



MASTER OF COMPUTER APPLICATION

CHOICE BASED CREDIT SYSTEM -
LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

Sem	Course	Course Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Core Course - 1 (CC - 1)	Mathematical Foundations for Computer Science	6	4	3	30	70	100
	Core Course - 2 (CC - 2)	Design and Analysis of Algorithms	6	4	3	30	70	100
	Core Practical - 1 (CP - 1)	Design and Analysis of Algorithms	4	4	3	40	60	100
	Discipline Centric Elective Course - 1 (DCEC - 1)	Any one from the list	5	3	3	30	70	100
	Discipline Centric Elective Practical - 1 (DCEP - 1)	Any one from the list	3	3	3	40	60	100
	Generic Elective Course - 1 (GEC - 1)	Any one from the list	6	3	3	30	70	100
	Value Added Course - 1 (VAC - 1) *	Front End Web Development	-	2*	3	30	70	100*
Total			30	21	-	-	-	600

MANDATORY BRIDGE COURSE FOR STUDENTS OF
NON-COMPUTER SCIENCE STREAM – 1st SEMESTER

Sem	Bridge Courses	Bridge Courses Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Bridge Course - 1 (BC - 1)	Problem Solving Techniques		4	3	30	70	100
	Bridge Practical - 1 (BP - 1)	Problem Solving Techniques Lab		3	3	40	60	100
	Total			7	-	-	-	200

2nd SEMESTER

Sem	Course	Course Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
II	Core Course - 3 (CC - 3)	Advanced Database Management System	6	4	3	30	70	100
	Core Course - 4 (CC - 4)	Compiler Design	6	4	3	30	70	100
	Core Practical - 2 (CP - 2)	Advanced Database Management SystemLab	4	4	3	40	60	100
	Discipline Centric Elective Course - 2 (DCEC - 2)	Any one from the list	5	3	3	30	70	100
	Discipline Centric Elective Practical - 2 (DCEP - 2)	Any one from the list	3	3	3	40	60	100
	Generic Elective Course - 2(GEC - 2)	Any one from the list	4	3	3	30	70	100
	Non-Major Elective - 1 (NME -1)	One Course from Outside Department	2	2	3	30	70	100
		Total	30	23	-	-	-	700
Summer Internship / Industrial Activity during the Summer Vacation after 1 st Year								

**MANDATORY BRIDGE COURSE FOR STUDENTS OF
NON-COMPUTER SCIENCE STREAM – 2nd SEMESTER**

Sem	Bridge Courses	Bridge Courses Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
II	Bridge Course - 2 (BC - 2)	Fundamentals of Computers		4	3	30	70	100
	Bridge Practical - 2 (BP - 2)	Fundamentals of Computers lab		3	3	40	60	100
		Total		7	-	-	-	200

3rd SEMESTER

Sem	Course	Course Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
III	Core Course - 5 (CC - 5)	Basics of Machine Learning	6	4	3	30	70	100
	Core Course - 6 (CC - 6)	Quantum Computing	6	4	3	30	70	100
	Core Practical - 3 (CP - 3)	Machine Learning Lab	4	4	2	40	60	100
	Discipline Centric Elective Course - 3 (DCEC - 3)	Any one from the list	5	3	3	30	70	100
	Discipline Centric Elective Practical - 3 (DCEP - 3)	Any one from the list	3	3	2	40	60	100
	Generic Elective Course - 3 (GEC - 3)	Any one from the list	4	3	3	30	70	100
	Non-Major Elective - 2 (NME - 2)	One Course from Outside Department	2	2	3	30	70	100
	Summer Internship / Industrial Activity @			2		20	80	100
		Total	30	25	-	-	-	800

**MANDATORY BRIDGE COURSE FOR STUDENTS OF
NON-COMPUTER SCIENCE STREAM – 3rd SEMESTER**

Sem	Bridge Courses	Bridge Courses Title	Ins. Hrs.	Credit	Exam Hrs.	Marks		Total
						Int.	Ext.	
III	Bridge Course - 3 (BC - 3)	Web Technologies		4	3	30	70	100
	Bridge Practical - (BP - 3)	Web Technologies Lab		3	3	40	60	100
		Total		7	-	-	-	200

4th Semester

Sem	Course	Course Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
IV	Core Course - 7 (CC - 7)	Introduction to Prompt Engineering	5	4	3	30	70	100
	Core Course - 8 (CC - 8)	Software Testing and Quality Assurance	5	4	3	30	70	100
	Core Course - 9 (CC - 9)	Generative AI	5	4	3	30	70	100
	Entrepreneurship / Industry Based Course @	Entrepreneurship and Start-Ups	3	3	3	30	70	100
	Project Work @		12	6	-	20	80	100
	Value Added Course - 2 (VAC - 2)*	Ethical Hacking	-	2*	3	30	70	100*
		Total	30	21	-	-	-	500
Grand Total				90/ 111[#]				2600/ 3200[#]

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE / PRACTICAL

Discipline Centric Elective Course 1		Discipline Centric Elective Practical 1	
1.	Advanced Python Programming	1.	Advanced Python Programming Lab
2.	Network Security and Cryptography	2.	Network Security and Cryptography Lab
Discipline Centric Elective Course 2		Discipline Centric Elective Practical 2	
1.	Natural Language Processing	1.	Natural Language Processing Lab
2.	Mobile Application Development	2.	Mobile Application Development Lab
Discipline Centric Elective Course 3		Discipline Centric Elective Practical 3	
1.	Big Data Analytics	1.	Big Data Analytics Lab
2.	Blockchain Technology	2.	Blockchain Technology Lab

LIST OF NON-MAJOR ELECTIVE COURSE (for other Department Students only)

Sl. No.	Non-Major Elective Course (NMEC)
1.	Cyber Security
2.	Web designing principles

LIST OF GENERIC ELECTIVE COURSE

Generic Elective Course 1	
1.	Accounting and Financial Management
2.	Organisational Behaviour
3.	E-Learning Techniques
Generic Elective Course 2	
1.	E-Commerce Technologies and Management
2.	Design Thinking and Innovation Skills
3.	Operations Research
Generic Elective Course 3	
1.	Management Concepts And Strategies
2.	Digital Marketing and Business Analytics
3.	Green Computing and Sustainability

**SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES
MCA FOR COMPUTER SCIENCE STUDENTS**

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course	9	4	36	900
2.	Core Practical	3	4	12	300
3.	Discipline Centric Elective Course	3	3	9	300
4.	Discipline Centric Elective Practical	3	3	9	300
5.	Generic Elective Course	3	3	9	300
6.	Non-Major Elective Courses	2	2	4	200
7.	Summer Internship/Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course @	1	3	3	100
9.	Project @	1	6	6	100
Total		26	-	90	2600
Value Added Courses *		2*	2	4*	200

**SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES
MCA FOR NON COMPUTER SCIENCE STUDENTS**

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course	9	4	36	900
2.	Core Practical	3	4	12	300
3.	Discipline Centric Elective Course	3	3	9	300
4.	Discipline Centric Elective Practical	3	3	9	300
5.	Generic Elective Course	3	3	9	300
6.	Bridge Course	3	4	12	300
7.	Bridge Practical	3	3	9	300
8.	Non-Major Elective Courses	2	2	4	200
9.	Summer Internship / Industrial Activity @	1	2	2	100
10.	Entrepreneurship / Industry Based Course @	1	3	3	100
11.	Project @	1	6	6	100
Total		35	-	111	3200
Value Added Courses *		2*	2	4*	200

*	The value added courses credit will not be included in the total CGPA these courses are extra-credit courses. Instruction hours for these courses are 30 hours.								
@	Summer Internship / Industrial Activity and Project Work Scheme of Evaluation: <table border="1" style="margin-left: 20px;"> <tr> <th>Description</th><th>Marks</th></tr> <tr> <td>Report</td><td>80</td></tr> <tr> <td>Viva</td><td>20</td></tr> <tr> <td>Total</td><td>100</td></tr> </table>	Description	Marks	Report	80	Viva	20	Total	100
Description	Marks								
Report	80								
Viva	20								
Total	100								

Programme Outcome

PO1	Disciplinary Knowledge: Broad and in-depth knowledge of advanced scientific concepts, principles, and methodologies within the chosen domain. Ability to critically explain, integrate, and apply scientific knowledge to theoretical and practical problems. Opportunities to earn additional credits through specialized and interdisciplinary courses further enhance expertise and broaden disciplinary understanding.
PO 2	Critical Thinking: Field visits, academic interactions, and experiential learning activities will help students develop critical observation, interpretation, and analytical skills. Ability to evaluate and interpret scientific data, formulate hypotheses, and draw logical conclusions. Encourages independent thinking and the ability to assess scientific problems from multiple perspectives.
PO 3	Analytical Reasoning: Through classroom discussions, scientific literature reviews, and interactive learning environments, students will strengthen their analytical reasoning abilities. Ability to critically evaluate scientific texts, identify gaps in existing knowledge, formulate research questions, and synthesize new ideas and concepts. Promotes evidence-based reasoning and logical interpretation of scientific information.
PO 4	Scientific Reasoning: Strong foundation in scientific methods, experimental design, and data interpretation through laboratory-based courses. Enhances practical knowledge of scientific instrumentation, calibration procedures, laboratory safety, and appropriate research techniques. Ability to conduct scientifically sound experiments and interpret results accurately.
PO 5	Self-Directed Learning: Encourages independent and self-directed learning through assignments, field reports, project work, and literature-based studies. Ability to organize, analyze, and present scientific findings in professional formats relevant to academic and industrial settings. Fosters responsibility, time management, and continuous self-improvement in learning.
PO 6	Reflective Thinking: Laboratory-intensive core courses will expose students to a broad range of research methodologies and experimental techniques. Ability to reflect on learning experiences, evaluate the effectiveness of scientific approaches, and understand the broader applications of scientific techniques within the discipline.
PO 7	Problem-Solving Skills: Ability to develop and apply scientific principles, quantitative reasoning, and mathematical concepts to solve discipline-specific problems. Ability to analyze experimental data, interpret scientific observations, and derive meaningful conclusions. Prepares students to address real-world scientific and societal challenges effectively.
PO 8	Research-Related Skills: Internships, dissertation work, and research-oriented projects provide opportunities to design, develop, and execute independent research studies. Students gain hands-on experience in research methodology, experimental techniques, data analysis, scientific writing, and ethical research practices. These experiences strengthen laboratory competence and prepare students for advanced research and professional careers.
PO 9	Lifelong Learning: Cultivates a mindset of continuous learning and professional adaptability. Ability to identify gaps in knowledge and skills, adapt to emerging technologies and scientific advancements, and pursue self-directed learning throughout their careers. Encourages lifelong learning that supports academic growth, employability, and professional excellence.
PO 10	Leadership Readiness: Ability to take initiative, work collaboratively, and manage academic and research responsibilities effectively. Through seminars, group projects, internships, and research activities, students develop decision-making, problem-solving, organizational, and interpersonal skills. Ability to lead scientific teams, communicate effectively in professional environments, and contribute responsibly to academic, industrial, and societal development.

Programme Specific Outcome

- PSO 1.** Understand, analyze and develop Computer Programs in the areas related to algorithms, process and solutions for specific application development using appropriate data modeling concepts
- PSO 2.** Design and develop web-based solutions, cloud computing systems, and e-commerce applications.
- PSO 3.** Understand the recent technologies and tools to provide innovative ideas and solutions to the existing problems
- PSO 4.** Utilize project management concepts, tools, and techniques across the project lifecycle to ensure successful delivery.
- PSO 5.** Demonstrate practical skills in a wide Variety of programming languages and software platforms.
- PSO 6.** Stay updated with the latest industry tools, technologies, and development methodologies.
- PSO 7.** Apply the appropriate Software Engineering practices to deliver a Quality products catering to the needs of Industry and Society at a large
- PSO 8.** Instil life-long learning skills through the development of a research environment and higher educational opportunities.
- PSO 9.** Manage multiple operating systems, system software, network services, and ensure security protocols are maintained.
- PSO 10.** Deliver intensive software solutions for real world applications with the help of advanced computational tools and techniques.

Year: I

CORE COURSE 1

Semester: I

Mathematical Foundations of Computer Science

Code:

(Theory)

Credits: 4

Course objectives: After completing this course, students will be able to:

1. To provide a strong foundation in set theory, linear algebra, and vector operations essential for computer science applications.
2. To develop analytical skills in probability, statistics, and their application in data analysis and decision-making.
3. To equip students with numerical techniques for solving differentiation and integration problems arising in computational tasks.
4. Students will be able to apply mathematical concepts such as sets, matrices, vectors, and probability to solve real world computing problems.
5. Students will gain the ability to use numerical methods for differentiation and integration in scientific engineering computations.

UNIT - I Set Theory Sets and Subsets (Intersection Union and Complements), Demorgan's Law, Cardinality, Relations, Mapping.

UNIT-II Linear Equations and Matrices (Types and Operations), Determinants (Properties and Operations), Solving linear equations, Solving Simultaneous equation.

UNIT-III Vector Algebra Vectors in 2D and 3D, Vector addition and subtraction, product (Scalar and Vector), triple product (Scalar and Vector)

UNIT-IV Probability and Statistics Random variables, Discrete random variables, Probability Distributions (Binomial and Poisson). Measures of central tendency (mean, median for grouped data), Measures of dispersion (Mean deviation and Standard deviation. Variance)

UNIT-V Numerical Differentiation and Integration Finite differences. Newton's forward and backward difference formulas, Numerical differentiation using finite differences, Central difference formulas, Numerical integration, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Error analysis in numerical integration.

UNIT - VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Discrete Mathematics and Its Applications - Kenneth H. Rosen, McGraw Hill
2. Higher Engineering Mathematics - B.S. Grewal, Khanna Publishers
3. Advanced Engineering Mathematics - Erwin Kreyszig, Wiley
4. Probability and Statistics for Engineers and Scientists - Ronald E. Walpole, Pearson
5. Numerical Methods for Engineers- S.S. Sastry, PHI Learning
6. Vector Algebra - R. Gupta, Laxmi Publications

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Apply concepts of set theory.
2. Solve problems involving Linear Equations and Matrices
3. Analyze vector algebra concepts
4. Model and solve problems using Probability and Statistics
5. Apply Numerical Differentiation and Integration

Year: I

CORE COURSE 2
Design and Analysis of Algorithms
(Theory)

Semester: I

Code:

Credits: 4

Course objectives: After completing this course, students will be able to:

1. Understand the Computational Complexities
2. Apply Divide and Conquer methods
3. Explore Greedy algorithms
4. Analyze Dynamic Programming techniques
5. Perform string processing methods

Unit-I Computational Complexity: Review of Growth of Functions, asymptotic notation, Master's Theorem. Iterative Algorithms: Searching and Sorting Techniques- Linear search, Binary search, insertion sort– time complexity and proof of correctness.

Unit-II Divide and Conquer: Binary Search, Merge sort and Quick sort– time complexity Linear Sorting: Count Sort, Radix Sort, Bucket Sort.

Unit-III Greedy Algorithms: Interval Scheduling, Minimum Spanning Trees– Prim's algorithm, Kruskal Algorithm, Shortest Path Problem– Dijkstra's algorithm.

Unit-IV Dynamic Programming: Weighted Interval Scheduling, Matrix chain multiplication, Knapsack problem, Longest common subsequence.

Unit-V String Processing: Brute-force method, KMP algorithm. Randomized algorithms: Introduction to random numbers, randomized Qsort

Unit – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

- 1 . J. Kleinberg and E.Tardos, Algorithm Design, 1st Edition 2013., Pearson Education India,
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, 3rd Edition, 2010, Prentice-Hall of India Learning Pvt. Ltd.
3. Sara Baase, Allen Van Gelder, Computer Algorithm– Introduction to Design and Analysis, 3rd edition , 2002, Pearson Education.
4. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, Algorithms, 1st Edition, 2017, Tata McGraw Hill.
5. Richard Johnsonbaugh and Marcus Schaefer, Algorithms, 2014, Pearson Education India.

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1: Describe various algorithm design techniques, including iteration, divide and conquer, dynamic programming, and greedy approach algorithms.
- 2: Analyze the strengths and weaknesses of each technique.
- 3: Identify and apply technique(s) suitable for simple applications.
- 4: Demonstrate the correctness of algorithms and analyze their time complexity theoretically and practically.
- 5: Model simple problems as graphs and solve them using Graph Algorithms.

Year: I

CORE PRACTICAL 1
Design and Analysis Algorithm Lab

Semester: I

Code:

Credits: 4

List of Programs:

1. Write a program for iterative and recursive Binary Search
2. Write a program for Quick sort.
3. Write a program for Merge Sort
4. Write a program for Heap Sort
5. Write a program for insertion Sort
6. Write a program for Selection Sort
7. a.To implement knapsack problem using Greedy Technique
b.To implement 0/1Knapsack problem using Dynamic Programming
8. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm
9. To Implement Floyd's warshall algorithm.
10. To Implement N Queen Problem using Backtracking.

Year: I

DISCIPLINE CENTRIC ELECTIVE COURSE 1

Semester: I

1. Advanced Python Programming

Code:

Credits: 3

Course objectives :After completing this course, students will be able to:

1. Acquire programming skills in core Python
2. Learn Strings and function
3. Develop object oriented skills in Python.
4. Comprehend various Python Packages
5. Develop web applications using Django

Unit I Introduction: Fundamental ideas of Computer Science - Strings, Assignment, and Comments - Numeric Data types and Character sets – Expressions – Loops and Selection Statements: Definite iteration: the for Loop - selection: if and if-else statements - Conditional iteration: the while Loop

Unit II Strings and Text Files: Accessing Characters and substrings in strings - Data encryption - Strings and Number systems- String methods – Text - Lists and Dictionaries: Lists – Dictionaries – Design with Functions: A Quick review - Problem Solving with top-down Design - Design with recursive Functions - Managing a Program’s namespace - Higher Order Functions

Unit III Design with Classes: Getting inside Objects and Classes – Data-Modeling Examples – Building a New Data Structure – The Two – Dimensional Grid - Structuring Classes with Inheritance and Polymorphism – Graphical User Interfaces - The Behavior of terminal Based programs and GUI-Based programs - Coding Simple GUI-Based programs - Windows and Window Components - Command Buttons and responding to events

Unit IV Working with Python Packages: NumPy Library-Ndarray – Basic Operations – Indexing, Slicing and Iteration – Array manipulation - Pandas –The Series – The Data Frame - The Index Objects – Data Visualization with Matplotlib – The Matplotlib Architecture – pyplot – The Plotting Window – Adding Elements to the Chart – Line Charts – Bar Charts – Pie charts

Unit V Django: Installing Django – Building an application – Project Creation – Designing the Data Schema - Creating an administration site for models - Working with Query Sets and Managers – Retrieving Objects – Building List and Detail Views

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book:

K. A. Lambert, “Fundamentals of Python: first programs”, Second Edition, Cengage Learning, 2018

1. Fabio Nelli, “Python Data Analytics: With Pandas, NumPy, and Matplotlib”, Second Edition, Kindle Edition, 2018

2. □ Antonio Mele, “Django 3 By Example”, Third Edition, 2020

Reference books:

1. Advanced Python Programming, Dr. Gabriele Lanaro, Quan Nguyen, Sakis Kasampalis, Packt Publishing, 2019
2. Daniel Howard," Python and SQL: Step-By-Step Guide to Database Programming".
3. Python: The Complete Reference, Martin C. Brown, McGraw Hill, 2018

Web Resources:

<https://onlinecourses.nptel.ac.in> □

<https://k21academy.com/datascience-blog/step-by-step-guide-setup-sql-withpython/>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Comprehend the programming skills in python and develop applications using conditional branches and loops.
2. Create Python applications with strings and functions.
3. Understand and implement the Object Oriented Programming paradigm with the concept of objects and classes, Inheritance and polymorphism.
4. Evaluate the use of Python packages to perform numerical computations and data visualization.
5. Design interactive web applications using Django.

Year: I

DISCIPLINE CENTRIC ELECTIVE PRACTICAL 1

Semester: I

1. Advanced Python Programming Lab

Code:

Credits: 3

1. Program using elementary data items, lists, dictionaries and tuples
2. Program using conditional branches, loops
3. Program using functions
4. Program using classes and objects
5. Program using inheritance
6. Program using polymorphism
7. (i) Create a text file and write data using write() and writelines(). (ii) Append Data to a Text File (iii) Add new content to an existing text file using append mode ('a')
8. (i) Copy Contents of One File to Another (ii) Read data from one text file and write it into another file.
9. Analyze a text file and display the total number of lines, words, and characters.
10. Check whether a specific word exists in a text file and count its occurrences.
11. Use the numpy package: (i) Create arrays. (ii) Perform arithmetic operations on arrays. (iii) Find the mean, median, and standard deviation
12. Create forms using the Django forms module. ·Validate user input and display error messages.
13. Use the pandas package : (i) Read data from a CSV file. (ii) Display the first and last five rows. (iii) Filter and sort data.

Year: I

DISCIPLINE CENTRIC ELECTIVE COURSE 1

Semester: I

2. Network Security and Cryptography

Code

Credits: 3

Course objectives : After completing this course, students will be able to:

- 1:** Understand the foundations of cryptographic attacks.
- 2:** Gain knowledge of encrypting data, and to choose between different algorithms.
- 3:** Prepare students for research in the area of cryptography and enhance students communication and problem solving skills
- 4:** Differentiate between the encryption techniques and know their suitability to an application.
- 5:** Effectively apply their knowledge to the construction of secure cryptosystems.

Unit I Introduction: Understand basic Encryption Concepts: Symmetric Cipher Model, Cryptography, Cryptanalysis Substitution and Transposition techniques

Unit II: Symmetric Key Cryptography and Attacks; Stream ciphers and block ciphers, Block Cipher structure, Feistel Cipher, Diffusion and Confusion, Data Encryption standard (DES) with example, strength of DES, Design principles of block cipher, AES, Multiple encryption and triple DES, Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback mode, Output Feedback mode, Counter mode, RC4 algorithm, Confidentiality using Symmetric encryption, Key Distribution, Random Number Generator

Unit III Public Key Cryptography : Principles, RSA, Public Key Management, Diffie Helman Key Exchange, Elliptic Curve Cryptography

Unit IV Message Authentication and Hash Functions : Authentication Requirements, Authentication Functions, MAC, Hash Functions, Security of Hash Functions and MACs, SHA, MD5

Unit V : Digital Signatures and Authentication Applications : Digital Signatures, Authentication Protocols, DSS, Kerberos, X.509, Public key Infrastructure. Email, IP and Web Security PGP, S/MIME, IPSec Architecture, Authentication Header, ESP, Combining Security Association, Key Management, Web Security Consideration, SSL and TLS, Introduction to E Commerce, Secure Electronic Transaction (SET).

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

- 1). William Stallings : “Cryptography and Network Security – Principles and Practice”, 4/E, Pearson Education, 2005
- 2). Bruce Schneier : “Applied Cryptography”, 2/E, John Wiley, 1996
- 3). Behrouz Forouzan : “Cryptography & Network Security”, 1/E, TMH, 2007

Reference Books:

- 1). Menezes, Oorschot, Vanstone : “Handbook of Applied Cryptography”, CRC Press,1996
- 2). D Stinson, “Cryptography: Theory and Practice”, 2/E,Chapman & Hall ,2002

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Define the concepts of Information security and their use.
2. Describe the principles of symmetric and asymmetric cryptography.
3. Understand and apply the various symmetric key algorithms.
4. Understand and apply the various asymmetric key algorithms.
5. Understand the concepts of hashing with algorithms and apply them. 6

Year: I

DISCIPLINE CENTRIC ELECTIVE PRACTICAL 1

Semester: I

2. Network Security and Cryptography Lab

Code:

Credits: 3

LIST OF EXPERIMENTS

1. Perform encryption, decryption using the following substitution techniques
(i) Ceaser cipher (ii) playfair cipher (iii) Hill Cipher (iv) Vigenere cipher
2. Perform encryption and decryption using following transposition techniques
(i) Rail fence (ii) row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the Digital Signature Standard

Year: I

GENERIC ELECTIVE COURSE 1

Semester: I

1. Accounting and Financial Management

Code:

Credits: 3

Course objectives :After completing this course, students will be able to:

1. Understand the fundamental concepts, principles, and practices of financial accounting
2. Develop the ability to prepare and interpret financial statements
3. Analyze financial statements using ratio analysis and other financial tools for decision-making.
4. Develop knowledge of cost, profit, and budgeting techniques used in business organizations.
5. Enhance decision-making skills through the application of accounting and financial management concepts in real-world business scenarios

Unit-I Assets and Liabilities: Types - Trading account – Accounting records and Systems – Limitations - Income statement – Preparation and Interpretation.

Unit-II Depreciation Methods: Inventory methods, Sources of working capital, Fund flows, Cash flows – Financial Statement analysis.

Unit-III Ratio analysis : Use of ratios in interpreting Trading Accounts and Financial Statements, Limitations – Management Accounting.

Unit-IV Variable costs: Fixed costs – Cost Volume Profit Analysis – Break even marginal and full costing contribution, Standard costing - Analysis of variance - Computer accounting and algorithms.

Unit-V Characteristics of Budgets: Forecasting – Long term, Short term – Methods of capital investment decision making, Sensitivity Analysis, Cost of capital.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbooks: 1. Title- An Introduction to Accountancy, Author- N. Maheswari and S.K. Maheswari, Publisher- Vikas Publishing, New Delhi, Edition- 11th edition, 2013

Reference Books: 1. Title- Principles of Management and Accounting, Author- Manmohan and Goyal, Publisher- SahityaBhawan, Edition- 5th Edition, 1994 2. Title- Management Accountancy, Author- J.Batty, Publisher- Macdonald & Evan Ltd., London, Edition- 3rd Edition, 1970

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1 Prepare and analyse the final accounts of the firm Applying, Analyzing
- 2 Prepare and analyse the funds & cash flow statements of the firm Applying, Analyzing
- 3 Perform basic analysis of financial statements and write a report on the financial performance, conditions and effectiveness of the firm Analyzing, Evaluating
- 4 Analyse and evaluate costing systems Analyzing, Evaluating
- 5 Prepare different types of budgets and policies Applying,

Year: I

**GENERIC ELECTIVE COURSE 1
2. ORGANISATIONAL BEHAVIOUR**

Semester: I

Code:

Credits: 3

Course objectives: After completing this course, students will be able to:

- 1 Find differences of various basic concepts of organization.
- 2 Relate the factors of formation of attitudes and formulate factors for attitude change
- 3 Apply and build the perceptual interpretation and motivation
- 4 Categorize leadership skills through various activities
- 5 Create new organizational structure and projects

Unit – I NATURE OF ORGANIZATION: features – types – goals. NATURE OF ORGANIZATIONAL BEHAVIOR – Nature of OB – Role of OB – Foundations of OB.

Unit – II NATURE OF HUMAN BEHAVIOR: Nature and causes of individual differences – models of man. PERCEPTION: concept – process – perceptual selectivity and distortion – Developing perceptual skills. ATTITUDES: Concept – Theories – Formation factors – measurements – Attitude change.

Unit – III PERSONALITY: Concept – theories – determinants of personality- Personality and behaviour - MOTIVATION: Definition – Motivation & Behavior – Theories – approaches – incentives. INTERPERSONAL BEHAVIOR: Transactional analysis – Ego states – life scripts – life positions – transactions – stroking – Psychological games – Benefits of TA.

Unit – IV GROUP DYNAMICS: Concepts & features of group – types of groups – group behavior – group decision making – committee – task group – inter group behavior. LEADERSHIP: Definitions – types – importance theories – styles. COMMUNICATION: Basics of communication – Communication network – Factors affecting communication – Business writing – Office management – Presentation strategies.

Unit – V ORGANIZATION THEORY: Classical organizational theory – neoclassical organization theory – DESIGNING OF ORGANIZATIONAL STRUCTURE: need – planning and process – Departmentation Span of management – delegation of authorities – centralization & decentralization – FORMS OF ORGANIZATIONAL STRUCTURES: line and staff – functional – divisional – project – matrix – free form.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Books for Study

1. Prasad LM, “Organisational Behavior”, Sultan Chand and Sons, New Delhi, 2014.

Books for Reference

1. S. S. Khanka, “Organisational Behavior”, S. Chand Ltd., New Delhi, 2001
2. K. Aswathappa, “Organisational Behavior”, Himalaya Publishing house, New Delhi, 2001

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the fundamental concepts, theories, and principles of organisational behaviour and their application in organizations
2. Analyze individual behaviour, including personality, perception, learning, motivation, attitudes, and job satisfaction in the workplace.
3. Evaluate group behaviour, team dynamics, leadership styles, communication processes, and conflict management techniques
4. Assess the impact of organisational culture, organisational structure, and change management on employee performance and organizational effectiveness
5. Apply organisational behaviour concepts and managerial skills to solve workplace problems, improve employee performance, and support effective decision-making in organizations

Year: I

GENERIC ELECTIVE COURSE 1
3. E - LEARNING TECHNIQUES

Semester: I

Code:

Credits: 3

Course Objective: After completing this course, students will be able to:

1. Learn the various E-learning approaches, components and the types of design models of E-Learning.
2. Explore the models for E-learning courseware development and E-learning authoring tools.
3. Introduce the concepts, principles, and evolution of e-learning and digital education
4. Develop skills in designing, developing, and delivering effective online learning content
5. Explore methods for online assessment, learner engagement, and collaborative learning in virtual environments

UNIT I INTRODUCTION Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

UNIT II DESIGNING E-LEARNING COURSE CONTENT Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III CREATING INTERACTIVE CONTENT Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development – Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.

UNIT IV LEARNING PLATFORMS Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNIT V COURSE DELIVERY AND EVALUATION Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

REFERENCES:

1. Clark, R. C. and Mayer, R. E, “eLearning and the Science of Instruction”, Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, “Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies”, Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, “Understanding the Learning Personalities of Successful Online Students”, Educause Review, 2014.
4. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O’ Riley Media, 2011.
5. Madhuri Dubey, “Effective E – learning Design, Development and Delivery”, University Press, 2011.

Course Outcome:

- 1: Distinguish the phases of activities in the models of E-learning.
- 2: Identify appropriate instructional methods and delivery strategies.
- 3: Choose appropriate E-learning authoring tools.
- 4: Create interactive E-Learning courseware.
- 5: Evaluate and manage the E-learning courseware

Year I

Value Added Course - 1
Front End Web Development
(VAC-1)

Semester: I

Code:

Credit: 2

Course Objectives: After completing this course, students will be able to,

1. Introduce the basic concepts and techniques of client-side web programming.
2. Enable the students to develop simple, interactive, and stylish websites
3. Explore CSS
4. Apply Javascript
5. Understand front end and back end technology

Unit-I: Introduction : Introduction: Introduction to internet and web design. Basic concepts of web architecture.

Unit-II: HTML : Introduction to hypertext mark-up language (html), creating web pages, lists, hyperlinks, tables, web forms, inserting images, frames.

Unit-III: Cascading style sheet (CSS) :Concept of CSS, creating style sheet, Importing style sheets, CSS properties, CSS styling (background, text format, controlling fonts), CSS rules, Style Types, CSS Selectors, CSS cascade, working with block 94 elements and objects, working with lists and tables, CSS id and class, box model (introduction, border properties, padding properties, margin properties).

Unit-IV: Basics of Javascript : Document object model, data types and variables, functions, methods and events, controlling program flow, built-in objects and operators, validations.

Unit -V: Introduction to PHP : PHP Basics Variables, data types, operators of PHP

Unit – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

- Nixon, R., Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML5, O'Reilly, 2018.
- Powell, T.A. HTML & CSS: The Complete Reference, 5th edition, Tata McGrawHill, 2017.
- Duckett, J., JavaScript and JQuery: Interactive Front-End Web Development, Wiley, 2014. 2 WEB Programming Using PHP and MySQL, Dr. K. Meena, Dr.R.Sivakumarand, Dr.Karyhick Anand Babu, Himalaya Publishing House References
- Boehm, A., &Ruvalcaba, Z., Murach's HTML5 and CCS, 4th edition, Mike Murach& Associates, 2018.
- Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml, Javascript, Perl CGI, BPB Publications, 2010.
- Web Technology --- Black book- Dream Tech Press John Duckett , beginning HTML, XHTML,CSS and JavaScript HTML5 for Web Designers—Jeremy Keith

Course Outcomes:Upon successful completion of the course, the student will be able to

- After studying this course, students will be able to build websites using the elements of HTML.
- After studying this course, students will be able to build interactive and stylish websites using client-side programming techniques with CSS and Javascript.
- After studying this course, students will be able to learn to validate client-side data.
- After studying this course, students will be able to define the structure and contents of the website using different features of CSS

Year: I

**Bridge Course - 1
Problem Solving Techniques**

Semester: I

Code:

Credits: 4

Course objectives: After completing this course, students will be able to:

1. Provide the basic Concepts in Information Technology
2. Provide the concepts of mathematical logic and discrete structures
3. Provide the techniques for solving problems
4. Understand the fundamental syntax and concepts of C programming, Control statements and Looping structures
5. Write programs using various control structures, strings, arrays and pointers.

UNIT I: Fundamentals of Information Technology: Introduction to Computers - Generation of Computers - Classification of Digital Computer - Anatomy of Digital Computer. CPU and Memory - Secondary Storage Devices - Input Devices - Output Devices. Introduction to Computer Software - Programming Language - Operating Systems - Introduction to Database Management System.

UNIT II: Mathematical Foundations for Computer Science: Mathematical Logic: Statements and Notation - Connectives-Statement. Formulas and Truth Tables - Tautologies - Equivalence of Formulas - Duality Law. Tautological implications.

UNIT III: Problem Solving Techniques Algorithms: Flow charts - Developing algorithms and flowcharts for solving simple problems using sequential, selection and iterative programming Structures.

UNIT IV: Programming in C: Structure of a C program - Data Types - Constants and Variables - Operators and Expressions - Control structures - Looping structures. Arrays - Functions - Built-in-functions - User defined functions - Scope of Variables - Passing Arrays to function - Strings and pointers.

UNIT V: Coding Practices: Simple Programs using Operators - Branching structures - Looping structures - Arrays Strings - Functions - Structures - Union - Pointers. Teaching Methodology Lecture-based instruction, Demonstration

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Leon, A., & Leon, M. (2009). Fundamentals of Information Technology, (2nd Ed.). Vikas Publishing House Pvt. Ltd.
2. Tremblay, J. P., & Manohar, R. (2008). Discrete Mathematical Structures with Applications to Computer Science, (1st Ed.). McGraw-Hill International Edition, India.
3. Jaiswal, S. (2009). Information Technology Today, (4th Ed.). Galgotia Publications, New Delhi, India.
4. Balagurusamy, E. (2016). Programming in ANSI C, (7th Ed.). Tata McGraw Hill Education Private Limited, India.

Books for Reference

1. Gottfried, B., & Schaum's. (2018). Outline Programming with C, (4th Ed.). Tata McGraw Hill Education Private Limited, India.
2. Kernighan., & Ritchie. (1998). The C Programming Language, (2nd Ed.). Prentice Hall, India.
3. Kanetkar, Y. (2021). Let Us C, (18th Ed.). BPB Publications, India.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the fundamental concepts, strategies, and methodologies used in problem solving and algorithmic thinking.
2. Understand Mathematical Foundations for Computer Science
3. Analyze problems systematically and develop appropriate algorithms, flowcharts, and pseudocode to represent solutions.
4. Apply programming constructs such as variables, operators, control structures, functions, and arrays to solve computational problems.
5. Design, implement, test, and debug programs to solve real-world problems using a suitable programming language.

Year: I

Bridge Course - 1
1. Problem Solving Techniques Lab

Semester: I

Code:

Credits: 3

1. Write the program for simple and compound interest.
2. Write a C program to implement relational, logical and bitwise operators.
3. Write a C program for finding the maximum and minimum of three numbers.
4. Write a C program to Convert Celsius temperature to Fahrenheit and vice versa using type conversion.
5. Write a C program to find the roots of a quadratic equation using if-else.
6. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use Switch Statement).
7. Write a program to display prime numbers between X to Y.
8. Write a C program to calculate the sum of following series:
 - (i) $S1 = 1 + x/1 + x^2/2 + x^3/3 + \dots + x^n/n$
 - (ii) $S2 = 1 + x/1! - x^2/2! + x^3/3! + \dots + x^n/n!$
- TASK 5 a. Write a C program to display the following patterns:
9. Write a C program to implement factorial of a given integer
10. Write a C program to print first 'n' terms of Fibonacci series

Year: I

CORE COURSE 3

Semester: II

Advanced Database Management System

Code:

(Theory)

Credits: 4

Course objectives :After completing this course, students will be able to:

1. Knowledge of database design
2. A general understanding of database, design and dependency
3. Understanding of different types of databases
4. Knowledge of databases on the internet
5. Application on enhanced database

UNIT I INTRODUCTION TO DATABASE DESIGN Entities, Attributes, Entity Sets, Relationships, Key Constraints, Participation Constraints, Weak Entities, UML Class Diagrams, Subclasses, Super classes, Inheritance, Specialization, Generalization, Constraints and Characteristics of Specialization and Generalization Hierarchies, Modeling of UNION Types Using Categories, Representing Specialization and Generalization In UML Class Diagrams, Data Abstraction, Knowledge Representation and Ontology Concepts.

UNIT II DATABASES DESIGN THEORY Problems Caused by Redundancy, Decompositions, Problems Related to Decomposition, Reasoning About FD's, FIRST, SECOND, THIRD Normal Form, BCNF, Fourth Normal Form, Lossless Join Decomposition, Dependency Preserving Decomposition, Schema Refinement in Data Base Design, Multi Valued Dependencies.

UNIT III OBJECT- ORIENTED, PARALLEL AND DISTRIBUTED DATABASES Overview of Object-Oriented Concepts, Object Identity, Object Structure, Type Constructor, Encapsulation of Operations, Methods and Persistence; Architectures for Parallel Databases, Parallel Query Evaluation, Parallelizing Individual Operations, Sorting Joins, Distributed Database Concepts, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Query Processing in Distributed Databases, Concurrency Control and Recovery in Distributed Databases.

UNIT IV DATABASES ON THE WEB AND SEMI-STRUCTURED DATA

Web interface, XML, structure of XML data, querying XML data, storage of XML data, XML applications, semi-structured data model, indexes for text data.

UNIT V ENHANCED DATA MODELS FOR ADVANCED APPLICATIONS

Active database concepts, temporal database concepts, spatial databases: concept and architecture, deductive databases and query processing, mobile databases, Geographic Information Systems (GIS).

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbooks:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Education, 2003

References Books:

1. Korth, Silberschatz, Sudarshan, Database System Concepts
2. Rob and Coronel, Database Systems: Design, Implementation and Management
3. Date and Longman, Introduction to Database Systems.

Web References:

- 1 <https://www.guru99.com/data-mining-vs-datawarehouse.html>
- 2 https://www.tutorialspoint.com/dwh/dwh_overview
- 3 <https://www.geeksforgeeks.org/>
- 4 <https://blog.eduonix.com/internet-of-things/web-mining-text-miningdepth-mining-guide/>

Course Outcomes: Upon successful completion of the course, the student will be able to:

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

- 1 Basic knowledge and understanding of ER diagram and UML class diagram.
- 2 Ability to apply functionality and Normalization in relational databases.
- 3 Recognize and fetch data from object oriented, parallel and distributed databases.
- 4 Use XML and understand unstructured data
- 5 Implement concept and deduction of enhanced database on different applications

Year: I

CORE COURSE 4
COMPILER DESIGN
(Theory)

Semester: II

Code:

Credits: 4

Course objectives : After completing this course, students will be able to:

1. Provide an understanding of automata, grammars, language translators.
2. Know the various techniques used in compiler construction.
3. Aware of the process of semantic analysis.
4. Analyze the code optimization & code generation techniques.
5. Explore run time storage

UNIT - I: Formal Language and Regular Expressions: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA. Context Free grammars and parsing, derivation, parse trees, Application of Finite Automata.

UNIT - II: Introduction To Compiler: Phases of Compilation, ambiguity LL(K) grammars and LL(1) parsing Bottom up parsing handle pruning LR Grammar Parsing, LALR parsing, parsing ambiguous grammars, YACC programming specification. Semantics: Syntax directed translation, S-attributed and L-attributed grammars,

UNIT - III: Intermediate code: Abstract syntax tree, translation of simple statements and control flow statements. Context Sensitive features – Chomsky hierarchy of languages and recognizers, type checking, type conversions, equivalence of type expressions, overloading of functions and operations.

UNIT - IV: Run time storage: Storage organization, storage allocation strategies scope access to nonlocal names, Code optimization: Principal sources of optimization, optimization of basic blocks, peephole optimization,

UNIT - V: Code generation: Machine dependent code generation, object code forms, generic code generation algorithm, Register allocation and assignment. Using DAG representation of Block.

Unit – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS:

1. Introduction to Theory of computation. Sipser, 2nd Edition, Thomson.
2. Compilers Principles, Techniques and Tools Aho, Ullman, Ravisethi, Pearson Education. Automata & compiler Design

REFERENCES:

1. Modern Compiler Construction in C , Andrew W.Appel Cambridge University Press.
2. Compiler Construction, LOUDEN, Thomson.
3. Elements of Compiler Design, A. Meduna, Auerbach Publications, Taylor and Francis Group.
4. Principles of Compiler Design, V. Raghavan, TMH.

5. Engineering a Compiler, K. D. Cooper, L. Torczon, ELSEVIER.
6. Introduction to Formal Languages and Automata Theory and Computation - Kamala Krithivasan and Rama R, Pearson.
7. Modern Compiler Design, D. Grune and others, Wiley-India. \
8. A Text book on Automata Theory, S. F. B. Nasir, P. K. Srimani, Cambridge Univ. Press.
9. Automata and Language, A. Meduna, Springer.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the necessity and types of different language translators in use.
2. Apply the techniques and design different components (phases) of a compiler.
3. Ability to implement practical aspects of automata theory.
4. Use the tools Lex, Yacc in compiler construction
5. Explore Machine dependent code generation

Year: I

CORE PRACTICAL 2

Semester: II

Advanced Database Management System Lab

Code:

Credits: 4

1. Exercise on Data Manipulation Language and Transaction Control Commands
2. Exercise on Types of Data Constraints
3. Exercise on JOINS (Single-Table) Using Normalization
4. Exercise on JOINS (Multiple-Table) Using Normalization
5. Exercise on GROUP BY/ORDER BY Clause and Date Arithmetic
6. Exercise on different Functions (Aggregate, Math and String)
7. Exercise on different types of sub queries
8. Procedures, View and Triggers
9. Convert XML data into an HTML webpage.
10. Create a web page that reads XML data using JavaScript.
11. Export database tables into XML format.
12. Import XML data back into the database.

Year: I

DISCIPLINE CENTRIC ELECTIVE COURSE 2

Semester: II

1. Natural Language Processing

Code:

Credits: 3

Course objectives: After completing this course, students will be able to:

- 1 Introduce the students to the field of Language Computing and to learn its applications
- 2 Get acquainted with the basic concepts and algorithmic description of the main language levels: Morphology, Syntax, Semantics, and Pragmatics.
- 3 Study and implement various approaches to tackle morphology/syntax of a Language.
- 4 Design and implement various language models and POS tagging techniques.
- 5 Compare and contrast use of different statistical approaches for carrying out NLP tasks.

Unit - I Introduction: History of NLP, Generic NLP system, levels of NLP, Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP

Unit II Word Level Analysis: Morphology analysis – survey of English Morphology, Inflectional morphology & Derivational morphology, Tokenization, Stemming and Lemmatization, Stop word removal, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST, N – Grams- N-gram language model.

Unit III : Syntax analysis: Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues – Multiple tags & words, Unknown words. Named Entity Recognition (NER), Introduction to CFG, Sequence labeling: Markov Model, Hidden Markov Model (HMM)

Unit IV: Semantic Analysis: Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, Bag of Words (BoW), Term Frequency-Inverse Document Frequency (TF-IDF), Word embeddings (Word2Vec, GloVe), Robust Word Sense Disambiguation (WSD), Dictionary based approach

Unit V: Pragmatic & Discourse Processing: Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coreference Text Summarization, Classification and Opinion Mining: Text classification, Text summarization- LEXRANK, Optimization based approaches for summarization, Sentiment Analysis introduction, Sentiment Analysis-Affective lexicons, Sentiment analysis techniques, Aspect based sentiment analysis

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

- 1 Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.CRC Press Taylor and Francis Group
2. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008)

Reference Books:

- 1 Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
- 2 Introduction to Natural Language Processing by Jacob Eisenstein, MIT Press, 2019
- 3 Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall / CRC Press, 2010.
- 4 Dan Jurafsky and James Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Prentice Hall, Second Edition, 2009.
- 5 Alexander Clark, Chris Fox, Shalom Lappin — The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
- 6 Daniel M Bikel and Imed Zitouni — Multilingual natural language processing applications, Pearson, 2013
- 7 Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009

Web References:

- 1 <http://www.cse.iitb.ac.in/~cs626-449>
- 2 <http://cse24-iiith.virtual-labs.ac.in/#>
- 3 <https://nptel.ac.in/courses/106105158>
- 4 <https://www.coursera.org/learn/language-processing>
- 5 https://www.udemy.com/course/natural-language-processing/?trk=profile_certification_title&utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
2. Apply various Grammar formalisms and mathematical techniques in different fields of studies.
3. Analyze various algorithms and approaches for the given task, dataset, and stage of the NLP product.
4. Evaluate various techniques of machine learning
5. Understand various text categorization, text summarization and information extraction methods

1. To implement Tokenization of text.
2. To implement Stop word removal.
3. To implement Stemming of text
4. To implement Lemmatization
5. To implement N-gram model.
6. To implement POS tagging.
7. Training and using word embeddings
8. Implementing a text classifier
9. Building a sentiment analysis system
10. Write a code to develop Spam Filter using NLP
11. Write a code to detect Fake News using NLP

Year: I

DISCIPLINE CENTRIC ELECTIVE COURSE 2

Semester: II

2. Mobile Application Development

Code:

Credits: 3

Course Objective: After completing this course, students will be able to:

1. Provides a hands-on introduction to building mobile applications, focusing on both native Android and iOS platforms.
2. It covers platform-specific programming concepts, architecture, UI/UX design, and app deployment strategies
3. Through hands-on development using Android Studio and X code in building native mobile apps that interact with databases, web services, and device features.
4. Apply backend process
5. Integrate third-party APIs

Unit I : Foundation to Mobile Platforms and Android Studio : Android, iOS, and emerging platforms - Android platform architecture: Linux kernel, Libraries, Android Runtime, Application Framework, and Apps - Installing and configuring Android Studio and SDK tools - Creating the first Android project: app structure, AndroidManifest.xml, Gradle files - Android components: Activities, Services, Broadcast Receivers, Content Providers- Emulators vs real device deployment.

Unit II: UI/UX Design Principles and XML Layouts : Layout managers: Linear Layout, Relative Layout, Constraint Layout, Frame Layout - UI widgets: Buttons, Text View, Edit Text, Image View, Check Box, Spinner - Event handling and input validation - Material Design principles and guidelines - Designing adaptive UI: screen densities, multi-language support, orientation handling - Introduction to themes, styles, drawable resources, and custom views.

Unit III: Activity Lifecycle, Intents, and Navigation Activity lifecycle: onCreate(), onStart(), onResume(), onPause(), onStop(), onDestroy() - Explicit and Implicit Intents: launching apps and components - Passing data between activities using Bundle, Serializable, Parcelable - Using Fragments for reusable UI components - Introduction to Jetpack Navigation Component for seamless screen transitions - Back-stack management and deep linking.

Unit IV: Data Persistence and SQLite Shared Preferences: storing simple key-value pairs - Working with SQLite databases using SQLite Open Helper - Introduction to Room Database: Entities, DAOs, and Live Data - Performing CRUD operations on local databases - Handling migrations and database versioning- Best practices for secure and efficient data storage.

Unit V: Web API Integration and Networking : HTTP/HTTPS protocols and API formats (JSON/XML) - Consuming RESTful APIs using Retrofit and Volley - JSON parsing and serialization/deserialization - Error handling, timeouts, and retry mechanisms - API authentication (API keys, OAuth basics - Integrating third-party APIs (e.g., Google Maps, Firebase)

Unit – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester
Concerned

Text Books:

1. Barry Burd, Android Application Development for Dummies, 5th Edition, Wiley, 2023.
2. Joseph Annuzzi Jr., Lauren Darcey, Shane Conder, Android Programming: The Big Nerd Ranch Guide, 4th Edition, Addison-Wesley, 2022.
3. John Horton, Android Programming for Beginners, 3rd Edition, Packt Publishing, 2023.
4. Matt Neuburg, Programming iOS 14 with SwiftUI, O'Reilly Media, 2021.
5. Raywenderlich Tutorial Team, iOS Apprentice (Swift 5.5), Razeware LLC, 2022.

E-Resources:

1. Android Developers: <https://developer.android.com>
2. NPTEL Android Course:
<https://archive.nptel.ac.in/courses/106/106/106106156/>
3. Kotlin Docs: <https://kotlinlang.org/docs/home.html>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Describe the fundamental concepts, architectures, and development environments used in mobile application development.
2. Analyze mobile application requirements and platform-specific constraints to understand performance, usability, and resource management issues.
3. Evaluate mobile application frameworks, tools, and deployment strategies to assess their effectiveness for building robust mobile solutions.
4. Design user-centric mobile applications by selecting appropriate platforms, frameworks, and interface guidelines to address real-world needs.
5. Integrating third party tools

Year: I

DISCIPLINE CENTRIC ELECTIVE PRACTICAL 2

Semester: II

2. Mobile Application Development Lab

Code:

Credits: 3

1. Install and configure Java Development Kit (JDK), Android Studio, Android SDK, and Xcode. Create and deploy a basic 'Hello World' app on both Android and iOS simulators.
2. Design a user interface using basic widgets: buttons, text fields, image views, and spinners in Android. Create an equivalent UI layout in iOS using Storyboard and UIKit.
3. Develop a mobile app that responds to user interactions using event listeners. Demonstrate layout switching, form submission, and feedback using Android's XML layouts and iOS View Controllers.
4. Implement a four-function calculator that performs addition, subtraction, multiplication, and division. Use platform-specific UI controls, and validate user input in both Android and iOS versions.
5. Create custom views and animations using Android's Canvas and Animator classes.
6. Create an application to perform insert, update, delete, and display operations using SQLite in Android.
7. Build an app that integrates Firebase to send SMS or email notifications from an Android device.
8. Implement file reading/writing on external storage (SD card) in Android. Use Notification Manager to display persistent and time-based notifications.

Year: II

GENERIC ELECTIVE COURSE 2

Semester: III

1. E-Commerce Technologies and Management

Code:

Credits: 3

Course Objective: After completing this course, students will be able to:

1. Introduction to Electronic Commerce –Evolution and Models.
2. Payment transactions in a secured network.
3. Different payment modes of e-Commerce like Electronic data interchange
4. Manage different E-business Enterprise.
5. Understand Mobile commerce and security of e-Commerce.

Unit I :Electronic Commerce: Definition, categories & nature of e-Commerce, advantages and disadvantages of e-Commerce, eCommerce Opportunities for Industries, benefits to Organization and Society. Traditional Commerce v/s e-Commerce: Traditional business commerce, differences b/w e-Commerce and traditional commerce, Technical and nontechnical limitations. e-Commerce Models: Business-to-Business (B2B), Business-to-Consumer (B2C), Consumer-to-Consumer (C2C), Consumer-to-Business (C2B), Business-to-Government (B2G), Government to Business (G2B), Government –to- Citizen (G2C), Intra organization e-Commerce and Inter organization eCommerce

Unit II: e-Payment System: Electronic Payment System: Types of electronic payment system, cost involved in electronic payment system, Legal issues of e-Payment Systems, Risk and Electronic Payment Systems. Designing Electronic Payment systems. Electronic Data Interchange (EDI) :Concept of EDI, Benefits of EDI, How EDI works, legal and security and privacy issues in EDI, Applications of EDI Self-Learning topics: Internet Banking, Digital Signatures,

Unit III: Corporate Digital Library: Document Library, digital Document types, corporate Data warehouses. Advertising and Marketing – Information based marketing, Advertising on Internet, On-line marketing process, market research. Consumer Search and Resource Discovery Information search and Retrieval, Commerce Catalogues, Information Filtering. Multimedia –Key multimedia concepts, Desktop video processing, Desktop video conferencing Self-Learning topics: E-marketing, E-advertising, Ebranding

Unit IV: Managing the e-Enterprise: Introduction of eEnterprise, building the e-Enterprise: e-Transformation, Methodology, Org Models, e-Enterprise Architecture: Introduction, Business Architecture & Technology Architecture, E-Enterprise Technology Components: Technology Components & Technology Standards

Unit V : m-Commerce: Introduction to Mobile commerce, Applications, Advantages, Limitations, architecture, transaction model, payment methods, Payment operations, future trends. Self-Learning topics: Difference between eCommerce & m-Commerce, Value Chain & Life Cycle. e-Commerce Security Implications and Opportunities: Security Implications: Introduction, Security Policy, EDI Security Concepts, Security Mechanism, Internet Security. Issues and Opportunities in Implications: Introduction, Commercial Issues, Security Issues, Infrastructure Issues, Social and Cultural Issues.

Unit – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Reference Books:

- 1 E-COMMERCE An Indian Perspective 3rd Edition, P. T. Joseph, S. J., PHI Learning Private Limited
- 2 E-COMMERCE AND MOBILE COMMERCE TECHNOLOGIES, Dr. U. S. Pandey, S Chand Publishing, S Chand & Company Limited
- 3 Fundamentals of e-Commerce, Manjot Kaur
- 4 Frontier of e Commerce, Ravi Kalakota& Andrew B. Whinston
- 5 Business Models, Architecture and Components, Faisal Hoque, Cambridge University Press
- 6 e-Commerce “A Manager’s Guide to E_BUSINESS” by Parag Diwan & Sunil Sharma Published by Anurag Jain for Excel Books.

Web References:

- 1 <https://www.scribd.com/doc/20489539/Corporate-Digital-Library>
- 2 https://www.researchgate.net/publication/228854622_eCommerce_and_Digital_Libraries
- 3 <https://www.coursehero.com/file/52491570/32pdf/>
- 4 https://www.google.co.in/books/edition/E_COMMERCE_SEVENTH_EDITION/G8fAEAAAQBAJ?hl=en&gbpv=1
- 5 https://www.google.co.in/books/edition/E_Enterprise/gOWsBfEZ5TMC?hl=en&gbpv=1&dq=Books+for+e-Enterprise+in+eCommerce&printsec=frontcover

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1 Identify the anatomy of e-Commerce applications and its process models.
- 2 Categorize different Electronic payment systems
- 3 Analyze various marketing strategies of e-Commerce for an online business.
- 4 Understanding the operations of e-enterprises.
- 5 Discuss mobile application and payment method of m-commerce

Year: II

GENERIC ELECTIVE COURSE 2
2. Design Thinking and Innovation Skill

Semester: III

Code:

Credits: 3

Course objectives : After completing this course, students will be able to::

- 1 Understand the Design Thinking and its role in fostering creativity, innovation, and problem-solving.
- 2 Identify user needs and generate innovative solutions.
- 3 Develop prototypes and test ideas iteratively.
- 4 Apply design thinking tools to solve real-world problems.
- 5 Integrate innovation skills in technology projects and product development.

Unit I: Introduction to Design Thinking: - Meaning , Definition and Importance of Design Thinking -Origins of Design Thinking -Features of Design Thinking - Principles of Design Thinking -Stages of Design Thinking - Benefits of Design Thinking

Unit II: Creativity & Innovation: Meaning & Definition, of creativity & innovation, Theories of Innovation and Levels , Types of Innovation, Fundamentals of innovation and its role in technology. Building an innovative mindset: Creativity and adaptability. Design thinking in software development Tools for innovation: Business Model Canvas, Value Proposition Canvas. Creative Industries & Potential for Growth.

Unit III:Design Thinking Process: Emphasize: Understanding users and their needs. Observation: Conducting interviews, surveys, and observations. Define: Framing problems through user insights. Creating maps: Affinity diagram, mind map, journey map, combining ideas into complex innovation concepts. Ideate: Brainstorming and divergent thinking techniques. Tools: SCAMPER, mind mapping, and six thinking hats.

Unit IV: Wireframe and Prototyping Wireframe: Definition, Types, Usage and guidelines Creating Story Board: Definition, Usage, guidelines, scenario planning. Prototyping: Definition, Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Types: Low Fidelity and High Fidelity, Usage, Guidelines. Lean Start-up Method for Prototype Development Tools for Prototyping: Paper Prototyping, Figma, Adobe XD, or similar software

Unit V: Prototype Testing: Heuristic testing, it's Principles and reporting, Kano Model for testing. Different types of Testing: First Click method, second test case, Navigation Test, Preference Test, Design Test, Prototype test, Questionnaire test (Quantitative evaluation and Qualitative Evaluation).

Unit – VI: Current Contours: (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Reference Books:

- 1 Johny Schneider, “Understanding Design Thinking, Lean and Agile”, O'Reilly Media, 2017.

- 2 Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
- 3 The UX Book: Process and Guidelines for Ensuring a Quality User Experience , by Rex Hartson, Pardha S. Pyla , MK publication, 2012.
- 4 Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown, HarperCollins e-books; 1st edition (16 September 2009).
- 5 Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand-Improve-Apply". Springer, 2011.
- 6 Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie. ,Columbia Business School publishing, 2011.
- 7 Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests, 2nd Edition Jeffrey Rubin, Dana Chisnell, Jared Spool, Wiley Publication.
- 8 Design thinking success stories from IDEO, Google, and IBM.
- 9 Six Thinking Hats: An Essential Approach to Business Management-Edward De Bono
- 10 Christian Mueller-Roterberg, Handbook of Design Thinking – Tips & Tools for how to design thinking, Nov.2018, paperback.
- 11 Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie. ,Columbia Business School publishing, 2011.

Web References:

- 1 <https://venturewell.org/class-exercises>
- 2 <https://www.goodreads.com/shelf/show/design-thinking>
- 3 <https://www.nngroup.com/articles/ten-usability-heuristics/>
- 4 <https://www.lyssna.com/>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Define the principles of Innovation, Creativity, Design Thinking and its applications.
2. Apply empathy-driven research methods to identify and articulate user needs.
3. Analyze user insights and generate innovative solutions using ideation techniques.
4. Design and test prototypes through iterative processes, incorporating user feedback to improve solution effectiveness.
5. Integrate design thinking principles into technology projects to develop innovative, sustainable, and user-centric solutions.

Year: II

GENERIC ELECTIVE COURSE 2

Semester: III

3. Operations Research

Code:

Credits: 3

Course objectives: After completing this course, students will be able to:

1. Formulate and solve linear programming problems
2. Impart knowledge in duality concept, transportation problem and assignment problem.
3. Capable of utilizing project scheduling techniques like PERT and CPM
4. Gain insights into the principles of Queueing Theory
5. Give solid foundation in game theory.

UNIT I: Linear Programming:- Formulations and Graphical solution to L.P. Problem- Simplex method - Degeneracy, Unbounded and infeasible solution - Two Phase Method.

UNIT II: Linear Programming (contd.): Duality-Primal and Dual Computations - Dual Simplex Method - Transportation problem and its solution - Assignment problem and its solution by Hungarian method.

UNIT III: PERT: CPM -Phases of project scheduling - Arrow Diagram - Critical Path Method - Probability Considerations in Project Scheduling.

UNIT IV: Queueing Theory: Queueing System - Characteristics of Queueing system - classification of queues - Poisson Queues - M/M/1 and M/M/C Queueing Models.

UNIT V: Game Theory : Introduction - Two-Person Zero - Sum Games-Some Basic Terms - The Maximin- Minimax Principles - Games without Saddle points - Mixed Strategies - Graphic Solution of $2 \times n$ and $m \times 2$ GamesDominance Property. Teaching Methodology Lecture-based Instruction, PPT, Demonstration

TextBooks

Swarup, K., Gupta, P. K., & Man Mohan. (2013). Operations Research. Sultan Chand & Sons.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Books for Reference

1. Taha, A.H. (1987). Operations Research-An Introduction, (5th Ed.). Macmillan Publishing Co.
2. Gupta, P. K., Mohan, M. (1987). Operations Research and Quantitative Analysis, (1st Ed.). Sultan Chand & Sons.
3. Kalavathy, S. (2013). Operations Research. Vikas Publishing House Pvt. Ltd. M C A (Computer Applications)

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1** Recall the basic concepts of LPP, TP, AP, CPM, PERT, Queue and game theory
- 2** Understand the characteristics and relationships in LPP, TP, AP, CPM, PERT, Queue and game theory
- 3** Identify the activities, models, methods and procedures in LPP, TP, AP, CPM, PERT, Queue and game theory
- 4** Analyze and apply the procedure for problem solving in LPP, TP, AP, CPM, PERT, Queue and game theory
- 5** Select the suitable LPP, TP, AP, CPM, PERT, Queue and game theory to solve real-life problems

Year: I

**NON MAJOR ELECTIVE – I
Cyber Security**

Semester: II

Code:

Credits: 2

Course Objectives: After completing this course, students will be able to:

Unit I INTRODUCTION : Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cyber crime and Punishment.

Unit II ATTACKS AND COUNTERMEASURES : Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

Unit III Fighting Cyber Attacks: Defense in depth - authentication – cryptography – Firewall – Data Loss Prevention – Antivirus Software – Virtual Private Network – Web Browsers – Data Backup.

Unit IV INTRUSION DETECTION : Host –Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Unit V INTRUSION PREVENTION : Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

COURSE OUTCOMES Upon successful completion of the course, the student will be able to:

- 1: Explain the basics of cyber security, cyber crime and cyber law
- 2: Classify various types of attacks.
- 3: Learn the tools to launch various attacks.
- 4: Apply various tools to perform information gathering
- 5: Apply intrusion techniques to detect intrusion
- CO6: Apply intrusion prevention techniques to prevent intrusion

TEXT BOOKS:

1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011
3. Akash Kamal Mishra, “An Overview on Cybercrime & Security, Volume – I”, XPress Publishing, 2020, ISBN:9781649836007.

4. Anand Shinde, "Introduction to Cyber Security", Notion Press, 2021, ISBN:9781637816431.
5. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", 4th edition, Jones & Bartlett Learning Publishers, 2021
6. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2013 .
7. Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2010

REFERENCES

1. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Global Edition, Pearson Education, 2018
2. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2014

Year: I

Bridge Course – II
Fundamentals of Computers

Semester: II

Code:

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Get familiar with the fundamental concepts of Computers.
2. Understand basics of Microprocessor
3. Apply the concepts of Operating systems
4. Explore DBMS concepts
5. Understand Computer networks technology

Unit-I: Computer Basics: Simple Model of a Computer, Characteristics of Computers – Computer classifications and generations - Data Representation.

Unit-II: Introduction to Microprocessor - Input / Output Units – Computer Memory – Storage – - Binary Arithmetic – Logic Circuits.

Unit-III: Introduction to Operating Systems – Programming languages

Unit-IV: Database Management Systems - SQL Commands -DDLs DMLs DCLs TCLs and DQL.

Unit-V: Multimedia - Computer Networks.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book:

1. V. Rajaraman, Neeharika Adabala : Fundamentals of computers, Prentice Hall India Learning Private Limited; 6th Revised Edition (2014)
2. PRINCIPLES OF DIGITAL ELECTRONICS, Dr. K. MEENA, PHI Learning, ISBN : 9788120332706

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Understand Computer classification
2. Explore Microprocessor
3. Understand operating systems concepts
4. Apply DBMS concepts
5. Analyze computer networks

Year: I

Bridge Course –II

Semester: II

Fundamentals of Computers lab

Code:

Credits: 3

1. Implementation of DDL commands of SQL with suitable examples
 - (i) Create table
 - (ii) Alter table
 - (iii) Drop Table
2. Implementation of DML commands of SQL with suitable examples
 - (i) Insert
 - (ii) Update
 - (iii) Delete
3. Implementation of different types of function with suitable examples
 - (i) Number function
 - (ii) Aggregate Function
 - (iii) Character Function
 - (iv) Conversion Function
 - (v) Date Function
4. Implementation of different types of operators in SQL
 - (i) Arithmetic Operators
 - (ii) Logical Operators
 - (iii) Comparison Operator
5. Implementation of the following operators in SQL
 - (i) Special Operator
 - (ii) Set Operation

Year: II

CORE COURSE 5
BASICS OF MACHINE LEARNING
(Theory)

Semester: III

Code:

Credits: 4

Course objectives: After completing this course, students will be able to:

1. Formulate machine learning problems corresponding to different applications.
2. Understand various supervised, semi-supervised and unsupervised machine learning algorithms.
3. Familiarize various machine learning software libraries and data sets publicly available.
4. Develop machine learning based system for various real-world problems.
5. Assess how the choice of a machine learning algorithm impacts the accuracy of a system.

Unit I Introduction to Machine Learning Machine Learning – what and why? Supervised learning and unsupervised learning. Basics of Linear Algebra - matrices and vectors, Eigen value decomposition, principal component analysis.

Unit II Supervised Learning Linear Regression with one variable, cost function, gradient descent for linear regression. Linear regression with multiple variables, normal equation, gradient descent. Logistic regression, cost function, gradient descent. Regularization - the problem of overfitting, regularization in linear regression and logistic regression.

Unit III Dimensionality reduction: Principal components. Decision Tree, Overfitting and Pruning, Support Vector Machine and Kernel; Noise, bias-variance trade-off, under-fitting and overfitting concepts.

Unit IV Neural Networks representations :Forward propagation, multi class classification. neural networks cost function, backpropagation algorithm. Regularization and bias/ variance. Recurrent networks.

Unit V Unsupervised and Semi Supervised Learning Clustering - K-means partitional clustering, choosing the number of clusters. Hierarchical Agglomerative Clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeled data.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Mitchell Tom, “Machine Learning”, Latest Edition, Mc-Graw Hill.

Reference Books:

1. Shwartz Shai Shalev, and David Shai Ben, “Understanding Machine Learning”, Cambridge University Press, 2017.
2. Bishop Christopher “Pattern Recognition and Machine Learning”, Springer, 2006.
3. A Course in Machine Learning by Hal Daumé III (freely available online)

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1 Formulate machine learning problems corresponding to different applications: data, model selection, model complexity
- 2 Demonstrate understanding of a range of machine learning algorithms along with their strengths and weaknesses
- 3 Implement machine learning solutions to classification, regression, and clustering problems
- 4 Design and implement various machine learning algorithms in a range of real-world applications
- 5 Evaluate and analyse the performance of a machine learning algorithm or a system based on machine learning algorithm.

Course objectives: After completing this course, students will be able to:

1. Provide foundational knowledge of quantum computing principles, including quantum mechanics, qubits, and quantum gates, and their role in computational systems.
2. Enable students to understand and analyze quantum algorithms, such as Shor's and Grover's algorithms, and their advantages over classical algorithms.
3. Develop practical skills in quantum programming using tools like Qiskit and Cirq, enabling the design and simulation of quantum circuits.
4. Identify and assess challenges in quantum computing, including hardware limitations, error correction, and scalability issues.
5. Explore the application of quantum computing in fields like cryptography, optimization, and machine learning, and propose solutions for real-world problems.

UNIT 1: Introduction to Quantum Computing- Fundamentals of Quantum Computing: Quantum mechanics principles (superposition, entanglement, measurement). Qubits: Representation, properties, and differences from classical bits. Quantum Gates: Single-qubit gates (Hadamard, Pauli), multi-qubit gates (CNOT, Toffoli). Quantum Circuits: Design and representation. Quantum Computing Models: Gate-based, adiabatic, and measurement-based quantum computing. Overview of Quantum Hardware: Superconducting qubits, trapped ions, and topological qubits.

UNIT 2: Quantum Algorithms : Introduction to Quantum Algorithms: Classical vs. quantum computational paradigms. Key Quantum Algorithms: Shor's algorithm (factoring), Grover's algorithm (search), Deutsch-Jozsa algorithm. Quantum Fourier Transform (QFT) and its applications. Algorithm Complexity: Speedup analysis and limitations. Algorithm Design Principles: Quantum parallelism, interference, and amplitude amplification. Simulation of Quantum Algorithms: Tools and techniques for algorithm testing

UNIT 3: Quantum Programming and Tools Quantum Programming Frameworks: Qiskit (IBM), Cirq (Google), PennyLane. Building Quantum Circuits: Syntax, libraries, and simulation environments. Quantum Programming Concepts: Quantum registers, measurements, and classical-quantum hybrid programs. Error Correction: Basics of quantum error correction codes (surface codes, stabilizer codes). Quantum Simulators vs. Real Quantum Hardware: Capabilities and limitations. Debugging and Optimization: Techniques for improving quantum circuit performance.

UNIT 4: Quantum Computing Applications: Cryptography (post-quantum cryptography), optimization problems, machine learning, and chemistry simulations. Quantum Computing in Industry: Use cases in finance, logistics, and healthcare. Challenges in Quantum Computing: Decoherence, noise, and scalability. Ethical and Security Implications: Impact on classical cryptography, data privacy, and responsible innovation.

Unit 5: Emerging Trends: Quantum cloud computing (IBM Quantum, Amazon Braket), quantum supremacy, and quantum internet. Future Directions: Hybrid quantumclassical systems, fault-tolerant quantum computing, and quantum machine learning.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbooks:

1. Quantum Computing: An Applied Approach, Jack D. Hidary, Springer, 2019.
2. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2010.

Reference Books

1. Learn Quantum Computing with Python and IBM Quantum Experience, Jack D. Hidary and Noson S. Yanofsky, Packt Publishing, 2020.
2. Quantum Computing for Computer Scientists, Eleanor G. Rieffel and Wolfgang H. Polak, Cambridge University Press, 2011.
3. Programming Quantum Computers, Eric R. Johnston, Nic Harrigan, and Mercedes GimenoSegovia, O'Reilly Media, 2019.

COURSE OUTCOMES (CO):

Upon successful completion of the course, the student will be able to:

1. Understand the fundamental principles of quantum mechanics such as superposition, entanglement, and measurement, and differentiate classical computing from quantum computing models and hardware architectures.
2. Explore Quantum Algorithms
3. Analyze Quantum Programming and Tools
4. Understand applications of Quantum Computing
5. Explore Emerging Trends

1. Perform PCA on a dataset to reduce attributes. Compare performance with available PCA modules in python.
2. Perform Linear regression on a dataset and compute the relevant parameters.
3. Classify a dataset with binary class distribution using logistic regression. Compute the values for accuracy, precision and recall and present the confusion matrix. Perform all necessary data preprocessing of the attributes involved.
4. Classify a dataset using the K-NN algorithm.
5. Classify a dataset using the Naïve Bayes algorithm. Extend your algorithm to incorporate numerical attributes.
6. Cluster a dataset using the K-Means algorithm. Compute a suitable value of K using the grid search mechanism. Report the performance metrics of your algorithm e.g. homogeneity score, silhouette coefficient etc.
7. Write a program in python to cluster a dataset using the DBSCAN algorithm. The inputs to the algorithm would include epsilon and “p”.
8. Perform agglomerative clustering of a dataset in python. The number of clusters would be an input to the algorithm and your algorithm should provide options to choose the distance metrics e.g. distance between centers, distance between nearest neighbours, distance between farthest points etc.
9. Write a program use Information Gain to decide the splitting attribute for a dataset to be used in a decision tree classifier.

Year: II

DISCIPLINE CENTRIC ELECTIVE COURSE 3

Semester: III

1. Big Data Analytics

Code:

Credits: 3

Course objectives: After completing this course, students will be able to :

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop • Provide HDFS Concepts and Interfacing with HDFS • Understand Map Reduce Jobs
3. Provide hands on Hadoop Eco System
4. Apply analytics on Structured, Unstructured Data.
5. Exposure to Data Analytics with R.

UNIT I :INTRODUCTION TO BIG DATA AND HADOOP Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II :HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III :Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV :Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

UNIT V : Data Analytics with R : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR. Introduction to R - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books

- Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

References

- Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.
- Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)

- Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oracle press.
- Anand Rajaraman and Jeffrey David Ulman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
- Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
- Glen J. Myat, “Making Sense of Data”, John Wiley & Sons, 2007
- Pete Warden, “Big Data Glossary”, O’Reily, 2011.
- Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
- ArvindSathi, “BigDataAnalytics: Disruptive Technologies for Changing the Game”, MC Press, 2012
- Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Identify Big Data and its Business Implications.
2. List the components of Hadoop and Hadoop Eco-System
3. Access and Process Data on Distributed File System
4. Manage Job Execution in Hadoop Environment
5. Apply Machine Learning Techniques using R.

1. Implement the following file management tasks in Hadoop: i) Adding files and directories ii) Retrieving files iii) Deleting files and directories.
2. i) Develop a Map Reduce program to calculate the frequency of a given word in a given file. ii) Develop a Map Reduce program to find the maximum temperature in each year.
3. Design Map Reduce algorithms to take a very large file of integers and produce as output: i) The largest integer ii) The average of all the integers.
4. Implement Matrix Multiplication on Hadoop Using Map Reduce.
5. Run Pig and perform basic PIG commands. ii) Write Pig Latin scripts to sort, group, join, project, and filter your data.
6. i) Practice Basic HiveQL Commands, read data from various File Formats and create Data Definition Statements and Data Manipulation Statements. ii) Write Queries using select

Year: I

DISCIPLINE CENTRIC ELECTIVE COURSE 3

Semester: I

2. Blockchain Technology

Code:

Credits: 3

Course objectives: After completing this course, students will be able to:

- 1 Understand the fundamental structure, mechanisms, and cryptographic primitives of Blockchain technology.
- 2 Understand the structure and underlying mechanisms of permissionless and permissioned blockchain.
- 3 Understanding smart contracts, solidity basics and tokens.
- 4 Understand the Hyperledger case studies in Blockchain.
5. Explore hyper ledger

Unit I: Cryptographic Primitives: Cryptographic hash functions collision free, hiding, puzzle friendly (properties), Hash Chain, Hash tree- Merkle Tree, Public Key cryptography, Digital signatures. Use of hash functions and digital signatures in blockchain

Unit II : Introduction: Basics of blockchain, History, Uses of Blockchain, Structure of a block, Transactions, Public Ledger, Distributed Consensus and its objective. Peer to peer systems, centralized and decentralized systems, Types of blockchain

Unit III: Bitcoin: Basics (Structure of block, creation of coins), Double Spending, Bitcoin Script (FORTH), Mining Process, Block Propagation, Sybil Attack, Consensus in Bitcoin - Proof of Work, Proof of Elapsed Time, Proof of Stake, Proof of Burn

Unit IV: Ethereum: History, Architecture, Ethereum Virtual Machine, Accounts, Account Types , Ether, Gas, Transactions, Structure (Blocks, Transactions), Ethereum Mining process, Smart Contracts, Introduction to Solidity, Non Fungible Tokens

Unit V: Permissioned Blockchain: Distributed Consensus, Faults in Distributed Consensus, Algorithms Paxos, RAFT, Byzantine Fault Tolerance, Practical Byzantine Fault Tolerance Hyperledger Fabric: Features of hyperledger, Architecture, ordering service, Transaction Flow, Membership and Identity Management, Gossip Protocol.

Unit - VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press
2. Don Tapscott, Alex Tapscott, Blockchain Revolution, ISBN No. 9781101980132

3. Mark Gates, Blockchain ultimate Guide to understanding Blockchain, Bitcoin, Cryptocurrencies, Smart Contracts and Future of money, Wise Fox Publishing
4. Vikram Dhillon, David Metcalf, Max Hooper, Blockchain Enabled Applications, Apress, ISBN No. 978-1-4842-3081-7
5. Sharad Mangrulkar, R., Vijay Chavan, P., Blockchain Essentials. Apress, Berkeley, CA, ISBN No. 978-1-4842-9974-6
6. Andreas M. Antonopoulos, Mastering Bitcoin Programming the Open Blockchain, 2nd Edition, O'Reilly Publication, ISBN: 978-1-4842-5213-5
7. Mayukh Mukhopadhyay, Ethereum Smart Contract Development, Packt publishing, First Edition, ISBN No. 978-1-78847-304-0
8. Chris Dannen, Introducing Ethereum and Solidity, Apress, ISBN No. 978-1-4842-2535-6
9. Martin Quest, Cryptocurrency Master Bundle
10. Nitin Gaur, Luc Desrosiers, Petr Novotny, Venkatraman Ramkrishna, Anthony O'Dowd, Salman A. Baset, Hands-On Blockchain with Hyperledger, Packt
11. Andreas Antonopoulos & Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Publications,
12. Imran Bashir, Mastering Blockchain, 4th Edition, Packt Publishing, ISBN-10 : 1803241063, ISBN-13: 978-1803241067

Web References:

1. <https://www.blockchain.com/explorer>
2. https://en.wikipedia.org/wiki/Digital_signature
3. <https://nptel.ac.in/courses/106/105/106105184/?authuser=0>
4. <https://github.com/ethereum/wiki/wiki/White-Paper>
5. https://hyperledger-fabric.readthedocs.io/en/latest/key_concepts.html
6. <https://hyperledger-fabric.readthedocs.io/en/release-1.3/arch-deep-dive.html>
7. <https://www.investopedia.com/non-fungible-tokens-nft-5115211>
8. <https://www.forbes.com/advisor/investing/cryptocurrency/nft-non-fungible-token/>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Explain Blockchain technologies, their components, and the importance of cryptographic primitives in ensuring security and functionality.
2. Explain the structure and underlying mechanisms of permissionless and permissioned blockchain.
3. Develop the ethereum smart contract and token in ethereum
4. Analyze the use of Blockchain technology in various domains.
5. Understand Permissioned Blockchain

Year: II

DISCIPLINE CENTRIC ELECTIVE COURSE 3

Semester: III

2. Blockchain Technology Lab

Code:

Credits: 3

LIST OF EXPERIMENTS:

1. Create a Public Ledger and Private Ledger with the various attributes like Access, Network Actors, Native token, Security and Speed
2. Write Hello World smart contract
3. Use Geth to Implement Private Ethereum Block Chain. Software
4. Build Hyperledger Fabric Client Application.
5. Build Hyperledger Fabric with Smart Contract.
6. Using Python Libraries to develop Block Chain Application
7. Build a payment request URI
8. Create simple wallet transaction from one account to another account
9. Construct the Naïve block chain

Year: II

GENERIC ELECTIVE COURSE 3

Semester: III

1. MANAGEMENT CONCEPTS AND STRATEGIES

Code:

Credits: 3

Course objectives :After completing this course, students will be able to:

1. Discuss Fundamentals of Management & Decision Making
2. Analyze Management & Communication Process Concepts
3. Understanding techniques for Management System
4. Manage the human resources
5. Explore different forms of control techniques

Unit-I: Management Theories :Science Theory and Practice - Management and Society: Social Responsibility and Ethics. The nature and purpose of planning - objectives – Strategies Policies and planning premises.

Unit-II: Decision Making:The Nature and purpose of organizing - Basic departmentalization - Line/Staff Authority and Decentralization - Effective Organizing and organizational culture.

Unit-III: Human Resource:Management & Selection -Performance appraisal and career strategy - Manager and organizational development.

Unit-IV: Managing the Human factor Motivation: - Leadership - Communication.

Unit-V: The System & Process of Controlling: Control techniques and Information Technology - Productivity and Operations Management - Overall and Preventive Control - Towards a Unified, Global management theory.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS:

1. Herald Knootz and Heinz Weihrich, “Essentials of Management”, McGraw-Hill Publishing Company, Singapore International Edition, 2000.
2. Ties AF, Stoner and R. Edward Freeman, “Management”, Prentice Hall of India Pvt., Ltd., New Delhi, 2003.
3. Joseph l, Massie, “Essentials of Management”, Prentice Hall of India Pvt., Ltd., New Delhi, 2002

Course Outcomes: Upon successful completion of the course, the student will be able to :

1. Understand Fundamentals of Management & Decision Making
2. Analyze Management & Communication Process Concepts
3. Understand various techniques for Management
4. Explore leadership communication
5. Apply control process for global management theory

Year: II

GENERIC ELECTIVE COURSE 3

Semester: III

2. Digital Marketing and Business Analytics

Code:

Credits: 3

Course objectives :After completing this course, students will be able to::

1. Examine and explore the role and importance of Digital Marketing in the current business scenario.
2. Apply Search Engine Optimization
3. Familiarize with the various Digital Marketing Tools.
4. Apply social media marketing platforms for formulating a Digital Marketing Strategy.
5. Understand the need and practices of trending technologies in Digital Marketing.

Unit I: Fundamentals of Digital Marketing: Digital Marketing. Digital Marketing Strategy. Skills Required in Digital Marketing, Digital Marketing Plan, Dignified Digital Marketing – Ethics and Data Privacy Display Advertising: Introduction to Display Advertising, Types of Display Ads, Buying Models, Display Plan

Unit II: Search Engine Advertising and Optimization: Introduction, Understanding Ad Placement, Understanding AdRanks, Creating First Ad Campaign, Enhance Your Ad Campaign, Performance Reports. SEO: Search Engine, Concept of Search Engine Optimization (SEO), SEO Phases, On Page Optimization, Off Page Optimization, Social Media Reach, Maintenance

Unit III: Social Media Marketing: Building a Successful Strategy Facebook Marketing: Facebook Marketing for Business, Anatomy of an Ad Campaign, Adverts, Facebook Insights, Other Marketing Tools, Other Essentials LinkedIn Marketing: Importance of LinkedIn Presence, LinkedIn Strategy, Sales Leads Generation Using LinkedIn, Content Strategy, LinkedIn Analytics, Targeting, Ad Campaign

Unit IV: Twitter Marketing: Getting Started with Twitter, Building a Content Strategy, Twitter Usage, Twitter Ads, Twitter Analytics, Twitter Tools and Tips for Marketers Instagram: Getting started with Instagram, content strategy, different features of Instagram, Promo Codes in Ads, Message Editing and Pinning, Multiple Links in Bio, Scheduling Posts, Reels Templates and Interactive Elements, Instagram Threads YouTube Marketing: YouTube Channel, Optimize Your YouTube Videos for SEO, YouTube Ads, YouTube Analytics Mobile Marketing: Mobile Usage, Mobile Advertising, Mobile Marketing Toolkit, Mobile Marketing Features, Mobile Analytics

Unit V: Web Analytics: Data Collection, Key Metrics, Making Web Analytics Actionable, Multi- Channel Attribution, Types of Tracking Codes, Competitive Intelligence . Technological advancements in digital marketing: Voice Search, AI in advertising, AI for Social Media marketing, Chatbots, Big data in marketing, Virtual Reality, Augmented Reality

Unit – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Reference Books:

1. Digital Marketing, Seema Gupta, McGraw Hill Education (India) Private Limited
2. Social Media & Mobile Marketing: Includes Online Worksheets Puneet Singh Bhatia, ISBN: 9788126578078
3. Digital Marketing for Dummies, Ryan Deiss & Russ Henneberry, John Wiley & Son, Inc.
4. Social Media Marketing All-In-One, Jan Zimmerman, Deborah Ng, John Wiley & Sons Inc.
5. Epic Content Marketing, Joe Pulizzi, McGraw Hill Education
6. The Art of SEO, Eric Enge, Stephan Spencer, Jessie Stricchiola, O'Reilly Media Inc,
7. Digital Marketing 2020, Danny Star

Web References:

- 1 Digital Marketing Strategy - Course (swayam2.ac.in)
- 2 Basics of Digital Marketing - Course (swayam2.ac.in)
- 3 Digital Marketing - Course (swayam2.ac.in)
- 4 <https://www.hubspot.com/youtube-marketing>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the role of Digital Marketing and key elements of Digital Marketing Strategy. Remembering, Understanding
2. Optimization of search engines
3. Demonstrate use of various Digital Marketing Tools for digital marketing campaigns. Applying and Analyzing
4. Assess/Evaluate the effectiveness of social media marketing strategies for improving business. Evaluating
5. Demonstrate web analytics using trending technologies in Digital Marketing.

Year: II

GENERIC ELECTIVE COURSE 3
3. Green Computing and Sustainability

Semester: III

Code:

Credits: 3

Course objectives :After completing this course, students will be able to:

1. Understand the principles of green computing.
2. Create awareness among stakeholders and promote green initiatives in their environments leading to a green movement
3. Assess environmental impacts of computing technologies and need for green computing.
4. Create an eco-friendly environment
5. Explore sustainable IT practices and energy-efficient hardware system for sustainability growth.

Unit I: Introduction to Green Computing: Scope - Environmental Impact of Computing - Need for Sustainable Computing – Power-Aware Resource Management - Green IT - OCED Green IT Framework – Greening IT - Benefits and Challenges - Quantifying IT Energy Efficiency.

Unit II: Green Hardware: Life cycle of hardware - Reuse, Recycle and Dispose Green Design and Manufacturing of Computers- Green Software - Energy-Saving Software Techniques

Unit III: Sustainable Software Development: attributes – metrics – Methodology – Energy aware Software Engineering - Green Algorithms

Unit IV: Green Data Center: Infrastructure for Energy Efficiency – server power management . Green Data Storage: Practices for Improving the Energy Efficiency of Data Storage - Optical Interconnects for Green Computers and Data Centers

Unit V: Managing Green IT: Strategizing Green Initiatives – Implementation - Green IT Laws, Standards and Protocols- Regulatory Environment and IT Manufacturers. Nonregulatory Government Initiatives: Green Building Standards - Sustainability Reporting and Green Audits

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. San Murugesan, Harnessing Green IT: Principles and Practices, Wiley, 2012.
2. Suyel Namasudra(Editor), Green and Sustainable Computing, 1st Edition, Volume 87, Elsevier, 2012.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Green IT: Reduce Your Information System's Environmental Impact", McGraw Hill, 2008.
4. Bhuvan Unhelkar, "Green IT Strategies and Applications: Using Environmental Intelligence", CRC Press, 2011.
5. Balamurugan Balusamy, Naveen Chilamkurti, Seifedine Kadry, Green Computing in Smart Cities: Simulation and Techniques, Springer Singapore, 2020.

6. Mike Halsey, The Green IT Guide - How to Make Your IT Systems and Business Sustainable and Carbon Neutral, A press, 2025

E-Resources

1. Prof. Deepu Philip, Prof. Amandeep Singh | IIT Kanpur
Link http://onlinecourses.nptel.ac.in/noc21_mg85/preview
2. Prof. Sayak Banerjee | IIT Hyderabad
Link "https://onlinecourses.nptel.ac.in/noc23_me138/preview"

Course Outcomes: Upon successful completion of the course, the student will be able to:

- 1 Describe the fundamental concepts, principles, and practices of green computing and sustainability in modern information technology systems
- 2 Analyze computing systems and technologies to assess their energy efficiency, environmental impact, and sustainability metrics.
- 3 Evaluate green computing strategies, sustainable IT practices, and regulatory frameworks for their effectiveness in reducing environmental impact.
4. Recognize the necessity for long-term sustainability in IT Understanding
- 5 Design sustainable computing solutions by selecting energy efficient architectures, technologies, and practices for environmentally responsible systems.

Year: II

NON-MAJOR ELECTIVE - 2
Web designing principles

Semester: III

Code:

Credits: 2

Course Objectives: After completing this course, students will be able to

1. Understand Web Design concepts
2. Explore basics of web design
3. Apply different HTML tags
4. Explore CSS
5. Apply the web hosting techniques

Unit I Web design Principles - Basic principles involved in developing a web site - Planning process - Five Golden rules of web designing - Designing navigation bar - Page design - Home Page Layout - Design Concept.

Unit II Basics in Web Design - Brief History of Internet –World Wide Web – need to create a website – web standards – Audience requirements.

Unit III Introduction to HTML – What is HTML - HTML Documents - Basic structure of an HTML document - Creating an HTML document - Mark up Tags - Heading-Paragraphs - Line Breaks - HTML Tags- Working with Text - Working with Lists, Tables and Frames - Working with Hyperlinks, Images and Multimedia - Working with Forms and controls.

Unit IV Introduction to Cascading Style Sheets - Concept of CSS - Creating Style Sheet - CSS Properties - CSS Styling(Background, Text Format, Controlling Fonts) - Working with block elements and objects - Working with Lists and Tables - Working with Lists and Tables - CSS Id and Class - Box Model Creating page Layout and Site Designs.

Unit V Introduction to Web Hosting - Creating the Web Site - Saving the site - Working on the web site - Creating web site structure - Creating Titles for web pages - Themes-Publishing web sites.

Text Books:

1. HTML in simple steps , Dreamtech press, Kogent Learning,2010.
2. Creating a Web Page and Web Site, Murray,Tom/Lynchburg,2008.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Assess the effectiveness of Web design
2. Attain knowledge of web design concepts
3. Explore the HTML tags
4. Understand CSS
5. Apply the web hosting techniques

Year: II

**Bridge Course 3
WEB TECHNOLOGIES**

Semester: III

Code:

Credits: 4

Course objectives: After completing this course, students will be able to:

1. Teach students the basics of server side scripting using PHP
2. Explain web application development procedures
3. Impart servlet technology for writing business logic
4. Facilitate students to connect to databases using JDBC
5. Familiarize various concepts of application development using JSP

UNIT – I Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc., Handling File Uploads, Connecting to database (My SQL as reference), executing simple queries, handling results, Handling sessions and cookies. File Handling in PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.

UNIT – II Client side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Simple AJAX applications.

UNIT – III XML: Introduction to XML, Defining XML tags, their attributes and values, Document type definition, XML Schemas, Document Object model, XHTML Parsing XML Data - DOM and SAX parsers in java

UNIT – IV Introduction to Servlets: Common Gateway Interface (CGI), Lifecycle of a Servlets, deploying a Servlets, The Servlets API, Reading Servlets parameters, Reading initialization parameters, Handling Http Request & Responses, Using Cookies and sessions, connecting to a database using JDBC.

UNIT – V Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session tracking, connecting to database in JSP.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS:

1. Web Technologies, Uttam K Roy, Oxford University Press
2. The Complete Reference PHP – Steven Holzner, Tata McGraw-Hill

REFERENCE BOOKS:

1. Web Programming using PHP and MySQL, Dr. K. Meena, Dr. R. Sivakumar, A.B. Karthick Anand Babu, Himalaya Publishing House Pvt. Ltd, ISBN 978-93-5051-530-3, 2016
2. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dremtech
3. Java Server Pages – Hans Bergsten, SPD O'Reilly
4. Java Script, D. Flanagan, O'Reilly, SPD.
5. Beginning Web Programming-Jon Duckett WROX.
6. Programming world wide web, R.W. Sebesta. Fourth Edition, Pearson.
7. Internet and World Wide Web – How to program, Dietel and Nieto, Pearson

Course Outcomes: Upon successful completion of the course, the student will be able to: :

1. Create web pages using PHP
2. Identify the difference between the HTML PHP and XML documents.
3. Identify the engineering structural design of XML and parse tree
4. Identify the difference between the JSP and Servlet.
5. Understand the JSP and Servlet concepts.

Year: II

**Bridge Course 3
WEB TECHNOLOGIES LAB**

Semester: III

Code:

Credits: 3

1. Create a HTML page, which has properly aligned paragraphs with image along with it.
2. Write a program to display list of items in different styles.
3. Create both client side and server side image maps.
4. Create your own style sheets and use them in your web page
5. Create a form with various fields and appropriate front and validations using any one of the scripting languages.
6. Create a web page using XML.
7. Write a program to connect a XML web page to any database engine

Year: II

CORE COURSE 7
Introduction to Prompt Engineering
(Theory)

Semester: IV

Code:

Credits: 4

Course objectives :After completing this course, students will be able to:

1. Help students understand the basics of Generative AI and how prompts are used to interact with AI systems.
2. Teach students how to create effective prompts that produce useful and accurate responses from AI tools.
3. Explore real-world applications of prompt engineering across various fields like education, business, healthcare, and creative writing.
4. Use Prompt Engineering for Industries
5. Understand the applications of Prompts

Unit 1:The Basics of Generative Artificial Intelligence: Understanding AI, Machine Learning, and Deep Learning, What Is Generative AI, The Future of Generative AI, Language Model, Transformer Models, GPT (Generative Pretrained Transformer), Applications of AI in Business.

Unit 2: The Role of Prompts in Generative AI: How Did Prompts Originate, How Prompts Guide the AI's Response, Tokenization and Vectorization, Generative Capability, Bias and Ethical Considerations, How Do Generative AI Systems Understand Input and Provide Output, The Need to Create Prompts to Receive the Best Output.

Unit 3: A Step-by-Step Guide to Creating Effective Prompts: A Step-by-Step Guide to Creating Effective Prompts, Common Mistakes to Avoid When Crafting Prompts, Understanding Different Components of a Prompt, The Role of Context in Shaping AI Responses, Using Temperature and Max Tokens to Guide AI Responses, The Art of Iterative Prompting.

Unit 4: Prompt Engineering across Industry: Mastering Creative Writing Use Cases for Content Creators, Transforming Operations: Business Applications of Prompt Engineering, Revolutionizing Education: Classroom Applications of Prompt Engineering, Streamlining Research Applications for Academics and Market Analysts, Prompt Engineering in Health Care: Reinventing Patient Communication and Data Analysis.

Unit 5: Advanced Topics and Applications in Prompt Engineering: Understanding Bias in AI and Prompts, Strategies for Reducing Bias in Your Prompts, Ethical Guidelines for Prompt Design, Prompts and Privacy Considerations, Advanced Techniques: Automated Bias Detection, Applications in Prompt Engineering, GPT-4, Exploring Prompts with ChatGPT, Use Cases and Examples.

Unit - VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Unit - VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook:

1. Ian Khan, The Quick Guide to Prompt Engineering: Generative AI Tips and Tricks for ChatGPT, Bard, Dall-E, and Midjourney, 1st edition, Wiley, 2024.

Reference Book:

1. James Phoenix, Mike Taylor, Prompt Engineering for Generative AI, 1st edition, O'Reilly Media, 2024.
2. Jay Alammar, Maarten Grootendorst, Hands-On Large Language Models, 1st edition, O'Reilly Media, 2024.

Web Resources:

1. "Prompt Engineering Guide", <https://www.promptingguide.ai/>
2. "Prompt Engineering", OpenAI, <https://platform.openai.com/docs/guides/promptengineering/strategy-test-changessystematically>
3. <https://developers.google.com/machine-learning/resources/prompt-eng>

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Describe the core concepts of AI and Generative AI, including how models like GPT function.
2. Explain how prompts influence the behavior and responses of generative AI systems.
3. Develop clear and effective prompts for different AI tools and applications.
4. Apply prompt engineering techniques across domains such as education, business, and healthcare.
5. Identify bias, and privacy considerations in prompt engineering and explore the use of advanced tools like GPT-4 and ChatGPT.

Year: II

CORE COURSE 8
Software Testing Quality Assurance
(Theory)

Semester: IV

Code:

Credits: 4

Course objectives :After completing this course, students will be able to:

1. Define key terminologies in software testing.
2. Understand and apply various testing strategies and techniques.
3. Understand the process of regression testing and designing test cases for regression in Object-Oriented (OO) systems.
4. Develop the skills and knowledge to achieve quality throughout the product lifecycle.
5. Apply software quality audit

Unit I : Introduction to software testing and test process Errors, Faults, Failures, How to test, Testing Activities over entire Life Cycle of Software Development, Verification versus Validation, V Model, Test data versus Test cases, Test cases and Test Suites, Testing Team, Test Plan, Incident Management – Test Log, Incident Reporting, Classification, Test Summary Report

Unit II: Testing Strategy – Unit Testing, Approaches to Design of Unit Test Cases – Black-box approach, White-box approach Black box testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision table-based Testing, Cause Effect Graph, State Transition Test White box testing -Statement coverage, Branch coverage, , Condition/decision coverage, Control flow graph, Path coverage, Cyclomatic complexity

Unit III:Integration Testing and System testing Integration testing - Big bang approach, top-down approach, bottom-up approach, System testing – Alpha Testing, Beta Testing, acceptance Testing, Performance Tests, Stress Testing, Load Testing, Volume testing, Configuration Testing, Compatibility testing, Recovery Testing, Maintenance Testing, Documentation Tests, Usability testing

Unit IV:Regression Testing Need and importance for Regression Testing, Automated Regression Testing, Software Regression process, Regression Testing Tasks, Testing OO systems, Test case design for Regression Testing

Unit V:Introduction to Software Quality Definition of Quality, Concept of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Achieving and Maintaining Quality, Quality Control Stakeholders and their Expectations, Quality Assurance, Quality Audit, Quality Survey

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Reference Books:

1. Spillner, Andreas, Tilo Linz, and Hans Schaefer. Software Testing Foundations. 4th ed., Rocky Nook, 2014.
- 2 Desikan, Srinivasan, and Gopalaswamy Ramesh. Software Testing: Principles and Practice. Pearson Education India, 2006

- 3 Defeo, Joseph A., and J. M. Juran. Juran's Quality Handbook: The Complete Guide to Performance Excellence. 6th ed. McGraw Hill Professional, 2010
- 4 Hoyle, David. ISO 9000 Quality Systems Handbook: Using the Standards as a Framework for Business Improvement. Routledge, 2017.
- 5 Stephan H.Kan, "Metric and Model in Software Quality Engineering", Addison Wesley, 1995.
- 6 Software Testing & Quality Assurance Theory & Practice" By Kshirasagar Naik & Priyadarshi Tripathi, Wiley Student Edition.
- 7 "Software Quality Assurance Principles & Practice", by Nina S. Godbole, Narosa.
- 8 Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition ,McGraw Hill, 2001

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the fundamental concepts and terms related to software testing.
2. Analyze test scenarios and choose the most appropriate techniques thorough software testing strategies.
3. Design test cases for effective regression testing strategy for various software systems.
4. Assess the effectiveness of quality by maintaining quality standards throughout the product lifecycle.
5. Explore Software quality assurance

Year: II

CORE COURSE 9

Semester: IV

Generative AI

Code:

(Theory)

Credits: 4

Course objectives: After completing this course, students will be able to:

1. Understand the basics of Generative AI.
2. Know the basics of Text Generation.
3. Understand the process of generating videos.
4. Know about GAN and its variants.
5. Understand and Apply Gen AI tools.

UNIT I: INTRODUCTION TO GEN AI : Historical Overview of Generative modeling - Difference between Gen AI and Discriminative Modeling – Importance of generative models in AI and Machine Learning – Types of Generative models – GANs, VAEs, autoregressive models and Vector quantized Diffusion models - Challenges of Generative Modeling – Future of Gen AI – Ethical Aspects of AI – Responsible AI.

UNIT II: GENERATIVE MODELS FOR TEXT : Language Models Basics – Building blocks of Language models - Transformer Architecture – Encoder and Decoder – Attention mechanisms - Generation of Text – Models like BERT and GPT models

UNIT III: GENERATION OF IMAGES : Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium – Variational Autoencoders – Encoder-Decoder Architectures - Stable Diffusion Models – Introduction to Transformer

UNIT IV: GENERATION OF PAINTING, MUSIC, AND PLAY : Variants of GAN – Types of GAN - Cyclic GAN – Using Cyclic GAN to Generate Paintings – Neural Style Transfer – Style

UNIT V: OPEN SOURCE MODELS AND PROGRAMMING FRAMEWORKS : Training and Fine tuning of Generative models – GPT4All - Transfer learning and Pretrained models - Training vision models – Google Copilot - Programming LLM – LangChain – Open Source Models – Llama - Programming for TimeSformer – Deployment – Hugging Face.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXTBOOKS:

1. Denis Rothman, “Transformers for Natural Language Processing and Computer Vision”, Third Edition , Packt Books, 2024

REFERENCES:

1. David Foster, "Generative Deep Learning", O'Reily Books, 2024.
2. Altaf Rehmani, "Generative AI for Everyone", BlueRose One, 2024.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the concepts of Generative Modeling.
2. Apply Gen AI to Generating Texts.
3. Understand and Apply Gen AI for generating video.
4. Understand and Apply Gen AI for generating video.
5. Apply Open Source Tools for solving problems using Gen AI.

Objectives: After completing this course, students will be able to:

1. Create a learning experience to enable the students to face the challenges of starting new ventures.
2. Prepare the students for starting new businesses and the skills for managing existing family businesses.
3. Gain knowledge in business plan preparation by using various sources of finance and to become entrepreneurs in different fields.
4. Understand the Steps in Promoting Start-up Micro-Enterprises
5. Analyze a New Start-up Enterprise with respect to management policies

UNIT I: Introduction to Entrepreneurship: Concept, Significance, Theories and Models of Entrepreneurship Development - Traits and Characteristics, Functions, Types - Entrepreneurial Processes - Problems - Capacity building - Risk Analysis - Scope of Entrepreneurship in India.

UNIT II: Entrepreneurial Environment for Start-up Enterprises: Significance - Internal and External Environment forces - Entrepreneurial Culture and Society - EDP: Objectives, Features, Steps and Issues in EDP Process - Role of Institutions and Government in EDP.

UNIT III: Developing Start-up Enterprises: Developing a Business Idea: Opportunity, Methods, and Creativity - Deciding to setup a Start-up Enterprise: Effectual Reasoning, Forms, Size and Location - Entrepreneurial skills and Competences - Feasibility Study: Market Survey, Techno-Economic feasibility and Preparing Project Report - Financial Requirements.

UNIT IV: Steps in Promoting Start-up Micro-Enterprises: Entrepreneurial Success in Rural Areas - Establishing Entrepreneurial System - Assistance and Sickness - Institutions Supporting and providing Financial Assistance: SSI, KVIC, MSME-DO, NSIC, NIESBUD, IIE, SIDC, SDIs, DICs NGOs, Industry Association, SIDBI and SFCs - Self-help Groups - Technological Up-gradation - Challenges.

UNIT V: Managing a New or Start-up Enterprise: Management - HRM, Marketing, Financial Management, Production and Operations Management in a New Start-up Enterprise.

Unit – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester
Concerned

REFERENCES:

1. Saravanel, P. (2020): Entrepreneurial Development, Margham Publication, Chennai.
2. Prasanna Chandra, (2019) : Protect Preparation, Appraisal, Implementation, Tata McGraw Hill. New Delhi.
3. Srinivasan, N.P. & Gupta, C.B. (2017): Entrepreneurial Development, Sultan Chand & Sons
4. Barringer, Bruce R. (2008): Entrepreneurship: Successfully launching new ventures, Pearson Education, India.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand Models of Entrepreneurship Development
2. Explore Internal and External Environment forces for Start-up Enterprises
3. Analyze Feasibility Study for Start-up Enterprises
4. Understand the Start-up Micro-Enterprises
5. Explore the management activities of New Start-up Enterprise

Year: II

Value Added Course - 2
Ethical Hacking

Semester: IV

Code:

Credits: 2

Course Objectives: After completing this course, students will be able to:

1. Understand ethical hacking concepts
2. Explore footprinting concepts
3. Analyze vulnerabilities
4. Explore Tools for Web Attacks
5. Understand network protection systems

UNIT I INTRODUCTION : Ethical Hacking Overview - Role of Security and Penetration Testers. - Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing. - Network and Computer Attacks-Phishing Attacks - Malware - Protecting Against Malware Attacks. - Intruder Attacks - Addressing Physical Security.

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS : Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - API Analysis - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall – Exploiting Third-Party Dependencies.

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS :Enumeration Concepts - Building your hack box - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded OS - The world wide web of Vulnerabilities

UNIT IV SYSTEM HACKING : Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade - Securing Modern Web Applications - Securing Third-Party Dependencies.

UNIT V NETWORK PROTECTION SYSTEMS : Files and File sharing - Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Based Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems -Network- and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams –Honeypots.

UNIT – VI Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

COURSE OUTCOMES:

Upon successful completion of the course, the student will be able to:

- 1: Express knowledge on basics of computer-based vulnerabilities
- 2: Gain understanding on different foot printing, reconnaissance and scanning methods.
- 3: Demonstrate the enumeration and vulnerability analysis methods
- 4: Gain knowledge on hacking options available in Web and wireless applications.
- 5: Acquire knowledge on the options for network protection.

Text Books:

1. Simpson, Michael T., Kent Backman, and James Corley. Hands-on ethical hacking and network defenses, Course Technology Press, Second Edition, 2012.
2. Hickey, Matthew, and Jennifer Arcuri. Hands on Hacking: Become an Expert at Next Gen Penetration Testing and Purple Teaming. John Wiley & Sons, First Edition, 2020.

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1. Hoffman, Andrew. Web Application security: exploitation and countermeasures for modern web applications. O'Reilly Media, 2020.
2. Black Hat Python: Python Programming for Hackers and Pentesters. Seitz, Justin, and Tim Arnold, No starch press, Second Edition, 2021.
