Scheme for B.Tech. In Data Science –VI SEM according to NEP

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VI													
23BTDSL321 23BTDSP321	Neural Computing and Applications	PCC9	3		2	5	4	10	15	50	25	25	125
23BTDSL322 23BTDSP322	Algorithms Analysis and Design	PCC10	3		2	5	4	10	15	50	25	25	125
23BTDSL331 23BTDSP331	Program Elective II	PEC2	3		2	5	4	10	15	50	25		100
23BTDSL341	Program Elective III	PEC3	4		-	4	4	10	15	50	-	-	75
23BTDSL323	Multidisciplinary Minor -IV	MD4	2		-	2	2	10	15	50	-	-	75
23BTDSL324	Vocational and Skill Enhancement Course -IV	VSEC4	1	-	2	3	2	10	15	-	25	-	50
23BTSHP302	Research Ethics & Technical Writing	RM	-	-	4	4	2	-	-	-	50		50
TOTAL			**16**	-	**12**	**28**	**22**	**60**	**90**	**250**	**150**	**50**	**600**

Subject Component	Subject options
Program Elective II	• NLP and Applications • Fundamentals of Blockchain Technology • Data Warehousing and Data Mining
Program Elective III	• Data Analytics using POWERBI • Web Application Security • R Programming for Data Analytics
Multidisciplinary Minor -IV	• Next-Generation Database Technologies
Vocational and Skill Enhancement Course -IV	• Full Stack Web Development • Digital Forensics

Course Title: Neural Computing and Applications										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC9	3	0	2	4	10	15	50	25	25
Course Code	23BTDSL 321 23BTDSP 321									
Duration of ESE	3 Hours	5			Total	75			50	
						125				
Course Objectives	1. To introduce the fundamental concepts and architectures of artificial neural networks. 2. To develop understanding of supervised and unsupervised neural learning algorithms. 3. To explore associative memory models and feature extraction methods. 4. To analyse trainable and non-trainable parameters for evaluating neural network complexity. 5. To apply neural network techniques for solving real-world problems through case studies.									
Course Outcomes	On successful completion of the course, students will be able to: CO1: Understand fundamental neural network concepts, neuron models, and activation functions. CO2: Apply supervised learning algorithms (Perceptron, Delta Rule, Backpropagation) to train neural networks. CO3: Implement and compare unsupervised learning techniques such as Hebbian learning, K-Means, PCA. CO4: Calculate and analyze trainable and non-trainable parameters to assess neural network complexity. CO5: Design neural network solutions for applications like image classification, detection, navigation, and segmentation.									

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	3							2	2	1
CO2	3	2	1	2	3								2	1
CO3	3	2	2	2	3								2	1
CO4	3	2	2	3	3							2	2	1
CO5	3	3	3	3	3				2			3	2	1

Unit	Contents	Hours
I	**Fundamentals of Neural Networks:** What is Neural Network, Model of Artificial Neuron, Learning rules and various activation functions, Neural Network Architecture: Single layer Feed-forward networks, Multilayer Feed-forward networks.	8
II	**Learning in ANN:** Supervised learning, Unsupervised learning, Reinforcement learning, **Supervised learning:** Role of labelled data, Perceptron learning, Delta Rule, Gradient descent rule, Backpropagation learning algorithm, Batch Normalization.	10
III	**Unsupervised Learning Network:** Concept of unsupervised learning, Hebbian learning, K-means as a neural computational model, Principal Component Analysis (PCA), Feature learning, Anomaly Detection, Feature Extraction.	9
IV	**Trainable and Non-Trainable Parameters:** Introduction to Parameters in NN, Difference between trainable and non-trainable parameters, Importance of parameter count, Parameter Calculation in Dense/Fully connected layer, Multi Layer Perceptron, Embedding Layer and Batch Normalization, Layer Freezing.	9
V	**Case Studies:** Image Classification and Object Detection, Autonomous Vehicle Navigation, Threat Detection, Customer segmentation, etc.	9

Text Books	Neural Networks and Deep Learning, by Michael Nielsen
	Introduction to Artificial neural System, JACEK M. ZURADA WEST PUBLISHING COM
Reference Books	Neural Network Design, Martin T. Hagan, Howard B. Demuth, Mark H. Beale
	Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.
Online TL Material	https://www.coursera.org/learn/neural-networks-deep-learning
	https://archive.nptel.ac.in/courses/117/105/117105084/

Sr. No	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1, PSO2
1	Design and simulate a Single Layer Feed-Forward Neural Network for logical operations (AND, OR, NAND).	CO1	PO1 , PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
2	Implement a Multi-Layer Feed-Forward Neural Network and visualize decision boundaries.	CO1	PO1 , PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
3	Implement Perceptron Learning Rule and observe convergence for linearly separable data.	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1, PSO2
4	Implement Backpropagation Algorithm for a multi-layer neural network on a simple dataset (e.g., XOR problem).	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1, PSO2
5	Implement Hebbian Learning for simple patterns and analyze weight updates.	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1, PSO2
6	Implement K-Means as a Neural Computational Model with visualization.	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1, PSO2
7	Calculate trainable and non-trainable parameters for Dense layers, MLP, and Batch Norm using manual formulas + model.summary().	CO4	PO1 , PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
8	Implement embedding layers and compute parameter counts for different vocabulary sizes.	CO4	PO1 , PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
9	Develop an Image Classification Model using CNN on MNIST/CIFAR dataset.	CO5	PO1 , PO2, PO3, PO4, PO5,PO9	PSO1, PSO2
10	Implement a Threat Detection or Customer Segmentation model using ANN/CNN.	CO5	PO1 , PO2, PO3, PO4,PO9	PSO1, PSO2

Course Title : Algorithms Analysis and Design										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC10	3	_	2	4	10	15	50	25	25
Course Code	23BTDL322 23BTDP322									
Teaching Mode	Offline	5			Total	75			50	
Duration of ESE	3 hours					125				

Course Objectives	1. Understand Core Algorithmic Concepts and Design Efficient Algorithms 2. Apply Algorithms to Real-World Problems including text data, graph data, tree data
Course Outcomes	CO1: Understand basic concepts of algorithm and Design of algorithms. CO2: Apply Greedy and Dynamic programming approach for real world problem. CO3: Understand performance and use-cases of AVL trees, Red-Black trees, and Tree Maps. CO4: Create and evaluate graph traversal, shortest path algorithm, and Minimum Spanning Trees and Knowledge graph. CO5: Analyze string matching algorithms with different approaches

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	--	--	--	--	--	--	2	2	2
CO2	3	3	3	3	3	--	--	--	--	--	--	3	1	2
CO3	3-	2	3	3	3	--	--	--	--	--	--	3	2	2
CO4	2	2	3	3	3	--	--	--	--	--	--	3	3	2
CO5	3	3	3	3	3	--	--	--	2	--	--	3	2	3

Unit	Contents	Hours
I	**Introduction of Algorithms and its analysis** Analysis of algorithms: Space Complexity, Time Complexity, recurrence relation and Asymptotic Notation, Divide and Conquer: General Methods, Analysis and Design, Binary Search, Quick sort, Merge sort, Strassen's matrix multiplication.	9
II	**Greedy Strategy vs. Dynamic programming and Analysis** Examples of greedy method like optimal merge pattern, Huffman coding, Minimum spanning trees, knapsack problem, Introduction, Problem based on this approach such as 0/1 Knapsack, Multistage graph, Floyd-warshall algorithms, Job sequencing with deadlines problem, LCS	12
III	**Self-Balancing Trees and its analysis** Introduction to Self-Balancing Trees, AVL Trees: Overview, **Operations**, Analysis Red-Black Trees: Overview, **Operations**, Analysis, and Treap: Overview, **Operations**, Analysis, Comparative Analysis of AVL Trees, Red-Black Trees and Treap.	8
IV	**Graph Algorithms and Analysis** Graph Traversal: Breadth-First Search (BFS), Depth-First Search (DFS). Shortest Path Algorithms: Bellman-Ford Algorithm, Floyd-Warshall Algorithm. Minimum Spanning Trees: Kruskal's Algorithm, Prim's Algorithm. **Knowledge Graph**: building a knowledge graph, analysis & Tools (Neo4j & graphDB)	8
V	**Text Processing and Analysis** Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm and its Analysis, The Knuth-Morris-Pratt Algorithm and its analysis, Standard Tries and types, The Huffman Coding Algorithm and its analysis	8
Text Books	Introduction to Algorithms, Thomas H. Cormen. Prentice Hall of India.	
	Advanced Data Structures: Theory and Applications *by Suman Saha and Shailendra Shukla, CRC Press (Taylor & Francis Group), 2029*	
E Books	Algorithms: Design and Analysis By Harsh Bhasin, All it Books .net. Advanced Algorithms by Prof. Michel Goemans.	
Reference Books	Computer Algorithms, Galgotia Publications Pvt. Ltd. Brassard, Bratley, Fundamentals of Algorithms, Prentice Hall	
	Computer Algorithms: Introduction to Design and analysis, 3rd Edition, By Sara Baase & A. V. Gelder Pearson Education.	
On-line TL Material	NPTEL course on Design and Analysis of Algorithms: https://www.class-central.com/course/nptel-design-and-analysis-of-algorithms- 3984	

Sr. No	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1, PSO2
1	To implement and analyze time complexity of Searching & sorting Algorithm.	CO1	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
2	To implement Strassen Matrix multiplication on the given matrix.	CO1	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
3	To implement and analyze time complexity o f optimal merge pattern	CO2	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
4	To implement and analyze time complexity o f Job sequencing problem.	CO2	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
5	To implement and analyze time complexity of AVL tree insertion and Deletion operations	CO3	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
6	To implement and analyze time complexity R B t r e e insertion and Deletion operations	CO3	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
7	To implement and analyze Knuth-Morris-Pratt Algorithm.	CO4	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
8	To implement and analyze The Boyer-Moore Algorithm.	CO4	PO1 , PO2, PO3, PO4, PO5,PO12	PSO1,2
9	To implement and analyze time complexity of BFS Algorithm or DFS Algorithm	CO5	PO1 , PO2, PO3, PO4, PO5,PO9, PO12	PSO1,2
10	Building Knowledge graph, Study of Neo4j & graphDB)	CO5	PO1 , PO2, PO3, PO4, PO5, PO9,PO12	PSO1,2

Course Title: NLP and Applications										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	2	4	10	15	50	25	-
Course Code	23BTDSL331 23BTDSP331									
Teaching Mode	Offline	3			Total	75			25	
Duration of ESE	3					100				

Course Objectives	1. To introduce students to the basic fundamentals used in NLP applications. 2. To provide students with in-depth understanding on designing procedures for natural language resourceannotation and the use of tools for text analysis. 3. To encourage students towards research in information retrieval, information extraction and knowledge discovery.
Course Outcomes	Upon successful completion of this course, student will be able to: CO1: Understand basic fundamental methods used in NLP applications. CO2: Analyze different techniques to be followed for NLP application. CO3: Design formal grammars for NLP applications. CO4: Implement and understand semantic aspects of NLP and its applications. CO5: Design various real life NLP applications.

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	1	1	1								1	2
CO2	3	3	2	2	3								1	2
CO3	2	2	3	3	3							1	1	1
CO4	2	2	3	3	3							2	2	3
CO5	2	2	3	3	3							2	2	3

Unit	Contents	Hours
I	**Introduction** What is NLP? Phases of NLP, Challenges and Applications. Empirical Laws, Text Processing-Basics, Key Issues such as information extraction, question answering. Problem of ambiguity. Some successful NLP system such as Alexa, Chatbot, Chatgpt. Tools: NLTK, Spacy. POS Tagging, chunking, parsing, tokenization, stemming, lemmatization.	8
II	**Language Models** Role of language models, Spelling Correction: Edit distance, Estimating parameters and smoothing, Simple N-gram models, Evaluating language models. Part of Speech Tagging and Lexical syntax. Hidden Markov Models. Maximum Entropy models.	10
III	**Syntactic Parsing** Grammar formalisms and tree banks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs, Dependency Parsing: Transition based and MST based learning.	9
IV	**Semantic Analysis** Lexical semantics and word-sense disambiguation, Novel word sense detection, Distributional semantics: Similarity Measures, Attributional v/s Relational similarity, Word Embedding, Bag of Words. Discourse Processing Introduction.	8
V	**Case Studies** Entity Linking, Named entity recognition and Relation Extraction, Distant Supervision. Use cases of NLP: Text Summarization, Text Classification, Sentiment Analysis, Machine Translation, Speech Recognition, Speech Synthesis, etc.	10

Text Books	1.	Natural Language Processing and Information Retrieval, Tanveer Siddique and U.S.Tiwary, Oxford press.
	2.	Speech and Language Processing, D. Jurafsky and R. Martin, 2nd edition, Pearson Education, 2009.
	3.	Natural Language Understanding, Allen and James; Second Edition, Benjamin Cumming, 1995.
Reference Books	1.	NLP: A Paninian Perspective, Akshar Bharati, Vineet Chaitanya and Rajeev Sangal, Prentice Hall, New-Delhi, 1994
	2.	Language as a Cognitive Process, T. Winograd; Addison-Wesley, 1983

S. No.	Name of Experiment	CO	PO	PSO
1	Implement text preprocessing using tokenization, stemming, and lemmatization in Python using NLTK and SpaCy.	CO1	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
2	Implement POS tagging and chunking using SpaCy.	CO1	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
3	Implement an N-gram based language model using a given text corpus.	CO2	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
4	Use HMM for POS tagging on a sample text using Python.	CO2	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
5	Implement a context-free grammar parser using NLTK.	CO3	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
6	Implement dependency parsing using SpaCy.	CO3	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
7	Implement word sense disambiguation using simplified Lesk algorithm.	CO4	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
8	Design a Bag of Words model and analyze text similarity.	CO4	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
9	Build a sentiment analysis model using machine learning.	CO5	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
10	Implement a named entity recognition (NER) system using SpaCy.	CO5	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2

Course Title: Fundamentals of Blockchain Technology										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	--	2	4	10	15	50	25	-
Course Code	23BTDSL332 23BTDSP332	5 Hrs per Week			Total	75			25	
Duration of ESE	3 Hrs					100 Marks				

Course Objectives	1. To introduce blockchain concepts, architecture, and evolution. 2. To understand cryptographic methods and consensus algorithms. 3. To develop smart contracts using Ethereum and Solidity. 4. To explore blockchain platforms and real-world applications. 5. To examine blockchain challenges, trends, and future scope.
Course Outcomes	Upon successful completion of this course, student will be able to: CO1: Understand the fundamental architecture, characteristics, and types of blockchain technology. CO2: Apply cryptographic principles and consensus mechanisms to ensure blockchain security. CO3: Analyze smart contracts on Ethereum using Solidity. CO4: Analyze various blockchain platforms and their applications in real-world domains. CO5: Evaluate the challenges, trends, and future scope of blockchain in emerging technologies.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3					2		3	3	2
CO2	3	2	3	2	3			2	3	2		3	3	2
CO3	3	2	3	3	3				2	2	3		3	3
CO4	3	2	3	3	3		4			2		3	2	3
CO5	3	3	3	3	3	3	5	2		2		3	3	2

Unit	Contents	Hours
I	**Introduction to Blockchain**, Evolution of blockchain technology, Centralized vs. decentralized systems, Blockchain architecture and components, Types of blockchain: Public, Private, Consortium, Benefits, limitations, and myths	8
II	**Cryptography and Consensus Mechanisms** Cryptographic primitives: Hash functions, Digital signatures, Public key cryptography, Blockchain security aspects, Consensus algorithms:Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, Practical Byzantine Fault Tolerance (PBFT), Proof of Authority, Proof of Elapsed Time Comparison of consensus algorithms, Attacks on blockchain: 51% attack, Sybil attack, Replay attack	10
III	**Smart Contracts and Ethereum:-**Introduction to smart contracts, Ethereum architecture, Ethereum Virtual Machine (EVM),Introduction to Solidity, Writing and deploying smart contracts, Gas fees and transaction cost, DApps: Concept and examples, ERC standards (ERC-20, ERC-721)	9
IV	**Blockchain Platforms and Applications** Overview of Hyperledger Fabric, Components: Peers, Orderers, Channels, Chaincode, Comparison of Ethereum and Hyperledger Use cases of blockchain:Supply chain, Healthcare, Voting systems, Identity management, Banking and finance, Blockchain-as-a-Service (BaaS)	9
V	**Challenges, Trends and Future Directions** Blockchain scalability and interoperability, Layer 2 solutions (e.g., Lightning Network, Plasma), Regulatory and legal considerations, Environmental concerns and green blockchain Integration with emerging technologies: IOT, AI/ML, Web 3.0 and Metaverse	9

Text Books	1.	Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, by Imran Bashir
	2.	Blockchain Basics: A Non-Technical Introduction, by Daniel Drescher
E--Books	1.	Mastering Blockchain (4th Edition)
	2.	Blockchain Basics: A Non-Technical Introduction in 25 Steps
Reference Books	1.	Blockchain Revolution: How the Technology Behind Bitcoin and Other Crypto currencies is Changing the World
	2.	Blockchain Applications: A Hands-On Approach, Arshdeep Bahga and Vijay Madisetti
online TL Material	1.	https://www.coursera.org/courses?query=free&skills=Blockchain
	2.	https://www.springboard.com/resources/learning-paths/blockchain-foundations/

Experiment Number	Title of the Experiments	COs	POs	PSO
1.	Set up a private Ethereum blockchain using Ganache and connect with MetaMask.	CO1	PO3, PO5	PSO1,2
2.	Develop and deploy a basic smart contract in Solidity on the local Ethereum network.	CO1	PO3, PO5	PSO1,2
3.	Perform Ethereum transactions on a private blockchain (e.g., send ETH between accounts).	CO2	PO2, PO5	PSO1,2
4.	Create and deploy an ERC-20 token contract, interact with it by transferring tokens.	CO2	PO3, PO5	PSO1,2
5.	Implement cryptographic functions like SHA-256 hashing and digital signature generation.	CO3	PO1, PO5	PSO1,2
6.	Build a decentralized application (DApp) using React and Web3.js to interact with smart contracts.	CO3	PO3, PO5	PSO1,2
7.	Use Truffle to automate the development, testing, and deployment of smart contracts.	CO4	PO5, PO11	PSO1,2
8.	Simulate Proof of Work (PoW) and Proof of Stake (PoS) consensus mechanisms using Python.	CO4	PO2, PO4	PSO1,2
9.	Build and deploy a blockchain-based voting system using smart contracts.	CO5	PO3, PO5	PSO1,2
10.	Analyze blockchain data using open-source blockchain explorers like Etherscan.	CO5	PO2, PO5	PSO1,2

Course Title: Data Warehousing and Data Mining										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3	-	2	4	10	15	50	25	-
Course Code	23BTDSL332 23BTDSP332									
Teaching Mode	Offline	3			Total	75			25	
Duration of ESE	3					100				

Course Objectives	1. To understand the fundamental concepts of data warehousing. 2. To develop the ability to design and build a data warehouse. 3. To introduce core concepts of data mining. 4. To familiarize students with various data mining algorithms.
Course Outcomes	On successful completion of the course, students will be able to: CO1: Understand Explain the architecture and components of a data warehouse and differences with OLTP systems. CO2: Analyze dimensional data models (star/snowflake) and small data marts for analytical applications. CO3: Understand ETL/data preprocessing pipelines and perform typical data cleaning operations. CO4: Apply core data mining algorithms for association, classification, clustering and evaluate results. CO5: Apply and Design a small end-to-end prototype combining warehousing, preprocessing and mining for a real dataset.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	3							2	3	1
CO2	3	3	1	2	3								3	1
CO3	3	2	2	2	3								2	2
CO4	3	2	3	3	3							2	2	2
CO5	3	3	3	3	3				3	2		3	2	1

Unit	Contents	Hours
I	Data, information and knowledge; need for integrated decision support, Data warehouse definition, differences between DBMS and DW, Data warehouse architecture (single-tier, two-tier, three-tier), Data marts (dependent and independent), metadata, warehouse bus architecture, OLTP vs OLAP, OLAP operations (roll-up, drill-down, slice, dice, pivot)	8
II	Dimensional modelling: facts, dimensions, star schema, snowflake schema, slowly changing dimensions, Normalization vs denormalization, conformed dimensions, surrogate keys, ETL concepts: extraction, transformation, load; data cleaning, data integration, data transformation, ETL tools and frameworks (batch vs streaming), performance & scalability considerations	10
III	Data preprocessing: data cleaning, handling missing values, data integration, transformation, normalization, discretization, Feature engineering basics, dimensionality reduction overview (PCA), OLAP cube implementation concepts, MOLAP vs ROLAP vs HOLAP, Indexing, partitioning, and query performance tuning for warehouses	9
IV	Introduction to data mining tasks and KDD process, Frequent itemset mining: Apriori, FP-growth algorithms; measures: support, confidence, lift, Classification: decision trees (ID3, C4.5), Naive Bayes, k-NN, model evaluation (cross-validation, confusion matrix, ROC)	9
V	Clustering algorithms: k-means, hierarchical clustering, DBSCAN, evaluation metrics (silhouette score, Anomaly and outlier detection techniques, density-based approaches, Scalable mining: mining large datasets, MapReduce-style approaches, brief on streaming data mining, Applications: business intelligence, recommendation systems, web mining, social network analysis	9

Text Books /	1. Data Mining: Concepts and Techniques (Morgan Kaufmann), Jiawei Han, Micheline Kamber, Jian Pei 2. Building the Data Warehouse, W. H. Inmon (Wiley). 3. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, (Pearson/Addison-Wesley).
Reference Books	1. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling , Ralph Kimball & Margy Ross - (Wiley). 2. Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank, Mark A. Hall (O'Reilly).
OnlineTL Material	Coursera: Data Warehousing for Business Intelligence Specialization — University of Colorado System. Coursera: Design and Build a Data Warehouse for Business Intelligence Implementation (capstone). • NPTEL / IIT courses on Data Mining and Business Analytics (selectable lectures and materials).

Sr. No	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1, PSO2
1	To study and understand single-tier, two-tier, and three-tier data warehouse architectures.	CO1	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
2	To implement and analyse OLAP operations (roll-up, drill-down, slice, dice, pivot) for multidimensional data analysis and decision making.	CO1	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
3	To identify and design fact and dimension tables and implement star schema and snowflake schema for a given dataset.	CO2	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
4	To study ETL scripts and implement using data warehouse tools.	CO2	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
5	To download, install and configure the WEKA Data Mining Tool on the system and verify successful installation for performing data mining experiments.	CO3	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
6	Perform the statistical analysis of data. Discretization, missing values, numeric transform using WEKA Tool (Explorer).	CO3	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
7	Demonstration of association rule mining using Apriori algorithm on supermarket data using WEKA.	CO4	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
8	Perform classification using Bayesian classification algorithm.	CO4	PO1, PO2, PO3, PO4, PO5, PO12	PSO1, PSO2
9	Perform the cluster analysis by k-means algorithm.	CO5	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12	PSO1, PSO2
10	To apply the web mining technique clustering algorithm for the given Dataset.	CO5	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12	PSO1, PSO2

Course Title: Data Analytics using POWERBI										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MD3	4	--	--	4	10	15	50	--	-
Course Code	23BTDSL341									
ESE exam	3 hrs.	5 hrs.			TOTAL	75			--	
						75				

Course Objectives	1. Understanding the Power BI interface and navigation and Connecting to various data sources
	2. Creating and formatting visualizations, such as charts, tables, and maps.
	3. Creating interactive dashboards and reports.
	4. Understand Best practices for data modeling and data visualization.
	Upon successful completion of this course, student will be able to:
Course Outcomes	CO1: Understand key components of Power BI, including its interface, data connectors, and visualization tools.
	CO2: Understand the process of importing, transforming, and preparing data for visualization in Power BI.
	CO3: Apply Power BI tools to create interactive dashboards and reports by applying data visualization techniques.
	CO4: Analyze complex datasets using Power BI's DAX (Data Analysis Expressions) and query editor to derive insights.
	CO5: Design and publish customized Power BI dashboards to effectively communicate data-driven stories tailored to specific business needs.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2								3	2
CO2	3			3	3								3	3
CO3	2	3	2		3								3	3
CO4	3		3		2	3							3	3
CO5	3	2	3	3	3	1				3		3	2	3

Unit	Contents	Hours
I	**Introduction:** Introduction to Business intelligence concept. Various tools and techniques in BI. Why we Need BI? Components and stages in Power BI. Overview of Power Bi Desktop Understanding the Power BI interface and navigation.	10
II	**Power BI Desktop (Power Query)** Loading and transforming the data, combine, append, merge the data, Column operations add column, Transform, Custom Function split, trim operations, Group By concept. Custom column, conditional column. Text function, Number Function and Date Function	12
III	**Basic Visuals in Power BI** Introduction to Basic Charts, Creating Column Chart, Bar chart, stacked chart, Pie Chart, Donut Chart, Funnel Chart, Ribbon Chart, Line Chart, Area Chart, Scatter Plot, Waterfall chart, Tree Map, Gauge Chart, Tables and Matrix, Number Card, Text card, Date card. Formatting the chart. Creation and doing basic setting for map, creating filled map, shape map, Formatting of Map in Power BI	14
IV	**Advance Charts and visuals in Power BI** Introduction to Slicers a filter in Power BI. Insert toolbar for image, text box, shapes and buttons. Creating AI visuals. Introduction to advanced visuals and power BI service. Introduction to DAX function.	10
V	**Capstone project: - Creating report page or dashboard.**	14
Text Books	Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence by Brett Powell	
	The Definitive Guide to DAX: Business Intelligence for Microsoft Power BI by Marco Russo, Alberto Ferrari Alberto Ferrari	
Reference Books	Microsoft Power BI Quick Start Guide, Devin Knight	
	Microsoft Power BI Dashboards Step by Step 1st Edition by Errin O'Connor	
Online TL Material	Training - Microsoft Learn- Power BI - Power BI for business users - Power BI | Microsoft Learn	

	Name of Experiments	PO	PSO
1	Introduction to interface of Power BI with various data file import and creating basic charts.	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
2	To transform, clean dataset using power query editor.	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
3	To create basic visuals of Power BI – (at least 6 visuals)	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
4	To create and set up the map visuals in Power BI	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
5	To use slicers and filters in report page.	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
6	To use DAX function	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
7	To use insert features in visualization	PO1,PO2,PO3,PO4 ,PO5,PO6	PSO1,PSO2
8	To create report page for specific dataset (dashboard creation)	PO1,PO2,PO3,PO4 ,PO5,PO6, PO10, PO12	PSO1,PSO2
Open Ended Experiments			
1	Case study-real data	PO7, PO12	PSO1, PSO2
2	Case study-real data-KAGGLE ETC	PO7, PO12	PSO1,PSO2
Details of on line Laboratory Resource Material Instruction / Operating Manuals			
1.	https://learn.microsoft.com/en-gb/training/modules/get-started-with-power-bi/		

Course Title : Web Application Security										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC3	4	-	-	4	10	15	50	-	-
Course Code	23BTDSL342									
Teaching Mode	Offline	4			Total	75			-	
Duration of ESE	3 Hrs					75				

Course Objectives	1. To reveal the underlying in web application.
	2. To identify and aid in fixing any security vulnerabilities during the web development process
	3. To understand the security principles in developing a reliable web application.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: State the vulnerabilities in the web applications.
	CO2: Identify the various types of threats and mitigation measures of web applications.
	CO3: Demonstrate the security principles in developing a reliable web application.
	CO4: Select industry standard tools for web application security.
	CO5: Formulate penetration testing to improve the security of web applications

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		2								3	2
CO2	3	3											1	2
CO3		3	2	2									2	3
CO4		2		3				2					2	3
CO5		2	3	3	3		2						2	3

Unit	Contents	Hours
I	**Overview of Web Applications Security Fundamentals** Introduction history of web applications interface ad structure benefits and drawbacks of web applications Web application Vs Cloud application Security Fundamentals: Input Validation - Attack Surface Reduction Rules of Thumb- Classi- fying and Prioritizing Threads. Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection	**12**
II	**Web Application Vulnerabilities** Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application- Session vulnerabilities and testing - Cross-site request forgery.	**12**
III	**Web Application Mitigations** Http request , http response, rendering and events , html image tags, image tag security, issue, java script on error , JavaScript timing , port scanning , remote scripting , running remote code, frame and iframe , browser sandbox, policy goals, same origin policy, library import, domain relaxation	**12**
IV	**Secure API Development** API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys, OAuth2, Securing Micro service APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.	**12**
V	**Hacking Techniques and Tools** Social Engineering, Injection, Cross-Site Scripting (XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc	**12**
Text Books	1. Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Profe ssional, 2011. 2. Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011	
Referenc e Books	Web Application Security: Exploitation and Countermeasures for Modern Web Applications Paperback – Import, 13 March 2020 by Andrew Hoffman (Author)	
Online TL Material	https://onlinecourses.nptel.ac.in/noc24_cs121/preview	

Course Title: R Programming for Data Analytics										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC-III	4	--	--	4	10	15	50	--	--
Course Code	23BTDSL 343									
Teaching Mode	OFFLINE	4			Total	75				
Duration of ESE	3									
Course Objectives	1. To introduce the basic concepts in R programming. 2. To equip the students with the popular statistical programming language R. 3. To familiarize the students with utility of 'R' for managerial decision making.									
Course Outcomes	On successful completion of the course, students will be able to: CO1: Learn Syntax and Semantics of R Programming. CO2: Analyze R programming to generate the graph and other data representation methods. CO3: Develop Proficiency in R for Statistical Analysis CO4: Visualize and analyse the data using statistical methods.. CO5: Apply best practice model design methodologies to real problems using R.									

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3							2	2	1
CO2	2	3	3	2	2								2	1
CO3	2	3	3	1	2								2	1
CO4	2	3	3	3	2							2	2	1
CO5	2	3	3	3	2							3	2	1

Unit	Contents	Hours
I	**Introduction and Background:** Introduction to R and familiarization of R Studio, Basic components in R Studio. R Syntax And programming, understanding tidyverse, tibble, dplyr, ggplot2, tidyr, purrr, readr, forcats, stringr for tidying, manipulating and plotting data	12
II	**Introduction to Data Visualization with R:** Basic Plotting types: Barchart, Pie Chart, Histogram, Density plot, Boxplot; Plot customization: Adding legend, adding colour in plots, adding axis labels and chart title, Modifying axis and scales; Overlay plots in R	12
III	**Basic Statistics with R:** Measures of central tendency, Measures of Variability, Measures of Shape; summary statistics by group; Dealing with outliers: Truncate and Winsorize. **Probability and Stochastics with R**: Probability Distribution, Binomial Distribution, Normal Distribution, Sampling Distribution, Types of Sampling: Probability vs non-Probability	14
IV	**Advanced Inferential Statistics with R:** One-sample test, two-sample test, T statistics, Z statistics, Test with Proportion, Test with variances; ANOVA: one way and two ways	10
V	**Introduction to Model Building and Evaluation:** Linearity and normality, Fitting SLRM, Storing and printing the regression results, Interpretation of the regression results, Diagnosis of the fitted model	12
Text Books	R for Data Science, Hadley Wickham, O'Reilly, 1st Edition	
	Chris Chapman and Elea McDonnell Feit, "R for Marketing Research and Analytics," Springer, 2nd Edition	
Reference Books	ggplot2 Elegant Graphics for Data Analysis, Hadley Wickham, Springer, 2nd Edition,	
	R for everyone: Advanced analytics and graphics. Pearson Education. Lander, J. P. (2014).	
Online TL Material	https://onlinecourses.nptel.ac.in/noc24_mg113/preview	
	https://www.udemy.com/course/marketing-analytics-using-r-and-excel	
	https://www.coursera.org/learn/data-analyticsbusiness	

Course Title : Next Generation Database Technologies										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MD4	2	–	–	2	10	15	50	–	–
Course Code	23BTDSL323									
Teaching Mode	Offline	2			Total	75			-	
Duration of ESE	3 hours					75				

Course Objectives	Understanding MongoDB Fundamentals
	Distinguish the different types of NoSQL databases
	Familiarize with NoSQL database framework
Course Outcomes	CO1: Understand different types of NoSQL Databases, mongodb architecture and data modeling.
	CO2: Understand and analyze the MongoDB & CRUD commands
	CO3: Demonstrate and analyze working of Indexing, Pipeline and Database operation.
	CO4: Understand and demonstrate replication in mongodb
	CO5: Understand and apply advanced mongodb concepts

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	-	2	-	-	-	-	-	3	2	1
CO2	3	3	-	2	-	2	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	2	-	-	-	-	-	3	2	1
CO4	3	3	3	2	-	1	-	-	-	-	-	3	2	1
CO5	3	3	3	3	3	3	-	-	-	-	-	3	2	1

Unit	Contents	Hours
I	**Introduction**: SQL vs NoSQL, Introduction to NoSQL Databases. NoSQL features, Different types of NoSQL databases, Use cases of NoSQL **Introduction to MongoDB**: MongoDB architecture, Data modelling in MongoDB, Advantages of MongoDB over RDBMS, Mongo Shell, Configuration file in MongoDB.	**6**
II	**Documents and collections:** JSON File format for storing documents Introduction to Documents, Collections, Database Commands in MongoDB, Inserting and Saving Documents, Inserting multiple documents **CRUD Operation:** Updating Documents, Removing Documents, Document Replacement, Operator and Modifiers	**6**
III	**Indexing:** Indexing in MongoDB, Single index, Finding index, Multikey index **Aggregation:** Aggregation Framework, Pipeline Operations-: match, sort, group **Pipeline operations:** Pipeline Operations- project, limit, skip, Map Reduce, Aggregation commands	**6**
IV	**Replication**, Advantages of replication, Implementation of replication, Managing Configuration File in MongoDB, setting up replica set in MongoDB, MongoDB, Sharding.	**6**
V	**Advanced MongoDB**: MongoDB Transactions, Data Validation using Schema (validator), MongoDB Security Basics, Authentication, Role-based access control	**6**
Text Books	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Sadalage, P. & Fowler, Wiley Publications, 1st Edition, 2019.	
Online TL Material	https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp	
	https://www.geeksforgeeks.org/introduction-to-nosql/	
	https://www.w3schools.com/mongodb/	

Course Title: Full Stack Web Development										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VSEC4	1	0	2	2	10	15	-	25	-
Course Code	23BTDSL324 23BTDSP324									
Duration of ESE	3 Hours	3			Total	25			25	
						50 Marks				
Course Objectives	1. To introduce students to foundational web technologies including HTML, CSS, and JavaScript. 2. To equip students with skills to build dynamic front-end applications using React and manage application state. 3. To enable students to develop server-side logic and RESTful APIs using Node.js and Express. 4. To teach integration of relational and non-relational databases in full-stack applications. 5. To prepare students to design, deploy, and maintain scalable full-stack applications on cloud platforms.									
Course Outcomes	On successful completion of the course, students will be able to: CO1: Describe core web development concepts using HTML, CSS, and JavaScript. CO2: Develop responsive front-end interfaces using React and state management. CO3: Build server-side applications and RESTful APIs using Node.js and Express. CO4: Integrate SQL and NoSQL databases with web applications. CO5: Design and deploy a full-stack application on a cloud platform.									

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	3				3		3	3	3	
CO2	3	2	3	3	2				3		3	3	3	3
CO3	3	2	3	3	3				3	3		3	3	3
CO4	3	3	3	3	3		3		2		3			3
CO5	3	3	3	3	3	3	3		3		3	3		3

Unit	Contents	Hours
I	Introduction to Web Development: Client-side vs. Server-side, HTML5: Structure, forms, semantics, CSS3: Flexbox, Grid, Responsive Design, JavaScript Basics: Variables, loops, functions, DOM manipulation, Version Control: Git & GitHub basics	3
II	DOM Manipulation: Selecting and modifying elements, events, React.js Introduction: Components, Props, State, Hooks, Basic State Management: Context API or Redux overview, Mini Project: Interactive front-end app using React	3
III	Back-End Development using Node.js and Express.js, Creating RESTful APIs (CRUD operations),User Authentication: JWT, password hashing, Overview: Django, Flask (Python); Spring Boot (Java)	3
IV	Databases: SQL (MySQL/PostgreSQL), NoSQL (MongoDB), Basic Data Structures: Arrays, Lists, Trees (overview), API Integration with Database (Project-based)	3
V	System Design: Scalability, Security, Deployment, Cloud Platforms Overview: Vercel, Firebase, AWS, GCP, Capstone Project: Full-stack Application (Front-end + Back-end + DB + Deployment), Presentation and Portfolio using GitHub	3

Text Books	1.	Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, by Jennifer Robbins
	2.	Full-Stack React Projects: Modern web development using React 18, Node, Express, and MongoDB, BY Shama Hoque
E--Books	1.	Full Stack Open" by University of Helsinki Link: https://fullstackopen.com/en/
	2.	The Odin Project – Full Stack JavaScript Path Link: https://www.theodinproject.com/paths/full-stack-javascript
Reference Books	1.	Eloquent JavaScript: A Modern Introduction to Programming, BY Marijn Haverbeke
	2.	Node.js Design Patterns" Author: Mario Casciaro
online TL Material	1.	Link: https://www.freecodecamp.org/learn/
	2.	Link: https://developer.mozilla.org/en-US/

Experiment Number	Title of the Experiments	CO	PO	PSO
1.	Create a static personal portfolio website using HTML and CSS.	CO1	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12	PSO1
2.	Build a responsive landing page with interactive features using JavaScript.	CO1	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12	PSO1
3.	Develop a simple React application with state and props.	CO2	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12	PSO1, PSO2
4.	Create a RESTful API using Node.js and Express.js.	CO2	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PO12	PSO1, PSO2
5.	Implement JWT-based user authentication in a Node.js backend.	CO3	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12	PSO1, PSO2
6.	Design and integrate a MySQL or MongoDB database with an Express.js app.	CO3	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PO12	PSO1, PSO2
7.	Perform CRUD operations through a React frontend connected to an API.	CO4	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO11	PSO2
8.	Deploy a full-stack application using Vercel, Firebase, or Heroku.	CO4	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO11	PSO2
9.	Build a mini full-stack project (e.g., task manager, blog, or notes app).	CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO11, PO12	PSO2
10.	Develop and present a capstone full-stack project with deployment.	CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO11, PO12	PSO2

Course Title: Digital Forensics										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VSEC4	1	-	2	2	10	15	-	25	-
Course Code	23BTDSL325									
Teaching Mode	Offline	3 Hrs			Total	25			25	
Duration of ESE	3 Hrs					50				

Course Objectives	To correctly define and cite appropriate instances for the application of computer forensics Correctly collect and analyse computer forensic evidence.
	Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Computer Forensics.
Course Outcomes	Upon successful completion of this course, student will be able to: CO1: Understand the fundamentals of cyber-crimes and digital forensics. CO2: Identify and describe emerging digital crimes and trends in cyber security. CO3: Demonstrate proficiency in basic computer systems and components. CO4:Apply computer forensic techniques and methods for digital investigations. CO5: Investigate and process digital evidence using advanced techniques.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	3	2			2		2		3	3	
CO2	2	2	2	1	3			3				3		2
CO3	3	1	3	2	3			2				3	1	
CO4	3	3	3	2	3			3			1	2	2	1
CO5	3	2	2	1	3			3				2		2

Unit	Contents	Hours
I	**Basics of Computer:** Computer organisation, components of computer- input and output devices, CPU, Memory hierarchy, types of memory, storage devices, system software's, application software's, basics of computer languages.	2
II	**Cyber Crime and computer crime:** Introduction to Digital Forensics, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.	2
III	**Computer Forensics and Digital Forensics** **Computer Forensics:** Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, computer artifacts, Internet Artifacts, OS Artifacts and their forensic applications . **Digital Forensics**: Definition, Nature and Scope. Role of Forensic Analysist and forensic tools, Traditional Analysis vs Tools-based Analysis, Forensic Analysis Tools Requirements	4
IV	**Forensic Tools and Processing of Electronic Evidence** **Forensic Tools:** Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters. **Processing of Electronic Evidence:** Retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.	4
V	**Digital Forensics Tools Categories**: Disk & Data capture tools, File Viewers, File Analysis Tools, Network Forensic Tools, Database Forensics Tools, Mobile Devices Analysis Tools, Email Analysis Tools, Internet Analysis Tools, Registry Analysis Tools, Tools for Analysis and Prevention	3
Text Books	1. Digital Forensics with Open Source Tools, C. Altheide& H. Carvey, Syngress, 2011.	
Online TL Material	https://onlinecourses.swayam2.ac.in/nou22_cs05/preview	

Sr. No.	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1, PSO2
1	Study of Digital Forensics and different tools used for forensic investigation	CO1	PO1, PO2 PO3, PO4, PO5, PO8, PO10, PO12	PSO1
2	Study the methods to Recover Deleted Files using Forensics Tools	CO2	PO1, PO2 PO3, PO4, PO5, PO8, PO12	PSO2
3	Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.	CO3	PO1, PO2 PO3, PO4, PO5, PO8, PO12	PSO1
4	Study the methods to Extract Exchangeable image file format (EXIF) Data from Image Files using Exifreader Software.	CO4	PO1, PO2 PO3, PO4, PO5, PO8, PO11, PO12	PSO1, PSO2
5	Study the various methods of Steganography	CO5	PO1, PO2 PO3, PO4, PO5, PO8, PO12	PSO2
6	Study and implement various types of Key loggers	CO5	PO1, PO2 PO3, PO4, PO5, PO8, PO12	PSO2
7	How to Collect Email Evidence in Victim PC	CO5	PO1, PO2 PO3, PO4, PO5, PO8, PO12	PSO2
8	How to Extracting Browser Artifacts	CO4	PO1, PO2 PO3, PO4, PO5, PO8, PO11, PO12	PSO1, PSO2

9	How to View Last Activity of Your PC	CO4	PO1, PO2 PO3, PO4, PO5, PO8, PO11, PO12	PSO1, PSO2
10	Find Last Connected USB on your system (USB Forensics)	CO4	PO1, PO2 PO3, PO4, PO5, PO8, PO11, PO12	PSO1, PSO2

Course Title: Research Ethics & Technical Writing										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	RM	-.	-	4 Hrs	2	-	-	-	50	-
Course Code	23BTSHP302									
Teaching Mode	Offline	4Hrs			Total				50	
Duration of ESE	-					50				

Course Objectives	1. To introduce the basics of scientific communication
	2. To develop skills in scientific writing, ensuring ethical standards
	3. To enable students to identify research problems, formulate objectives and hypotheses
	4. To familiarize students with plagiarism detection tools, ensuring academic integrity and originality in research work.
	5. To provide knowledge on research ethics, intellectual property rights
Course Outcomes	CO1: Understanding of communication skills and various forms of scientific communication
	CO2: Apply ethical principles in scientific writing and research reporting
	CO3: Analyze and develop research proposals by identifying research problems
	CO4:Utilize plagiarism detection and anti-plagiarism software, and critically evaluate the authenticity and originality of research content.
	CO5: Explain the principles of research ethics, intellectual property rights, and publishing processes,

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		3	3	3					3	3					
CO2	3	3	3	3						1					
CO3		3		3						3					
CO4		3		3											
CO5				3				3							

Course Contents:

Unit	Contents	Hours
I	**Communication Research reports and Thesis writing**: Basics of Communication Skill,Types of Scientific Communication, Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.	6
II	**Scientific Writing of Research report:** Ethics of qualitative research and quality of researcher, Research papers: Norms of writing research papers and articles in National and International Journals.	6
III	**Research Proposal:** Research Proposal: Concept, Need, Importance and Types Research Problem: Meaning, Types, Sources, & Importance; Locating the Research Problem; Criteria for Selecting Research Problem, and Evaluation of Research Problem. Objectives: Concept, Nature and Types. Research variable.	6
IV	**Research Proposal:** Meaning and Types. Hypothesis/Assumption: Meaning, Need, Characteristics, Sources, Types (Null & Alternative); and Testing of Hypothesis (Parametric & Non-Parametric Test). Anti-Plagiarism Software : URKUND …etc.	6
V	**Research Ethics, IPR and Publishing:** intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.	6

Text Books	1	Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011.
	2	C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
	3	Gupta S.C, Fundamentals of Statistics, Himalaya Publication House, Bombay Rajaram V. (1996),
E--Books	1	Wayoc C. Booth : The Craft of Research
	2	David Willinson : Research Tools Kits : A Complete Guide to Practitioner Research
Reference Books	1	Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004.
on line TL Material	1	http:// www.shodhaganga.inflibnet.ac.in
	2	http:// www.inflibnet.ac.in.
	3	http:// www.zotero.org

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Writing scientific report (CO1)
2	Oral presentation of research(CO1)
3	Identifying real life engineering problem (CO2)
4	Write review paper with proper referencing (CO2)
5	Preparing proposal of 500 words (CO3)
6	Generating anti-plagiarism report (CO4)
7	Paraphrasing and summarizing to retain originality (CO4).
8	Case study on real world patent dispute (CO5)
9	Art of abstract writing (CO1,CO3)
10	Do's and don'ts of user research (CO2)
11	How to write research methodology (CO3)
12	Accurate referencing (CO2)