TUMKUR UNIVERSITY

Board of Studies in Computer Science

Curriculum Structure and Syllabus for V and VI Semesters

Bachelor of Science in Data Science (BSc Data Science)

Choice Based Credit System

2026 - 27 onwards

BOS in UG Computer Science Committee Members

1.	**Dr. M. Basavanna** **Professor & Chairman,** Department of Studies in Computer Applications (MCA), Davangere University, Davangere	Chairperson
2.	**Dr. Kusuma Kumari B.M** **Associate Professor** Department of Studies and Research in Computer Applications, Tumkur University, Tumakuru	Member
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6.	**Dr. Girija D.K** **Associate Professor** Department of Computer Science Government First Grade College, Koratagere	Member
7.	**Dr. Nagaraju K V** **Associate Professor** Department of Computer Science Government First Grade College for Womens, Tumkur.	Member

Special Thanks to:

1.	**Capt. Ramalinga Reddy S** Assistant Professor Department of Computer Science Sri Siddaganga Arts and Commerce Evening College Tumkur.
2.	**Dr. Haridas S.** Associate Professor Department of Computer Science Government First Grade College, Tumkur.
3.	**Dr. Husna Sultana** Associate Professor Department of Computer Science Government First Grade College, Tumkur.
4.	**Dr. Prakash B.R** Assistant Professor and HOD Department of Computer Science Government First Grade College, Tipatur.
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6.	**Dr. Manjunath S** Assistant Professor, Department of Computer Science Y.E.R Government First Grade College, Pavagada.
7.	**Kiran Kumar M** Assistant Professor Department of Computer Science Government First Grade College, Tipatur.
8.	**Mujtaba Farheen** Assistant Professor Department of Computer Science Government First Grade College, Madhugiri.
9.	**Harikumar M E** Assistant Professor Department of Computer Science Government First Grade College, Madhugiri

Internal Assessment Marks for Theory and Practical

Internal Assessment Marks Allotment for Theory	
Internal Test 1	05
Internal Test 2	05
Assignment	05
Seminar/Quiz	05
TOTAL	**20**

Internal Assessment Marks Allotment for Practical	
Internal Test	05
Record and Attendance	05
TOTAL	**10**

Internal Assessment Marks Allotment for V Semester SEC Paper	
Internal Test 1	05
Internal Test 2	
Assignment	02
Seminar/Quiz	03
TOTAL	**10**

Evaluation Scheme for Lab Examination

Assessment Criteria	
Writing 2 Programs	**10**
Execution of 2 Programs	**20**
Viva	**10**
Total	**40 Marks**

SEMESTER – V

Sl. No	Paper	Title of the Paper	Instruction Hrs. per Week	No. of Credits :	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Exam.	Total
1	BSCDSTA1-501	Natural Language Processing	3	3	3 Hrs.	20	80	100
2	BSCDSTA2-502	Artificial Intelligence	3	3	3 Hrs.	20	80	100
3	BSCDSPA3-503	Artificial Intelligence Lab	4	2	3 Hrs.	10	40	50
4	BSCDSTB1-504	Software Engineering	3	3	3 Hrs.	20	80	100
5	BSCDSTB2-505	Cloud Computing for Data Analysis	3	3	3 Hrs.	20	80	100
6	BSCDSPB3-506	Mini Project	4	2	3 Hrs.	10	40	50
7	BSCDSTC1-507	Exploratory Data Analytics	3	3	3 Hrs.	20	80	100
8	BSCDSTC2-508	Web Technology	3	3	3 Hrs.	20	80	100
9	BSCDSPC3-509	Web Technology Lab	4	2	3 Hrs.	10	40	50
10.	BSCDSTSEC-510	Cyber Law and Ethics	3	2	1 1/2 Hrs.	10	40	50
TOTAL			33	**26**				**800**

NOTE:
Theory: 1 Hr. = 1 Credit **Practical: 2 Hrs. = 1 Credit**

BSCDST: BSc Data Science Core Paper Theory
BSCDSP: BSc Data Science Core Paper Practical

SEMESTER – VI

Sl. No	Paper	Title of the Paper	Instruction Hrs. per Week	No. of Credits :	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Exam.	Total
1.	BSCDSTA1-601	Big Data Analytics	3	3	3 Hrs.	20	80	100
2.	BSCDSTA2-602	Data Visualization	3	3	3 Hrs.	20	80	100
3.	BSCDSPA3-603	Data Visualization Lab	4	2	3 Hrs.	10	40	50
4.	BSCDSTB1-604	Fundamentals of Neural Networks	3	3	3 Hrs.	20	80	100
5.	BSCDSTB2-605	NoSQL Database	3	3	3 Hrs.	20	80	100
6.	BSCDSPB3-606	NoSQL Database Lab	4	2	3 Hrs.	10	40	50
7.	BSCDSTC1-607	Generative AI	3	3	3 Hrs.	20	80	100
8.	BSCDSTC2-608	Cryptography and Network Security	3	3	3 Hrs.	20	80	100
9.	BSCDSPC3-609	Major Project	4	2	3 Hrs.	10	40	50
10.	BSCDSTSEC-610	Research Methodology and Survey Project	3	2	1 1/2 Hrs.	10	40	50
TOTAL			33	**26**				**800**

NOTE:
Theory: 1 Hr. = 1 Credit **Practical: 2 Hrs. = 1 Credit**

BSCDST: BSc Data Science Core Paper Theory
BSCDSP: BSc Data Science Core Paper Practical

FIFTH SEMESTER			
Subject Name: Natural Language Processing			
Subject code:	**BSCDST A1-501**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To introduce the fundamental concepts, techniques, and applications of Natural Language Processing (NLP) and text analytics.
2. To develop an understanding of text pre-processing, language modelling, syntactic and semantic analysis techniques used in NLP systems.
3. To provide knowledge of deep learning, transformer-based architectures, and modern NLP tools for building intelligent language applications.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Apply text pre-processing, language modeling, and syntactic analysis techniques to process and analyze textual data.
2. Implement information extraction, sentiment analysis, word embeddings, and deep learning models for various NLP tasks.
3. Analyze and utilize transformer-based models such as BERT, GPT, and Llama using modern NLP frameworks and tools.

UNIT 1	**Foundations of NLP & Text Pre-processing**	**Hours 8**
	Introduction to NLP: What is NLP? Evolution, applications, and challenges of human language. Text Pre-processing Pipeline: Sentence segmentation, tokenization, stop-word removal. Text Normalization: Stemming, lemmatization, and morphological analysis. Lexical Resources: Introduction to WordNet, dictionaries, and semantic relationships.	
UNIT 2	**Syntactic Processing & Language Modeling**	**Hours 10**
	Language Modeling: Unigram, Bigram, N-gram models. Advanced Smoothing Techniques: Laplace, Good-Turing, and Kneser-Ney smoothing. Syntactic Analysis: Phrase structure grammars, dependency graphs, and parse trees. Parsing Algorithms: CYK parsing and Shift-Reduce Parsing	
UNIT 3	**Information Extraction & Semantics**	**Hours 10**
	Part-of-Speech (POS) Tagging: Rule-based tagging and Hidden Markov Models (HMM).Information Extraction (IE): Named Entity Recognition (NER) and Relation Extraction. Word Sense Disambiguation (WSD): Supervised and knowledge-based approaches. Sentiment Analysis: Aspect-based sentiment mining and opinion classification	

UNIT 4	**Vector Semantics & Deep Learning in NLP**	**Hours 10**
	Text Representation: Bag-of-Words (BoW), Term Frequency-Inverse Document Frequency (TF-IDF).Word Embeddings: Word2Vec, GloVe, and fastText. Neural Architectures: Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks	
UNIT 5	**Modern Generative Models & Transformers**	**Hours 10**
	The Transformer Architecture: Attention mechanisms and Self-Attention .Pre-trained Language Models: Overview of BERT, GPT, and Llama. Hands-on NLP Tools: Practical labs utilizing Python libraries like NLTK, spaCy, Hugging Face, or OpenAI API.	

TEXT BOOKS:

1. Speech and Language Processing – Daniel Jurafsky and James H. Martin, 3rd Edition, Pearson Education.
2. Natural Language Processing with Python: Analyzing Text with the NLTK – Steven Bird, Ewan Klein and Edward Loper, O'Reilly Media.

REFERENCE BOOKS:

1. Foundations of Statistical Natural Language Processing – Christopher D. Manning and Hinrich Schütze, MIT Press.
2. Deep Learning – Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.

FIFTH SEMESTER			
Subject Name: Artificial Intelligence			
Subject code:	**BSCDST A2-502**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To understand the primitives of AI
2. To familiarize Knowledge Representation Issues
3. To understand fundamentals of Statistical Reasoning, Natural Language Processing.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Identify the problems where the adaptation of AI has significant impact.
2. Analyze the different approaches of Knowledge Representation.
3. Explain Symbolic Reasoning under Uncertainty and Statistical reasoning.

	Fundamentals of Artificial Intelligence	**Hours 10**
UNIT 1	**Introduction to Artificial Intelligence:** Meaning and Definition of AI, History and Evolution of AI, Characteristics and Goals of AI, Applications of AI in Daily Life, Advantages and Limitations of AI. **Intelligent Agents:** Concept of Agents and Environment, Types of Agents, Rational Agents, Agent Architecture, Agent Programs. **Knowledge-Based Systems:** Introduction to Knowledge-Based Agents, Knowledge Representation, Wumpus World Problem, Real-Life Examples of Intelligent Agents. **Problem Solving in AI:** Problem-Solving Agents, State Space Representation Components of a Problem, Performance Measures.	
UNIT 2	**Search Techniques and Problem Solving**	**Hours 10**
	Uninformed Search Techniques: Breadth First Search (BFS), Depth First Search (DFS), Iterative Deepening Search, Comparison of Search Algorithms. **Informed Search Techniques:** Heuristic Functions, Best First Search, A* Search Algorithm, AO* Search Algorithm. **Adversarial Search and Game Playing:** Introduction to Game Playing, Two-Player Zero-Sum Games, Minimax Algorithm, Alpha-Beta Pruning. **Constraint Satisfaction Problems:** Introduction to CSP, Variables, Domains, and Constraints, Backtracking Search.	

UNIT 3	**Knowledge Representation and Reasoning**	**Hours 10**
	Logic in AI: Introduction to Logic, Propositional Logic, Predicate Logic, Comparison of Propositional and Predicate Logic. **Inference Techniques:** Forward Chaining, Backward Chaining, Resolution Method, Truth Maintenance Systems. **Planning in AI:** Introduction to Planning, Blocks World Problem, STRIPS Representation, Goal-Based Planning. **Reasoning Under Uncertainty:** Non-Monotonic Reasoning, Probabilistic Reasoning, Introduction to Fuzzy Logic, Applications of Fuzzy Systems.	
UNIT 4	**Machine Learning and Modern AI Technologies**	**Hours 09**
	Introduction to Machine Learning: Concept and Need for Machine Learning, Types of Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Applications of Machine Learning **Natural Language Processing (NLP):** Introduction to NLP, Text Processing, Speech Recognition, Chatbots and Virtual Assistants. **Computer Vision:** Image Processing Basics, Object Detection, Face Recognition, Applications of Computer Vision **Deep Learning Fundamentals:** Artificial Neural Networks, Introduction to Deep, AI Tools and Platforms.	
UNIT 5	**Applications of AI, Robotics, and Ethical Issues**	**Hours 09**
	Robotics and Intelligent Systems: Introduction to Robotics, Components of Robots, Industrial and Service Robots, Autonomous Systems. **Expert Systems:** Definition and Characteristics, Architecture of Expert Systems, Knowledge Base and Inference Engine, Case Study: Medical Diagnosis System. **AI Applications:** AI in Education, AI in Healthcare, AI in Banking and Finance, AI in Agriculture, AI in E-Commerce. **Ethical and Social Issues in AI:** Responsible AI, Bias and Fairness, Privacy and Security Concerns, AI and Employment, Future Trends in AI.	

TEXT BOOKS:

1. **Stuart Russell and Peter Norvig**, *Artificial Intelligence: A Modern Approach*, 4th Edition, Pearson Education, 2021.
2. **Elaine Rich, Kevin Knight and Shivashankar B. Nair**, *Artificial Intelligence*, 3rd Edition, McGraw Hill Education, 2017.
3. **S. Kaushik and S. P. Mishra**, *Artificial Intelligence*, Cengage Learning India, 2019.

REFERENCE BOOKS:

1. **Nils J. Nilsson**, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publishers, 1998.
2. **George F. Luger**, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, 6th Edition, Pearson Education, 2009.

FIFTH SEMESTER			
Subject Name: Artificial Intelligence Lab			
Subject code:	**BSCDSPA3-503**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

PART - A

1. Installation of Python, execution of Hello World program, and accepting user input.
2. Implementation of Stack and Queue using Python Lists.
3. Demonstration of NumPy arrays and matrix operations.
4. Matrix multiplication using NumPy (dot(), matmul()).
5. Linear Search and Binary Search implementation.
6. Generation of random numbers using Gaussian distribution.
7. Plot Gaussian Distribution using Matplotlib.
8. Data preprocessing using NumPy and Pandas (handling missing values and normalization).
9. Simple Machine Learning model using Linear Regression.
10. Text processing using NLP techniques (tokenization, stop-word removal, word frequency analysis).

PART - B

1. Implement Breadth First Search (BFS) for state-space search problems.
2. Implement Depth First Search (DFS) on the Water Jug Problem.
3. Implement Best First Search on the Missionaries and Cannibals Problem.
4. Implement A* Search Algorithm for shortest path finding.
5. Implement AO* Search Algorithm for problem reduction.
6. Solve the 8-Queens Problem using Backtracking.
7. Implement Constraint Satisfaction Problem (Map Coloring or Sudoku Solver).
8. Implement Forward Chaining or Backward Chaining Expert System.
9. Implement Resolution Principle for Predicate Logic problems.
10. Develop an AI-based application Tic-Tac-Toe using Minimax Algorithm

FIFTH SEMESTER			
Subject Name: Software Engineering			
Subject code:	**BSCDST B1-504**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.
2. To Develop proficiency in project management methodologies and strategic decision making for successful software project execution.
3. To Master the art of software design, development, and testing to produce robust and efficient software solutions.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. An ability to understand basic concepts of software engineering.
2. An ability to describe project management methodologies and strategic decision making for successful software project execution.
3. An ability to understand software design, development, and testing to produce robust and efficient software solutions.

UNIT 1	**Introduction**	**Hours 8**
	The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process. **Agile software development:** Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.	
UNIT 2	**Software Requirements Engineering and Risk Management**	**Hours 10**
	Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management. **Risk Management:** Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.	

UNIT 3	**Project Planning and Design**	**Hours 10**
	Project Planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques. **Design:** Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.	
UNIT 4	**Testing and Metrics**	**Hours 10**
	Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. **Product Metrics:** Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.	
UNIT 5	**Quality and Release Management**	**Hours 10**
	Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability. **Release Management:** Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring. **Product Sustenance:** Maintenance, updates, End of life, migration strategies.	

TEXT BOOKS:

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023
2. Software Engineering, Ian Somerville, 9th edition, Pearson education.
3. Software Engineering A Practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

REFERENCE BOOKS:

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
2. Software Engineering: Principles and Practice Hans van Vliet.

FIFTH SEMESTER			
Subject Name: Cloud Computing for Data Analysis			
Subject code:	**BSCDST B2-505**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the fundamental concepts of cloud computing, including service models, deployment models, and their role in data science and analytics.
2. Learn virtualization technologies, cloud infrastructure components, virtual machines, containers, and cloud resource management techniques.
3. Explore cloud storage systems, databases, data warehouses, and data management solutions for handling large-scale datasets.
4. Apply cloud-based machine learning platforms and services to build, train, evaluate, and deploy machine learning models.

COURSE OUTCOMES:

1. Explain cloud computing concepts and identify suitable service and deployment models.
2. Configure virtual machines and understand virtualisation techniques.
3. Apply cloud storage solutions to manage and query large datasets.
4. Use cloud platforms to build and train machine learning models.

UNIT 1	**Introduction to Cloud Computing**	**Hours 10**
	What is cloud computing definition and evolution, Characteristics: on demand, broad access, pooling, elasticity, metering; Cloud vs traditional computing (mainframe, grid, cluster), Service models: SaaS, PaaS, IaaS with everyday examples. Deployment models: public, private, hybrid, commUNITy. Advantages and limitations for data centric workloads. Major cloud providers: AWS, Azure, GCP overview. Role of cloud in data science and analytics workflows.	
UNIT 2	**Virtualisation and Cloud Infrastructure**	**Hours 9**
	Introduction to virtualisation concept and need, Types: server, desktop, network, storage, application, data. Hypervisors Type 1 and Type 2, examples, Virtual Machines: creation, configuration, snapshots. Containers vs VMs Docker basics, Load balancing, auto scaling, and elasticity, Identity and Access Management (IAM) basics, Hands on: create a VM on VMware / cloud consol.	

UNIT 3	**Cloud Storage and Data Management**	**Hours 9**
	Cloud storage types: block, file, and object based, Use cases: backup, archiving, disaster recovery, delivery, Relational vs non relational (NoSQL) databases in cloud, Key value stores: features, limitations, examples (DynamoDB), Cloud data warehouse: AWS Redshift, GCP BigQuery, Batch vs streaming data for machine learning ,AWS S3: buckets, objects, versioning, access policies, Hands on: upload and query a dataset using BigQuery	
UNIT 4	**Machine Learning on the Cloud**	**Hours 10**
	Why use cloud for ML scalability, cost, collaboration, AIaaS and GPUaaS types of managed ML services, Cloud ML platforms: AWS SageMaker, Azure ML Studio, GCP AutoML, Managed vs unmanaged ML environments, Feature engineering and data preparation in the cloud, Training a simple model on SageMaker notebook instance, Model evaluation metrics accuracy, precision, recall, F1,Pre tuned AI services: Vision API, Natural Language API	
UNIT 5	**Deploying and Monitoring Data Pipelines**	**Hours 10**
	End to end ML project lifecycle on cloud, ETL vs ELT pipelines concepts and tools (Glue, Dataflow), Selecting a cloud ML platform decision criteria, Model deployment: REST endpoints, serverless (AWS Lambda), Monitoring deployed models drift, performance, retraining, Service Level Agreements (SLAs) and cloud billing basics, Data security, privacy, and compliance in analytics Micro project: build and deploy a simple end to end pipeline.	

TEXT BOOKS:

1. Mastering Cloud Computing: Foundations and Applications Programming: Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi · Morgan Kaufmann / McGraw Hill · 2013
2. Cloud Computing: A Hands On Approach Arshdeep Bahga & Vijay Madisetti · University Press (India) · 2014
3. Data Science on the Google Cloud Platform (2nd ed.): Valliappa Lakshmanan, Jordan Tigani · O'Reilly Media · 2022 · ISBN: 9781098118952

REFERENCE BOOKS:

1. Cloud Computing for Data Analysis: Noah Gift & Alfredo Deza · Pragmatic AI Labs · Available free online Open access book from Duke University instructors covering cloud native data analysis workflows with Python.
2. AWS Documentation & Tutorials (official): Amazon Web Services, docs.aws.amazon.com · Continuously updated, Official AWS getting started guides for EC2, S3, SageMaker, and Glue. SageMaker, Free Google Cloud Skills Boost (Qwiklabs)
3. Google Cloud · cloudskillsboost.google · Free tier available, Hands on labs covering BigQuery, Vertex AI, Cloud Storage and Dataflow.

FIFTH SEMESTER			
Subject Name: Mini Project			
Subject code:	**BSCDSP B3-506**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

COURSE OBJECTIVES:

1. Apply acquired knowledge in chosen technology for project development.
2. Identify and justify technical aspects of the chosen project systematically.
3. Reproduce, improve, and refine technical aspects for engineering projects.
4. Work individually or in a team to develop technical projects.
5. Communicate and report project activities and findings effectively.

Project Planning

The topic must be selected at the beginning of the V semester. Related reading, training and discussions of first internal project viva voce should be completed in the first week of the V Semester.

Types of Project Work (Only Suggestive): Real Life Problem Solution on Statistics, Visualization, Survey, NLP, Finance, Classification, Clustering, Health

Team Selection

- Team size: 3 to 5 members; a team leader must be selected.
- Meeting minutes must be maintained and included in the final project report.
- Tasks must be assigned to each member in writing.
- Each member must work on a separate module and submit an independent report.

Tools & Platform

No restrictions on platform, tools, or languages. Open-Source tools are strongly recommended. Tool selection does not affect evaluation.

Documentation

Final mini-project to be submitted as a report + code notebook.

Two copies of the project report must be submitted: one for the department library and one for the student. Format of report is as per the suggested format given in Major project

FIFTH SEMESTER			
Subject Name: Exploratory Data Analytics			
Subject code:	**BSCDST C1-507**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To outline an overview of exploratory data analysis.
2. To implement data visualization using Matplotlib.
3. To perform univariate data exploration and analysis.
4. To apply bivariate data exploration and analysis.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Understand the fundamentals of exploratory data analysis.
2. Implement the data visualization using Matplotlib.
3. Perform univariate data exploration and analysis.
4. Apply bivariate data exploration and analysis.

UNIT 1	**Exploratory Data Analysis**	**Hours 8**
	EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.	
UNIT 2	**Eda Using Python**	**Hours 10**
	Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.	
UNIT 3	**Univariate Analysis**	**Hours 10**
	Introduction to Single variable: Distribution Variables – Numerical Summaries of Level and Spread – Scaling and Standardizing – Inequality.	
UNIT 4	**Bivariate Analysis**	**Hours 10**
	Relationships between Two Variables – Percentage Tables – Analysing Contingency Tables – Handling Several Batches – Scatterplots and Resistant Lines.	

	Multivariate And Time Series Analysis	Hours 10
UNIT 5	Introducing a Third Variable – Causal Explanations – Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.	

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (UNIT 1)
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (UNIT 2)
3. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (UNIT 3,4,5)

REFERENCE BOOKS:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization:

FIFTH SEMESTER			
Subject Name: Web Technology			
Subject code:	**BSCDST C2-508**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets.
2. To understand the concepts of event handling and data validation mechanisms.
3. To understand the concepts of embedded dynamic scripting on client and server side Internet Programming and basic full stack web development.
4. To develop modern interactive web applications.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Learn about WWW and webpage.
2. Understand domain and assigning name to them.
3. Understand basic web languages and its components.
4. Perform simple web page designing for practical exposure.

	Basics of Internet and Web	**Hours 10**
UNIT 1	**The basics of Internet**, World Wide Web, Web page, Home page, Web site, Static, Dynamic and Active web page, Overview of Protocols – Simple Mail Transfer Protocol, Gopher, Telnet, Emails, TFTP, Simple Network Management Protocol, Hyper Text Transfer Protocol, Client server computing concepts. **Working of Websites**, Webpages, Front End, Back End, Client and Server Scripting Languages, Responsive Web Designing, Types of Websites (Static and Dynamic Websites). Editors Downloading free Editors like Notepad++, Sublime Text Editor, making use of Editors, File creation and editing, saving.	
UNIT 2	**Introduction to HTML**	**Hours 10**
	Introduction to HTML, Essential Tags, Tags and Attributes, Text Styles and Text Arrangements, Text, Effects, Exposure to Various Tags (DIV, MARQUEE, NOBR, DFN, HR, LISTING, Comment, IMG), Color and Background of Web Pages, Lists and their Types, Attributes of Image Tag, Hypertext, Hyperlink and Hypermedia, Links, Anchors and URLs, Links to External Documents, Different Section of a Page and Graphics, Footnote and eMailing, Creating Table, Frame, Form and Style Sheet. Dynamic HTML, Document Object Model, Features of DHTML	

UNIT 3	**CSS**	**Hours 8**
	CSS: Introduction to CSS, Types of CSS, CSS Selectors: Universal Selector, ID selector, Tag Selector, Class Selector, Sub Selector, Attribute Selector, Group Selector, CSS Properties: Back Ground properties, Block Properties, Box properties, List properties, Border Properties, Positioning Properties, CSS Lists CSS Tables, CSS Menu Design CSS Image Gallery, CSS Framework Web Site Development using W3.CSS Framework, W3.CSS Intro, W3.CSS Colors, W3.CSS Containers, W3.CSS Panels, W3. CSS Borders, W3.CSS Fonts, W3.CSS Text, W3.CSS Tables, W3.CSS List, W3.CSS Images, W3.CSS Grid	
UNIT 4	**Java Script**	**Hours 8**
	Introduction to Client Side Scripting Language, Literals , Operators, Data Types, Functions, Methods, Type Casting and Objects in JavaScript, Conditions Statements, JS Popup Boxes, JS Events, Basic Form Validations in JavaScript. Introduction to Angular JS: Expressions, Modules and Directives. Relating JavaScript to DHTML, Dynamically Changing Text, Style, and Content.	
UNIT 5	**PHP**	**Hours 12**
	Server Side Programming , Introduction to PHP, Basic Programming Concepts of PHP: Variables, Data-types, Constants, Scope of Variables, Type of Variables, Type Casting, Operators, Operators Precedence, References, Arrays; Control Structures: Branching, If statement, Switch statement; Looping: for Loop, while Loop, do while Loop, for each Loop; Functions: User Defined Functions, Built-in Function, Functions for Variables; Script Controlling Functions, Array Functions, Date and Time Functions, Mathematical Functions, String Functions, PHP Server Variables; Working with form, Database Connectivity using PHP (CRUD Operations: Create, Read, Update, Delete).Building a simple dynamic web application such as Student Registration, Login System, or Employee Management System.	

TEXT BOOKS

1. **Kogent Learning Solutions Inc.** – *HTML5 Black Book*, Dreamtech Press.
   Comprehensive guide covering HTML5, CSS3, JavaScript, and modern web development concepts.
2. **Luke Welling & Laura Thomson** – *PHP and MySQL Web Development*, Addison-Wesley.
   Well-known textbook for learning PHP programming and MySQL database integration.
3. **Jon Duckett** – *HTML & CSS: Design and Build Websites*, Wiley.
   Beginner-friendly book with visual explanations of HTML5 and CSS3 concepts.
4. **Jon Duckett** – *JavaScript and jQuery: Interactive Front-End Web Development*, Wiley.
   Covers JavaScript fundamentals and techniques for creating interactive web pages.

REFERENCE BOOKS:

1. **Robin Nixon** – *Learning PHP, MySQL & JavaScript*, O'Reilly Media.
   Practical reference for full-stack web application development using PHP and JavaScript.
2. **David Flanagan** – *JavaScript: The Definitive Guide*, O'Reilly Media.
   Authoritative reference covering modern JavaScript programming and browser APIs.
3. **Elisabeth Robson & Eric Freeman** – *Head First HTML and CSS*, O'Reilly Media.
   Concept-oriented book with hands-on examples for learning HTML and CSS.

FIFTH SEMESTER			
Subject Name: Web Technology Lab			
Subject code:	**BSCDSP C3-509**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS
PART - A

1. Design a personal portfolio webpage using HTML5 semantic elements, including profile photo, education, skills, hobbies, and contact information.
2. Create a student admission form using HTML5 with text boxes, radio buttons, checkboxes, date picker, email, password, file upload, and submit/reset buttons.
3. Develop a college timetable using HTML tables with row span, column span, captions, and styling.
4. Design a multimedia webpage by embedding images, audio, video, hyperlinks, and Google Maps or YouTube content.
5. Create a responsive webpage using CSS3, applying external style sheets, Flexbox/Grid layouts, colors, fonts, borders, and media queries.
6. Design a professional navigation menu with drop-down items and hover effects using CSS.
7. Develop a JavaScript calculator to perform addition, subtraction, multiplication, division, and modulus operations.
8. Create a JavaScript program to accept marks in five subjects and display total, percentage, grade, and pass/fail status.

PART - B

1. Validate a registration form using JavaScript for mandatory fields, email format, mobile number, password strength, and confirmation password.
2. Create a digital clock and display the current date and time dynamically using JavaScript Date objects.
3. Demonstrate JavaScript arrays by performing insertion, deletion, searching, sorting, and reversing of student records.
4. Implement light mode and dark mode switching using JavaScript and DOM manipulation.
5. Dynamically modify webpage content, images, styles, and CSS classes in response to button clicks and user interactions.
6. Develop an interactive webpage demonstrating mouse events, keyboard events, and form events using JavaScript.
7. Create a PHP program to process an HTML form and display the submitted user information on another webpage.
8. Build a PHP-MySQL application to perform CRUD (Create, Read, Update, Delete) operations on a Student or Employee database.
9. Develop a secure user login system using PHP sessions and logout functionality.
10. Create a PHP application that uploads image or document files to the server and stores file details in a MySQL database.

FIFTH SEMESTER			
Subject Name: Cyber Law and Ethics			
Subject code:	**BSCDST SEC-510**	CIE Marks:	10
No. of Hours/Week:	3	SEE Marks:	40
Total Hours:	45	Credits:	2

COURSE OBJECTIVES:

1. Understand the fundamentals of cyber law, cyber ethics, and cyberspace governance.
2. Explain the provisions of the Information Technology Act and identify common cyber crimes and legal remedies.
3. Describe intellectual property rights and legal issues related to digital content and online activities.
4. Analyze legal and security aspects of e-commerce and electronic transactions.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. **Understand the fundamentals of cyber law and cyber ethics**, including the legal and ethical issues associated with the use of information and communication technologies.
2. **Familiarize themselves with the Information Technology Act and related legal frameworks**, enabling them to recognize cyber crimes, digital evidence, and legal responsibilities in cyberspace.
3. **Develop knowledge of intellectual property rights and electronic commerce laws**, including copyright, trademarks, patents, digital contracts, and online transactions.
4. **Analyze legal, social, and ethical challenges in emerging technologies** such as Artificial Intelligence, blockchain, and digital platforms, and understand the importance of responsible technology use.

UNIT 1	**Introduction to Cyber Law and Cyber Ethics**	**Hours 10**
	Evolution of computers and cyberspace, concept of cyber law, cyber jurisprudence, cyber ethics, cyber jurisdiction, hierarchy of courts, internet governance, domain names, web hosting, and legal aspects of cyberspace.	
UNIT 2	**Information Technology Act and Cyber Crimes**	**Hours 10**
	Overview of the Information Technology Act, 2000 and amendments, electronic records, digital signatures, cryptography, certifying authorities, electronic governance, cyber crimes and offences, penalties, adjudication, and liability of network service providers.	
UNIT 3	**Intellectual Property Rights and Legal Frameworks**	**Hours 10**
	Copyright, patents, trademarks, software protection, domain name disputes, database protection, relevant provisions of the Indian Evidence Act, Indian Penal Code, Civil and Criminal Procedure Codes, RBI regulations, employee internet usage policies, and online dispute resolution.	

UNIT 4	**Electronic Commerce and Digital Transactions**	**Hours 08**
	Introduction to e-commerce, paperless contracts, e-commerce models (B2B, B2C), electronic payments, e-security, taxation issues, Electronic Data Interchange (EDI), supply chain management, digital markets, and emerging trends in electronic business.	
UNIT 5	**Emerging Technologies and Ethical Issues**	**Hours 07**
	Importance of cyber regulations and ethics, ethics in the information society, introduction to Artificial Intelligence ethics, fairness and accountability in AI, blockchain ethics, responsible use of digital technologies, privacy, and future challenges in cyberspace.	

TEXT BOOKS:

1. **Kumar, K.** *Cyber Laws: Intellectual Property and E-Commerce Security*. Dominant Publishers and Distributors Pvt. Ltd., New Delhi.
2. **Stuckelberger, Christoph** and **Duggal, Pavan**. *Cyber Ethics 4.0: Serving Humanity with Values*. Globethics Publications, Geneva.
3. **Seth, Karnika**. *Computers, Internet and New Technology Laws: A Comprehensive Reference for Cyber Laws*. LexisNexis Butterworths Wadhwa, Nagpur.

REFERENCE BOOKS:

1. **NIIT**. *Information Security Policy and Implementation Issues*. Prentice Hall of India (PHI Learning), New Delhi.
2. **Verma, S. K.** and **Mittal, Raman**. *Legal Dimensions of Cyberspace*. Indian Law Institute, New Delhi.
3. **Rosenoer, Jonathan**. *Cyber Law: The Law of the Internet*. Springer-Verlag, New York.

SIXTH SEMESTER			
Subject Name: Big Data Analytics			
Subject code:	**BSCDST A1-601**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To understand the fundamentals of Big Data, its characteristics, and the architecture of Big Data systems.
2. To learn distributed data storage and processing using the Hadoop ecosystem and MapReduce programming.
3. To explore NoSQL databases and apply MongoDB for modern data management.
4. To develop data analytics solutions using Apache Spark and its SQL capabilities.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Explain the types, characteristics, and challenges of Big Data and compare it with traditional data systems.
2. Utilize Hadoop ecosystem tools and implement MapReduce programs for distributed data processing.
3. Choose appropriate NoSQL data stores based on the CAP theorem and real-world business requirements.
4. Build data processing pipelines using Apache Spark, RDDs, and Spark SQL for scalable analytics.

UNIT 1	**Foundations of Big Data**	**Hours 10**
	Types of Digital Data: Classification of Digital Data. **Introduction to Big Data:** What is Big Data? Definition of Big Data, Characteristics of Data, Evolution of Big Data, Challenges with Big Data, Architecture of Big Data Systems, Core Layers of Big Data, Service Layers, Differences between Traditional and Big Data Systems. Advantages and Challenges of Big Data **Big Data Analytics:** What are Big Data Analytics? Classification of Analytics, Terminologies Used in Big Data Environments.	
UNIT 2	**Hadoop Ecosystem and MapReduce Programming**	**Hours 12**
	Hadoop: Introduction; What is Hadoop, Why Hadoop, Hadoop Goals, Hadoop Assumptions, Core Hadoop Components, Hadoop Common Package, Hadoop Distributed File System (HDFS), Processing Data with Hadoop, Yet Another Resource Negotiator (YARN), Hadoop Ecosystem; HBase, Hive, HCatalog, Pig, Sqoop, Oozie, Mahout, ZooKeeper. Physical Architecture, Hadoop Limitations; Security Concerns, Vulnerable by Nature, Not Fit for Small Data, Potential Stability Issues, General Limitations.**Introduction to MAPREDUCE Programming:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression	

UNIT 3	**NoSQL Databases and Data Architectural Patterns**	**Hours 08**
	What is NoSQL, Learning Objectives, Why NoSQL, CAP Theorem, NoSQL Business Drivers, Volume, Velocity, Variability, Agility, NoSQL Case Studies; Amazon DynamoDB, Google's BigTable, MongoDB, Neo4j. NoSQL Data Architectural Patterns, Types of NoSQL Data Stores.	
UNIT 4	**MongoDB and Apache Spark Analytics**	**Hours 10**
	Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB,Data Types in MongoDB, MongoDB Query Language. **Introduction to Data Analysis with Spark:** What is a Apache Spark? A unified Spark, who uses Spark and for what? A Brief History of Spark, Spark version and releases, Storage layers for Spark. **Programming with RDDs:** RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. **Spark SQL:** Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-defined functions, Spark SQL Performance.	
UNIT 5	**Web Mining, Text Analytics and Recommendation Systems**	**Hours 08**
	Text, Web Content and Link Analytics: Introduction, Text Mining, Web Mining, Web Content and Usage Analytics, Page Rank, Structure of Web and Analysing a Web Graph. **Recommendation Systems:** Introduction, A Model for Recommendation Systems, Collaborative Filtering System and Content Based Recommendations	

TEXT BOOKS:

1. Seema Acharya and Subhashini Chellappan "Big data and Analytics" Wiley India Publishers, 2nd Edition,2019.
2. Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning",McGraw Hill Publication, 2019.

REFERENCE BOOKS:

1. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012
2. Tom White, "Hadoop: The Definitive Guide" 4th Edition, O'Reilly Media, 2015.
3. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016
4. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data

SIXTH SEMESTER			
Subject Name: Data Visualization			
Subject code:	**BSCDST A2-602**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the fundamentals of data visualization and its importance.
2. Learn about visual perception and its impact on data interpretation.
3. Explore the ethical considerations and challenges in data visualization.
4. Study different types of visualizations and their appropriate uses.

COURSE OUTCOMES:

After successful completion of this course, students will be able to:

1. Understand the concepts, importance, and processes of data visualization, including different data types, data preparation, and ethical considerations.
2. Use visualization tools and Python libraries such as Excel, Tableau, Power BI, Matplotlib, Seaborn, Plotly, and Bokeh to create effective visualizations and data-driven stories.
3. Apply visualization design principles, color theory, and appropriate chart selection techniques to communicate information clearly and accurately.
4. Develop interactive dashboards and advanced visualizations by incorporating filters, drill-down features, geospatial analysis, and performance optimization techniques.

	Fundamentals of Data Visualization	**Hours 10**
UNIT 1	**Introduction to Data Visualization:** Definition and Importance of Data Visualization, History and Evolution of Data Visualization, Role of Visualization in Data Science and Analytics, Applications of Data Visualization in Business, Healthcare, Finance, Education, and Social Media. **Understanding Data:** Types of Data: Numerical Data, Categorical Data, Ordinal Data, Temporal Data, and Geospatial Data. Structured, Semi-Structured, and Unstructured Data. **Data Visualization Process:** Data Collection and Integration, Data Cleaning and Pre-processing, Exploratory Data Analysis (EDA), Visualization Design and Development, Interpretation and Communication of Insights. **Challenges and Limitations:** Data Quality Issues, Visual Clutter and Information Overload, Bias and Misrepresentation, Ethical Considerations in Visualization.	

UNIT 2	**Visualization Tools and Data Storytelling**	**Hours 10**
	Visualization Tools: Overview of Visualization Software, Microsoft Excel for Data Visualization, Tableau Fundamentals, Power BI Fundamentals, Introduction to Python Visualization Ecosystem. **Python Libraries for Visualization:** Matplotlib, Seaborn, Plotly, Bokeh. **Data Storytelling:** Concept and Importance of Data Storytelling, Storytelling Frameworks, Building Narratives with Data, Audience-Centred Visualization Design. **Dashboard Design:** Dashboard Components, KPI-Based Reporting, Interactive Dashboard Design, Best Practices for Dashboard Layout and User Experience.	
UNIT 3	**Visualization Design Principles and Techniques**	**Hours 10**
	Principles of Effective Visualization: Simplicity and Clarity, Accuracy and Integrity, Consistency and Readability, Visual Hierarchy and Emphasis. **Color Theory and Visual Perception:** Importance of Color in Visualization, Color Models and Color Schemes, Accessibility and Color-Blind Friendly Design, Psychological Effects of Colors. **Chart Selection and Design:** Bar Charts, Column Charts, Line Charts, Area Charts, Pie and Donut Charts, Histograms, Box Plots. **Data Modelling for Visualization:** Data Relationships, Data Aggregation, Dimensional Modelling Concepts, Data Transformation for Reporting.	
UNIT 4	**Advanced Visualization and Interactive Dashboards**	**Hours 10**
	Advanced Visualization Techniques: Scatter Plots and Bubble Charts, Heat Maps, Tree Maps, Waterfall Charts, Funnel Charts, Radar Charts. **Geospatial Visualization:** Maps and Spatial Analytics, Choropleth Maps, Geographical Dashboards, Location-Based Data Analysis. **Interactive Visualizations:** Filters and Slicers, Drill-Down and Drill Through, Tooltips and Dynamic Labels, Interactive Reports and Dashboards. **Dashboard Development:** Dashboard Planning and Design, KPI Visualization, Real-Time Dashboard Concepts, Dashboard Performance Optimization.	
UNIT 5	**Data Visualization Applications and Emerging Trends**	**Hours 08**
	Visualization for Data Science: Exploratory Data Analysis (EDA), Feature Analysis and Selection, Data Pattern Discovery, Outlier Detection Visualization. **Visualization in Machine Learning:** Confusion Matrix Visualization, ROC and Precision-Recall Curves, Feature Importance Visualization, Clustering and Classification Visualizations. **Big Data Visualization:** Challenges in Visualizing Large Datasets, Streaming Data Visualization, Real-Time Analytics Dashboards. **Emerging Trends:** AI-Assisted Visualization, Augmented Analytics, Self-Service Business Intelligence, Predictive and Prescriptive Analytics Visualization.	

TEXT BOOKS:

1. "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.
2. “The Visual Display of Quantitative Information” by Edward Tufte, Graphics Press USA; 2nd edition, 2001.

REFERENCE BOOKS:

1. "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press.
2. "Data Science and Data Analytics Using Python", M.C. Trivedi, Khanna Publications.
3. "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.

SIXTH SEMESTER			
Subject Name: Data Visualization Lab			
Subject code:	**BSCDSP A3-603**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS
Using Power BI
PART - A

1. Install Microsoft Power BI Desktop and explore its interface, including the Ribbon, Report View, Data View, and Model View.
2. Navigate the Power BI workspace by identifying the Report Canvas, Fields Pane, Visualizations Pane, and Filters Pane.
3. Import data from an Excel workbook and create a simple report using a table visualization.
4. Import data from a CSV file and compare it with data imported from Excel.
5. Connect Power BI to multiple data sources and combine them into a single report.
6. Create a basic report containing bar charts, tables, and slicers, and save the report file.
7. Use Power Query Editor to inspect and transform imported datasets.
8. Clean data by removing duplicate records and replacing or removing missing values.
9. Change data types, rename columns, split columns, and merge multiple columns using Power Query.
10. Merge two related tables using a common key and append multiple datasets into a single table.

PART - B

1. Create custom columns and calculated columns using Power Query and DAX expressions.
2. Create relationships between multiple tables and build a star schema data model.
3. Identify and resolve data inconsistencies by validating relationships and correcting data issues.
4. Create calculated columns and measures using DAX to compute totals, averages, and percentages.
5. Build a data model involving Customers, Products, and Sales tables and verify relationship behavior.
6. Create bar charts, column charts, line charts, pie charts, and area charts to visualize business data.
7. Format and customize visualizations by modifying colors, labels, titles, legends, tooltips, and themes.
8. Design an interactive dashboard by combining multiple visuals with slicers and filters.
9. Publish a Power BI report to the Power BI Service and create an online dashboard.
10. Share reports and dashboards with users, configure scheduled data refresh, and manage access permissions for collaborative reporting.

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SIXTH SEMESTER			
Subject Name: Fundamentals of Neural Networks			
Subject code:	**BSCDST B1-604**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To realize the significance of Artificial Intelligence in today's era
2. To study neural networks and become able to design neural network-based algorithms
3. To study fuzzy logic and use it as an alternative tool for modelling.
4. To study genetic algorithms and learn about optimizing solutions using genetic algorithms
5. To be able to work with imprecise and uncertain solution data for solving problems.

COURSE OUTCOMES:

At the end of this course, students will be able to

1. Realizing the significance of Artificial Intelligence and basic Neural Networks
2. Learn the neural network algorithms, modelling using optimizing solutions
3. Apply knowledge of Hybrid Systems
4. Work with imprecise and uncertain solution data for solving problems
5. Design and evaluate associative memory networks (Hopfield, BAM) and apply competitive learning techniques like Kohonen SOM and LVQ for pattern recognition tasks

UNIT 1	**Basics of Artificial Intelligence System**	**Hours 08**
	Basics of Artificial Intelligence System: Neural Network, Fuzzy Logic, Genetic Algorithm, Human intelligence vs Machine intelligence. Fundamentals of Neural Networks: Definition of Neural Network, Model of Artificial Neuron, Neural Networks as Directed Graphs, Learning rules and various activation function.	
UNIT 2	**Neural Network Architecture**	**Hours 10**
	Neural Network Architecture: Mathematical Models of Neurons, Artificial neuron model Error Correction Learning, Learning Paradigms-Supervised, Unsupervised and Reinforcement Learning, ANN training algorithms-perceptron, training rules, Single Layer Feed-forward networks, Multilayer Feed-forward networks.	
UNIT 3	**Single Layer Perceptions**	**Hours 10**
	Single Layer perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule.	

UNIT 4	**Competitive Learning and Self-Organizing Networks**	**Hours 10**
	Competitive Learning and Self-Organizing Networks: Fixed-Weight Competitive Nets, The Idea Behind Competitive Learning, Kohonen Self-Organizing Maps (SOM), Learning Vector Quantization (LVQ), Counter propagation Network. The Stability-Plasticity Problem and Introduction to ART, ART1: Binary Input Version, ART2: Continuous Input Version. t-SNE and UMAP as modern alternatives to SOM for visualization, A brief note on clustering with neural approaches (k-means analogy). PyTorch or TensorFlow basics	
UNIT 5	**Feedback Neural Networks**	**Hours 10**
	Feedback Neural Networks: Pattern storage and retrieval, Hopfield Model, Boltzmann Machine, CNN, Recurrent Neural Networks. &LSTMs Transformers & Attention (brief intro), Transfer Learning, Ethical considerations and bias in neural networks Fuzzy Logic and Genetic Algorithm: Introduction to Fuzzy Logic, Overview of Fuzzy Sets and Membership.	

TEXT BOOKS:

1. Deep Learning, Goodfellow, Bengio & Courville (2016)
2. Hands-On Machine Learning, Aurélien Géron (2022, 3rd Ed.)
3. Laurene Fausett, Fundamentals of Neural Networks: Architectures, Algorithms, and Applications, Prentice Hall, 1994.

REFERENCE BOOKS:

1. NEURAL NETWORK by Simon Haykin, Pearson
2. NP Padhy,"Artificial Intelligence and Intelligent Systems", Oxford University Press
3. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications", PHI New Delhi.
4. Lin C. and Lee G., "Neural Fuzzy Systems", Prentice Hall International Inc.

SIXTH SEMESTER			
Subject Name: NoSQL Database			
Subject code:	**BSCDST B2-605**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVE:

1. To provide knowledge of NoSQL database concepts, data models, and modern database technologies used for handling large-scale and unstructured data applications.

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Understand the fundamentals and architecture of NoSQL databases.
2. Compare relational databases with different NoSQL database models.
3. Perform CRUD operations using MongoDB and Cassandra databases.
4. Apply graph and column-family databases for real-world applications.

UNIT 1	**Introduction to NoSQL Databases**	**Hours 10**
	Why NoSQL? Limitations of Relational Databases, Impedance Mismatch, Application vs Integration Databases. Characteristics of NoSQL Databases. CAP Theorem and BASE Properties. Types of NoSQL Databases: Key-Value Stores, Document Databases, Column-Family Databases, Graph Databases. Aggregate Data Models: Aggregates, Aggregate Orientation, Consequences. Schema less Databases, Materialized Views. Comparison of SQL and NoSQL Databases. Applications of NoSQL.	
UNIT 2	**Document Databases using MongoDB**	**Hours 10**
	Document Databases: Structure of Documents, JSON and BSON Formats. Introduction to MongoDB: Architecture, Collections, Documents, Data Types. CRUD Operations: Insert, Update, Delete, Query Documents. Indexing in MongoDB. Aggregation Framework. Distribution Models: Single Server, Sharding, Master-Slave and Peer-to-Peer Replication. Suitable Use Cases: Event Logging, CMS, Web Analytics, E-Commerce. When Not to Use MongoDB.	
UNIT 3	**Key-Value Databases and Map-Reduce**	**Hours 08**
	Key-Value Databases: Concepts, Features, Advantages and Limitations. Introduction to Redis: Architecture, Data Types, Basic Operations, Persistence (RDB/AOF). Suitable Use Cases: Session Storage, User Profiles, Shopping Carts, Caching. When Not to Use Key-Value Stores. Introduction to Map-Reduce: Basic Map-Reduce, Partitioning, Combining, Composing Map-Reduce Calculations.	

UNIT 4	**Column Family Databases**	**Hours 10**
	Column-Oriented Databases: Concepts and Features. Introduction to Apache Cassandra: Architecture, Data Model, Keyspace, Column Family, Data Types. CRUD Operations in Cassandra (CQL). Replication and Partitioning in Cassandra. Consistency Levels, Update Consistency, Read Consistency, Quorums. Version Stamps and Distributed Consistency. Suitable Use Cases and When Not to Use Cassandra.	
UNIT 5	**Graph Databases and NoSQL in Practice**	**Hours 10**
	Graph Databases: Graph Theory Basics, Nodes, Relationships, Properties and Traversals. Introduction to Neo4j: Architecture and Features. Cypher Query Language: Creating Nodes and Relationships, Querying Graph Data. Suitable Use Cases: Social Networks, Recommendation Engines, Fraud Detection, Routing and Location-Based Services. When Not to Use Graph Databases. Choosing the Right NoSQL Database: Evaluating NoSQL models for real-world application scenarios.	

TEXT BOOKS:

1. Pramod.J.Sadalage and Martin Fowler, "NoSQL Distilled : A Brief guide to the emerging world of polygot persistence", Pearson Education corporation, I Edition, 2019.
2. Shanshank Tiwari "Professional NOSQL", WROX Press, 2011

REFERENCE BOOKS:

1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015.
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013.
3. Kristina Chodorow, "MongoDB: The Definitive Guide- Powerful and capable Data Storage", 2nd Edition, O'Reilly Publications, 2013.

SIXTH SEMESTER			
Subject Name: NoSQL Lab			
Subject code:	**BSCDSP B3-606**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

PART – A

1 a. Illustration of Where Clause, AND, OR operations in MongoDB.
b. Execute the Commands of MongoDB and operations in MongoDB: Insert, Query, Update, Delete and Projection. (Note: use any collection)

2 a. Develop a MongoDB query to select certain fields and ignore some fields of the documents from any collection.
b. Develop a MongoDB query to display the first 5 documents from the results obtained in a. [use of limit and find].

3 a. Execute query selectors (comparison selectors, logical selectors) and list out the results on any collection
b. Execute query selectors (Geospatial selectors, Bitwise selectors) and list out the results on any collection.

4 Create and demonstrate how projection operators ($, $elematch and $slice) would be used in the MongoDB.

5 Execute Aggregation operations ($avg, $min,$max, $push, $addToSet etc.). students encourage to execute several queries to demonstrate various aggregation operators).

PART – B

1 Execute Aggregation Pipeline and its operations (pipeline must contain $match, $group, $sort, $project, $skip etc. students encourage to execute several queries to demonstrate various aggregation operators)

2 a. Find all listings with listing URL, name, address, host_picture_url in the listings And Reviews collection that have a host with a picture url
b. Using E-commerce collection write a query to display reviews summary

3 a. Demonstrate creation of different types of indexes on collection (unique, sparse, compound and multikey indexes) using indexes.
b. Demonstrate optimization of queries

4 a. Develop a query to demonstrate Text search using catalog data collection for a given word
b. Develop queries to illustrate excluding documents with certain words and phrases

5 Develop an aggregation pipeline to illustrate Text search on Catalog data collection.

SIXTH SEMESTER			
Subject Name: Generative AI			
Subject code:	**BSCDST C1-607**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the core differences between traditional/discriminative AI and generative AI.
2. Master the basics of prompt engineering and interacting with Large Language Models (LLMs).
3. Explore the architecture and applications of image, audio, and video generation models.
4. Learn to build basic GenAI applications using frameworks like Lang Chain and Retrieval-Augmented Generation (RAG).

COURSE OUTCOMES:

1. Differentiate traditional discriminative AI from generative models.
2. Formulate effective prompts to interact with Large Language Models (LLMs)
3. Evaluate the architecture and use cases of multimodal models (image, audio, video).
4. Develop foundational Generative AI applications using APIs and vector databases.
5. Analyze the ethical, security, and legal implications of deploying GenAI.

	AI Fundamentals	**Hours 10**
UNIT 1	Introduction to AI- Defining AI, Machine learning; Supervised and unsupervised learning, semi-supervised learning and reinforcement learning, Generative AI : Introduction to Generative AI ,So, What Is Generative AI?, Components of AI ,Domains of Generative AI ,Text Generation ,Image Generation, Audio Generation ,Video Generation ,Generative AI: Current Players and Their Models ,Generative AI Applications	
UNIT 2	**Evolution of Neural Networks to Large Language Models:**	**Hours 10**
	Natural Language Processing Tokenization, N-grams , Language Representation and Embeddings , Probabilistic Models , Neural Network–Based Language Models, Recurrent Neural Networks (RNNs) , Long Short-Term Memory (LSTM) , Gated Recurrent UNIT (GRU) Encoder-Decoder Networks , Transformer, Large Language Models (LLMs).	

UNIT 3	**LLMs and Transformers**	**Hours 10**
	The Power of Language Models, Transformer Architecture, Motivation for Transformer, Architecture, Encoder-Decoder Architecture, Attention, Position-wise Feed-Forward Networks Advantages and Limitations of Transformer Architecture	
UNIT 4	**Prompt engineering**	**Hours 10**
	Importance of prompt, prompt engineering process, setting objectives, prompt design, evaluation of responses, prompt refining, prompt templating, **Large Language Model Framework**: Introduction, introduction to LangChain. prototype; **Large language operations**: introduction to LLMOps**, LLMOps phase 1**- data preparation , model training and fine tuning, pre-training, AI alignment **LLMOps phase 2**- model serving, inference optimization.	
UNIT 5	**Addressing Ethical Considerations**	**Hours 08**
	Ethical norms and values in the context of generative AI, Investigating and minimizing bias in generative LLMs and generative image models, Constrained generation and eliciting trustworthy outcomes, Understanding jailbreaking and harmful behavior	

TEXT BOOKS:

1. Akshay Kulkarni, Adarsha Shivanaanda, Anoosh Kulkarni, Dilip Gudivada, "Applied Generative AI for Beginners" ISBN-13 (pbk): 978-1-4842-9993-7,apress publication, 2023(UNIT 1, 2,3,)

2. Karthikeyan Sabesan, Sivagamisundari, Nilip Dutta, "Generative AI for everyone" BPB Publications 2025 edition (UNIT 1, 4, 5)

3: Omar Sanseviero, Pedro Cuenca , Apolinário Passos, Jonathan Whitaker "Hands-On Generative AI with Transformers and Diffusion Models" O'Reilly Media, edition 2024 (UNIT 5)

REFERENCE BOOKS:

1. Stuart Russel, Peter Norvig, "Artificial Intelligence: A Modern Approach" Second edition, Pearson Education 2013.

2. Elaine Rich, Kevin Knight, Shivashankar B Nair, "Artificial Intelligence" Tata McGraw Hill 3rd Edition, 2013

3. Generative AI: Foundations, Models, and Applications by Munesh Chandra Trivedi, Nandita Goyal, and Ankit Srivastava. (Khanna Publishing House).

4. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster. (O'Reilly Media).

SIXTH SEMESTER			
Subject Name: Cryptography and Network Security			
Subject code:	**BSCDST C2-608**	CIE Marks:	20
No. of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the fundamental concepts of network security, security principles, services, threats, vulnerabilities, and various cyber-attacks.
2. Learn the basics of cryptography, classical encryption techniques, symmetric and asymmetric key cryptographic systems, and steganography.
3. Explore modern encryption algorithms including DES, AES, stream ciphers, and block ciphers for secure data communication.
4. Understand public key cryptography, RSA, Diffie-Hellman key exchange, digital signatures, authentication mechanisms, and cryptographic hash functions.

COURSE OUTCOMES:

1. Identify network security requirements, security threats, vulnerabilities, and attack methodologies in information systems.
2. Apply classical and modern cryptographic techniques for secure communication and data protection.
3. Explain the operation and implementation of DES, AES, stream ciphers, and block cipher algorithms.
4. Demonstrate the use of public key cryptography, digital signatures, authentication techniques, and cryptographic hash functions to ensure data integrity and user authentication.

UNIT 1	**Foundations of Cyber Security and Network Protection**	**Hours 10**
	Introduction to cybersecurity and information security, security goals and the CIA Triad, authentication, authorization, and non-repudiation. Threats, vulnerabilities, risks, and attack surfaces. Malware including viruses, worms, Trojans, ransomware, and spyware. Network attacks such as phishing, spoofing, DoS/DDoS, man-in-the-middle attacks, and social engineering. Security models, defense-in-depth strategy, risk management, and emerging trends in cyber threats.	
UNIT 2	**Fundamentals of Cryptography and Secure Communication**	**Hours 10**
	Introduction to cryptography, cryptographic terminology, plaintext, ciphertext, encryption, decryption, and key management. Symmetric and asymmetric encryption concepts, cryptanalysis techniques, and brute-force attacks. Classical encryption methods including Caesar, Vigenère, Playfair, Rail Fence, and Columnar Transposition ciphers. Introduction to	

	steganography, hybrid cryptography, and applications of cryptography in digital systems.	
UNIT 3	**Modern Encryption Standards and Data Protection**	**Hours 9**
	Stream and block ciphers, Data Encryption Standard (DES), Triple DES, and Advanced Encryption Standard (AES). AES architecture, key expansion, encryption and decryption processes, and transformation functions. Secure key management practices and real-world applications of encryption in banking, cloud storage, e-commerce, IoT devices, and digital payments.	
UNIT 4	**Public Key Infrastructure and Digital Trust**	**Hours 10**
	Principles of public key cryptography, RSA algorithm, Diffie-Hellman Key Exchange, and Elliptic Curve Cryptography (ECC). Cryptographic hash functions, SHA family, Message Authentication Codes (MAC), digital signatures, digital certificates, Public Key Infrastructure (PKI), blockchain fundamentals, and secure communication protocols. Applications in secure transactions and identity verification.	
UNIT 5	**Network Security Technologies and Cyber Laws**	**Hours 9**
	Authentication mechanisms including passwords, biometrics, tokens, Kerberos, and Multi-Factor Authentication (MFA). Firewalls, Intrusion Detection and Prevention Systems (IDS/IPS), Virtual Private Networks (VPN), Zero Trust Architecture, cloud security, web security (HTTPS, SSL/TLS), wireless and mobile security, email security, and endpoint protection. Cybercrime, digital privacy, intellectual property rights, ethical hacking concepts, and the Information Technology Act (India) with current cybersecurity best practices.	

TEXT BOOKS:

1. **William Stallings** – *Cryptography and Network Security: Principles and Practice*, Pearson.
2. **Charles P. Pfleeger & Shari Lawrence Pfleeger** – *Security in Computing*, Pearson.
3. **Nina Godbole & SUNIT Belapure** – *Cyber Security*, Wiley India.

REFERENCE BOOKS:

1. **Atul Kahate** – *Cryptography and Network Security*, McGraw Hill.
2. **Behrouz A. Forouzan & Debdeep Mukhopadhyay** – *Cryptography and Network Security*, McGraw Hill.
3. **Joseph Migga Kizza** – *Guide to Computer Network Security*, Springer.
4. **William Stallings & Lawrie Brown** – *Computer Security: Principles and Practice*, Pearson.
5. **Parag Diwan** – *Cyber Laws in India*, Allahabad Law Agency.

SIXTH SEMESTER			
Subject Name: Major Project			
Subject code:	**BSCDSP C3-609**	CIE Marks:	10
No. of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

PROJECT GUIDELINES

Project Instructions:

- The aim of the Project work is to acquire practical knowledge on the implementation of the programming concepts studied.
- **Type of the Project**
  - ✓ The project report should be documented with scientific approach to the solution of the problem that the students have sought to address.
  - ✓ The majority of the students are expected to work on a latest real-life project.
  - ✓ The project should be prepared in order to solve the problem in a methodical and professional manner, making due references to appropriate techniques, technologies and professional standards.
  - ✓ Use the latest versions of the software packages for the development of the project.
- Project work may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea.
- Project should be carried out in batch with minimum of three and maximum of five students. Each member must work on a separate module and submit an independent report. Tasks must be assigned to each member in writing.
- Brief synopsis not more than two pages to be submitted during V semester in prescribed format by the team as per the format given.
- It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
- The student should also include the details from the project diary, in which they will record the meeting minutes, progress of their project throughout the course.
- The Project work should be compulsorily done in the College/ Software Industry /R&D Centres/ only under the supervision of the concerned department staff.
- Students should be encouraged to visit software industry to experience the real time environment.
- University Exam will be conducted as follows.
  Viva-voce will be conducted at the end of VI semester.
  Both the Examiners (50%+50%) should conduct the Viva-Voce Examination during practical exam session. Out of the 50 marks, 25 for Project Evaluation and 15 for Project

Report and 10 for Viva. For awarding a pass, a candidate should have obtained 40% of the Total marks.

- Report Preparation: The content of the Project report must be paid utmost attention, which is being submitted in partial fulfilment of the requirements of Degree. The project report should contain enough details to enable examiners to evaluate the work. The important points should be highlighted in the body of the report, with details often referred to appendices.
  - ✓ Paper: Report should be done on A4 Size paper
  - ✓ Text: Times new roman with 1.5-line spacing. Running text font is 12, Sub heading 14 pt. bold. Chapter Heading is 20 pts. Justified
  - ✓ Margins: Left margin 1.5, right, top, bottom is 1 inch. Header, footer, no page border
  - ✓ Fig: Tables, graph, diagrams should have respective number, caption and source.
  - ✓ Student shall maintain project diary and get signatures from both guide and department head.
  - ✓ Two copies of the project report must be submitted: one for the department library and one for the student.

Recommended Chapter Sequence

1. Cover Page
2. Inner Title Page
3. Original Copy of the Approved Proforma of the Project Proposal
4. Certificate of Authenticated work
5. Role and Responsibility Form
6. Certificate
7. Acknowledgement
8. Abstract
9. Table of Contents
10. List of Figures
11. List of Tables
12. Introduction
13. Literature Survey / Review
14. System Analysis & Design
15. Implementation / Methodology
16. Results & Discussion
17. Conclusion & Future Work
18. References
19. Appendices

SIXTH SEMESTER			
Subject Name: Research Methodology and Survey Project			
Subject code:	**BCA SEC-610**	CIE Marks:	10
No. of Hours/Week:	**3**	SEE Marks:	40
Total Hours:	45	Credits:	2

COURSE OBJECTIVES:

After studying this course, students will be able to:

1. Understand the fundamental concepts, objectives, significance, and process of research.
2. Identify and formulate research problems, literature review and develop appropriate research designs.
3. Learn various methods of data collection and select suitable techniques for research studies.
4. Develop skills in research report writing, presentation, and documentation.
5. Understand the role of computers and information technology in conducting and supporting research activities.

COURSE OUTCOMES:

1. Explain research concepts, types, approaches, methodologies, and the importance of research in various domains.
2. Identify research problems, formulate objectives, literature review and design suitable research plans and sampling strategies.
3. Apply appropriate primary data collection methods such as observation, interviews, questionnaires, and schedules.
4. Prepare and present research reports following standard formats, ethical practices, and reporting guidelines.

UNIT 1	**Introduction**	**Hours 10**
	Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.	
UNIT 2	**Research Problem and Literature Review**	**Hours 10**
	What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem. Reviewing the literature: Place of the literature review in research, how to review the literature, searching the existing literature, reviewing the selected literature, writing about the literature reviewed.	
UNIT 3	**Research Design and Data Collection**	**Hours 10**
	Meaning of Research Design, Need for Research Design, Features of a Good Design, Steps in Sampling Design. Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules.	

UNIT 4	**Report Writing**	**Hours 08**
	Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics and precautions for Writing a Research Report.	
UNIT 5	**Computer Role in Research**	**Hours 07**
	Introduction, The Computer and Computer Technology, The Computer System, Important Characteristics, Computer Applications, Computers and Researcher.	

TEXT BOOKS:

1. Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018
2. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005
3. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.

REFERENCE BOOKS:

1. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov , "Introduction to Design", Prentice Hall, 1962.

Note: Students must prepare a survey Report (including Literature Review and Data Collection Details) on their major project topic and submit it to the concerned department for internal assessment of this subject. Five marks are allotted for this activity.

Internal Assessment Marks Allotment for Research Methodology and Survey Project	
Internal Test 1	03
Internal Test 2	
Assignment	02
Survey Report Submission	05
TOTAL	**10**

Question Paper Pattern for Semester End Examination (SEE)
(Common for V and VI Semester)
SUBJECT NAME

Time: 3 Hrs **Max. Marks: 80**

Instruction to Candidate: Answer all the Sections

SECTION A

I. Answer any ten of the following questions **(10X2 = 20)**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

SECTION B

II. Answer any five of the following questions **(5X5 = 25)**

13.
14.
15.
16.
17.
18.
19.

SECTION C

III. Answer any five of the following questions **(5X7 = 35)**

20.
21.
22.
23.
24.
25.
26.

Question Paper Pattern for Semester End Examination (SEC)
(Common for V and VI Semester)
SUBJECT NAME

Time: 1 1/2 Hrs **Max. Marks: 40**

Instruction to Candidate: Answer all the Sections

SECTION A

I. Answer any ten of the following questions **(10X2 = 20)**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

SECTION B

II. Answer any four of the following questions **(4X5 = 20)**

13.
14.
15.
16.
17.
18.