipelines, Fixed-Function Graphics Pipelines, Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, GPU Computing, Scalable GPUs, Recent Developments.
UNIT 2
DATA PARALLELISM AND CUDA: Data Parallelism, CUDA Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kemel Functions and Threading, Function Declarations, Kemel Launch, Predefined Variables, Runtime APIs.
UNIT 3
EXECUTION MODEL: CUDA Thread Organization, Mapping Threads to Multidimensional Data, Matrix - Matrix Multiplication, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Querying Device Properties, Thread Scheduling and Latency Tolerance.
UNIT 4
MEMORIES AND PERFORMANCE CONSIDERATIONS: Memories: Importance of Memory Access Efficiency, Device Memory Types, Reducing Global Memory Traffic, Memory as a Limiting Factor to Parallelism. Performance Considerations: Warps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of Execution Resources, Instruction Mix and Thread Granularity.
UNIT 5
FLOATING-POINT CONSIDERATIONS AND APPLICATIONS: Floating-Point Considerations: Floating-Point Format, Representable Numbers, Special Bit Patterns and Precision in IEEE Format, Arithmetic Accuracy and Rounding, Algorithm Considerations. Applications: Applications of GPU Architecture like Gaming, Computer Vision, and Optimizing GPU Applications.

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BOOKS

Textbooks:

1. Programming Massively Parallel Processors: Hands-on Approach, David B. Kirk and Wen-mei A W. Hwu, 2nd Edition, 2013, Elsevier Inc.
2. Multicore and GPU Programming an Integrated Approach, Gerassimos Barlas, 1st Edition, 2015 Elsevier Inc.

Reference Books:

1. Heterogeneous Computing with OpenCL, Benedict Gaster, Lee Howes, David R. Kaeli
2. Computer Architecture: A Quantitative Approach, John L. Hennessy David A. Paterson

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective III - Blockchain Technologies(TH)	
Total Credits: 03T	**Subject Code:** BCSE6T24.2
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-III	**BoS :** CS

S.N.	Course Objectives
1	To understand the architecture and working principles of GPU computing.
2	To learn parallel programming models and GPU programming using CUDA/OpenCL.
3	To develop and optimize parallel algorithms for high-performance computing applications.

Course Outcomes :	
After completing the course, students will be able to	
CO1	Understand GPU architecture and parallel computing concepts.
CO2	Develop GPU programs using CUDA/OpenCL frameworks.
CO3	Apply parallel programming techniques for performance improvement.
CO4	Analyze and optimize GPU-based applications.
CO5	Design efficient solutions for real-world problems using GPU computing.

UNIT 1

INTRODUCTION OF PARALLEL COMPUTING AND EVOLUTION OF GPU ARCHITECTURES: Review of Traditional Computer Architecture, Heterogeneous Parallel Computing, Architecture of a Modern GPU, Need of More Speed or Parallelism, Speeding Up Real Applications, Parallel Programming Languages and Models.
Evolution Of GPU Architectures: Evolution of Graphics Pipelines, Fixed-Function Graphics Pipelines, Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, GPU Computing, Scalable GPUs, Recent Developments.

UNIT 2

DATA PARALLELISM AND CUDA: Data Parallelism, CUDA Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kemel Functions and Threading, Function Declarations, Kemel Launch, Predefined Variables, Runtime APIs.

UNIT 3

EXECUTION MODEL: CUDA Thread Organization, Mapping Threads to Multidimensional Data, Matrix - Matrix Multiplication, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Querying Device Properties, Thread Scheduling and Latency Tolerance.

UNIT 4

MEMORIES AND PERFORMANCE CONSIDERATIONS: Memories: Importance of Memory Access Efficiency, Device Memory Types, Reducing Global Memory Traffic, Memory as a Limiting Factor to Parallelism. Performance Considerations: Warps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of Execution Resources, Instruction Mix and Thread Granularity.

UNIT 5

FLOATING-POINT CONSIDERATIONS AND APPLICATIONS: Floating-Point Considerations: Floating-Point Format, Representable Numbers, Special Bit Patterns and Precision in IEEE Format, Arithmetic Accuracy and Rounding, Algorithm Considerations. Applications: Applications of GPU Architecture like Gaming, Computer Vision, and Optimizing GPU Applications.

BOOKS

Textbooks:

1. Programming Massively Parallel Processors: Hands-on Approach, David B. Kirk and Wen-mei A W. Hwu, 2nd Edition, 2013, Elsevier Inc.

2. Multicore and GPU Programming an Integrated Approach, Gerassimos Barlas, 1st Edition, 2015 Elsevier Inc.

Reference Books:

1. Heterogeneous Computing with OpenCL, Benedict Gaster, Lee Howes, David R. Kaeli
2. Computer Architecture: A Quantitative Approach, John L. Hennessy David A. Paterson

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective III - Blockchain Technologies(TH)	
Total Credits: 03T	**Subject Code:** BCSE6T24.2
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : PEC-III	**BoS :** CS

Course Objectives	
1	To understand the fundamental concepts and architecture of **Blockchain**.
2	To study the working principles of **Bitcoin** and other blockchain-based systems.
3	To explore consensus mechanisms, smart contracts, and decentralized applications.
4	To analyze real-world applications, challenges, and security issues in blockchain technology.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Explain** the architecture and working principles of **Blockchain** systems.
CO2	**Describe** cryptographic techniques used in blockchain networks.
CO3	**Develop and analyze Smart Contract** based applications.
CO4	**Evaluate** security, privacy, and scalability issues in blockchain systems.
CO5	**Identify** practical applications of blockchain in finance, supply chain, and other industries.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
UNIT 1: Introduction to Blockchain			

Introduction to distributed systems, Basics of **Blockchain,** History and evolution of blockchain, Structure of blocks and blockchain architecture, Public vs private blockchain networks.	6	-	1
UNIT 2: Cryptography and Blockchain Fundamentals			
Basics of cryptography, Hash functions and digital signatures, Public key cryptography, Merkle trees, Role of cryptography in blockchain security.	8	-	2
UNIT 3: Blockchain Platforms and Cryptocurrencies			
Working of Bitcoin, Blockchain transactions and wallets, Mining and incentives, Introduction to Ethereum, Comparison of blockchain platforms.	7	-	3
UNIT 4: Smart Contracts and Decentralized Applications			
Concept of **Smart Contract,** Smart contract lifecycle, Introduction to **Solidity,** Decentralized Applications (DApps), Use cases of smart contracts.	7	-	4
UNIT 5: Blockchain Applications and Challenges			
Blockchain in finance and banking, Supply chain management applications, Healthcare and identity management, Security and privacy issues, Scalability challenges and future trends.	8	-	5

Text Books:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, 1st Edition, 2017.
2. Mastering Blockchain, Imran Bashir, Packt Publishing, 3rd Edition, 2020.

Reference Books:

1. Blockchain Revolution, Don Tapscott and Alex Tapscott, Portfolio, 1st Edition, 2016
2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Princeton University Press, 1st Edition, 2016.
3. Hands-On Blockchain with Hyperledger, Nitin Gaur, Packt Publishing, 1st Edition, 2018.

Sixth Semester B. Tech. (Computer Science and Engineering)

Program Elective - III Generative AI	
Total Credits: 03 T	**Subject Code :** BCSE6T24.3
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment:70 Marks
Course Category : PEC-III	**BoS :CS**

Course Objectives	
1	This course covers the mathematical and computational foundations of generative modeling, as well as applications.
2	Specific topics include variational autoencoders, generative adversarial networks, autoregressive models such as Transformers, normalizing flow models, information lattice learning, neural text decoding, prompt programming, and detection of generated content.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Understand principles of Generative AI and their applications.
CO2	Analyze Autoencoder and transformer in real-world scenarios
CO3	Analyze GAN architectures and applications.
CO4	Analyze graphs for probabilistic models..
CO5	Apply concepts of large language models and prompt engineering to design effective prompts and utilize pretraining and fine-tuning strategies for solving generative AI tasks.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1:			
Introduction to Generative AI, Autoencoders – Representational power, layer size and depth, Undercomplete autoencoders, Denoising autoencoders, Contractive autoencoders, Variational autoencoders, Case study: Applications of autoencoders in dimension reduction.	7		1
UNIT 2:			
Generative Adversarial networks (GAN) – structure and training algorithm, Deep Convolutional GAN, Autoregressive models –	8		2

Finite memory, long range memory through RNN and CNN, Transformers – Encoder, decoders, scaling laws, Case study: Generative Adversarial Networks-aided Intrusion Detection System.			
UNIT 3:			
Structured probabilistic models – Issues of unstructured models, Directed and Undirected Graphs to describe the models, Partition function, separation and D-separation, Conversion of graphs, sampling from graphical models, Case study: Restricted Boltzmann machine.	7		3
UNIT 4:			
Generative AI Applications: Applications in Various Fields : Art and Creativity, Image and Video Generation, Text Generation,Music Composition, Healthcare Finance.Real-world use cases and challenges in deploying generative AI models.	7		4
UNIT 5:			
Large Language Models (LLMs) and Foundation Models Introduction to foundation models, Architecture overview of modern LLMs (e.g., GPT, BERT), Pretraining vs fine-tuning, Transfer learning in generative AI **Prompt Engineering -** Basics of prompt design, Zero-shot, one-shot, and few-shot prompting, Chain-of-thought prompting.	7		5

Text Books:

1. Goodfellow, Y. Bengio, and A. Courville, "Deep Learning", MIT Press, 2016.

Reference Books:

1. Raut, R., Pathak, P. D., Sakhare, S. R., & Patil, S. (Eds.), "Generative Adversarial Networks and Deep Learning: Theory and Applications". CRC Press, 2023.
2. M. Tomcsak, "Deep Generative Modeling", Springer, 2022.
3. "Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology".Altaf Rehmani
4. "Introduction to Generative AI" , Numa Dhamani, Kindle Edition, 2024.
5. e-sources:
   1.https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/?v=c86ee0d9d7ed
   2.https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed

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Sixth Semester B. Tech. (Computer Science and Engineering)

MDM IV: Data Science for IOT	
Total Credits: 02T	**Subject Code: BMD6T25.1**
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : MDM - IV	**BoS :** CS

Course Objectives	
1	Understand the fundamentals of data science and its relevance to IoT.
2	Gain proficiency in collecting and preprocessing IoT data.
3	Learn techniques for exploratory data analysis and visualization of IoT data.
4	Develop skills in applying machine learning algorithms to IoT datasets.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Interpret & analyze diverse IoT data .
CO2	Leverage machine learning for predictive & optimized IoT solutions.
CO3	Craft compelling visualizations to communicate IoT insights effectively.
CO4	Design secure & privacy-conscious IoT systems for user trust.Build & deploy real-world IoT applications, solving practical problems.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: INTRODUCTION TO DATA SCIENCE			
Fundamentals of Data Science–Overview, Basic concepts, Data collection, processing, and analysis, Data Acquisition in IoT-Sensors and actuators, Data acquisition techniques and challenges, Data Processing and Analytics-Data preprocessing and cleaning, Exploratory data analysis (EDA),Statistical analysis and visualization techniques	6	-	1
UNIT 2: MACHINE LEARNING IN DATA SCIENCE			
Introduction to Machine Learning, The Machine Learning Landscape - Main Challenges of Machine Learning, Testing and Validating, Support Vector Machines-Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, Under the Hood, Decision Trees-Training and Visualizing a Decision Tree, Dimensionality Reduction-PCA, Kernel PCA, LLE, Other Dimensionality Reduction Techniques	8	-	2
UNIT 3: INTERACTIVE DATA VISUALIZATION FOR THE WEB			
Interactive Data Visualization--Applications & Principles, Web Technologies for Interactive Visualization--HTML--CSS—Java script, D3.js Fundamentals-Data Structures--Operations—Basic Visualizations, User Interaction in D3-Events--Dynamic Visualizations--User Experience Exploring & Preparing IoT Data for Visualization, Designing IoT Visualizations--Sensor Data--Time Series--Maps--Graphs, Advanced D3 Techniques--Animations--Custom Visualizations--Libraries, Deploying & Sharing Interactive Visualizations	7	-	3
UNIT 4:INTRODUCTION TO REAL-TIME DATA PROCESSING AND STREAM ANALYTICS FOR IOT			
Introduction to Real-time Data Processing in IoT-Overview, Characteristics, Stream Processing Frameworks for IoT-Apache Kafka, Apache Flink, and Apache Storm, Techniques for Real-time Stream Analytics-Windowing techniques for processing streaming data, Aggregation and summarization	7	-	4

Text Books:

1. P. G. Madhavan, Ph.D., "Data Science for IoT Engineers A Systems Analytics Approach", MERCURY LEARNING AND INFORMATION 2016.

2. Aurélien Géron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow-2018
3. Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015
4. Shilpi Saxena, Saurabh Gupta, Practical Real-Time Data Processing and Analytics-2017

Reference Books:

1. S.Smys, Tomonobu Senjyu, Pavel Lafata Editors, Second International Conference on Computer Networks and Communication Technologies2019
2. Data Science and Internet of Things, Springer

Sixth Semester B. Tech. (Computer Science and Engineering)

MDM IV: Digital VLSI Design	
Total Credits: 02 T	**Subject Code: BMD6T25.2**
Teaching Scheme :	**Examination Scheme :**
Lectures: 3 Hours/Week	Duration of University Exam : 03 Hrs.
Tutorials: 0 Hours/Week	College Assessment: 30 Marks
Practical: 0 Hours/Week	University Assessment: 70 Marks
Course Category : MDM-IV	**BoS :** CS

Course Objectives	
1	Introduction about MOS & CMOS
2	Discuss about CMOS logic circuit design
3	Design sequential circuits
4	It covers various VLSI design methodologies

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Interpret the design of digital integrated circuits, MOS fundamentals and analysis of MOSFET-based digital circuits.
CO2	Design and study the MOS inverters and combinational circuits,
CO3	Design the CMOS-based sequential circuit, dynamic logic circuits and MOS memories.
CO4	To understand the VLSI design flow and design styles.

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SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
UNIT 1: INTRODUCTION			
Basic principle of MOS transistor, Introduction to large signal MOS models (long channel) for digital design. MOS Circuit Layout & Simulation and manufacturing: scaling, MOS SPICE model and simulation, CMOS layout: design rules, Transistor layout, Inverter layout, NMOS and CMOS basic manufacturing steps. CMOS latch-up and its prevention.	6	-	1
UNIT 2: The MOS Inverter			
Inverter principle, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, switching characteristics, Propagation Delay, Power Consumption. Combinational MOS Logic Design: Static MOS design, Ratioed logic, Pass Transistor logic, complex logic circuits. CMOS Transmission Gates, Complementary Pass Transistor Logic, Transistor sizing in static CMOS, logical effort, Pass-transistor logic, sizing issues.	8	-	2
UNIT 3: Sequential Logic Circuits			
Introduction, Static Latches and Registers, Dynamic Latches and registers, Pipelining. Timing issues in Digital Circuits: Timing classification of digital systems, Synchronous Design Timing basics, clock skew, clock jitter and their combine impact. Dynamic Logic Circuits: Voltage Bootstrapping, Synchronous Dynamic Logic, Dynamic CMOS Logic, High Performance Dynamic CMOS Circuits, Domino CMOS logic, NP-Domino Logic, Zipper CMOS Circuits, TSPC Dynamic CMOS.	7	-	3
UNIT 4:Design Methodology			
VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles. CMOS Sub system design: Adders, Multipliers, MOS memories: Introduction, DRAM and SRAM.	7	-	4

Text Books:

1. Title CMOS Digital Integrated Circuits Author Sung-Mo Kang, Yusuf Leblebici Publisher Tata McGraw Hill Edition 2014 Title Digital Integrated Circuits: A Design Perspective Author J.M Rabaey, A. Chandrakasan, B.Nikolic Publisher Pearson Edition 2012
2. Title : Introduction to VLSI Circuits and Systems Author J. P. Uyemura Publisher Wiley Edition 2006

Reference Books:

1. CMOS VLSI Design: A Circuits and Systems Perspective Neil H.E. Weste, David Harris Pearson Education 2015

Sixth Semester B. Tech. (Computer Science and Engineering)

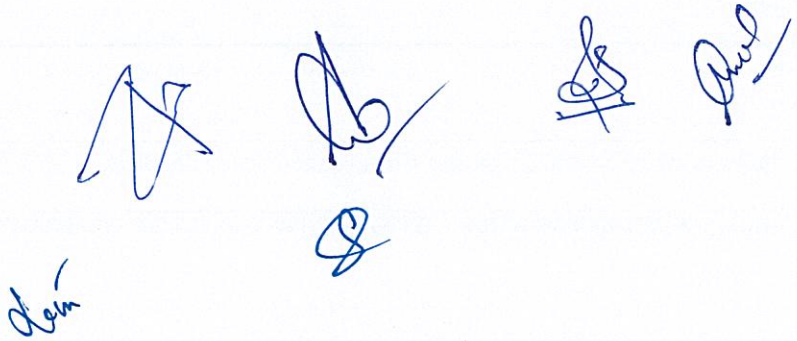
SEC II: Android Application Development	
Total Credits: 02 P	**Subject Code: BSE6P02.1**
Teaching Scheme :	**Examination Scheme :**
Lectures: 0 Hours/Week	Duration of University Exam :
Tutorials: 0 Hours/Week	College Assessment: 50 Marks
Practical: 4 Hours/Week	University Assessment: 50 Marks
Course Category : SEC - II	**BoS :** CS

Course Objectives	
1	To introduce the fundamentals of Android platform, architecture, and application development environment.
2	To develop user interfaces using Activities, Fragments, Views, and Material Design components.
3	To understand data storage, networking, and background processing in Android apps.
4	To integrate advanced features like location services, notifications, databases, and Firebase.

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	Understand Android architecture, development environment, and build basic applications.
CO2	Design and implement interactive User Interfaces using Activities, Fragments, and Material Design.
CO3	Apply Intents, permissions, and data passing mechanisms between Android components.
CO4	Implement data persistence using Shared Preferences, Room/SQLite, and Firebase.
CO5	Develop complete Android applications incorporating networking, location services, notifications, and deployment.

List of Experiments:

- Install Android Studio, configure Emulator and Real Android Device. Create and run first "Hello World" application. Explore project structure and Manifest file.
- Design User Interface using ConstraintLayout, LinearLayout, and Material Design Components (TextView, EditText, Button, ImageView, CardView etc.) and implement click event handling.
- Implement Activity Lifecycle and Fragment Lifecycle. Handle configuration changes and save/restore activity state.
- Create application using Explicit and Implicit Intents. Pass data between activities using Intent and Bundles.
- Design and implement RecyclerView with custom Adapter to display list of items (with images and text).
- Implement Shared Preferences for saving and retrieving user data (e.g., login credentials, settings).
- Create SQLite Database application to perform CRUD (Create, Read, Update, Delete) operations.
- Implement Room Persistence Library for database operations with LiveData and ViewModel.
- Develop an application to fetch data from REST API using Retrofit/Volley library and parse JSON data.
- Implement Firebase Authentication (Email/Password and Google Sign-In) and integrate Firebase Firestore database.
- Implement Notifications (Local and Push) and Broadcast Receivers in Android application.
- Implement Google Maps, Location Services and Geocoding in an Android app.
- Create an application using WorkManager for background tasks and scheduling.
- Mini Project: Develop a complete Android Application (e.g., Notes App, Todo List, E-commerce, Food Delivery, Chat App, etc.) with multiple features and prepare APK.



Sixth Semester B. Tech. (Computer Science and Engineering)

SEC II: Cloud Infrastructure and DevOps	
Total Credits: 02 P	**Subject Code:** BSE6P02.2
Teaching Scheme :	**Examination Scheme :**
Lectures: 0 Hours/Week	Duration of University Exam : Hrs.
Tutorials: 0 Hours/Week	College Assessment: 50 Marks
Practical: 4 Hours/Week	University Assessment: 50 Marks
Course Category : SEC-II	**BoS :** CS

Course Objectives	
1	To understand the fundamentals of cloud computing, including its benefits and different service models
2	To understand Configuration management using Ansible
3	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

Course Outcomes	
After completion of syllabus, students would be able to	
CO1	**Implement** and manage core cloud services like IAM, EC2, S3, VPC, and RDS effectively
CO2	**Understand** different actions performed through Version control tools like Git
CO3	**Ability** to Perform Automated Continuous Deployment and to do configuration management using Ansible
CO4	**Build**, test, and deploy a simple sample application through the CI/CD pipeline, demonstrating automation and efficiency in software delivery.

Practical based on Syllabus

Details of Topic
UNIT 1: Cloud Computing Introduction
Cloud Computing,Advantages of Cloud Computing, Virtualization, cloud service models, Cloud deployment models, Public clouds: Amazon Web Services, Microsoft Azure, and Google Cloud Services AWS Cloud services: IAM Roles, and Policies, EC2, S3, VPC, RDS
UNIT 2: DevOps Introduction
DevOps definition, History of DevOps, DevOps Roles, DevOps Need, DevOps Problems & Solution, DevOps Main Objectives, DevOps: Continuous Delivery and Benefits, DevOps and Software Development Life Cycle: Waterfall Model, Agile Model, DevOps on Cloud Version control systems: Git and Github GIT Features, 3-Tree Architecture, GIT – Clone /Commit / Push, GIT Hub Projects, GIT Hub Management, GIT Rebase & Merge, GIT Stash, Reset, Checkout, GIT Clone, Fetch, Pull.
UNIT 3: Configuration management and containerization
Containerization: Docker, What is Docker Image, Docker Installation, Working with Docker Containers, Container, Docker Engine, Crating Containers with an Image, Working with Images, Docker Command Line Interface, Docker Compose, Docker Hub, Docker Trusted Registry, Docker swarm, Docker attach, Docker File & Commands Configuration: Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles
UNIT 4: Building Devops Pipelines Using AWS
Create Github Account, Repository, Create AWS Organization, Create a new pipeline, Build a sample code, Modify AWS-pipelines