TUMKUR UNIVERSITY

Board of Studies in Computer Science

Curriculum Structure and Syllabus for V and VI Semesters

Bachelor of Computer Applications (BCA)
Choice Based Credit System

2026 - 27 onwards

BOS in Computer Science Committee Members

1.	**Dr. M. Basavanna** **Professor & Chairman,** Department of Studies in Computer Applications (MCA), Davangere University, Davangere	Chairperson
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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.
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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	BCAT A1-501	Cryptography and Network Security	3	3	3 Hrs.	20	80	100
2	BCAT A2-502	Statistical Computing with R	3	3	3 Hrs.	20	80	100
3	BCAP A3-503	Statistical Computing with R Lab	4	2	3 Hrs.	10	40	50
4	BCAT B1-504	Data Mining and Data Warehousing	3	3	3 Hrs.	20	80	100
5	BCAT B2-505	Artificial Intelligence	3	3	3 Hrs.	20	80	100
6	BCAP B3-506	Artificial Intelligence Lab	4	2	3 Hrs.	10	40	50
7	BCAT C1-507	C# with Dot Net	3	3	3 Hrs.	20	80	100
8	BCAT C2-508	Software Engineering	3	3	3 Hrs.	20	80	100
9	BCAP C3-509	Minor Project	4	2	3 Hrs.	10	40	50
10.	BCA SEC-510	A. Raspberry Pi Or B. Prolog	3	2	1 1/2 Hrs.	10	40	50
TOTAL			33	**26**				**800**

NOTE:

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

BCAT: BCA Core Paper Theory

BCAP: BCA 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	BCAT A1-601	Blockchain Technology	3	3	3 Hrs.	20	80	100
2	BCAT A2-602	Machine Learning	3	3	3 Hrs.	20	80	100
3	BCAP A3-603	Machine Learning Lab	4	2	3 Hrs.	10	40	50
4	BCAT B1-604	Natural Language Processing	3	3	3 Hrs.	20	80	100
5	BCAT B2-605	Data Analysis with Python	3	3	3 Hrs.	20	80	100
6	BCAP B3-606	Data Analysis with Python Lab	4	2	3 Hrs.	10	40	50
7	BCAT C1-607	Generative AI	3	3	3 Hrs.	20	80	100
8	BCAT C2-608	Digital Image Processing	3	3	3 Hrs.	20	80	100
9	BCAP C3-609	Major Project	4	2	3 Hrs.	10	40	50
10.	BCA SEC-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**

BCAT: BCA Core Paper Theory
BCAP: BCA Core Paper Practical

FIFTH SEMESTER			
Subject Name: Cryptography and Network Security			
Subject code:	**BCAT A1-501**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To understand the fundamental concepts of network security, types of threats, and the principles underlying secure communication.
2. To introduce classical and modern cryptographic techniques including substitution, transposition, symmetric, and asymmetric encryption methods.
3. To study block cipher design principles, Data Encryption Standard (DES), and Advanced Encryption Standard (AES) in depth.
4. To explain public key cryptography, RSA, key exchange protocols, digital signatures, message authentication, and user authentication mechanisms.

COURSE OUTCOMES:

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

1. Describe the need for network security, identify various types of attacks, and explain security principles and services.
2. Apply classical cryptographic techniques such as Caesar cipher, Playfair cipher, Rail Fence, and columnar transposition for encryption and decryption.
3. Analyse the structure and working of block ciphers, DES, and AES transformation functions.
4. Evaluate public key cryptosystems including RSA and Diffie-Hellman, and implement digital signature and user authentication mechanisms.

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.

FIFTH SEMESTER			
Subject Name: Statistical Computing with R Programming			
Subject code:	**BCAT A2-502**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

The course enables students to:

1. Understand the fundamentals of Statistical Computing.
2. Learn R Programming for statistical analysis and visualization.
3. Perform real-world data analysis using R.
4. Apply statistical techniques to business, healthcare, education, finance, and social datasets.

COURSE OUTCOMES:

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

1. Understand statistical computing concepts and R programming fundamentals.
2. Perform statistical analysis using R.
3. Visualize and interpret data effectively.
4. Apply regression and predictive analytics techniques.

UNIT 1	**Introduction to Statistical Computing and R Programming**	**Hours 12**
	Introduction to Statistical Computing: Meaning and importance of Statistical Computing, Applications in Business, Healthcare, Banking, Education, Research, AI, and Data Science, Role of statistics in decision-making, Types of data and scales of measurement, Structured and unstructured data. **Introduction to R Programming:** History and features of R, Installing R and RStudio, RStudio interface and working environment, Writing and executing R programs, R packages and libraries. **Basic R Programming:** Variables and constants, Data types in R , Operators in R , Input and output functions, Decision-making statements, Looping statements	
UNIT 2	**Functions and Data Structures in R**	**Hours 10**
	Functions in R: Introduction to Functions in R, Type of Functions, Function syntax and Structure, Function arguments and return values, Default arguments and named arguments, Recursive functions, Anonymous functions in R, Built in Functions: Mathematical functions,	

	Statistical functions, String handling functions, Date and time functions, Error handling in R. **Data Structures in R- Vectors**: Introduction to vectors, creating vectors using c(), Types of vectors, Vector operations and indexing. **Lists:** Introduction to lists, Creating and accessing lists, Nested lists and modifying elements. **Matrices:** Introduction to matrices, creating matrices using matrix (), Matrix operations and indexing, Row-wise and column-wise operations. **Arrays:** Introduction to arrays, creating multidimensional arrays, Accessing and modifying array elements. **Factors:** Introduction to factors, Ordered and unordered factors, Levels and factor manipulation. **Data Frames:** Introduction to data frames, Creating and accessing data frames, importing datasets, Filtering, sorting, and modifying data, Handling missing values	
UNIT 3	**Data Handling and Descriptive Statistics Using R**	**Hours 10**
	Data Import and Export: Reading CSV files, Reading Excel datasets, Importing text files, Exporting processed data. **Data Cleaning and Preparation:** Handling missing values, Removing duplicates, Data transformation, Sorting and filtering datasets, Data merging and reshaping. **Descriptive Statistics:** Mean, Median, Mode, Quartiles, Variance, Standard deviation, Range, Correlation. **Data Visualization in R:** Bar charts, Pie charts, Histograms, Line graphs, Box plots, Scatter plots.	
UNIT 4	**Probability Distributions and Statistical Inference**	**Hours 8**
	Probability Concepts: Basics of probability, Conditional probability, Bayes theorem, Random variables. **Probability Distributions:** Introduction to probability distributions, Discrete and continuous distributions, Binomial distribution, Poisson distribution, Normal distribution, Uniform distribution (Probability calculations using R) **Sampling Techniques:** Random sampling, Stratified sampling, Systematic sampling. **Statistical Inference:** Estimation, Confidence intervals, Hypothesis testing, t-test, Chi-square test, ANOVA.	

	Regression and Correlation	Hours 8
UNIT 5	**Correlation Analysis:** Positive and negative correlation, Pearson correlation, Spearman rank correlation. **Regression Analysis:** Simple linear regression, Multiple regression, Regression diagnostics, Prediction using regression models. **R Packages for Analytics:** ggplot2, dplyr, tidyr, forecast.	

TEXT BOOKS:

1. R for Data Science — Hadley Wickham and Garrett Grolemund, O'Reilly Media.
2. The Art of R Programming — Norman Matloff, No Starch Press.
3. Practical Statistics for Data Scientists — Peter Bruce, Andrew Bruce, and Peter Gedeck, O'Reilly Media.
4. Statistical Computing with R — Maria L. Rizzo, Chapman & Hall/CRC.
5. An Introduction to Statistical Learning with Applications in R — Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer.

REFERENCE BOOKS:

1. Data Science with R Programming — Bharti Motwani, Wiley India.
2. Hands-On Programming with R — Garrett Grolemund, O'Reilly Media.
3. Introductory Statistics with R — Peter Dalgaard, Springer.
4. R Cookbook — Paul Teetor, O'Reilly Media.

FIFTH SEMESTER			
Subject Name: Statistical Computing with R Programming Lab			
Subject code:	**BCAP A3-503**	CIE Marks:	10
No of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

PART - A

1. Write an R program to calculate employee salary, bonus, and tax.
2. Write an R program to calculate student grades using if statements.
3. Write an R program to generate an electricity bill.
4. Write an R program to display multiplication tables using loops.
5. Write an R function to calculate Simple Interest and Compound Interest.
6. Write an R program to calculate mean, median, and standard deviation of student marks.
7. Write an R program to analyze stock prices using vectors.
8. Write an R program to store hospital patient details using lists.
9. Write an R program to calculate product sales using matrices.
10. Write an R program to store weather data using arrays.

PART – B

1. Write an R program to categorize customer feedback using factors.
2. Write an R program to manage employee payroll using data frames.
3. Write an R program to import and clean CSV data.
4. Write an R program to analyze shopping transaction data using statistical functions.
5. Write an R program to create bar charts, pie charts, histograms, and line graphs.
6. Write an R program to identify missing values in healthcare datasets.
7. Write an R program to implement Binomial and Poisson distributions.
8. Write an R program to perform t-test and Chi-square test.
9. Write an R program to analyze survey data using confidence intervals.
10. Write an R program for house price prediction using linear regression and ggplot2.

FIFTH SEMESTER			
Subject Name: Data Mining and Data Warehousing			
Subject code:	**BCAT B1-504**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To introduce the fundamental concepts, architecture, and components of Data Warehousing and Data Mining.
2. To develop an understanding of data preprocessing, data integration, ETL processes, and data warehouse design techniques.
3. To learn various data mining techniques such as classification, clustering, association rule mining, and prediction for knowledge discovery.
4. To analyze and evaluate patterns, trends, and relationships in large datasets for effective decision-making.

COURSE OUTCOMES:

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

1. Understand the fundamental concepts of Data Mining and Data Warehousing.
2. Apply data pre-processing and transformation techniques for knowledge discovery.
3. Analyze data using classification, clustering, and association rule mining methods.
4. Use data mining tools and techniques for solving real-world business problems.

	Introduction to Data Warehousing and Data Mining	**Hours 12**
UNIT 1	Definition of Data Warehouse, Architecture of DW Components and Processes, ETL, Data Mart, Decision Support System, Executive Information System. What is Data Mining? Motivating Challenges; The origins of data mining, Data Mining Tasks, DM versus Knowledge Discovery in Databases, Data Mining Issues, Data Mining Metrics, Social implementation of Data Mining, Architecture of DM, Data models, Applications of Data Warehousing and Data Mining in Business, Healthcare, Banking, Education, and E-commerce	

UNIT 2	**Data & Data Processing**	**Hours 10**
	Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity. Exploring Data: OLAP, Multidimensional Data Analysis, Data cube model, Visualization. Data processing – Need, Data cleaning, Missing Values, Noisy Data. Data integration and Transformation, Data reduction, Data mining software.	
UNIT 3	**Classification**	**Hours 09**
	Preliminaries, General approach to solving a classification problem, Decision tree induction, ID3, CD4.5, CART Algorithms, Rule-based classifier, Nearest-neighbour classifier.	
UNIT 4	**Association Analysis**	**Hours 08**
	Problem Definition, Frequent Item set generation, Rule Generation, Compact representation of frequent item sets, Alternative methods for generating frequent item sets. FP-Growth algorithm, Evaluation of association patterns, Effect of skewed support distribution, Sequential patterns.	
UNIT 5	**Cluster Analysis**	**Hours 09**
	Overview, K-means, Agglomerative hierarchical clustering, DBSCAN, Overview of Cluster Evaluation. Multidimensional analysis and descriptive mining of complex data objects; Spatial data mining, Multimedia data mining, Text mining. Ethical and Social Issues, Emerging Trends, and Future Directions in Data Mining.	

TEXT BOOKS:

1. Data Mining: Concept and Techniques Han Elsevier ISBN : 978938031913
2. Margaret H. Dunham , S. Shridhar Data Mining- Introductory and advanced topics Pearson Education.

REFERENCE BOOKS:

1. Tom Mitchell- machine learning McGraw hill 1997
2. Data Mining Techniques, Arun K Pujari , University Press
3. Bill Franks, Taming The Big Data Tidal Wave: Finding OpportUNIT ies in Huge Data Streams with Advanced Analytics, Wiley, 2012

FIFTH SEMESTER			
Subject Name: Artificial Intelligence			
Subject code:	**BCAT B2-505**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the fundamentals of AI and intelligent systems.
2. Learn various search and problem-solving techniques used in AI.
3. Understand knowledge representation and logical reasoning methods.
4. Explore machine learning, expert systems, and modern AI applications.

COURSE OUTCOMES:

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

1. Explain fundamental concepts of Artificial Intelligence and intelligent agents.
2. Apply search and problem-solving techniques to AI problems.
3. Use logical reasoning and knowledge representation methods.
4. Describe ML, NLP, computer vision, and deep learning concepts.

UNIT 1	**Fundamentals of Artificial Intelligence**	**Hours 10**
	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.
3. **Eugene Charniak and Drew McDermott**, Introduction to Artificial Intelligence, Addison-Wesley, 1985.

FIFTH SEMESTER			
Subject Name: Artificial Intelligence Lab			
Subject code:	**BCAP B3-506**	CIE Marks:	10
No of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

Implement the Programs Using Python

PART - A

1. Implementation of Stack and Queue using Python Lists.
2. Demonstration of NumPy arrays and matrix operations.
3. Matrix multiplication using NumPy (dot(), matmul()).
4. Linear Search and Binary Search implementation.
5. Generation of random numbers using Gaussian distribution.
6. Plot Gaussian Distribution using Matplotlib.
7. Data preprocessing using NumPy and Pandas (handling missing values and normalization).
8. Simple Machine Learning model using Linear Regression.
9. Implement a basic AI agent with simple decision-making rules.
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: C# with Dot Net			
Subject code:	**BCAT C1-507**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the architecture and core components of the .NET Framework, including CLR, CTS, and CLS.
2. Develop C# programs using variables, data types, control structures, arrays, methods, and object-oriented programming concepts.
3. Apply object-oriented principles such as encapsulation, inheritance, polymorphism, abstraction, and interfaces to design efficient applications.
4. Design Windows-based graphical user interfaces and perform database connectivity using ADO.NET for real-world software development.

COURSE OUTCOMES:

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

1. Explain the architecture and features of the .NET Framework and write basic C# programs using appropriate language constructs and data types.
2. Develop modular C# applications using methods, arrays, strings, exception handling, delegates, and multithreading concepts.
3. Apply object-oriented programming principles including classes, objects, inheritance, polymorphism, abstraction, encapsulation, and interfaces to create reusable software components.
4. Design event-driven Windows Forms applications and implement database operations using ADO.NET to build simple desktop applications.

UNIT 1	**Introduction to .NET Framework**	**Hours 10**
	Evolution of the .NET Framework and its applications. Features and advantages of the .NET Framework. Architecture of the .NET Framework. Components of the .NET Framework including Common Language Runtime (CLR), Common Type System (CTS), and Common Language Specification (CLS). Intermediate Language (IL) and Just-In-Time (JIT) compilation. Understanding the Common Type System (CTS) and Common Language Specification (CLS). Role and services provided by the Common Language Runtime (CLR). Overview of .NET-supported programming languages and the .NET Framework Class Library (FCL).	
UNIT 2	**Introduction to C#**	**Hours 12**
	Basics of C #: Introduction to C# and its features, need for C# in application development, structure of a C# console application, compilation and execution process, and C# preprocessor directives. **Language fundamentals**: Identifiers, keywords, literals, constants, variables, data types, value types, reference types, implicit and explicit type conversions, boxing, and unboxing.	

	Operators and Expressions: Arithmetic, relational, logical, assignment, and bitwise operators, operator precedence and associativity, null coalescing (??) operator, scope resolution (::) operator, and type checking using is and as operators. **Control flow statements:** Selection statements (if, if-else, switch), iteration statements (for, while, do-while, foreach), and jump statements (break, continue, goto, return). **Arrays and strings**: One-dimensional arrays, multidimensional arrays, jagged arrays, string manipulation, and the StringBuilder class. **Methods: M**ethod declaration and invocation, method overloading, pass by value, pass by reference, output parameters (out), variable-length parameters (params), and command-line arguments.	
UNIT 3	**Object-Oriented Programming in C#**	**Hours 10**
	Classes and Objects: Namespaces, classes, and objects including creating classes and objects, use of the this keyword, arrays of objects, nested classes, returning values from methods, and access modifiers. **Static Members and Properties:** Static classes and static class members, read-only properties, and static properties. **Encapsulation**: Data hiding, accessors and mutators, constructors, and constructor overloading. **Inheritance:** Its concept and benefits, types of inheritance, base and derived classes, sealed classes, and sealed methods. **Polymorphism**: Compile-time polymorphism (method overloading) and run-time polymorphism (method overriding). **Abstraction and Interfaces**: Abstraction using abstract classes and abstract methods. Interfaces including interface syntax, implementation of interfaces, and multiple interface implementation. **Exception handling: T**ypes of exceptions and the use of try, catch, finally, and throw statements, along with an introduction to custom exception handling. **Threads and delegates**: Including introduction to threads, main and child threads, thread life cycle, multithreading concepts, delegates, and their applications in C# programming.	
UNIT 4	**Graphical User Interface with Visual C#.NET**	**Hours 08**
	Introduction to Windows Forms: Windows forms applications and the Visual Studio IDE, including the menu bar, toolbar, Solution Explorer, Toolbox, Properties window, and integrated help features. **Windows Form Controls:** Design and development of Windows Forms using common controls such as Label, TextBox, Button, CheckBox, RadioButton, and ComboBox, along with control properties, layout management, and form design techniques. **Event Handling:** Event-driven programming concepts including button click events, mouse event handling, keyboard event handling, and writing event handlers for user interactions. **Dialogs and Menus:** Working with Windows dialog boxes, creating and managing menus using the MenuStrip control, and developing Multiple	

	Document Interface (MDI) applications for desktop-based graphical user interfaces.	
UNIT 5	**Data Access with ADO.NET**	**Hours 08**
	Introduction to ADO.NET: Architecture and components of ADO.NET, Connected and disconnected data models. **Database Connectivity:** Creating connection strings, SQL Server database connections, ODBC data source connections, Opening and closing database connections. **Command Objects:** Creating and executing command objects, Basic SQL command execution. **Data Access Components:** DataAdapter, DataSet, Filling and updating data, managing disconnected data. **Database Operations:** Retrieving records, Inserting, updating, and deleting data, Best practices for connection management	

TEXT BOOKS:

1. E. Balagurusamy, **Programming in C#**, 4th Edition, McGraw Hill Education (India), 2017. ISBN: 978-9352607251.
2. Paul Deitel and Harvey Deitel, **Visual C# 2012: How to Program**, 5th Edition, Pearson Education, 2014. ISBN: 978-0133379336.
3. Andrew Troelsen and Philip Japikse, **Pro C# 10 with .NET 6: Foundational Principles and Practices in Programming**, 11th Edition, Apress, 2022. ISBN: 978-1484278682.

REFERENCE BOOKS:

1. Arthur Gittleman, **Computing with C# and the .NET Framework**, 2nd Edition, Jones & Bartlett Learning, 2011. ISBN: 978-0763779704.
2. Joseph Albahari and Ben Albahari, **C# 12 in a Nutshell: The Definitive Reference**, O'Reilly Media, 2024. ISBN: 978-1098147442.
3. Mark J. Price, **C# 12 and .NET 8 – Modern Cross-Platform Development Fundamentals**, Packt Publishing, 2023. ISBN: 978-1837635872.

FIFTH SEMESTER			
Subject Name: Software Engineering			
Subject code:	**BCAT C2-508**	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: Mini Project			
Subject code:	**BCAP C3-509**	CIE Marks:	10
No of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

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 semester.

Types of Project Work(Only Suggestive)

a) Real Life Problem Solution

Develops computer-based solutions for real-world needs. E.g., accounting software, web-based e-commerce.

b) System Software Project

System-level implementation. E.g., Kannada language editor, compiler design.

c) Research Level Project

Involves R&D work. E.g., character recognition, neural net-based speech recognizer. Most challenging.

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

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 – SEC			
Subject Name: Raspberry Pi			
Subject code:	**BCA SEC-510**	CIE Marks:	10
No of Hours/Week:	3	SEE Marks:	40
Total Hours:	45	Credits:	2

COURSE OBJECTIVES:

1. To introduce students to the Raspberry Pi hardware platform, its various models, SoC architecture, and pin configuration.
2. To familiarise students with Linux-based operating systems, essential Linux commands, and programming interfaces (Python and C) for Raspberry Pi.
3. To enable students to interface sensors and communication modules with Raspberry Pi for real-world data acquisition.
4. To develop the ability to design and deploy basic IoT applications using Raspberry Pi, web technologies, and protocols such as MQTT and Node-RED.

COURSE OUTCOMES:

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

1. Describe the architecture, SoC design, pin layout, and on-board components of various Raspberry Pi models.
2. Install and configure the Raspbian OS, execute Linux commands, and write basic Python and C programs for GPIO control on Raspberry Pi.
3. Interface sensors (temperature, humidity, motion, ultrasonic) and communication modules (GSM, Wi-Fi) with Raspberry Pi and connect them to a database.
4. Design and implement IoT-based applications using LAMP server, Node-RED, MQTT protocol, and web-based GPIO control on Raspberry Pi.

UNIT 1	**Overview of Raspberry Pi**	**Hours 10**
	Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi, On-board components of Rpi.	
UNIT 2	**Booting up RPi**	**Hours 10**
	Operating System and Linux Commands, Linux- Introduction, Architecture, File System, Raspbian Operating System - Introduction, Tools like Leaf pad Editor, Installing Raspbian on Pi, First boot and Basic Configuration of Pi, Popular Linux Commands for RPi. Python for Sensing Data using Python. Using Wiring Pi for GPIO Programming, Interfacing Rpi using C.	

UNIT 3	**Sensors Interfacing**	**Hours 08**
	Temperature and Humidity Sensor, Motion Senso, Obstacle detection using Ultrasonic sensor, etc. Communicating using RPi- GSM interfacing, accessing on-board Wi-Fi, Connecting Database with RPi	
UNIT 4	**IoT Design using Raspberry Pi**	**Hours 07**
	IoT Applications based on Pi, LAMP Web-server, GPIO Control over Web Browser, Creating Custom Web Page for LAMP, communicating data using on-board module, home automation using Pi, Node-RED, MQTT Protocol, Using Node-RED Visual Editor on RPI	

TEXTS BOOKS:

1. Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition by Simon Monk McGraw Hill Professional, 04-Jun-2021 - Technology & Engineering
2. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition by Derek Molloy, wiley publications 2016.

REFERENCE BOOKS:

1. The Computer Programming Bible: A Step-by-Step Guide On How To Master From The Basics to Advance of Python, C, C++, C#, HTML Coding Raspberry Pi3 by C.P.A Inc 2020.
2. Raspberry Pi IoT Projects: Prototyping Experiments for Makersby John C. Shovic, APress 2016.

Practice Practical Programs (10 Hours)

1. Installation and configuration of Raspberry Pi OS.
2. Practice basic Linux commands and file operations.
3. GPIO LED blinking using Python.
4. Interfacing push button and LED using Raspberry Pi.
5. Temperature sensor interfacing and data display.
6. Humidity sensor interfacing using Python.
7. PIR motion sensor interfacing and motion detection.
8. Ultrasonic sensor interfacing for distance measurement.
9. Create a simple Node-RED dashboard for sensor monitoring.
10. Develop a mini IoT project:
    - Smart Home Automation System, or
    - Smart Room Monitoring System, or
    - IoT-based Temperature Monitoring System. Bottom of Form

Note: The above practical programs are for practice purposes only. There is no laboratory examination for this subject. The evaluation will be based solely on a theory examination for 40 marks.

FIFTH SEMESTER – SEC			
Subject Name: Prolog			
Subject code:	**BCA SEC-510**	CIE Marks:	10
No of Hours/Week:	3	SEE Marks:	40
Total Hours:	45	Credits:	2

COURSE OBJECTIVES:

1. Introduce the concepts of Logic Programming and Artificial Intelligence.
2. Develop problem-solving skills using Prolog.
3. Understand facts, rules, queries, recursion, and list processing.
4. Apply Prolog for knowledge representation and reasoning.

COURSE OUTCOMES:

After completing the course, students will be able to:

1. Understand the principles of Logic Programming.
2. Write Prolog programs using facts, rules, and queries.
3. Implement recursive and list-processing solutions.
4. Develop simple knowledge-based systems.

UNIT 1	**Introduction to Logic Programming**	**Hours 10**
	Introduction to Artificial Intelligence and Logic Programming, History and Features of Prolog , Structure of a Prolog Program, Facts, Rules, and Queries, Variables, Constants, and Predicates, Prolog Execution Model , Simple Prolog Examples.	
UNIT 2	**Control Structures and Recursion**	**Hours 10**
	Unification and Backtracking, Arithmetic Operations in Prolog, Decision Making using Rules, Recursive Predicates,Tail Recursion, Solving Mathematical Problems using Recursion, Debugging Prolog Programs.	
UNIT 3	**Lists and Knowledge Representation**	**Hours 08**
	Introduction to Lists, List Operations, Membership, Concatenation, and Length of Lists, Recursive List Processing, Knowledge Representation in Prolog, Family Tree and Relationship Modeling, Database Representation using Facts.	
UNIT 4	**Expert Systems and AI Applications**	**Hours 07**
	Introduction to Expert Systems, Knowledge Base and Inference Engine, Rule-Based Reasoning, Decision Support Systems, Natural Language Processing Basics in Prolog, AI Applications of Prolog, Case Studies and Mini Projects.	

TEXT BOOKS:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications,McGraw Hill Publications, 7th Edition,2007.

2. J. P. Tremblay and R. P. Manohar, Discrete Mathematical Structures with Applications to Computer Science,McGraw Hill Education Inc., 2002.

3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics,Sultan Chand & Sons Educational Publishers, New Delhi, 2020.

REFERENCE BOOKS:

1. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics,5th Edition,Pearson Education, 2004.

2. C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach,McGraw Hill, 3rd Edition,2012.

3. P. G. Hoel, S. C. Port, and C. J. Stone, Introduction to Probability Theory,Universal Book Stall.

4. Sheldon Ross, A First Course in Probability,6th Edition, Pearson Education India.

5. William Feller, An Introduction to Probability Theory and Its Applications, Vol. 1, Wiley.

Practice Practical Programs (10 Hours)

1. Installation of SWI-Prolog and execution of simple programs.
2. Write a Prolog program to represent family relationships using facts and rules.
3. Write a Prolog program to find the maximum of two and three numbers.
4. Write a Prolog program to calculate factorial using recursion.
5. Write a Prolog program to calculate Fibonacci series.
6. Write a Prolog program to check membership of an element in a list.
7. Write a Prolog program to find the length of a list.
8. Write a Prolog program to concatenate two lists.
9. Develop a simple student information knowledge base and perform queries.
10. Develop a simple expert system for career guidance or disease diagnosis.

Note: The above practical programs are for practice purposes only. There is no laboratory examination for this subject. The evaluation will be based solely on a theory examination for 40 marks.

SIXTH SEMESTER			
Subject Name: Blockchain Technology			
Subject code:	**BCAT A1-601**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES

1. Understand the fundamentals, evolution, and applications of blockchain technology.
2. Learn the cryptographic concepts that ensure blockchain security and integrity.
3. Explain decentralization, consensus mechanisms, and proof-of-work in blockchain networks.
4. Understand Bitcoin architecture, transactions, scripting, and network operations.

COURSE OUTCOMES

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

1. Explain the basic concepts, architecture, and applications of blockchain technology.
2. Apply cryptographic techniques such as hashing, Merkle trees, and digital signatures in blockchain systems.
3. Describe decentralized networks, consensus protocols, and proof-of-work mechanisms.
4. Explain Bitcoin transactions, block structure, scripting, and peer-to-peer network functionality.

UNIT 1	**Blockchain Fundamentals and Cryptography**	**Hours 12**
	Tracing Blockchain's Origin, traditional vs. distributed systems, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business? **Introduction to Cryptography:** Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.	
UNIT 2	**Digital Signatures**	**Hours 10**
	Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency model, Mechanics of Bit coin: Bitcoin transaction structure, Bitcoin scripts and their applications, Bitcoin blocks and network.	
UNIT 3	**Centralization vs. Decentralization**	**Hours 10**
	Centralisation vs. decentralisation, distributed consensus, proof-of-work, The Task of Bit coin miners, Mining Hardware, Mining pools, Mining incentives and strategies.	

UNIT 4	**Storage of and Usage of Bit coins:**	**Hours 08**
	Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets. Anonymity basics, coin mixing, Zerocoin and Zerocash.	
UNIT 5	**Smart Contracts, Ethereum, and Blockchain Applications**	**Hours 8**
	Ethereum architecture, EVM and smart contracts, Solidity basics, DeFi and tokens (ERC-20), enterprise blockchains (Hyperledger Fabric overview), blockchain use cases across industries, regulatory and ethical considerations	

TEXT BOOKS:

1. Blockchain Technology: From Theory to Practice Prof. Sudeep Tanwar (Senior Member, IEEE), Full Professor at Nirma University, Ahmedabad, authored this textbook published by Springer (2022).
2. Blockchain Technology Authored by Chandramouli Subramanian (Associate Director, Cognizant Technology Solutions, Chennai), Asha A George, Abhilash K A (Solution Architect, Bengaluru), and Meena Karthikeyan, and published by Universities Press (India) Private Limited, Hyderabad (2021).
3. Blockchain Technology By J. Indumathi, published by Oxford University Press India (2024).

REFERENCE BOOKS:

1. Mastering Blockchain- Imran Bashir, *Mastering Blockchain*, 4th Edition, Packt Publishing, 2023.
2. Blockchain Basics- Daniel Drescher, *Blockchain Basics: A Non-Technical Introduction in 25 Steps*, Apress, 2017.
3. Blockchain Revolution- Don Tapscott and Alex Tapscott, *Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World*, Portfolio, 2018.
4. Introducing Blockchain with Lisp-David R. Kopec, *Introducing Blockchain with Lisp: Implement and Extend Blockchains with the Racket Language*, Apress, 2019.

SIXTH SEMESTER			
Subject Name: Machine Learning			
Subject code:	**BCAT A2-602**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. Understand the fundamental concepts and applications of machine learning.
2. Identify and differentiate between supervised, unsupervised, and reinforcement learning.
3. Apply preprocessing techniques and perform feature selection and dimensionality reduction.
4. Implement and evaluate regression and classification models using real-world data.

COURSE OUTCOMES:

1. Explain the core concepts and categories of machine learning.
2. Preprocess data and apply feature engineering techniques.
3. Develop and evaluate regression models for prediction tasks.
4. Design and compare classification models using various algorithms.

UNIT 1	**Fundamentals of Machine Learning**	**Hours 12**
	Introduction to Machine Learning and its importance, Human vs. Machine Learning paradigms, Applications in Data Science, Data Mining, and Big Data Analytics, Core concepts and terminologies in Machine Learning, Categories of Machine Learning: Supervised, Unsupervised, Reinforcement Learning, Key challenges and scope of ML	
UNIT 2	**Data Preparation and Feature Engineering**	**Hours 12**
	Data Collection methods and sources, Data Preprocessing: Handling missing values, encoding, normalization/standardization, Feature Selection Techniques: Subset Selection, Ranking Methods, Decision Tree-based feature importance, Entropy and Information Gain, Exhaustive Search, Best-First, Greedy Forward and Backward, Dimensionality Reduction Techniques: PCA, LDA	
UNIT 3	**Regression Techniques**	**Hours 8**
	Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Interpreting Regression Output: Coefficients, R^2 score, P-values and significance testing	

UNIT 4	**Classification**	**Hours 08**
	Introduction to classifications, Logistic Regression, K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Naïve Bayes Classifier, Decision Tree Classifier, Random Forest Classifier,	
UNIT 5	**Clustering Techniques**	**Hours 8**
	Introduction to clustering, k-Means Clustering: Initialization traps, Elbow method for selecting clusters, Hierarchical Clustering: Agglomerative vs Divisive, Dendrograms and Linkage methods	

TEXT BOOKS:

1. "Introduction to Machine Learning with Python", Andreas C. Müller & Sarah Guido, O'Reilly
2. "Machine Learning" Tom M. Mitchell, McGraw-Hill.
3. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Author: Aurélien Géron, O'Reilly

REFERENCE BOOKS:

1. "Pattern Recognition and Machine Learning", Christopher M. Bishop, Springer
2. "Understanding Machine Learning: From Theory to Algorithms", Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press

SIXTH SEMESTER			
Subject Name: Machine Learning Lab			
Subject code:	**BCAP A3-603**	CIE Marks:	10
No of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

Implement the Programs Using Python

PART - A

1. Data Preprocessing & EDA: Handle missing data, normalize features, and visualize dataset.
2. Feature Selection using Decision Trees: Apply entropy and information gain methods.
3. Dimensionality Reduction with PCA & LDA: Visualize results using 2D projection.
4. Simple & Multiple Linear Regression: Predict numerical output, evaluate MSE and R^2.
5. Polynomial Regression: Model nonlinear patterns and compare with linear regression.

PART - B

1. Classification using Logistic Regression and KNN: Measure accuracy and confusion matrix.
2. Support Vector Machine and Naïve Bayes: Build classifiers and analyze performance.
3. Decision Tree and Random Forest Classifier: Visualize trees and analyze feature importance.
4. k-Means Clustering: Apply elbow method and interpret clustering output.
5. Hierarchical Clustering: Generate dendrograms and compare with k-means.

SIXTH SEMESTER			
Subject Name: Natural Language Processing			
Subject code:	**BCAT A2-602**	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.

SIXTH SEMESTER			
Subject Name: Data Analysis with Python			
Subject code:	**BCAT B2-605**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To develop the ability to analyze data using Python.
2. To understand data manipulation, cleaning, and preprocessing techniques.
3. To apply statistical tools for extracting meaningful insights.
4. To build effective data visualizations.

COURSE OUTCOMES:

Upon successful completion, students will be able to:

1. Understand the data analysis process and Python's role in it.
2. Clean, manipulate, and preprocess structured datasets using Python libraries.
3. Visualize data insights effectively using Matplotlib and Seaborn.
4. Apply statistical concepts and test hypotheses on datasets.

	Introduction to Data Analysis	**Hours 10**
UNIT 1	**What is Data Analysis, Types of Data:** Structured vs Unstructured Data, Qualitative vs Quantitative, Continuous vs Discrete, Time-series vs Cross-sectional data, **Data Analysis Process:** Data Collection, Data Cleaning, Data Exploration (EDA), Data Modelling (basic concepts only), Interpretation and Reporting, **Skills Required for Data Analysis, Tools and Libraries Used in Python:** NumPy, Pandas, Matplotlib, Seaborn, (Optional: Scikit-learn for further analysis), **Sources of Data:** CSV, Excel files, Databases (SQL), APIs and Web scraping, public datasets (Kaggle, UCI, etc.) **Challenges in Data Analysis:** Missing or inconsistent data, Data bias, Choosing the right model or visualization, Data privacy and ethics	
UNIT 2	**Data Handling with Python**	**Hours 10**
	Python as a Data Analysis Tool, Jupyter Notebooks and Working with Environments, Loading and Saving Data (CSV, Excel, JSON, APIs), Python Lists, Dictionaries, Loops, Functions NumPy: Arrays and Operations, Indexing, Slicing, Vectorization. Pandas: Series and DataFrames Reading and Writing Files, Filtering, Sorting, Grouping, Handling Missing and Duplicate Data, Data Transformation: merge, join, pivot, melt.	

UNIT 3	**Data Cleaning & Preprocessing**	**Hours 8**
	Importance of Clean Data, Detecting and Handling: Missing Values, Outliers, Inconsistent Data, Data Encoding: Label Encoding, One-Hot Encoding, Feature Scaling: Min-Max, Standardization, Data Type Conversion	
UNIT 4	**Data Visualization**	**Hours 10**
	Purpose of Visualization in Data Analysis & Data Storytelling, Visualization Tools in python: Matplotlib; Line, Bar, Scatter, Histogram, Plot Customization, Seaborn: Boxplot, Violin Plot, Heatmap, Pairplot. Styling and Themes Introduction to Interactive Visualization, Plotly. Overview of Visualization Tools-Excel, Tableau, Power BI.	
UNIT 5	**Exploratory and Statistical Data Analysis**	**Hours 10**
	Central Tendency: Mean, Median, Mode, Dispersion: Range, Variance, Standard Deviation, Correlation & Covariance, Cross-tabulations and Pivot Tables, Sampling Methods, Hypothesis Testing: t-test, ANOVA, Chi-square.	

TEXT BOOKS:

1. "Introduction to Machine Learning with Python", Andreas C. Müller & Sarah Guido, O'Reilly
2. "Doing Data Science Cathy O'Neil & Rachel Schutt".
3. "Python for Data Analysis Wes McKinney

REFERENCE BOOKS:

1. Python Data Science Handbook, Jake VanderPlas
2. Interactive Data Visualization for the Web Scott Murray

SIXTH SEMESTER			
Subject Name: Data Analysis with Python Lab			
Subject code:	**BCAP B3-606**	CIE Marks:	10
No of Hours/Week:	4	SEE Marks:	40
Total Hours:	60	Credits:	2

LIST OF LAB PROGRAMS

1: Python Refresher

Write a Python program to:

- Create a list, tuple, dictionary and perform basic operations (add, delete, update).
- Define a function to compute factorial of a number using recursion.
- Read and write a text file using file handling.

2: NumPy Basics

Write a program to:

- Create NumPy arrays and perform slicing, indexing, and reshaping.
- Perform element-wise operations (addition, multiplication) on arrays.
- Use NumPy to calculate mean, median, standard deviation of a dataset.

3: Working with Pandas – Data Frames

Using the **Titanic** dataset or any sample dataset:

- Load the dataset using pd.read_csv()
- Display basic information: shape, columns, data types.
- Filter rows where Age > 30.
- Sort the data based on Fare in descending order.

4: Data Cleaning and Missing Values

Using a dataset with missing values:

- Identify missing values using isnull()
- Fill missing values with mean/median.
- Drop columns or rows with too many null values.
- Detect and handle duplicate rows.

5: Data Transformation and Encoding

Using a dataset with categorical variables:

- Perform label encoding and one-hot encoding.
- Normalize/standardize numerical columns.
- Combine multiple datasets using merge and join operations.

6: Data Visualization with Matplotlib

Write a program to:

- Plot a line chart, bar chart, histogram, and scatter plot using Matplotlib.
- Customize plots: add title, labels, legends, grid, and color.

7: Data Visualization with Seaborn

Using the **Iris dataset** or Titanic:

- Create a boxplot of sepal length by species.
- Plot a heatmap of correlation matrix.
- Generate pairplot for all numeric variables.
- Customize plot aesthetics using Seaborn themes.

8: Descriptive Statistics

Write a program to compute:

- Mean, median, mode, variance, standard deviation of a dataset.
- Correlation between two numeric columns.
- Covariance matrix of a DataFrame.

9: Hypothesis Testing

Using a sample or real dataset:

- Perform a one-sample t-test to compare mean of a column to a fixed value.
- Perform a two-sample t-test between two groups (e.g., male vs. female fares).
- Apply chi-square test for independence between two categorical columns.

10: Exploratory Data Analysis (EDA) Project

Choose any dataset (from Kaggle, UCI, etc.) and perform:

- Data loading and inspection
- Data cleaning and preprocessing
- Visual exploration of features
- Statistical summary and correlation analysis
- Write a summary report or present findings

Sample Datasets to be used

- Titanic Dataset (titanic.csv)
- Iris Dataset (iris.csv)
- COVID-19 Dataset
- Sales Data
- Superstore Dataset

SIXTH SEMESTER			
Subject Name: Generative AI			
Subject code:	**BCAT 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 LangChain 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.

UNIT 1	**Introduction to Generative AI**	**Hours 10**
	Introduction to Generative AI, 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	**Data Handling with Python**	**Hours 10**
	Evolution of Neural Networks to Large Language Models: Natural Language Processing Tokenization, N-grams, Language Representation and Embedding's, 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 Frame work**: Introduction, introduction to long chain, 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 behaviors	

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 Sansevieria , 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).

SIXTH SEMESTER			
Subject Name: Digital Image Processing			
Subject code:	**BCAT C2-608**	CIE Marks:	20
No of Hours/Week:	3	SEE Marks:	80
Total Hours:	48	Credits:	3

COURSE OBJECTIVES:

1. To understand the fundamentals and applications of Digital Image Processing.
2. To learn image enhancement, restoration, segmentation, and morphological techniques.
3. To develop knowledge of feature extraction, pattern recognition, and image compression.
4. To explore advanced image processing using computer vision, machine learning, and artificial intelligence.

COURSE OUTCOMES:

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

1. Explain the fundamentals of digital images, image acquisition, representation, and processing tools.
2. Apply image enhancement, restoration, filtering, and segmentation techniques to analyze images.
3. Analyze image features and use image compression methods for efficient storage and transmission.
4. Utilize computer vision and AI-based image processing techniques to solve real-world problems.

	Fundamentals of Digital Image Processing	**Hours 14**
UNIT 1	**Introduction to Digital Image Processing:** Definition and Scope of Digital Image Processing, Applications of Image Processing in Healthcare, Agriculture, Security, Multimedia, Remote Sensing, and Artificial Intelligence, Components of an Image Processing System, Steps in Digital Image Processing. **Digital Image Fundamentals:** Image Formation and Acquisition, Analog and Digital Images, Pixels, Resolution, Aspect Ratio, and Image Dimensions, Gray Scale Images and Color Images, RGB, CMYK, HSV, and HSI Color Models. **Image Representation and Storage:** Image File Formats: BMP, JPEG, PNG, TIFF, GIF, Image Sampling and Quantization, Spatial and Intensity Resolution, Image Histograms and Their Interpretation. **Introduction to Image Processing Tools:** Overview of OpenCV, MATLAB, Python Imaging Library (PIL), and ImageJ, Basic Image Manipulation Operations.	

UNIT 2	**Image Enhancement Techniques**	**Hours 10**
	Spatial Domain Processing: Point Processing Operations, Image Negative Transformation, Logarithmic and Power-Law Transformations, Contrast Stretching, Thresholding Techniques. **Histogram Processing:** Histogram Equalization, Histogram Matching, Local Histogram Enhancement. **Image Smoothing and Sharpening:** Noise Models in Images, Mean Filter, Median Filter, Gaussian Filter, Laplacian Filter, High Pass and Low Pass Filtering. **Morphological Image Processing:** Structuring Elements, Dilation, Erosion, Opening and Closing Operations, Boundary Extraction.	
UNIT 3	**Image Restoration and Segmentation**	**Hours 10**
	Image Restoration: Image Degradation Models, Noise Reduction Techniques, Inverse Filtering, Wiener Filtering, Motion Blur and Restoration Concepts. **Image Segmentation Fundamentals:** Importance of Segmentation, Edge Detection Concepts. **Edge Detection Techniques :** Roberts Operator, Prewitt Operator, Sobel Operator, Canny Edge Detector. **Region-Based Segmentation:** Region Growing, Region Splitting and Merging, Watershed Segmentation, Threshold-Based Segmentation Methods.	
UNIT 4	**Feature Extraction**	**Hours 06**
	Feature Extraction: Concept of Features in Images, Shape Features, Texture Features, Color Features, Feature Vectors and Representation. **Pattern Recognition Basics:** Feature Selection, Feature Matching, Similarity Measures.	
UNIT 5	**Image Compression and Image Quality Assessment**	**Hours 08**
	Image Compression: Need for Compression, Redundancy in Images, Lossless Compression Techniques: Run Length Encoding (RLE), Huffman Coding. Lossy Compression Techniques: Transform Coding, JPEG Compression Standard. **Image Quality Assessment:** Compression Ratio, Mean Square Error (MSE), Peak Signal-to-Noise Ratio (PSNR).	

TEXT BOOKS:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, Pearson Education, 2018.
2. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, 3rd Edition, Pearson Education, 2020.
3. Fundamentals of Digital Image Processing, Anil K. Jain, Prentice Hall of India, Reprint Edition.

REFERENCE BOOKS:

1. Digital Image Processing, Oxford University Press, India.
2. Computer Vision: Algorithms and Applications, 2nd Edition, Springer.
3. Image Processing, Analysis and Machine Vision, 5th Edition, Cengage Learning.

SIXTH SEMESTER			
Subject Name: Major Project			
Subject code:	**BCAP 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:	**BCASEC-610**	CIE Marks:	10
No of Hours/Week:	3	SEE Marks:	40
Total Hours:	45	Credits:	2

COURSE OBJECTIVES:

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.

COURSE OUTCOMES:

After studying this course, students will be able to:

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.