B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

Department of Computer Science and Business Systems

Scheme and Syllabus

III and IV Semester

Semester-III

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	BS	24MA3BSPBS	Probability Theory for Business Systems	2	1	0	3	4
2	ES	24MA3BSDBS	Discrete Mathematics for Business Systems	2	1	0	3	4
3	PC	23BS3PCOPS	Operating Systems	2	1	0	3	4
4	PC	23BS3PCCOA	Computer Organization and Architecture	3	0	0	3	3
5	PC	23BS3PCFOM	Fundamentals of Management	3	0	0	3	3
6	PC	23BS3PCDSA	Data Structures and Applications	3	0	1	4	5
7	IPCC	23BS3PCUNP	Unix Programming	0	0	1	1	2
8	IPCC	23BS3PCMPD	MATLAB for Probability and Discrete Math	0	0	1	1	2
9	AE	23BS3AEBC1	Business Communication and Value Chain - I	0	0	1	1	2
10	NCMC	23BS3NCMC1	NSS/YOGA/Physical Edu. (Sports and Athletics)	0	0	0	NP/PP	0
	PC-15, ES-3,BS-3, AE/SDC-1		TOTAL	15	3	4	22	30

Semester-IV

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	BS	23MA4BSABS	Foundations of Algebra for Business Systems	2	1	0	3	4
2	ES	23MA4BSSBS	Statistical Modeling for Business Systems	2	1	0	3	4
3	PC	23BS4PCFLA	Formal Language and Automata Theory	2	1	0	3	4
4	PC/IPCC	23BS4PCADA	Analysis and Design of Algorithms	3	0	1	4	5
5	PC/IPCC	23BS4PCDBM	Database Management Systems	3	0	1	4	5
6	PC/IPCC	23BS4PCFMT	Financial Management	2	0	1	3	4
7	UHV	23BS4HSUHV	Universal Human Values	0	1	0	1	2
8	AE	23BS4AECPP	Competitive Programming using C/C++	0	0	1	1	2
9	NCMC	23BS4NCMC2	NSS/YOGA/Physical Edu. (Sports and Athletics)	0	0	0	NP/PP	0
	PC-14, ES-3,BS-3,UHV-1 &AE/SDC-1		TOTAL	14	4	4	22	30

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Probability Theory for Business Systems				
Course Code	23BS3PCPBS	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	40		

UNIT - 1
INTRODUCTION TO PROBABILITY: Introduction, Probability: Random Experiment: Sample point and sample space, event, operation of events, concepts of mutually exclusive and exhaustive events. Classical and relative frequency approach, axiomatic approach of probability. Independence of events, conditional probability, Bayes' theorem and its applications, Bayes' optimal classifiers and Naive Classifiers.
UNIT - 2
DISCRETE PROBABILITY DISTRIBUTIONS: Discrete Random variables, probability mass function, cumulative distribution function, Mathematical expectation, mean and variance, moments and their properties, Moment generating function. Poisson and Geometric distributions.
UNIT - 3
CONTINUOUS PROBABILITY DISTRIBUTIONS: Continuous Random variables, probability density functions, cumulative distribution function, Mathematical expectation, mean and variance, moments and their properties, Moment generating function. Exponential, Erlang and normal (Gaussian) distributions.
UNIT - 4
JOINT PROBABILITY: Introduction - Joint Probability distribution for two discrete and continuous random variables, Joint probability mass and density function, Joint probability Cumulative distribution function, Mathematical expectations, conditional distribution and independence, Covariance and Correlation.
UNIT - 5
MARKOV CHAINS: Introduction to stochastic process, probability vectors, Stochastic matrices, regular stochastic matrices, Markov chains, higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov processes: Chapman - Kolmogorov equations, Mean time spent in transient states.
Text Books:

1. S. M. Ross, “Introduction of Probability Models”, Academic Press, N.Y.
2. A. Goon, M. Gupta and B. Dasgupta, “Fundamentals of Statistics”, vol. I & II, World Press.
3. M. Baron, “Probability and Statistics for Computer Scientists", Taylor and Francis.
4. T. Veerarajan, “Probability, Statistics and Random Processes”, Tata McGraw-Hill Education, 3rd edition, 2017.
5. Murray R Spiegel , Ray Meddis, “Schaum’s Outline of Theory and Problems of Probability, Schaum Outline Series publication

Reference Books:

1. S. M. Ross, “A first course in Probability”, Prentice Hall.
2. I. R. Miller, J.E. Freund and R. Johnson, “Probability and Statistics for Engineers”, (Fourth Edition), PHI.
3. A. M. Mood, F. A. Graybill and D. C. Boes, “Introduction to the Theory of Statistics”, McGraw Hill Education.
4. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, Delhi.
5. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education, Delhi, 9th edition, 2012.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ma30/preview
2. https://archive.nptel.ac.in/courses/111/102/111102111/
3. https://onlinecourses.nptel.ac.in/noc22_ee123/preview
4. http://www.digimat.in/nptel/courses/video/111104146/L19.html
5. http://acl.digimat.in/nptel/courses/video/106101224/L46.html
6. http://www.digimat.in/nptel/courses/video/111102111/L38.html
7. https://www.almabetter.com/bytes/tutorials/applied-statistics/moment-generating-functions-and-expected-values

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of Probability distributions to solve engineering problems.
CO2	Analyse the problems in business system using probability theory.
CO3	Demonstrate the use of modern tools for solving problems in computer Science and Business systems using probability theory.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Discrete Mathematics for Business Systems				
Course Code	23BS3PCDBS	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	40		

UNIT - 1
MATHEMATICAL LOGIC: Propositional calculus - propositions and connectives, syntax; Semantics - truth assignments and truth tables, validity and satisfiability, tautology.
UNIT - 2
COUNTING TECHNIQUES: Basic counting, generating functions, recurrence relations (first order and higher order homogeneous relations). Principle of mathematical induction, pigeonhole principle.
UNIT - 3
BOOLEAN ALGEBRA: Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form.
UNIT - 4
GRAPH THEORY -1: Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, Shortest path – Dijkstra's algorithm.
UNIT - 5
GRAPH THEORY -2: Planar graphs, Euler's formula, dual of a planar graph, independence number and clique number, chromatic number, statement of Four-color theorem, Trees, minimal spanning tree – Kruskal's algorithm.
Text Books:
1. M. M. Mano, "Digital Logic & Computer Design", Pearson. 2. C. L. Liu, "Elements of Discrete Mathematics", (Second Edition) McGraw Hill Computer Science Series. 3. N. Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall, Englewood Cliffs. 4. L. Zhongwan, "Mathematical Logic for Computer Science", World Scientific, Singapore.

Reference Books:
1. R. A. Brualdi, "Introductory Combinatorics", North-Holland, New York. 2. J. A. Bondy and U. S. R. Murty, "Graph Theory with Applications", Macmillan Press, London. 3. E. Mendelson, "Introduction to Mathematical Logic", (Sixth Edition), CRC Press. 4. K. H. Rosen, "Discrete Mathematics and its applications", (Seventh Edition), McGraw Hill.
MOOCs:
1. https://nptel.ac.in/courses/111104026/(DiscreteMathematics) 2. https://nptel.ac.in/courses/111106086/(Combinatorics) 3. https://nptel.ac.in/courses/111106050/(Graphtheory)

COURSE OUTCOMES (COs)

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

CO1	Apply the concept of Discrete mathematical structures in Computer Science and Business systems
CO2	Analyse the concept of Discrete mathematical structures in Computer Science and business systems
CO3	Demonstrate the use of modern IT tools in solving Computer Science and Business systems applications through Discrete mathematical structures.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Operating Systems				
Course Code	23BS3PCOPS	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	25		

UNIT - 1
Introduction: Operating System structure, Operating System operations, Process management, Memory management, Storage management, Protection and security, Kernel data structures, computing environments. **Operating System structure:** Operating System Services, User-Operating System interface.
UNIT - 2
Processes: Process Concept, Process Scheduling, Inter process communication. **Process Synchronization:** The critical section problem, Peterson's solution, Mutex locks, Semaphores, Classical problems of synchronization. **Multithreaded Programming:** Multithreading models.
UNIT - 3
CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms. **Deadlocks:** System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.
UNIT - 4
Main Memory: Background, swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table. **Virtual Memory:** Background, demand paging, copy on write, Page replacement algorithms, Allocation of frames, Thrashing.
UNIT - 5
Disk performance optimization: Introduction, why disk scheduling is necessary, Disk scheduling strategies, rotational optimization. **File and Database Systems:** Free space management, File access control.
Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley India, 9th Edition,2012.

Reference Books:

1. Operating Systems, A Concept-Based Approach, DM Dhamdhere, Tata Mcgraw-Hill, 3rd Edition, 2012.
2. Modern Operating Systems, by Andrew S. Tanenbaum and Herbert Bos, Pearson, 4th Edition, 2014.
3. UNIX complete reference by Herbert Schildt, Mcgraw- Hill, 2nd edition.
4. Sumitabha Das: UNIX Concepts and Applications, Tata McGraw Hill, 4th Edition, 2006.

e- Books:

1. https://csc-knu.github.io/%20svs-prog/books/Andrew%20S.%20Tanenbaum%20-%20Modern%20Systems.pdf
2. http://ebooks.lpude.in/computer_application/mca/terms_1/DCAP403_OPERATING_SYSTEM.pdf

MOOCs:

1. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/ index.html
2. Introduction to Operating Systems, https://www.udacity.com/course/introduction-to-operating-systems--ud923

COURSE OUTCOMES (COs)

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

CO1	Understand the fundamentals of the operating system and its services
CO2	Apply CPU scheduling, memory management, synchronization and file management techniques to solve problems
CO3	Analyse different algorithms of process scheduling, disk scheduling, OS structures and services.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Computer Organization and Architecture				
Course Code	23BS3PCCOA	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Fundamentals of Computer Systems and Digital Logic Basic Structure of Computers: Functional Units, Basic Operational Concepts, Number Representation - Binary, Octal, Hexadecimal, Signed and Unsigned Numbers, Complements Simplification of Boolean Expressions: Canonical Formulas, Incomplete Boolean Functions and Don't Care Conditions, Formulation of the Simplification Problem, Prime Implicants and Irredundant Disjunctive Expressions, Prime Implicates and Irredundant Conjunctive Expressions, Karnaugh Maps, Using K-Maps to Obtain Minimal Expressions for Complete Boolean Functions and Incomplete Boolean Functions
UNIT – 2
Instruction Set Architecture and Assembly Concepts Memory Locations and Addresses, Instructions and Instruction Sequencing, Stacks, Subroutines Input/Output Handling: I/O Devices, Memory Mapped I/O, Interrupts Bus Structure and Arbitration
UNIT – 3
Memory Systems and Flip-Flops Memory System: Cache, Virtual Memory, DMA Flip-Flops: Gated Flip-Flops, Edge Triggered Flip-Flops, JK Master-Slave Flip-Flop, Various Representations of Flip- Flops
UNIT - 4
Arithmetic Unit and Counters Signed/Unsigned Addition & Subtraction, Design of Fast Adders Multiplication Techniques: Booth's Algorithm, Bit-pair recoding, Carry-Save Counters: Ripple, Synchronous, Design of Synchronous Counters
UNIT - 5
Parallel Processing & Sequential Circuits Parallel Architecture: Flynn's Taxonomy, Multicore, SMT Design of Synchronous Sequential Circuits: Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram, State Reduction Techniques

Text Books:

1. Computer Organization and Embedded Systems, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, McGraw- Hill, 6th Edition, 2012.
2. Digital Principles and Applications, Donald P Leach, Albert Paul Malvino & Goutam Saha,7th Edition, Tata McGraw Hill, 2010.

Reference Books:

1. Digital Principles & Design, Donald D Givone, Tata McGraw Hill, 2011.
2. Computer Organization and Design - The Hardware /Software Interface, David A. Patterson, John L. Hennessy, Elsevier, 5th Edition, 2014.
3. Parallel Programming for Multicore and Cluster Systems, Thomas Rauber, Gudula Runger, Springer, 2nd Edition, 2013.
4. Digital Logic and Computer Design, M Morris Mano, 10th Edition, Pearson Education, 2008.

COURSE OUTCOMES (COs)

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

CO1	Demonstrate an understanding of the fundamental principles of computer systems, digital logic, number systems and basics of modern parallel architectures.
CO2	Apply knowledge of Boolean algebra, Karnaugh maps, and sequential logic to simplify and design digital circuits.
CO3	Analyze the functioning of memory systems, instruction execution, I/O mechanisms, and control flow in a computing environment.
CO4	Design and evaluate combinational and sequential circuits, arithmetic units.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Fundamentals of Management				
Course Code	23BS3PCFOM	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Management Theories: Management Science or Art. Development of management thought. Early classical approaches: Scientific Management, Administrative Management, Bureaucracy, neo classical approaches, Modern approaches, Management Functions: Planning, Organizing, Directing, Controlling. Management process.
UNIT - 2
Planning and Decision Making: Nature of Planning. Importance of Planning, Hierarchy of plan, Types of plan, Vision, Mission, Objectives, Characteristics and requirement of objectives. Strategies: SWOT analysis, strategy formulation, Modes of Strategy Formulation, Operational plans: Standing plans, Policies, Types of Policies, Guidelines for effective policy making, procedures and methods. Single use plans. Steps in planning, Limitations of planning. Meaning of a decision, types of decisions, Steps in rational decision making
UNIT - 3
Organizational and Culture: Organization meaning, Characteristic of an organization, Typology of organization, process of organizing, Principles of organizing, Span of management, Appropriate Span of management, Departmentalization, Vertical, Horizontal and Matrix Organization. Organization structure, Organization chart, Mechanistic and organic structures, Emerging Organization structures, International Organization structures, Organization authority, Delegation of authority, coordination, Organization culture, Components or dimensions of Organization culture, Types of Organization culture, Quality of work life in Organization culture, national culture, Culture and international business
UNIT - 4
Staffing, Training and Development, Compensation Plan: Staffing: Manpower planning, recruitment. Selection: Importance of the Selection Process, Steps in the Selection Procedure, Placement, Induction (orientation), Staffing from global perspective. Training and development: Steps in Setting up a Training and Development Programme, Evaluation based on principles. Compensation plans: Time as Basis for Pay, Classification of Compensation, Primary Compensation: Factors Affecting Wages, Factors Affecting Executive Compensation, Monetary

Incentive, Kinds of Monetary Incentive Plans, Non-Monetary Incentive, Benefits. International Compensation.
UNIT - 5
Direction and Supervision and Leadership: Requirement of effective direction, Motivation, Nature of Motivation, Motivation theories, Systems Perspective of Motivation, Functions of a First-level Supervisor, Guidelines for Making Effective First-level Supervision. Communication: Importance of Communication, Purpose of Communication, Types of Communication, Forms of Communication, Principles of Effective Communication, Leadership: Difference between a leader and manager. Characteristics of Leadership, Functions of Leader, New approaches to leadership.
Text Books:
1. Principles of Management, Edition 2, P. C. Tripathi and P. N. Reddy, Tata McGraw Hill Publishing Company
Reference Books:
1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior 2. Richard L. Daft, Understanding the Theory and Design of Organizations

COURSE OUTCOMES (COs)

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

CO1	Understand the evolution of management thought, contribution of management thinkers, management theories and management functions
CO2	Apply various aspects planning and decision-making.
CO3	Apply various approaches to organizational structure and its culture
CO4	Demonstrate the importance staffing, selection, training and development, and compensation plan.
CO5	Analyse effective direction by motivation, communication and leadership style.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Data Structures and Applications				
Course Code	23BS3PCDSA	Credits	3	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Introduction to Data Structure: Data Management concepts, Data types – primitive and non-primitive, Types of Data Structures- Linear & Non-Linear Data Structures. Structures and pointers. **Dynamic memory allocation**: allocating a block of memory: Malloc, allocating multiple blocks of memory, Releasing the used space: Free Altering the size of memory.
UNIT - 2
Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list, circularly linked lists- insertion, deletion and searching operations for circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, maintaining directory of names, Manipulation of polynomials (addition), representing sparse matrices. Stack and queue implementation using linked lists.
UNIT - 3
Stacks: Operations, array representations of stacks, stack applications - infix to postfix conversion, postfix expression evaluation, and function call tracing, recursion. **Queues:** Introduction, Basic concept, linear queue operations, circular queue, priority queues, double ended queues. Applications of Queues.
UNIT - 4
Trees: Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, Binary Search Tree operations and its implementation, applications of trees.
UNIT - 5
Balanced Trees: AVL Trees, Splay trees, Red- Black Trees – Definitions, Rotation and other basic operations.
Text Books:

1. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed, Universities Press, 2nd Edition, 2008.
2. Data Structures using C, Reema Thareja, Oxford University press, 2nd Edition, 2014.

Reference Books:

1. Data Structures using C, Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, Pearson Education, 5th Edition, 2007.
2. Reference Book 2Data Structures - A Pseudocode Approach with C, Richard F. Gilberg, Behrouz A. Forouzan, Cengage Learning, 1st Edition, 2005.

e- Books:

1. Data Structures using C, E. Balaguruswamy, https://dokumen.pub/data-structures-using-c-9781259029547-1259029549.html
2. Data structures and program design in C, Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung, https://cdn.preterhuman.net/texts/math/Data_Structure_And_Algorithms/Data%20Structures20and%20Program%20Design%20in%20C++%20-%20Robert%20L.%20Kruse.pdf

MOOCs:

1. Data Structures, https://www.coursera.org /learn/data-structures
2. Data Structures and Algorithms, https://nptel.ac.in/ courses/106102064/

COURSE OUTCOMES (COs)

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

CO1	Apply the concept of linear and nonlinear data structures for computing problems.
CO2	Analyse the appropriate data structure operations for a given problem.
CO3	Design and develop solutions using the linear and nonlinear data structure for a given specification.
CO4	Conduct experiments for demonstrating the operations of different data structures.

Laboratory Work

	Unit#	Program Details
1	2	Write a program to implement Singly Linked List with following operations a) Create a linked list. b) Insertion of a node at first position, at any position and at end of list. c) Display the contents of the linked list.
2	2	Write a program to Implement Singly Linked List with following operations

		a) Create a linked list. b) Deletion of first element, specified element and last element in the list. c) Display the contents of the linked list.
3	2	Write a program to Implement Singly Linked List with following operations a) Sort the linked list. b) Reverse the linked list. c) Concatenation of two linked lists
4	2	Write a program to Implement doubly linked list with primitive operations a) Create a doubly linked list. b) Insert a new node to the left of the node. c) Delete the node based on a specific value d) Display the contents of the list
5	3	Write a program to simulate the working of stack using an array with the following: a) Push b) Pop c) Display The program should print appropriate messages for stack overflow, stack underflow
6	3	Write a program to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)
7	3	Write a program to simulate the working of a queue of integers using an array. Provide the following operations a) Insert b) Delete c) Display The program should print appropriate messages for queue empty and queue overflow conditions
8	3	Write a program to simulate the working of a circular queue of integers using an array. Provide the following operations. a) Insert b) Delete c) Display The program should print appropriate messages for queue empty and queue overflow conditions
9	3	Write a program to implement Stack & Queues using Linked Representation
10	4	Write a program a) To construct a binary Search tree. b) To traverse the tree using all the methods i.e., in-order, pre order and post order c) To display the elements in the tree.
11	4	Write a program a. To construct a binary search tree b. To implement iterative in order traversal c. To delete a given element
12	5	Write a program to construct an AVL tree of integers

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	**Business Communication and Value Science - I**				
Course Code	**23BS3PCBC1**	**Credits**	**1**	**L-T-P**	**0-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**2**	**Total Lecture Hours**	**15**		

Modules
Overview of the course with immersion activity, Overview of business communication, Self-awareness, confidence and communication, Essentials of Business communication, Application of communication skills, Application of Life Skills.
Reference Materials
1. English vocabulary in use – Alan McCarthy and O'Dell 2. APAART: Speak Well 1 (English language and communication) 3. APAART: Speak Well 2 (Soft Skills) 4. Business Communication – Dr. Saroj Hiremath

COURSE OUTCOMES (COs)

CO1	Recognize the need for life skills and values.
CO2	Apply the life skills to different situations
CO3	Apply the basic communication practices in different types of communication

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	MATLAB for Probability and Discrete Math				
Course Code	23BS3PCMPD	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Contact Hours	24		

LAB CYCLE

PART-A [Learning MATLAB]

1. MATLAB Fundamentals
https://matlabacademy.mathworks.com/details/matlab-fundamentals/mlbe
2. MATLAB Onramp
https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted
3. Statistics Onramp
https://matlabacademy.mathworks.com/details/statistics-onramp/orst
4. Explore Data with MATLAB Plots
https://matlabacademy.mathworks.com/details/explore-data-with-matlab-plots/otmledp
5. Make and Manipulate Matrices
https://matlabacademy.mathworks.com/details/make-and-manipulate-matrices/otmlmmm

PART-B [Basic MATLAB Programs]

1. Write a MATLAB program to check if a given number is even or odd.
2. Write a MATLAB program to compute the factorial of a given number.
3. Write a MATLAB program to find the sum of n numbers.
4. Write a MATLAB program to find the greatest common divisor (GCD) of two numbers using Euclid's algorithm.
5. Write a MATLAB program to check if a number is prime or not.
6. Write a MATLAB program to print the first n numbers of the Fibonacci series.
7. Write a MATLAB program to implement binary search for a given sorted array and a key to find.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

PART-C [Probability]

1. Write a MATLAB program to compute the normal probability and conditional probability.
2. Consider 2 boxes A and B. First box contains 2 white and 3 red balls. Second box contains 4 white and 5 red balls. One of the ball is drawn at random from one of the box and it is found to be red. Write a MATLAB program using Bayes' theorem to find the probability that it was drawn from the second box.
3. Write a MATLAB program to compute and plot the Poisson probability mass function for a given rate λ and number of events.
4. Write a MATLAB program to calculate and plot the probability mass function of a geometric distribution for a given success probability p.
5. Write a MATLAB program to calculate the joint probability mass function (PMF) for two discrete random variables X and Y.
6. Write a MATLAB program to verify if a given matrix is a valid Markov transition matrix.
7. Write a MATLAB program to verify the Chapman-Kolmogorov equations for a given Markov chain.

PART-D [Discrete Math]

1. Write a MATLAB program that generates the truth table for basic logic gates: AND, OR, NOT, NAND, NOR, and XOR.
2. Write a MATLAB program to check whether the expression "p ∨ ¬p" is a tautology or not.
3. Write a MATLAB program to demonstrate the **principle of duality** for a given Boolean expression.
4. Write a MATLAB program to verify **De-Morgan's Laws**.
5. Write a MATLAB program to check if two Boolean expressions are equivalent or not. Use the following examples.

$x \wedge y \vee x \wedge (\neg y) \vee (\neg x) \wedge (\neg y)$ vs. $x \vee (\neg y)$

$\neg((\neg x) \wedge (\neg z) \vee (\neg x) \wedge y \vee (\neg x) \wedge z \vee x \wedge y)$ vs. $x \wedge (\neg y)$

6. Write a MATLAB program to represent a graph as an adjacency matrix. Implement this for both directed and undirected graphs.
7. Write a MATLAB program to compute the complement of a given graph using its adjacency matrix.
8. Write a MATLAB program to check whether a graph is connected or not. Use **DFS** to traverse the graph.

9. Write a MATLAB program to implement Dijkstra's algorithm to find the shortest path in a weighted graph.
10. Write a MATLAB program to implement Kruskal's algorithm and find the **MST** of a graph.

Reference:
1. **MATLAB Tutorial for reference** https://www.youtube.com/playlist?list=PLho7ncbqgQbviwKeoJybXPnFY5t590dRJ

COURSE OUTCOMES (COs)

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

CO1	Demonstrate proficiency in MATLAB programming by developing simple programs for arithmetic, logical operations, and data handling using matrices and plots.
CO2	Apply algorithmic thinking to implement solutions for basic computational problems.
CO3	Analyze and compute probability measures including normal, conditional, Poisson, geometric, and joint probabilities using MATLAB.
CO4	Utilize MATLAB for modeling and analyzing discrete mathematical structures.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER III

Course Title	Unix Programming				
Course Code	23BS3AEUNP	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Lecture Hours	15		

Modules
Working with UNIX commands on Basic Operating System commands, file attributes, file creation and file handling, directories, Processes, Filters such as find, cut, grep & egrep, Handling Jobs, SSH. Working with UNIX scripts on various IPC's, Task Management, File Management, Device files management, Schedulers, File transfer using IPC's, Deadlocks resolving, Compression utilities and Directory utilities, etc.
Text Books:
1. UNIX Concepts and Applications, Sumitabha Das, Second Edition, TMGH, 2002.
Reference Materials:
1. Advanced Programming in the UNIX Environment, by Stephen A. Rago, W. Richard Stevens, 2 Edition, Pearson Education / PHI, 2005
e-Books
1. http://catb.org/~esr/writings/taoup/html/ 2. http://oopweb.com/CPP/Documents/DebugCPP/VolumeFrames.html
MOOCs:
1. http://www.coursera.org/learn/unix 2. http://www.pluralsight.com/courses/linux-systems-programming 3. http://www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-1

COURSE OUTCOMES (COs)

CO1	Acquire the knowledge on various UNIX shell commands.
CO2	Apply the shell commands to develop UNIX scripts for the given problem.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	**Foundations of Algebra for Business Systems**				
Course Code	**23MA4BSABS**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1
Groups, Rings and Fields: Definition and some examples of groups, Klein 4-group, Additive and multiplicative modulo group of integers, subgroups. Definition and examples of Rings, some special classes of Rings. Definition of field and some examples.
UNIT - 2
Linear Transformation: Review of vector space, Linear Transformation. Geometric Linear Transformation, change of basis, linear functional, Dual Spaces, ~~Homeomorphism,~~ $L(V,W)$, Composition of linear transformations, Affine Subspaces, Affine transformations
UNIT - 3
Inner Product Spaces: Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt orthogonalization process, QR-factorization. Method of least squares for inconsistent systems and least square error.
UNIT - 4
Eigenvalues and Eigenvectors: Introduction, Polynomials of Matrices, Cayley-Hamilton Theorem, eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.
UNIT - 5
Matrix Decomposition and Their Applications: Diagonalization, Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Singular value decomposition. Dimensional reduction and image compression – PCA.
Text Books:

1. I. N. Herstein, "Topics in Algebra", 2nd Ed., John Wiley & Sons
2. G. Strang, “Introduction to Linear Algebra”, Wellesley-Cambridge Press, 5th Edition, 2016.
3. D. C. Lay, Steven R. Lay, Judi J. McDonald, Linear Algebra and Its Applications Loose Leaf, Pearson College Div, 5th edition, 2015.
4. S. Boyd and L. Vandenberghe, Introduction to Applied Linear Algebra, Cambridge University Press, 2018

Reference Books:

1. J. B. Fraleigh, "A First Course in Abstract Algebra", 7th Ed., Pearson Education 2
2. S Lipschutz, “Schaum's Outline of Linear Algebra”, McGraw Hill Education, 3rd edition, 2017.
3. R. Bronson and G. Costa, “Linear Algebra: An Introduction”, Elsevier, 2007.
4. K. Singh, “Linear Algebra: Step by Step”, Oxford University Press, 1st Edition, 2013.
5. S. H. Friedberg, A J. Insel and L. E. Spence, Linear Algebra, Pearson, 2019, Fifth Edition.
6. K. Hoffman, R. Kunze, “Linear Algebra”, 2nd edition, Pearson.

E-Books and online materials

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of algebra and linear algebra in Computer and Business System.
CO2	Analyse the concept of linear algebra applied to computer science and business system.
CO3	Demonstrate the use of modern tools for solving computer science and business system problem using algebra.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	Statistical Modeling for Business Systems				
Course Code	23MA4BSSBS	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	40		

UNIT - 1
STATISTICAL METHODS: Curve Fitting: Fitting the straight line, parabola and geometric curve by the method of least squares. Correlation and regression - Karl Pearson's coefficient of correlation and Spearman's rank correlation. Lines of regression, angle between two regression lines. Multiple correlation and multiple regression - Problems.
UNIT - 2
SAMPLING TECHNIQUES AND ESTIMATION: Random sampling - Sampling from finite and infinite populations (sampling with replacement and sampling without replacement), Sampling distribution of sample mean - Stratified random sampling. Point estimation - Criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation: Concept and Examples, Complete sufficiency and its application in estimation.
UNIT - 3
PARAMETRIC INFERENCE: Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Z test: Single mean, difference of means, t: Single mean, difference of means, Paired t-test, F test, Analysis of variance (one way with as well as without interaction).
UNIT - 4
NON-PARAMETRIC INFERENCE: Comparison with parametric inference, use of order statistics, Sign test, Chi square test- Goodness of fit, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test, Spearman's and Kendall's test.
UNIT - 5
TIME SERIES ANALYSIS & FORECASTING: Basics: Trend lines, Stationary, ARIMA Models, identification, estimation and forecasting.
Text Books:

1. R. E. Walpole, R. H. Myers, S. L. Myers and K.Ye, "Probability & Statistics for Engineers & Scientists", International Edition, 9th Edition.
2. D.C. Montgomery, G. C. Runger, "Applied Statistics and Probability for Engineers", Wiley Edition, 6th Edition.
3. S. C. Gupta, V. K. Kapoor, " Fundamentals Of Mathematical Statistics", Sultan Chand & Sons Publication.

Reference Books:

1. R. A. Johnson, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education India (2015) 8th ed.
2. A. M. Goon, M. K. Gupta and B. Dasgupta, "Fundamentals of Statistics," Vol. I & II, The World Press (2002), 8th ed.
3. C. Chatfield, "The Analysis of Time Series: An Introduction", Chapman & Hall/CRC (2003) 6th ed.
4. G. G. Vining, E. A. Peck and D. C. Montgomery, "Introduction to Linear Regression Analysis", Wiley- Interscience (2006), 6th ed.
5. A. M. Mood, F. A. Graybill and D. C. Boes, "Introduction to the Theory of Statistics", McGraw Hill (2017), 4th ed.
6. N. R. Draper and H. Smith, "Applied Regression Analysis", Wiley-Interscience (1998), 3rd ed.

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of Statistical methods, sampling techniques and inference to solve problems in Computer & Business systems.
CO2	Analyze problems in Computer & Business systems through statistical methods, sampling techniques and inferences.
CO3	Apply modern IT tools to solve Business systems using statistical methods, sampling techniques and inferences.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	**Formal Language and Automata Theory**				
Course Code	**23BS4PCFLA**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction to Finite Automata: Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition, An Application Text Search
UNIT - 2
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata
UNIT - 3
Context-Free Grammars and Languages Parse Trees: Context-Free Grammars, Parse trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating Unit Productions, Chomsky Normal Form, Greibach Normal form.
UNIT - 4
Pushdown Automata: Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages.
UNIT - 5
Introduction to Turing Machine: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers, Definition of Post Correspondence Problem, A Language That Is Not Recursively Enumerable, An Undecidable Problem That is RE, Other Undecidable Problems. NP Problems solvable in Polynomial Time, Satisfiability Problem.
Text Books:

1. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson education, 3rd Edition, 2007
Reference Books:
1. Introduction to Languages and Automata Theory, John C Martin, Tata McGraw- Hill, 3rd Edition, 2007. 2. An Introduction to Formal Languages and Automata, Peter Linz, Narosa Publishing House, 5th Edition, 2012.
e- Books:
1. Introduction to Theory of Computation, Anil Maheshwari, Michiel Smid, https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
MOOCs:
1. Automata Theory, https://www.edx.org/course/automata-theory 2. Introduction to Automata, Languages and Computation, https://onlinecourses.nptel.ac.in/noc21_cs19/preview 3. Automata Theory, https://online.stanford.edu/courses/soe-ycsautomata- automata-theory

COURSE OUTCOMES (COs)

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

CO1	Apply the knowledge of Automata Theory, Grammars & Regular Expressions for the given requirement of the formal language.
CO2	Analyse the given Automata to identify the formal language it represents.
CO3	Design Automata and Grammar for pattern recognition and syntax checking of the given formal language.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	Analysis and Design of Algorithms				
Course Code	23BS4PCADA	Credits	4	L-T-P	3-0-1
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Contact Hours		40 (L) + 24 (P)	

UNIT – 1
Introduction: What is an Algorithm?, Fundamentals of Algorithmic Problem Solving. **Fundamentals of the Analysis of Algorithm Efficiency:** Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-Recursive Algorithms, Mathematical Analysis of Recursive Algorithms.
UNIT – 2
Brute Force: Bubble Sort, Brute-Force String Matching, Exhaustive Search: Traveling Salesman Problem, Knapsack Problem, Assignment Problem. **Decrease-and-Conquer:** Depth-First Search and Breadth-First Search, Topological Sorting, Algorithms for Generating Permutations.
UNIT – 3
Divide-and-Conquer: Mergesort, Quicksort, Binary Search, Multiplication of Large Integers and Strassen's Matrix Multiplication. **Transform-and-Conquer:** Presorting, 2-3 Trees, Heaps and Heapsort. **Space and Time Tradeoffs:** Horspool's Algorithm, Hashing.
UNIT – 4
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem. **Greedy Technique:** Prim's Algorithm, Kruskal's Algorithm without Disjoint Subsets and Union-Find Algorithms, Dijkstra's Algorithm, Huffman Trees.
UNIT – 5
Backtracking: n-Queens Problem, Subset-Sum Problem. **Branch-and-Bound:** Assignment Problem, Traveling Salesman Problem. **P, NP, and NP-Complete Problems:** P and NP Problems, NP-Complete Problems.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Text Book:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, 3rd Edition, 2014.

Reference Books:

1. Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, The MIT Press, 3rd Edition, 2009.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekhara M, University Press Pvt. Ltd., 2nd Edition,2009.
3. Analysis and Design of Algorithms, Padma Reddy, Sri Nandi Publications, 2009.

Lab Cycle

Part – A (10M)

1. Sort a given set of elements using Bubble sort and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus input size.
2. Implement binary search and determine the time required to search an element. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus input size.
3. Sort a given set of elements using Merge sort and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus input size.
4. Sort a given set of elements using Quick sort and determine time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus input size.
5. Sort a given set of elements using the Heap sort method and determine the time taken to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus input size.

Part - B (Virtual Learning Environment- VLE) (10M)

1. **Greedy Technique-**
Dijkstra's path finding algorithm
Tutorial Link:
https://ds2-iiith.vlabs.ac.in/exp/dijkstra-algorithm/pretest.html

2. **Decrease and conquer-**
i. Discovering nodes in a graph using the BFS and DFS method.
Tutorial Link: https://ds1-iiith.vlabs.ac.in/exp/depth-first-search/index.html
ii. Topological Sorting
Tutorial Link: https://ds2-iiith.vlabs.ac.in/exp/topo-sort/index.html

3. **Space and time trade-offs-**
Understanding and Implementing Hash table:
i. Collision resolution - open and closed addressing
ii. Linear Probing
Tutorial Link: https://ds1-iiith.vlabs.ac.in/exp/hash-tables/index.html

4. **Transform and Conquer-**
Illustrate a height balanced tree 2-3 trees.
https://ds2-iiith.vlabs.ac.in/exp/2-3-tree/index.html

5. **Dynamic Programming-**
Finding All Pair Shortest paths problem using Floyd's algorithm.
Tutorial Link: https://virtual-labs.github.io/exp-floyd-warshall-iiith/theory.html

Part - C (Puzzle Based Learning) (5M)

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand fundamental algorithmic strategies and evaluate the efficiency of recursive and non-recursive algorithms using asymptotic notations.
CO2	Apply brute-force, decrease-and-conquer, and divide-and-conquer techniques to solve classic problems in sorting, searching, and graph traversal.
CO3	Develop efficient algorithmic solutions using advanced strategies such as transform-and-conquer, dynamic programming, and greedy approaches.
CO4	Analyze and implement backtracking and branch-and-bound techniques for solving combinatorial optimization problems.
CO5	Conduct experiments to implement algorithms and provide valid conclusions.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	Database Management Systems				
Course Code	23BS4PCDBM	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	5	Total Lecture Hours	40		

UNIT - 1
Databases and Database Users- Introduction, Characteristics of the Database Approach, Advantages of using the DBMS Approach, When Not to use a DBMS. Database. **System Concepts and Architecture-**Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, The Database System Environment.
UNIT - 2
Data Modeling Using the Entity-Relationship Model-Using High-Level Conceptual Data Models for Database design, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions and Design issues, A Sample Database Application, Relationship Types of Degree Higher than Two. Relational Database Design Using ER-to Relational Mapping.
UNIT - 3
The Relational Data Model and Relational Database Constraints- Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint. **Basic SQL**- SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE and UPDATE Statements in SQL, Additional Features of SQL, More Complex SQL Retrieval Queries, Views, Schema Change Statements in SQL.
UNIT - 4
The Relational Algebra- Unary Relational Operations: SELECT, PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations-JOIN, DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. **Basics of Functional Dependencies and Normalization for Relational Databases-** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.
UNIT - 5

Introduction to Transaction Processing Concepts and Theory- Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL, Two-Phase Locking Techniques for Concurrency Control.

Text Books:

1. Fundamentals of Database Systems,7th Edition, Ramez Elmasri & Shamkant B. Navathe, Published by Pearson India Education Services Pvt. Ltd.,2017.

Reference Books:

1. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Sixth Edition, Tata McGraw-Hill,2010
2. An Introduction to Database Systems, C.J.Date, A. Kannan, S. Swamynathan, 8 th Edition, Pearson Education, 2006
3. Database Management Systems, Ramakrishnan and Gehrke, 3rd Edition McGraw Hill 2014

e- Books:

1. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf
2. https://ebooks.lpude.in/management/mba/term_3/DCAP204_MANAGING_DATABASEDCAP402_ DATABASE_ MANAGEMENT_ SYSTEMS.pdf

MOOCs:

1. https://ocw.mit.edu/courses/6 -830-database-systems-fall- 2010/pages/lecture-notes/
2. https://www.udemy.com/topic/database-management
3. https:// www. classcentral. com/ course/ swayam- data- base- management-system-9914 nptel

COURSE OUTCOMES (COs)

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

CO1	Acquire the knowledge of fundamentals of database management systems.
CO2	Apply the concepts of Entity–Relationship model, relational algebra, database design principles and transaction management properties.
CO3	Extract the information from the given database using SQL for the given problems.
CO4	Design and demonstrate the given application without anomalies using ER modelling and Normalizations

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	**Financial Management**				
Course Code	**23BS3PCFMT**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction: Introduction to Financial Management - Goals of the firm - Financial Environments. **Time Value of Money:** Simple and Compound Interest Rates, Amortization, Computing more that once a year, Annuity Factor. **Valuation of Securities:** Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM.
UNIT - 2
Risk & Return: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM) **Operating & Financial Leverage:** Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study **Cost of Capital** : Concept , Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital
UNIT - 3
Capital Budgeting: The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods
UNIT - 4
Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.
UNIT - 5
Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring. **Accounts Receivable Management:** Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period.

Text Books:

1. Pandey, I. M., Financial management, Vikas Publishing House Pvt. Ltd., Noida, 2011, 12th ed.
2. Chandra, Prasanna - Financial Management - Theory & Practice, Tata McGraw Hill.
3. Brigham. Eugene F. and Houston. Joel F. (2006). Fundamentals of Financial Management, 10th Edition, Cengage Learning
4. Khan, M.Y & Jain, P.K.: Financial Management; Tata McGraw Hill, New Delhi, 2008.

Reference Books:

1. Srivastava, Misra: Financial Management, OUP
2. Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/ Pearson Education.
3. Brealey and Meyers: Principles of Corporate Finance: Tata McGraw Hill, New Delhi, 2008.
4. Keown, Martin, Petty and Scott (Jr): Financial Management: Principles and Applications; Prentice Hall of India, New Delhi, 2002.
5. Gitman, L.J: Principles of Managerial Finance; Addison Wasley, 2009.
6. Vanhorne, James C: Financial Management and Policy; Prentice Hall of India, New Delhi, 2002.
7. Kishore Ravi, M: Financial Management; Taxman, 2006.

COURSE OUTCOMES (COs)

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

CO1	Understand time value of money concept and the role of a financial manager in the current competitive business scenario.
CO2	Apply the methods and procedures for the valuation of bonds and equity share capital.
CO3	Apply the methods and procedures of financial management, with particular reference to investment evaluation, investment management, capital budgeting, risk management.
CO4	Deal with different issues of working capital management, financing of short-term assets and cash management.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	Competitive Programming using C/C++				
Course Code	23BS4AECPP	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Contact Hours	24		

LAB CYCLE

C Sessions (5 Sessions - Strong Fundamentals in C)

Session 1: Data Types, Operators & Control Flow

- Data Types & Type Casting
- Operators (Arithmetic, Logical, Bitwise, Relational)
- Control Flow (if-else, loops, switch-case)
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 2: Functions, Recursion & Memory Management

- Pass by Value vs Pass by Reference
- Function Pointers & Callbacks
- Recursion (Tail & Non-Tail), Stack Memory
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 3: Pointers, Arrays & Strings

- Pointer Arithmetic & Dynamic Memory (malloc, calloc, free)
- 2D Arrays & String Manipulation (strcpy, strcmp)
- Pointer to Arrays & Array of Pointers
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 4: Structures, Unions & File Handling

- Structures & Unions (Bit Fields, Memory Allocation)
- File Handling (fopen, fclose, fread, fwrite)
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 5: Linked Lists in C

- Single, Double, Circular Linked Lists
- Dynamic Memory Allocation & Linked List Operations
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

C++ Sessions (7 Sessions - STL & OOP for Competitive Programming)

Session 6: Introduction to C++ & OOP Fundamentals

- Classes & Objects, Encapsulation
- Constructor & Destructor
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 7: STL - Containers & Iterators

- Vectors, Lists, Deques
- Pairs, Tuples & Sorting with Comparators
- Iterators & Lambda Functions
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 8: STL - Stacks, Queues & Priority Queues

- Stack (LIFO), Queue (FIFO), Deque
- Priority Queue & Min/Max Heaps
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 9: STL - Maps, Multisets & Unordered Maps

- Ordered & Unordered Maps
- MultiMap & Set Operations
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 10: Object-Oriented Programming - Inheritance & Polymorphism

- Encapsulation, Inheritance, Polymorphism
- Function Overriding & Virtual Functions
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 11: Operator Overloading & Friend Functions

- Operator Overloading
- Friend Functions & Friend Classes
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

Session 12: Linked Lists, Stacks & Queues in C++

- Implementing Linked Lists using STL
- Implementing Stack & Queue Using Classes
- Scenario-Based Problems: 5 Easy, 5 Medium, 5 Hard

COURSE OUTCOMES (COs)

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

CO1	Apply foundational concepts of C and C++ programming such as data types, control flow, functions, and memory management to solve real-world problems.
CO2	Demonstrate proficiency in using pointers, arrays, structures, and dynamic memory for efficient problem-solving and algorithm implementation.
CO3	Utilize Object-Oriented Programming principles and Standard Template Library (STL) features in C++ to develop modular and reusable code.
CO4	Solve computational problems of varying complexity using structured and object-oriented approaches, and implement data structures such as linked lists, stacks, queues using both C and C++.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER IV

Course Title	Universal Human Values				
Course Code	23BS4HSUHV	Credits	1	L-T-P	0-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Contact Hours	20		

UNIT - 1

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and ExperientialValidation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilmentof aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT – 2

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

UNIT – 3

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust andRespect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; theother salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution,Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal

Order-from family to world family.
UNIT - 4
Understanding Harmony in the Nature and Existence - Whole existence as Coexistence 1. Understanding the harmony in the Nature 2. Holistic perception of harmony at all levels of existence.
UNIT - 5
Implications of the above Holistic Understanding of Harmony on Professional Ethics 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct

Text Books:
1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
Reference Books:
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book). 4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews 7. Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – PanditSunderlal 9. Rediscovering India - by Dharampal 10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi 11. India Wins Freedom - Maulana Abdul Kalam Azad 12. Vivekananda - Romain Rolland (English)

COURSE OUTCOMES (COs)

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

CO1	Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual.
CO2	Analyze the value of harmonious relationship based on trust and respect in personal and professional life.
CO3	Examine the role of a human being in ensuring harmony in society and nature.
CO4	Apply the understanding of ethics in life and profession.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

Department of Computer Science and Business Systems

Scheme and Syllabus

V and VI Semester

Semester-V

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	BS	23BS5BSBIO	Bio-Informatics	0	0	1	1	2
2	PC	23BS5PCSEM	Software Engineering and Methodologies	2	1	0	3	4
3	PC	23BS5PCCON	Computer Networks	3	0	0	3	3
4	IPCC	23BS5PCJAP	Java Programming	2	0	1	3	4
5	IPCC	23BS5PCERP	Enterprise Resource Planning with AI	2	0	1	3	4
6	HS	23BS5HSEWM	Environmental Studies and E-Waste Management	1	0	0	1	1
7	PE	23BS5PEDAI	Artificial Intelligence	3	0	0	3	3
		23CS5PEPSI	Product, Services and IT Service Management					
		23BS5PEIOT	Internet of Things					
8	PW-1	23BS5PWFSD	Full Stack Development	0	0	2	2	4
9	AE	23BS5AEBRM	*Business Research Methods*	2	1	0	3	4
10	NCMC	23BS5NCMC3	NSS/YOGA/Physical Edu. (Sports and Athletics)	0	0	0	PP/NP	0
			Details of 40 AICTE Activity Points					
	BS-1, PC-12, PE-3,PW-2,HS-1,AE-3		TOTAL	15	2	5	22	29

Semester-VI

No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours
				L	T	P		
1	PC	23BS6PCCMA	Cloud, Microservices and Application	2	1	0	3	4
2	IPCC	23BS6PCCNS	Cryptography and Network Security	3	0	1	4	5
3	IPCC	23BS6PCIPM	IT Project Management	2	0	1	3	4
4	IPCC	23BS6PCMLP	Machine Learning with Python	2	0	1	3	4
5	PE	23BS6PEGAI	Generative AI	3	0	0	3	3
		23BS6PEMDM	Digital and Social Media Marketing					
		23BS6PERPA	Robotic Process Automation					
6	OE	23BS6OEXXX	Open Elective -1	3	0	0	3	3
7	PW-2	23BS6PWPW1	Project Work -1	0	0	2	2	4
8	AE	23BS6AEDOP	DevOps	0	0	1	1	2
9	NCMC	23BS6NCMC4	NSS/YOGA/Physical Edu. (Sports and Athletics)	0	0	0	PP/NP	0
			Details of 60 AICTE Activity Points Earned					
	PC-13, PE-3,OE-3,PW-2,AE-1		TOTAL	15	1	6	22	29

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Software Engineering and Methodologies				
Course Code	23BS5PCSEM	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	25(L)+20(T)		

UNIT - 1
Foundations of Software Engineering: Introduction - Software metrics, Overview of Software Development Projects, Emergence of Software Engineering. **Software Life Cycle Models**: Basic Concepts, Waterfall Model and its Extensions, Rapid Application Development, Agile Development Models: Essential Ideas Behind Agile Models, Agile vs. Other Models, Spiral Model, Comparison of Different Life Cycle Models
UNIT - 2
Requirements Analysis and Specification - Requirements Gathering and Analysis, Software Requirements Specification (SRS). **Software Design** - Overview of the Design Process, Characteristics of Good Software Design: Cohesion and Coupling, Approaches to Software Design.
UNIT - 3
Function-Oriented Software Design - Overview of SA/SD, Methodology, Structured Analysis: Developing the DFD Model of a System, Structured Design and Detailed Design. **Object Modelling using UML: Basic Object-oriented concepts, UML, UML diagrams.**
UNIT - 4
Understanding Agile - What is Agile?, The Agile Manifesto and Principles, Why Agile Works Better than Traditional Models. **Kanban and Lean** - Introduction to Kanban Method, Lean Principles in Agile. **Jira Fundamentals** - Overview of Jira: Project Boards, Enrich Issues, Kanban Boards, Scrum Projects, Quick Search and Basic Search, JQL (Jira Query Language), Filters, Epics, Dashboards.
UNIT - 5
Software Testing Strategies: A strategic approach to software testing, Test strategies for conventional software.

Testing Conventional Applications: Software Testing Fundamentals, Internal and external view of testing, White box testing, Black box testing, Model based testing.
Text Books:
1. Fundamentals of Software Engineering, Rajib Mall ,5th Edition, PHI Learning, 2018 2. Software Engineering: A Practitioners Approach, Rogers S Pressman, 7th Edition, McGraw-Hill ,2007 3. Agile Foundations: Principles, Practices, and Frameworks Peter Measey Fourth BCS Learning & Development Limited,2015 4. Atlassian Jira Service Desk A Complete Guide, Gerardus Blokdyk, First S Viswanathan Printers and Publishing Private Limited, 2020.
Reference Books:
1. Essential Scrum: A Practical Guide to the Most Popular Agile Process, Kenneth Rubin, First Edition, Pearson 2017. 2. The Art of Agile Development, James Shore & Shane Warden, Second Edition, O'Reily 2007.

COURSE OUTCOMES (COs)

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

CO1	Understand and apply software engineering principles and life cycle models.
CO2	Analyze software requirements and design effective solutions.
CO3	Design and model software systems using structured, object-oriented, and agile methodologies.
CO4	Demonstrate knowledge of agile methods, tools, and testing strategies.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	**Computer Networks**				
Course Code	**23BS5PCCON**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1
Introduction to Computer Networks and Layered Architecture Introduction to Networking Concepts - Need for computer networks, types of networks, Packet, circuit, and virtual circuit switching Layering Principles - OSI Model: Functions of each layer, TCP/IP Protocol Suite: Comparison with OSI **Protocol Concepts** - Protocol layers, encapsulation, interfaces, and services
UNIT – 2
Data Link Layer and MAC Sub-layer Data Link Layer Functions - Framing techniques, Error detection: Parity, CRC, Flow control: Stop-and-wait, Sliding window **Medium Access Control (MAC)** - CSMA/CD, CSMA/CA, Ethernet: Traditional and Switched Ethernet, Ethernet Bridging and Spanning Tree Protocol
UNIT – 3
Network Layer – Routing and IP Addressing Routing Protocols - Static vs. Dynamic Routing, Algorithms: Shortest Path (Dijkstra), Flooding, Distance Vector, Link State **IP Addressing and Fragmentation** - IPv4 addressing, subnetting, Classless Inter-Domain Routing (CIDR), Datagram fragmentation and reassembly **Support Protocols** - Address Resolution Protocol (ARP), Dynamic Host Configuration Protocol (DHCP), Internet Control Message Protocol (ICMP), Network Address Translation (NAT)
UNIT - 4
Transport Layer Basics of Transport Services - Process-to-process communication, ports and sockets Protocols and Mechanisms - User Datagram Protocol (UDP), Transmission Control Protocol (TCP): Connection establishment and teardown, Flow control: Sliding window, Congestion control: AIMD, Slow Start
UNIT - 5

Application Layer Protocols
Domain Name System (DNS) - Name resolution, DNS hierarchy, caching
Web Technologies - HTTP protocol (versions, persistent connections, cookies), File Transfer Protocol (FTP)
Email Protocols - SMTP, POP3, IMAP basics, Email architecture

Text Books:

1. Computer Networks, Andrew S. Tanenbaum and David J. Wetherall, 5th Edition, Pearson, 2014.

Reference Books:

1. Communication Networks - Fundamental Concepts and Key architectures, Alberto Leon-Garcia and Indra Widjaja, 2nd Edition Tata McGraw-Hill, 2004.
2. Data Communication and Networking, Behrouz A. Forouzan, McGraw-Hill, 5th Edition, 2017.
3. Computer Networks and Internets, Douglas E. Comer, Pearson Education, 5th Edition, 2008.

COURSE OUTCOMES (COs)

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

CO1	Explain the need for computer networks and layered architectures, including OSI and TCP/IP models, along with concepts of protocols, encapsulation, and services.
CO2	Analyze the functions and mechanisms of the Data Link and MAC layers, including error detection, flow control, Ethernet technologies, and medium access protocols like CSMA/CD and CSMA/CA.
CO3	Apply routing algorithms and IP addressing techniques such as subnetting and CIDR, and describe key network layer protocols like ARP, DHCP, ICMP, and NAT.
CO4	Compare the features of transport and application layer protocols, including TCP, UDP, DNS, HTTP, FTP, and email protocols, and illustrate their role in reliable data communication and network services.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	**Java Programming**				
Course Code	**23BS5PCJAP**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Contact Hours**	**25(L)+24(P)**		

UNIT - 1
Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword. **Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing Nested and Inner Classes.
UNIT – 2
Inheritance: Inheritance Basics, using super, creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface.
UNIT – 3
Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:** Exception-Handling Fundamentals**,** Exception Types**,** Uncaught Exceptions**,** Using try and catch, Multiple catch Clauses, Java's Built-in Exceptions, Creating Your Own Exception Subclasses.
UNIT - 4
Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.
UNIT - 5
Enumerations, Type Wrappers and Autoboxing: Enumerations (Enumeration Fundamentals**,** The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values). **The Collections and Framework:** Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, accessing a collection Via an Iterator, Storing User Defined Classes in Collections
Text Books:
1. Java the Complete Reference by Herbert Schildt, 12th edition, Tata Mc Graw-hill Edition 2022
Reference Books:
1. Introduction to JAVA Programming by Y. Daniel Liang, 10th edition, pearson education, 2007 2. The Java Hand Book by Patrick naughton, TMH, 11th reprint 2002 3. Programming in JAVA 5.0, James P Cohoon, Jack W Davidson; TATA McGraw hill.

4. Cay S Horstmann, Gary Cornell: Core Java2, Volume 1 and 2, 7th Edition, Pearson Education.

Lab Cycle

1. Create a class with private data members and parameterized constructors. Implement getter/setter methods and demonstrate object creation. Show use of `this` keyword.
2. Write a program demonstrating method overloading with different parameters. Use `static` variables and methods to track object count.
3. Implement multilevel inheritance (e.g., `Person → Student → Graduate`). Demonstrate method overriding and calling parent methods using `super`.
4. Create an abstract class with abstract and concrete methods. Implement interfaces with default and static methods. Show polymorphism via interface reference variables.
5. Create a user-defined package with multiple classes. Import and use classes from the package in another program.
6. Implement try-catch-finally for multiple exception types. Write a user-defined exception (e.g., invalid age or marks). Demonstrate exception chaining.
7. Create threads using `Thread` class and `Runnable` interface. Demonstrate thread priorities and `join()` method. Use synchronization for shared resources.
8. Implement `wait()`, `notify()`, `notifyAll()` methods. Demonstrate producer-consumer problem.
9. Create an enum with methods and variables (e.g., days of week, states). Demonstrate autoboxing/unboxing with wrapper classes.
10. Use `ArrayList` and `HashMap` to store and retrieve objects. Implement sorting with `Comparator` and `Comparable`. Traverse collections using `Iterator` and enhanced for loop.

COURSE OUTCOMES (COs)

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

CO1	Understand and apply the fundamental concepts of classes, objects, constructors, methods, and memory management in Java programming
CO2	Demonstrate the use of inheritance, interfaces, and method overriding to implement object-oriented programming principles and polymorphism
CO3	Develop robust Java applications by effectively using packages, exception handling mechanisms, and multithreaded programming constructs.
CO4	Utilize advanced Java features such as enumerations, type wrappers, autoboxing, and the collections framework to build efficient and modular software solutions

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Enterprise Resource Planning with AI				
Course Code	23BS3PCBERP	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Lecture Hours	25		

UNIT - 1
Introduction: Functional Areas of Operation, Business Processes, Functional Areas and Business Processes of a very Small Business. Marketing and Sales, Supply Chain Management, Accounting and Finance, Human Resources, Functional Area Information Systems, Management's Impetus to Adopt ERP, ERP for Midsized and Smaller Companies, Significance and Benefits of ERP Software and Systems
UNIT – 2
Marketing Information Systems and Sales Order Process: Sales Quotations and Orders, Order Filling, Accounting and Invoicing, Payment and Returns, Sales and Distribution in ERP, Presales activities, Sales order processing, Inventory sourcing, Delivery, Billing, Payment. **Customer Relationship Management (CRM):** Core CRM Activities, Benefits of CRM.
UNIT – 3
Production and Supply Chain Management Information Systems: Production Overview, Production Planning Process, Sales Forecasting, Sales and Operations Planning, Demand Management, Materials Requirements Planning (MRP), Detailed Scheduling, ERP and Suppliers, **Human Resources Processes with ERP:** Recruiting Process, Interviewing and Hiring Process, Relationships among persons, positions, jobs, and tasks, Advanced ERP Human Resources Features.
UNIT - 4
Accounting in ERP Systems: Accounting Activities, ERP for Accounting Information, Operational Decision-Making Problem, Credit Management, Credit Management in ERP, Product Profitability Analysis, Problems Consolidating Data from Subsidiaries, Management Reporting with ERP Systems, Trends in Financial Reporting.
UNIT - 5
Artificial Intelligence in ERP: Directions for the Development of Artificial Intelligence and ERP Systems, Types of AI in ERP, Traditional ERP vs AI-Driven ERP, Benefits of AI Integration in ERP Systems, Challenges of AI in ERP.

Application of AI in ERP Systems: Sales and marketing, Warehouse management, Financial management and controlling, Human resource management, Planning and production, Information security.
Text Books:
1. Ellen F. Monk, Bret J. Wagner, Concepts in Enterprise Resource Planning, 4th Edition, Cengage. 2. Rabi Jay, Enterprise AI in the Cloud, 2024, John Wiley & Sons
Reference Books:
1. Alexis Leon, Enterprise Resource Planning, Second Edition, Tata McGraw-Hill. 2. Ilya Katsov, The Theory and Practice of Enterprise AI, Second Edition, Grid Dynamics.

Lab
Hands on practice on ERP Basics, Accounting for ERP, Order to Cash, Procure to Pay, Item Management, Record to Report, and Fixed Asset Management.
Project
In the project phase, student teams will build mini ERP application for a small business organization.

COURSE OUTCOMES (COs)

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

CO1	Describe functional areas and business processes in ERP
CO2	Apply the concepts of Marketing, Sales, CRM for real world cases.
CO3	Analyse the application of SCM and HRM in ERP.
CO4	Understand the accounting principles in ERP.
CO5	Propose projects or solutions using AI-ERP concepts

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Environmental Studies and E-Waste Management				
Course Code	23BS5HSEWM	Credits	1	L-T-P	1-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	1	Total Lecture Hours	13		

UNIT - 1
Ecosystem and Sustainability: Ecosystem: Structure of Ecosystem, Types: Forest, Desert, Wetlands, Riverine, Oceanic ecosystems. Sustainability: 17SDG targets and possible actions. *Self-Study Component (SSC): Components of the environment.)*
UNIT – 2
Natural resources and Energy: Natural Resources: Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water. **Energy:** Different types of energy, Conventional sources & Non -Conventional sources of Energy, Solar energy, Wind Energy, Hydrogen as an alternative energy *Self-Study Component (SSC): Alternative Energy sources*
UNIT – 3
Environmental Pollution: Environmental Pollution: Water Pollution, Noise pollution, Air pollution (Sources, Impacts, Preventive measures and Public Health Aspects. *Self-Study Component (SSC): Case studies of air pollution episodes*
UNIT - 4
Waste management: Waste management: Solid Waste Management, types and sources, functional elements of SWM, Biomedical Waste Management - Sources, Characteristics Environmental Legislation: Solid Waste Management Rules,2016, Biomedical Waste Management Rules, 2016. *Self-Study Component (SSC): Case studies on waste management options*
UNIT - 5
E - Waste Management: E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management. E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2022 - Salient Features and its implications. *Self-Study Component (SSC): E-Waste (Management) Amendment Rules, 2023, 2024*

Text Books:

1. S M Prakash , "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018.
2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009.

Reference Books:

1. EarchBarucha, "Environmental Studies for UG students", 2004.
2. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
3. R. Rajagopalan, "Environmental Studies- From Crisis to Cure", 2nd Edition, Oxford university press, New Delhi, 2013.
4. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi.
5. Raman Sivakumar, "Principles of Environmental Science and Engineering", 2nd edition, Cengage learning Singapur, 2005.
6. G. Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006
7. Dr. Pratiba Singh, Dr.Anoop Singh and Dr. PiyushMalaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.

COURSE OUTCOMES (COs)

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

CO1	Comprehend the principles of ecology and environmental issues pertaining to air, land, and water on a global scale.
CO2	Acquire observation skills for solving problems related to the environment.
CO3	Conduct survey to describe the realities of waste management system.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Internet of Things				
Course Code	23BS5PEIOT	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - I
Introduction to IoT: Introduction, Evolution of IoT, IoT vs M2M, IoT vs CPS, IoT vs WoT , Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT. **IoT Sensing and Actuation:** Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.
UNIT - II
IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading. **IoT Connectivity technologies:** IEEE 802.15.4, ZigBee, RFID, NFC, LoRa, Wi-Fi, Bluetooth.
UNIT - III
IoT Communication Technologies: Introduction, Infrastructure Protocols:IPv6, LOADng, RPL, 6LoWPAN Data Protocols: MQTT, MQTT-SN, CoAP **Data Acquiring, organising:** Introduction, data acquiring and storing, organizing data **Storage and Computing Using a Cloud Platform:** Introduction, everything as a service and cloud computing, IoT Cloud based services using Xively, Nimbits and other platforms.
UNIT - IV
Prototyping Embedded Devices for IoT and M2M: Introduction, Embedded computing basics: Embedded software, Embedded Hardware units, Embedded platforms for prototyping: Arduino, IntelGalileo, IntelEdison, Raspberry Pi, BeagleBone, Things Always Connected to The Internet/Cloud. **Security Requirements and Challenges in IoT:** Overview of security needs, common threats, and vulnerabilities specific to IoT systems
UNIT - V
IoT Applications: Introduction to Agricultural IoT, Components of an agricultural IoT, Advantages of IoT in agriculture, Introduction to Vehicular IoT, Components of vehicular

IoT,Advantages of vehicular IoT,Introduction to Healthcare IoT,Components of healthcare IoT,Advantages and risk of healthcare IoT, Case Studies:Smart irrigation management system, Crime assistance in a smart IoT transportation system.
Text Books:
1. Introduction to IoT, Sudip Misra, Anandarup Mukherjee, Arijit Roy, Cambridge University Press 2021. 2. Internet of Things, Architecture and Design Principles, Raj Kamal, 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224). 3. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
Reference Books:
1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015 2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.

COURSE OUTCOMES (COs)

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

CO1	Describe the architecture, components, and principles of IoT systems.
CO2	Analyse hardware and software platforms used in IoT.
CO3	Demonstrate knowledge of communication technologies and data handling.
CO4	Analyse security challenges in IoT systems and Develop simple IoT solutions addressing real-world problems

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Artificial Intelligence				
Course Code	23BS5PEDAI	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			40

UNIT – 1
Introduction: What is AI? **Intelligent Agents:** How agent should act, Structure of Intelligent Agents, Environments. **Problem Solving:** Formulating Problems, Example Problems. **Uniformed-Search Strategies:** Breadth-First Search, Uniform Cost Search, Depth-First Search, Depth Limited Search, Iterative Deepening Search.
UNIT – 2
Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.
UNIT – 3
Knowledge Representation: Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic. **Representing Knowledge using Rules:** Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning.
UNIT – 4
Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Bayes' Rule and its Use, where do Probabilities come from, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.
UNIT – 5
Introduction to Expert Systems: Definition, Features of an Expert System, Organization, Characteristics, Prospector, Knowledge Representation in Expert Systems, Expert System Tools – MYCIN, EMYCIN.

Text Book: 1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third Edition, Pearson, 2014.
Reference Books: 1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third Edition, McGraw-Hill Education, 2015. 2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Explain the foundational concepts of Artificial Intelligence, including intelligent agents, environments, and uninformed search strategies such as BFS, DFS, and uniform cost search.
CO2	Apply heuristic search strategies like hill climbing, best-first search, and means-ends analysis to solve complex problem-solving tasks.
CO3	Represent and reason with knowledge using propositional and first-order logic, and differentiate between rule-based reasoning approaches such as forward and backward chaining.
CO4	Model uncertainty in AI systems using probabilistic reasoning and belief networks, and analyze the structure and applications of expert systems including tools like MYCIN and EMYCIN.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Business Research Methods				
Course Code	23BS5AEBRM	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Contact Hours	25 (L) + 20 (T)		

UNIT - 1
Business Research: Meaning, types, process of research- management problem, defining the research problem, formulating the research Hypothesis, developing the research proposals, research design formulation, sampling design, planning and collecting the data for research, data analysis and interpretation. Research Application in business decisions, Features of good research study. **Basics of Hypothesis Testing** – Null and Alternative Hypothesis, Type I and Type II Errors, Level of Significance, and p-value.
UNIT – 2
Business Research Design: Meaning, types and significance of research design. Exploratory and Conclusive Research Design. Exploratory Research: Meaning, purpose, methods- Literature search, experience survey, focus groups and comprehensive case methods. Conclusive Research Design - Descriptive Research - Meaning, Types – Cross sectional studies and longitudinal studies. Experimental Research Design – Meaning and classification of experimental designs-formal and informal, Pre experimental design, Quasi-experimental design, True experimental design, statistical experimental design.
UNIT – 3
Sampling: Concepts- Types of Sampling - Probability Sampling – simple random sampling, systematic sampling, stratified random sampling, cluster sampling -Non-Probability Sampling – convenience sampling- judgemental sampling, snowball sampling- quota sampling - Errors in sampling.
UNIT - 4
Data Collection: Meaning of Primary and Secondary data, Primary data collection methods - observations, survey, interview and Questionnaire, Qualitative Techniques of data collection, Questionnaire design – Meaning - process of designing questionnaire. Secondary data -Sources – advantages and disadvantages. Measurement and Scaling Techniques: Basic measurement scales-Nominal scale, Ordinal scale, Interval scale, Ratio scale. Attitude measurement scale - Likert's Scale, Semantic Differential Scale, Thurstone scale, Multi-Dimensional Scaling, Case Study.
UNIT - 5
Data Analysis, Hypothesis Testing and Report Writing: Data Analysis and Interpretation: Editing, Coding, Classification, Tabulation, Validation Hypothesis Testing: t-test, z-test, chi-square test, ANOVA (brief overview), Correlation and Regression Analysis: Pearson's correlation, Simple Linear Regression, Multiple Regression (conceptual with interpretation), Use of Statistical Tools: Overview of tools like SPSS, Excel, R, or Python for basic testing and analysis

Report Writing and Presentation of Results: Importance, Types of Reports, Structure, and Documentation Guidelines

Text Books:
1. Business Research Methods by Donald R. Cooper and Pamela S. Schindler.
Reference Books:
1. Research Methodology: Methods and Techniques by C.R. Kothari and Gaurav Garg. 2. The Craft of Research by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams. 3. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell and J. David Creswell.

COURSE OUTCOMES (COs)

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

CO1	Explain the process of business research by identifying and defining management problems, formulating hypotheses, and selecting appropriate research designs to support managerial decision-making.
CO2	Differentiate among various research designs and sampling techniques, including exploratory, conclusive, experimental, and both probability and non-probability sampling methods.
CO3	Apply suitable data collection methods and measurement techniques, including questionnaire design and scaling methods, to gather and analyze primary and secondary data effectively.
CO4	Demonstrate the ability to analyze research data and communicate findings through well-structured research reports using appropriate editing, coding, tabulation, and presentation formats.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Product, Services and IT Service Management				
Course Code	23BS5PEPSI	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Overview of Products and IT Services: Introduction to industrial revolutions from 1.0 to 5.0, overview of products, services, and their underlying components, IT Infrastructure, Data Center and Cloud computing, Application management (Development to maintenance)
UNIT – 2
IT Service Management and delivery of IT Services: Introduction to IT Service Management, the standards and frameworks in the industry and its evolution, concepts Value management, 4 Ps of IT service management, Principles and guidelines, IT Service management process and procedures overview
UNIT – 3
IT Service Management best practices: Application of IT service management best practices in IT Service delivery, **Portfolio, Program and Project Management while delivering IT Product and Services:** Introduction to Portfolio, Program and Project Management structure and its importance while delivering IT products and services. Methodologies and industry practices, Agile overview, Concepts of Scrum, Kanban and Lean, use of Agile mindset, principles and methods in IT products and service delivery
UNIT - 4
Everything as a Service: Different types of Cloud based computing models (IaaS, PaaS, SaaS), Role of service management in service-based cloud model, importance of service integration and management in multi supplier environment **DevOps and IT Service management:** Introduction to DevOps, management of deployment and releases, improve resilience and reliability of products and IT services, understanding service mindset
UNIT - 5
Use of technology to manage services: How technology enables management of services, tools for IT service management, IT operations management (event monitoring and integration), Toil reduction using automation, Artificial Intelligence infused IT service operations

Text Books:
1. Axelos, ITIL Foundation: ITIL 4 Edition (ITIL 4 Foundation)
Reference Books:
1. Nikhilesh Mishra, Mastering IT Infrastructure Management: Concepts, Techniques, and Applications 2. Rahul Shah, Agile Essentials: From Concepts to Customer Delight

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of IT Service management in product and service lifecycle
CO2	Analyse the underlying components (Infrastructure and Applications) of products and services
CO3	Design the value co-creation process to improve the overall customer and user experience

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	**Full Stack Development**				
Course Code	**23BS5PWFSD**	**Credits**	**1**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Contact Hours**	**48**		

Lab

Working with in-demand Full Stack Development skills like HTML, CSS, JavaScript, React.js, NodeJS etc. It is designed to give an essence of Front-end, Middleware, Backend and Testing with web developer technologies applying on real time projects.

- Building expertise in developing Front End Application using HTML, CSS, JavaScript along with jQuery and AngularJS framework or with the latest framework and technologies such as NodeJS.
- Exploring MVC architecture and implementing responsive web applications which will scale well across PC, Tablet and Mobile.
- Creating Databases and Users, Inserting, Retrieving and Updating Data into the Databases.
- Setting up a connection and Querying the Databases.
- Deploying and hosting web and mobile applications.
- Securing applications.

Mandatory Projects

1. **Project A:** Mini Uber (Weeks 1–6)

   Core focus: Real-time systems, mapping, driver-rider matching, queues

2. **Project B:** Mini Door Dash (Weeks 7–12)

   Core focus: Order lifecycle, async workers, delivery queue, inventory/db modelling

Projects

Students can form a team of two to four and develop a full stack of the identified project.

Text Books:

1. Philip Ackermann, Full Stack Web Development, The Comprehensive Guide,

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

COURSE OUTCOMES (COs)

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

CO1	Comprehend the principles of full stack development.
CO2	Acquire skills for developing a project on full stack.
CO3	Design and develop projects using full stack individually or in a team.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER V

Course Title	Bio-Informatics				
Course Code	23BS5BSBIO	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Contact Hours	24(P)		

Lab Cycle

Students are encouraged to utilize BioPython for coding the following questions

1. Using the Seq class from Biopython, create a DNA sequence object and: Slice the sequence to extract a specific region (e.g., from index 3 to 10), Concatenate this sequence with another sequence, and Transcribe and translate the concatenated sequence into RNA and protein sequences

2. Python Script to Read Sequence Data from a FASTA File and Extract Both the Sequence and its Description (Header)

3. Using a SeqRecord object, write the DNA sequence along with its annotations (e.g., gene name, function) to a GenBank file format

4. Given a FASTA file, write a Python script that reads the file and converts it into GenBank format, while preserving the sequence and annotations

5. Create a SeqRecord object for a DNA sequence and add annotations for a gene (start, end position, description). Modify the annotations and print the updated SeqRecord

6. Write a script that uses Entrez to fetch a nucleotide sequence from the NCBI database by using a known accession number, and print out the sequence and the related metadata

7. Using Bio.pairwise2, perform pairwise sequence alignment of two DNA sequences. Print the alignment result and the alignment score

8. Write a script to read a GenBank file and extract the following: Sequence ID, name, and description, all annotated features (e.g., CDS, gene), Start and end positions of each feature, and Product or gene name if available

9. Given a DNA sequence in FASTA format, write a script to: Calculate GC content using a sliding window approach (e.g., window size = 100), and Plot GC content along the length of the sequence using matplotlib

10. Write a Python script that: Reads a DNA sequence from a FASTA file, Identifies all possible ORFs (starting with ATG and ending with TAA, TAG, or TGA), Prints the position and length of each ORF, and Optionally translates each ORF into protein

Project

Final Project:
Sample Ideas
Project 1: Comparative Genomics and Phylogenetic Analysis, analyze evolutionary relationships between related species, perform multiple sequence alignment and construct a phylogenetic tree
Project 2: Protein Structure Analysis and Functional Prediction, Analyze the structure of a protein and predict its functional sites, compare with related proteins to understand its biological role

Some more ideas:
Mutation Mapping in Disease-Related Genes, Comparative Genomics of Viruses, Codon Optimization for Heterologous Expression, Genome Annotation Viewer from GenBank File, Drug Resistance Gene Detector in Bacteria, Cancer Biomarker Finder from Expression Data, Evolutionary Conservation Score Calculator, Design a DNA Barcode Identifier Tool

Text Books:

1. Introduction to Bioinformatics by Arthur M Lesk, University of Cambridge, Oxford University Press Inc., 2002.

Reference Books:

1. Bioinformatics and Functional Genomics by Jonathan Pevsner, Wiley-Blackwell, 3rd Edition (2015)
2. Essential Bioinformatics by Jin Xiong, Cambridge University Press

COURSE OUTCOMES (COs)

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

CO1	Apply Biopython tools to manipulate and analyze DNA sequences, including operations such as slicing, transcription, translation, and pairwise alignment.
CO2	Demonstrate proficiency in reading, writing, and converting biological sequence file formats (e.g., FASTA and GenBank) using SeqRecord objects and sequence annotation features.
CO3	Utilize online bioinformatics resources (e.g., NCBI Entrez) to fetch and analyze biological data, and visualize sequence properties like GC content through computational scripts and plots.

CO4	Utilize Biopython to design and implement bioinformatics solutions for sequence analysis and data processing, both independently and collaboratively

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	**Cloud, Microservices and Applications**				
Course Code	**23BS6PCCMA**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Contact Hours**	**25(L)+20(T)**		

UNIT - 1
Introduction to Cloud Computing: Introduction, Historical developments, Building cloud computing environments. **Cloud Computing Architecture:** The cloud reference model, Types of clouds, Economics of the cloud, Open challenges
UNIT - 2
Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples**.** **Orchestration:** Introduction to Orchestration, Automation with a Larger Scope, Kubernetes: An Example Container Orchestration System, Limits on Kubernetes Scope, The Kubernetes Cluster Model
UNIT - 3
Microservices: Introduction, Traditional Monolithic Applications, Monolithic Applications in A Data Center, The Microservices Approach, The Advantages of Microservices, The Potential Disadvantages of Microservices, Microservices Granularity, Communication Protocols Used for Microservices, Communication Among Microservices, Using A Service Mesh Proxy, The Potential for Deadlock, Microservices Technologies**.**
UNIT - 4
Cloud Security and Privacy: Cloud-Specific Security Problems, Security in A Traditional Infrastructure, Why Traditional Methods Do Not Suffice for The Cloud, The Zero Trust Security Model, Identity Management, Privileged Access Management (PAM), AI Technologies and Their Effect on Security, Protecting Remote Access, Privacy in A Cloud Environment, Back Doors, Side Channels, And Other Concerns, Cloud Providers as Partners for Security and Privacy.

UNIT - 5
Serverless Computing: Introduction, Traditional Client-Server Architecture, scaling a Traditional Server to handle multiple Clients, scaling a server in a Cloud environment, The Economics of Servers in the Cloud, The Serverless Computing Approach, Stateless Servers and Containers, The Architecture of a Serverless Infrastructure, An Example of Serverless Processing, Potential disadvantages of Serverless Computing. **Cloud for Industry, Healthcare and Education:** Cloud computing for Healthcare, Cloud computing for Energy Systems, Cloud computing for Transportation Systems, Cloud computing for Manufacturing Industry, Cloud computing for Education.
Text Books:
1. Mastering Cloud Computing, Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, ISBN: 978-0-12-411454-8,2013. 2. The Cloud Computing Book, The Future Of Computing Explained, Douglas E. Comer, CRC Press, 2021. 3. Cloud Computing- A Hands-on-Approach, Arshdeep Bahga, Vijay Madisetti, 2016
Reference Books:
1. Cloud Computing-Principles and paradigm, Rajkumar Buyya, James Borberg, Andrzej Goscinski, 2016. 2. Cloud Computing - Theory and Practice, Dan C. Marinesco, 2013 Elsevier Inc

COURSE OUTCOMES (COs)

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

CO1	Understand cloud paradigms, including architecture, security, privacy, and associated challenges and risks in cloud computing.
CO2	Apply computing principles to effectively utilize cloud environments and services.
CO3	Analyse the significance of virtualization, microservice architectures, orchestration in enhancing cloud-based solutions.
CO4	Evaluate the use of cloud technologies across various industry domains such as healthcare, education, transportation, and manufacturing.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	Machine Learning with Python				
Course Code	23BS6PCMLP	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Contact Hours	25 (L) + 24 (P)		

UNIT - 1
Introduction to Machine Learning What is Machine Learning? Categories: Supervised, Unsupervised, Reinforcement Learning, Real-world applications in business, finance, and systems, The ML pipeline: data preparation, model training, evaluation, deployment, Introduction to Scikit-Learn: Pipelines, transformers, estimators, The Jupyter ecosystem, Pandas, NumPy basics for ML
UNIT – 2
Supervised Learning – Regression & Classification Linear Regression: Gradient descent, normal equation Classification: k-NN, Logistic Regression, Softmax Performance metrics: RMSE, MAE, Confusion matrix, Precision, Recall, F1-Score, Cross-validation, train-test split
UNIT – 3
Decision Trees, Ensemble Methods and Model Evaluation Decision Trees, Gini index, Entropy, Overfitting, pruning Ensemble methods: Random Forest, Bagging, Voting Classifier Feature importance, hyperparameter tuning with GridSearchCV
UNIT - 4
Unsupervised Learning & Dimensionality Reduction Clustering: k-Means, DBSCAN Dimensionality Reduction: PCA, t-SNE, LDA Applications of clustering in business analytics, Introduction to anomaly detection
UNIT - 5
Neural Networks & Deep Learning Introduction to Neural Networks, Deep Neural Networks (DNNs), TensorFlow & Computational Graphs, Keras Model Architecture & Compilation, Regularization Techniques

Text Books:

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly, 2019. ISBN: 978-9352139055.
2. Deep Learning with Python, 2nd Edition by François Chollet, Manning Publications, 2021.

Reference Books:

1. Machine Learning - An Algorithmic Perspective, Stephen Marsland, 2nd Edition, 2015.
2. Introduction to Machine Learning with Python, A Guide for Data Scientists, Andreas C. Miller and Sarah Guido, O'Reilly Media, 2017.
3. Python Machine Learning- Third Edition by Sebastian Raschka and Vahid Mirjalili.

Lab Cycle

1. Write a Python program using NumPy and Pandas to load a CSV file, perform basic statistics, handle missing values, and visualize data using Matplotlib.
2. Build an ML pipeline using Scikit-learn that includes scaling, encoding categorical features, and splitting the dataset into training and test sets.
3. Implement Linear Regression using Scikit-learn and compare performance using Gradient Descent and Normal Equation. Evaluate using RMSE and MAE.
4. Train and compare k-Nearest Neighbors and Logistic Regression classifiers on a labeled dataset (e.g., Iris). Use confusion matrix and accuracy metrics.
5. Evaluate classification models using Precision, Recall, F1-score, and cross-validation. Use train-test split and k-fold methods.
6. Implement a Decision Tree classifier using Gini index and entropy. Demonstrate overfitting and pruning using max depth and min samples split.
7. Implement Random Forest and Voting Classifier using Scikit-learn. Compare performance with Decision Trees.
8. Tune hyperparameters for Random Forest or Decision Tree using GridSearchCV and report best parameters and performance.
9. Implement k-Means clustering and DBSCAN on a dataset. Visualize clusters and compare using silhouette score.
10. Apply PCA and t-SNE on a dataset for visualization and dimensionality reduction. Compare explained variance and plots.
11. Implement a Deep Neural Network using Keras to classify the Fashion-MNIST dataset. Use appropriate activation and loss functions.
12. Demonstrate overfitting and apply L2 regularization, dropout, and early stopping using Keras to improve generalization.

Group Project

Choose a real-world dataset (e.g., customer churn, fraud detection). Build a complete pipeline: data cleaning, training, model selection, evaluation, and result interpretation. Oral exam and demonstration of mini project with performance metrics, source code explanation, and outcomes.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

COURSE OUTCOMES (COs)

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

CO1	Explain the fundamental concepts and categories of machine learning, the ML pipeline, and tools like Scikit-Learn, Pandas, and NumPy for data preparation and model development.
CO2	Apply supervised learning techniques such as linear regression, logistic regression, k-NN, and softmax for predictive modeling, and evaluate models using standard performance metrics.
CO3	Implement decision trees, ensemble methods, and model tuning techniques like Random Forest and GridSearchCV to improve model performance and interpretability.
CO4	Use unsupervised learning and neural network approaches such as k-means, PCA, and deep neural networks with TensorFlow/Keras for clustering, dimensionality reduction, and complex pattern recognition tasks.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	**Cryptography and Network Security**				
Course Code	**23BS6PCCNS**	**Credits**	**3**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**3**	**Total Lecture Hours**	**40**		

UNIT - 1
Foundations of Cryptography Introduction to Security: Security services, threats, mechanisms, OSI security architecture **Classical Encryption Techniques**: Caesar cipher, monoalphabetic and polyalphabetic substitution, transposition ciphers **Cryptanalysis**: Frequency analysis, brute force **Introduction to Number Theory**: Modular arithmetic, Euclidean algorithm, Euler's theorem
UNIT – 2
Symmetric-Key Cryptography **Block Ciphers**: Block cipher principles, modes of operation (ECB, CBC, CFB, OFB, CTR) **Data Encryption Standard (DES)**: Design, Feistel structure, decryption **Advanced Encryption Standard (AES)**: Architecture, SubBytes, ShiftRows, MixColumns, Key Expansion, Stream Ciphers and RC4
UNIT – 3
Public-Key Cryptography **Principles of Public-Key Cryptography**: Key distribution, public key vs. private key, RSA Algorithm: Key generation, encryption, decryption, Diffie-Hellman Key Exchange. **Elliptic Curve Cryptography (ECC)**: Basic concepts and comparison with RSA, Security of Public Key Schemes
UNIT - 4
Authentication, Integrity & Digital Signatures Message Authentication Codes (MAC), Hash Functions: SHA-1, SHA-2, SHA-3, HMAC and CMAC **Digital Signatures**: RSA and DSA-based digital signature schemes **Authentication Applications**: Kerberos, X.509 Authentication Service, Entity Authentication: Challenge-Response protocols
UNIT - 5

Network Security & System-Level Security
Transport Layer Security: SSL/TLS Protocols, Cipher Suites, Record Layer
IP Security (IPSec): AH, ESP, Security Associations, IKE
Wireless Security: WPA, WPA2 basics
Firewalls and Intrusion Detection Systems (IDS): Packet filtering, stateful inspection
Email Security: S/MIME, PGP
Security Trends: Zero Trust, Zero-Day Exploits (brief overview)

Text Books:

1. William Stallings, Cryptography and Network Security – Principles and Practice, 7th Edition, Pearson, 2017.

Reference Books:

1. Network Security Essentials Applications and Standards, William Stallings, Pearson, 4th Edition, 2012.
2. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 2nd Edition, PHI, 2013.
3. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

COURSE OUTCOMES (COs)

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

CO1	Explain the foundations of cryptography, including classical encryption techniques, cryptanalysis, and number theory relevant to cryptographic systems.
CO2	Analyze and implement symmetric and public-key cryptographic algorithms, such as DES, AES, RSA, Diffie-Hellman, and ECC, along with their modes of operation and security considerations.
CO3	Apply cryptographic methods for authentication, integrity, and digital signatures, including the use of MACs, hash functions, and protocols like Kerberos and X.509.
CO4	Evaluate network and system-level security mechanisms, including TLS, IPSec, WPA2, firewalls, IDS, and email security protocols, and understand emerging trends like Zero Trust and Zero-Day Exploits.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	IT Project Management				
Course Code	23BS6PCIPM	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	4	Total Contact Hours	25(L)+24(P)		

UNIT - 1
Introduction to Project Management: Project Management Framework, Stakeholders, Knowledge Areas, Tools and Techniques, Program and Project Portfolio Management, A Systems View of Project Management, The Three-Sphere Model for Systems Management, Project Management Process Groups.
UNIT – 2
Project Integration Management: Strategic Planning and Project Selection, Developing a Project Management Plan, Directing and Managing Project Work, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases, **Project Scope Management:** Planning Scope Management, Creating the Work Breakdown Structure, Validating and Controlling Scope.
UNIT – 3
Project Time Management: Planning Schedule Management, Defining Activities, Sequencing Activities, Estimating Activity Resources and Durations, Developing the Schedule, Controlling the Schedule. **Project Cost Management:** Importance of Project Cost Management, Basic Principles of Cost Management, Planning Cost Management, Estimating Costs, Determining the Budget and Controlling Costs.
UNIT - 4
Project Quality Management: Planning Quality Management, Performing Quality Assurance, Tools and Techniques for Quality Control, Modern Quality Management, Improving IT Project Quality, **Project Risk Management:** Planning Risk Management, Common Sources of Risk on IT Projects, Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Planning Risk Responses, Controlling Risks
UNIT - 5

Project Procurement Management: Planning Procurement Management, Types of Contracts, Tools and Techniques for Planning Procurement Management, Procurement Management Plan, Statement of Work, Procurement Documents. **Project Stakeholder Management:** Identifying Stakeholders, Planning Stakeholder Management, Managing Stakeholder Engagement, Controlling Stakeholder Engagement
Text Books:
1. Kathy Schwalbe, Information Technology Project Management, Seventh Edition, Cengage Learning.
Reference Books:
1. A Guide to the Project Management Body of Knowledge (PMBOK Guide)-5th Edition, Project Management Institute. 2. Vasant Desai, Project Management, Fourth Edition, Himalaya Publishing House

Lab
Hands on practice on Project Management Basics, Create an Advanced Schedule, Enhance Tasks and Add Resources, Define Calendars, Assign Resources and Add Costs, Formatting, Sharing, Tracking, Enter Progress and Reporting.
Project
In the project phase, student teams will build project management solution designed for task scheduling, resource planning, and progress tracking.

COURSE OUTCOMES (COs)

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

CO1	Comprehend the concepts of Project Management
CO2	Develop project management plan and scope of the project
CO3	Estimate the time and cost of the project
CO4	Measure quality and risk of the project
CO5	Develop project procurement plan and statement of work.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMSTER VI

Course Title	Robotic Process Automation				
Course Code	23BS6PERPA	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			40

UNIT – 1
Introduction: What is Robotic Process Automation? **Scope and Techniques of Automation:** What should be automated?, What can be automated?, Techniques of automation. **Robotic Process Automation:** What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of Automation. **Record and Play:** Downloading and Installing UiPath Studio, UiPath Stack, Learning UiPath Studio.
UNIT – 2
Sequence, Flowchart and Control Flow: Sequencing the Workflow, Activities, Control flow, various types of loops, and decision making, how to use a sequence, how to use a flowchart, step by step example using sequence and control flow. **Data Manipulation:** Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa examples.
UNIT – 3
Taking control of the controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Recording, Screen scraping, When to use OCR?, Types of OCR available, How to use OCR?, Avoiding typical failure points.
UNIT – 4
Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event. **Exception Handling, Debugging, and Logging Exception handling:** Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMSTER VI

UNIT – 5
Managing and Maintaining the Code: Project Organization, Nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts, State Machines or sequences. **Deploying and Maintaining the Bot:** Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.

Text Book:
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940
Reference Books:
1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A Press. 2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: A Primer", Institute of Robotic Process Automation.

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the fundamental principles of Robotic Process Automation, discerning tasks suitable for automation and articulating the benefits of RPA.
CO2	Develop sequences and flowcharts, implement control flow structures, and master the effective design of workflows for process automation.
CO3	Demonstrate proficiency in data manipulation using variables, collections, and arguments, and integrate various plugins within UiPath to enhance automation capabilities.
CO4	Organize projects, enhance code reusability and successfully deploy and maintain bots using the publish utility and Orchestration Server.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	Generative AI				
Course Code	23BS6PEGAI	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			40

UNIT – 1
Introduction to Generative AI and Deep Learning Foundations **Generative AI:** What, Why, and Where? Use Cases in Business and Society, Generative vs. Discriminative Models **Basics of Neural Networks:** Neurons, Layers, Activation Functions, Latent Space and Feature Representations
UNIT – 2
Variational Autoencoders (VAEs) Overview of Generative Models: Autoencoders (AEs), VAEs, GANs (Only concepts), Limitations **Introduction to VAEs**: Key Intuition and Architecture, Sampling from Latent Space, Applications of VAEs: Denoising, Simple Image Generation, Implementing a VAE for simple datasets (Fashion-MNIST)
UNIT – 3
Generative Adversarial Networks (GANs) Introduction to GANs: Generator, Discriminator, Adversarial Loss, Simple GAN Training: The Minimax Game, Implementation of a Simple GAN, Visualizing Output Images over Training Epochs, Common Issues: Instability, Mode Collapse
UNIT – 4
Text Generation and Future Directions **Basics of Text Generation:** RNNs, LSTMs, Transformers and GPT, Text generation using GPT-2 via Hugging Face, Introduction to Prompt Engineering, Career Paths and Emerging Tools.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

UNIT – 5
Applications and Industry Use Cases of Generative AI CycleGAN (Conceptual) and Style Transfer (Hands-on), DALL·E and Stable Diffusion, Applications in Fashion, Marketing, Design, and Business Analytics, Ethical Considerations: Deep fakes, AI Bias, Responsible AI
Text Book: 1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play by David Foster, 2nd Edition, O'Reilly Media, 2019.

Reference Books:

1. Deep Learning with Python, François Chollet, Manning Publications, Second Edition, 2021.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, Thomas Wolf, O'Reilly Media, 2022.

COURSE OUTCOMES (COs)

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

CO1	Describe the fundamentals of Generative AI including its real-world applications, foundational neural network components, and differences between generative and discriminative models.
CO2	Implement basic generative models such as VAEs and GANs using simple datasets, and analyze their behavior and limitations during training.
CO3	Apply generative techniques for text and image generation using RNNs, LSTMs, and Transformer-based models like GPT, and understand prompt engineering basics.
CO4	Analyze industry applications of Generative AI in domains like design, marketing, and business analytics while identifying ethical implications such as bias and misuse.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	Digital and Social Media Marketing				
Course Code	23BS6PEMDM	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	39		

UNIT - 1
Digital Marketing Overview: Concept of Digital Marketing, Traditional Vs Digital Marketing, Understanding Digital Marketing Process, Digital Landscape. Digital advertising Market in India. Skills required in Digital Marketing, Digital Marketing Planning and Strategy.
UNIT – 2
Display Advertising: Concept of Display Advertising, types of display ads, buying models, display plan, Segmenting and customizing Messages, Targeting- contextual targeting placement targeting, remarketing, interest categories, geographic and language tagging. Programmatic digital advertising, You Tube Advertising. The P-O-E-M Framework.
UNIT – 3
Digital Advertising: Google Ad Words Overview; Understanding AdWords Algorithm; Creating Search Campaigns; Understanding Ad Placement, Understanding Ad Ranks, Types of Search Campaigns - Standard, All features, dynamic search & product listing. Tracking **Performance/Conversion**: conversion tracking and its importance, setting up of conversion tracking, Optimizing Search Ad Campaigns. Display ads and its features, Types of display campaigns, Creating Display Campaign, Optimizing Display Campaign and Re-marketing, customer engagement on e-portals. **Concept of Online Advertising**: Types of Online Advertising, Contextual advertising, Payment Modules, Different Online advertising platforms Creating Banner Ads Using Tools
UNIT - 4
Emerging trends in Digital Marketing: Affiliate Marketing- Affiliate marketing history, Affiliate marketing scenario in India, Different ways to do affiliate marketing. **Email Marketing**- email marketing and process. Types of email marketing- Opt-in & bulk emailing; Setting up email marketing account, creating a broadcast email. auto responders, Setting up auto responders; Tricks to land in inbox instead of spam folder; **Social Media Marketing**-Concept of social media marketing, Understanding Facebook marketing, LinkedIn Marketing, Twitter Marketing, Video Marketing and VIDEO & AUDIO (PODCASTING) marketing; and Content Marketing-Introduction to content marketing, Objective of content marketing, Content marketing 7 step strategy building process, writing a

great compelling content, optimizing content for search engines, opt-in email list with content marketing examples.

UNIT - 5

Search Engine Optimization (SEO): Introduction to SEO. Search engine Major functions and operating algorithm, Introduction to SERP, search engine keywords and types, Google keyword planner tool; Keywords research process; Understanding keywords; On page optimization; Off Page optimization; Top tools for SEO; Monitoring SEO process; Preparing SEO reports, creating SEO Strategy, link juice, Importance of domain and page authority, Optimize exact keywords for impactful search. Google Panda Algorithm, Google Penguin and Google EMD Update. How to save your site from Google Panda, Penguin and EMD Update, how to recover your site from Panda, Penguin and EMD.

Text Books:

1. The Essentials of E-Marketing, 4th edition by Quirk Education.

Reference Books:

1. Marketing 4.0: Moving from Traditional to Digital by P. Kotler. Wiley Publication.
2. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, by Damian Ryan and Calvin Jones. Kogan Page Publication, 3rd edition.
3. Digital Marketing Insights 2017, Social Beat Digital Marketing LLP, Kindle Edition.
4. Social Media for Business – Stories of Indian Brands, By Sorav Jain
5. Total E-mail Marketing: Maximizing your results from Integrated E-marketing (E-marketing essentials): Dave Chaffey. Cole, 2006
6. Dr. Pratiba Singh, Dr.Anoop Singh and Dr. PiyushMalaviya, “Text Book of Environmental and Ecology”, Acme Learning Pvt. Ltd. New Delhi.

COURSE OUTCOMES (COs)

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

CO1	Apply the knowledge of digital marketing strategy and planning on real world cases.
CO2	Develop a strategy for measuring and improving digital media effectiveness
CO3	Apply the concepts of online advertising including ad networks and behavioural targeting.
CO4	Evaluate Emerging trends in digital marketing.
CO5	Analyse search engine optimization strategy for own business.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	Fundamentals of Management				
Course Code	23BS6OEFOM	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Management Theories: Management Science or Art. Development of management thought. Early classical approaches: Scientific Management, Administrative Management, Bureaucracy, neo classical approaches, Modern approaches, Management Functions: Planning, Organizing, Directing, Controlling. Management process.
UNIT - 2
Planning and Decision Making: Nature of Planning. Importance of Planning, Hierarchy of plan, Types of plan, Vision, Mission, Objectives, Characteristics and requirement of objectives. Strategies: SWOT analysis, strategy formulation, Modes of Strategy Formulation, Operational plans: Standing plans, Policies, Types of Policies, Guidelines for effective policy making, procedures and methods. Single use plans. Steps in planning, Limitations of planning. Meaning of a decision, types of decisions, Steps in rational decision making
UNIT - 3
Organizational and Culture: Organization meaning, Characteristic of an organization, Typology of organization, process of organizing, Principles of organizing, Span of management, Appropriate Span of management, Departmentalization, Vertical, Horizontal and Matrix Organization. Organization structure, Organization chart, Mechanistic and organic structures, Emerging Organization structures, International Organization structures, Organization authority, Delegation of authority, coordination, Organization culture, Components or dimensions of Organization culture, Types of Organization culture, Quality of work life in Organization culture, national culture, Culture and international business
UNIT - 4
Staffing, Training and Development, Compensation Plan: Staffing: Manpower planning, recruitment. Selection: Importance of the Selection Process, Steps in the Selection Procedure, Placement, Induction (orientation), Staffing from global perspective. Training and development: Steps in Setting up a Training and Development Programme, Evaluation based on principles. Compensation plans: Time as Basis for Pay, Classification of Compensation, Primary Compensation: Factors Affecting Wages, Factors Affecting Executive Compensation, Monetary

Incentive, Kinds of Monetary Incentive Plans, Non-Monetary Incentive, Benefits. International Compensation.
UNIT - 5
Direction and Supervision and Leadership: Requirement of effective direction, Motivation, Nature of Motivation, Motivation theories, Systems Perspective of Motivation, Functions of a First-level Supervisor, Guidelines for Making Effective First-level Supervision. Communication: Importance of Communication, Purpose of Communication, Types of Communication, Forms of Communication, Principles of Effective Communication, Leadership: Difference between a leader and manager. Characteristics of Leadership, Functions of Leader, New approaches to leadership.
Text Books:
1. Principles of Management, Edition 2, P. C. Tripathi and P. N. Reddy, Tata McGraw Hill Publishing Company
Reference Books:
1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behavior 2. Richard L. Daft, Understanding the Theory and Design of Organizations

COURSE OUTCOMES (COs)

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

CO1	Understand the evolution of management thought, contribution of management thinkers, management theories and management functions
CO2	Apply various aspects planning and decision-making.
CO3	Apply various approaches to organizational structure and its culture
CO4	Demonstrate the importance staffing, selection, training and development, and compensation plan.
CO5	Analyse effective direction by motivation, communication and leadership style.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	Financial Management				
Course Code	23BS6OEFMT	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	3	Total Lecture Hours	40		

UNIT - 1
Foundation of Finance: Introduction to Financial Management, Financial Management Functions. Relationship of finance and related disciplines, Finance and Economics, Microeconomics, Finance and Accounting. Scope of financial management, investment decision, financing decision, and dividend policy decision. Objectives of financial management, Maximization Decision Criterion, Wealth Maximization Decision Criterion. Agency problem, Resolving the Agency Problem, Market Forces and Agency Costs. Organization of the finance function
UNIT - 2
Financial Analysis: Introduction to Financial statements, Balance Sheet, Profit and Loss Sheet, Cash Flow Statement. Financial Statement Analysis, Financial Ratio, Liquidity ratios, Leverage ratios, Turnover ratios, Profitability ratios, Valuation ratios. Financial analysis, Comparison with Industry Averages, Time Series of Financial Ratios, Guidelines for Financial Statement Analysis.
UNIT - 3
Financial Planning and Forecasting: Introduction to financial proforma statements, financial plan. Elements of the financial planning. Sales forecast, Qualitative Techniques, Time Series Projection Methods, Causal Models. Preparing the pro forma statement of profit and loss: the percent of sales method and the budgeted expense method, Combination Method. Pro forma balance sheet, Financial modelling. Growth and external financing requirement, Key growth rates, internal growth rate and the sustainable growth rate. **The Time value of money:** Time Lines and Notation, Future Value of a Single Amount, Present Value of a Single Amount, Present Value of an Uneven Series, Future Value of an Annuity, Present Value of an Annuity.
UNIT - 4
Capital Budgeting: Capital expenditure, Capital budgeting process. Project Classification, Investment Criteria, Net Present Value, Benefit-Cost Ratio, Internal Rate of Return, Modified Internal Rate of Return, Payback period. **Estimation of Project Cash Flows:** Elements of the cash flow stream. Basic principles of cash flow estimation: Separation, Incremental, Post-tax and Consistency principle. Cash flow illustrations.

UNIT - 5
Capital Risk Analysis: Techniques for Risk Analysis, Sources and Perspectives on Risk, Sensitivity Analysis, Scenario Analysis, Break-Even Analysis, Hillier Model, Simulation Analysis, Decision Tree Analysis, Corporate Risk Analysis. Managing Risk. Project Selection under Risk. Risk Analysis in Practice.
Text Books:
1. Chandra, Prasanna - Financial Management - Theory & Practice, Tata McGraw Hill. 2. Khan, M.Y & Jain, P.K.: Financial Management; Tata McGraw Hill, New Delhi, 2008.
Reference Books:
1. Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/ Pearson Education. 2. Brealey and Meyers: Principles of Corporate Finance: Tata McGraw Hill, New Delhi, 2008. 3. Keown, Martin, Petty and Scott (Jr): Financial Management: Principles and Applications; Prentice Hall of India, New Delhi, 2002. 4. Gitman, L.J: Principles of Managerial Finance; Addison Wasley, 2009. 5. Vanhorne, James C: Financial Management and Policy; Prentice Hall of India, New Delhi, 2002. 6. Kishore Ravi, M: Financial Management; Taxman, 2006.

COURSE OUTCOMES (COs)

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

CO1	Understand the core financial functions and its objectives.
CO2	Analysis different financial statements and evaluate the performance of the firm.
CO3	Forecast the financial planning with key growths of the firm.
CO4	Develop the capital budget and estimate the project cash flows.
CO5	Apply different capital risk analysis techniques for the selection of the projects.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMSTER VI

Course Title	Robotic Process Automation				
Course Code	23BS6OERPA	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			40

UNIT – 1
Introduction: What is Robotic Process Automation? **Scope and Techniques of Automation:** What should be automated? What can be automated? Techniques of automation. **Robotic Process Automation:** What can RPA do? Benefits of RPA, Components of RPA, RPA platforms, The future of Automation. **Record and Play:** About UiPath, Downloading and Installing UiPath Studio, UiPath Stack, Learning UiPath Studio.
UNIT – 2
Sequence, Flowchart and Control Flow: Sequencing the Workflow, Activities, Control flow, various types of loops, and decision making, how to use a sequence, how to use a flowchart, step by step example using sequence and control flow. **Data Manipulation:** Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa examples.
UNIT – 3
Taking control of the controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Recording, Screen scraping, When to use OCR? Types of OCR available, How to use OCR?, Avoiding typical failure points.
UNIT – 4

Handling User Events and Assistant Bots: What are assistant bots?, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event.

Exception Handling, Debugging, and Logging Exception handling: Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.

UNIT – 5

Managing and Maintaining the Code: Project Organization, Nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts, State Machines or sequences.

Deploying and Maintaining the Bot: Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.

Text Book:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A Press.
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMSTER VI

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the fundamental principles of Robotic Process Automation, discerning tasks suitable for automation and articulating the benefits of RPA.
CO2	Develop sequences and flowcharts, implement control flow structures, and master the effective design of workflows for process automation.
CO3	Demonstrate proficiency in data manipulation using variables, collections, and arguments, and integrate various plugins within UiPath to enhance automation capabilities.
CO4	Organize projects, enhance code reusability and successfully deploy and maintain bots using the publish utility and Orchestration Server.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	**Project Work -1**				
Course Code	**23BS6PWPW1**	**Credits**	**1**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours/ Week	**4**	**Total Contact Hours**	**5**		

Project Work -1

Project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Project Work Phase - 1:

i. **Single discipline**: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the Project report shall be the same for all the batch mates.

ii. **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

SEMESTER VI

Course Title	DevOps				
Course Code	23BS6AEDOP	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours/ Week	2	Total Contact Hours	25		

Lab
The students will learn the fundamentals of DevOps framework. The course would include two lab cycles and a project work. **Cycle 1**: students would be able to build CI/CD pipeline using Git and Jenkins. **Cycle 2**, students will be exposed to containerization with Docker and Kubernetes. They will also be able to use Grafana to setup a monitoring solution for an application.
Project
In the project phase, student teams will work to build an application and deploy the same to an environment using DevOps tools.
Text Books:
1. The DevOps Handbook, Gene Kim, Jez Humble, Patrick Debois, and John Willis, IT Revolution, 2016 2. The DevOps 2.0 toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices, Viktor Farcic, 2016 3. Cloud Native DevOps with Kubernetes, John Arundel and Justin Domingus, O'Reilly, 2019

COURSE OUTCOMES (COs)

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

CO1	Understand the concepts of DevOps, Docker Containerization, Micro service Architecture, CI/CD pipeline, Version control with Git, workflows of Git, Jenkins.
CO2	Acquainted with containerization with Docker and Kubernetes and apply the same for various applications.
CO3	Build applications using Git and Jenkins tools. Use of Grafana tool to setup a monitoring solution for an application.
CO4	Deploy an application to an environment using DevOps tools.