VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

B. Tech– II Year I Semester

S. No.	Category	Course Code	Title	L	T	P	Credits
1	BS	23BTHS08T	Discrete Mathematics & Graph Theory	3	0	0	3
2	HS	23BTBA01T	Universal Human Values-Understanding Harmony and Ethical Human Conduct	2	1	0	3
3	ES	23BTAI01T	Artificial Intelligence	3	0	0	3
4	PC	23BTCS03T	Data Structures & Design Analysis of Algorithm	3	0	0	3
5	PC	23BTCS04T	Object Oriented Programming Through Java	3	0	0	3
6	PC	23BTCS04P	Advanced Data Structures and Algorithm Analysis Lab	0	0	3	1.5
7	PC	23BTCS05P	Object Oriented Programming Through Java Lab	0	0	3	1.5
8	SC	23BTCS01S	**Skill Oriented Course– I** Python Programming	0	1	2	2
9	MC	23BTCE01A	**Mandatory noncredit course - I** Environmental Science	2	0	0	-
Total				**16**	**2**	**8**	**20**

B.Tech– II Year II Semester

S. No.	Category	Course Code	Title	L	T	P	Credits
1	ES	23BTME10T	Optimization Techniques	2	0	0	2
2	BS	23BTHS12T	Probability & Statistics	3	0	0	3
3	PC	23BTAI02T	Machine Learning	3	0	0	3
4	PC	23BTCS06T	Database Management Systems	3	0	0	3
5	ES	23BTEC07T	Digital Logic & Computer Organization	3	0	0	3
6	PC	23BTAI01P	Machine Learning Lab	0	0	3	1.5
7	PC	23BTCS07P	Database Management Systems Lab	0	0	3	1.5
8	SC	23BTCS02S	**Skill Oriented Course– II** Full Stack Development –I	0	1	2	2
9	MC	23BTME09T	Design Thinking &Innovation	1	0	2	2
Total				**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation							

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

B.Tech-III Year I Semester

S.No	Course Code	Title	L	T	P	Credits
1	23BTCS19c	Natural Language Processing	3	0	0	3
2	23BTAI03T	System Software Programming	3	0	0	3
3	23BTAI04T	Computer Vision & Image Processing	3	0	0	3
4	23BTCS11T	Introduction To Quantum Technologies And Applications	3	0	0	3
5	23BTAI05T 23BTCS12b 23BTAI06T 23BTAI07T	**Professional Elective-I** 1. Data Visualization 2. Soft computing 3. Exploratory Data Analysis with Python 4. Computational Intelligence	3	0	0	3
6		**Open Elective-I**	3	0	0	3
7	23BTAI02P	Computer Vision & Machine Learning Lab	0	0	3	1.5
8	23BTAI03P	AI & System Programming Lab	0	0	3	1.5
9	23BTCS03S	**Skill Enhancement course** Full Stack Development-II	0	1	2	2
10	23BTEC09P	Tinkering Lab	0	0	2	1
11	23BTCS13	Evaluation of Community Service Internship	-	-	-	2
Total			**18**	**1**	**10**	**26**

Open Elective–I

S.No.	Course Code	Course Name	Offered by the Dept.
1	23BTCE13a	Green Buildings	CIVIL
2	23BTCE13b	Construction Technology and Management	
3	23BTEE12T	Electrical Safety Practices and Standards	EEE
4	23BTME15T	Sustainable Energy Technologies	ME
5	23BTEC13T	Electronic Circuits	ECE
6	23BTCS14T	Quantum Technologies And Applications	CSE& Allied
7	23BTHS15T	Mathematics for Machine Learning and AI	Mathematics
8	23BTHS16T	Materials Characterization Techniques	Physics
9	23BTHS17T	Chemistry of Energy Systems	Chemistry
10	23BTHS18T	English for Competitive Examinations	Humanities
11	23BTHS19T	Entrepreneurship and New Venture Creation	

Note:

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline.

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

B.Tech-III Year II Semester

S.No	Course Code	Title	L	T	P	Credits
1	23BTAI05T	Cloud Computing for AI	3	0	0	3
2	23BTAI06T	Big Data Analytics &AI Applications	3	0	0	3
3	23BTAI07T	Full Stack AI Development	3	0	0	3
4	23BTAI08a 23BTAI08b 23BTAI08c 23BTAI08d	**Professional Elective-II** 1. Graph Neural Networks 2. Recommender Systems 3. Predictive Analytics 4. Block chain for AI	3	0	0	3
5	23BTAI09a 23BTAI09b 23BTAI09c 23BTAI09d	**Professional Elective-III** 1. AI for Finance 2. Introduction to Quantum Computing 3. Social Network Analysis 4. Cyber security & AI-driven Threat Detection	3	0	0	3
6		**Open Elective–II**	3	0	0	3
7	23BTAI04P	Big Data & Cloud Computing Lab	0	0	3	1.5
8	23BTAI05P	Full Stack AI Lab	0	0	3	1.5
9		**Skill Enhancement course** Soft skills	0	1	2	2
10		**Audit Course** Technical Paper Writing & IPR	2	0	0	-
11		Workshop	0	0	0	0
Total			**19**	**1**	**06**	**23**
Mandatory Industry Internship of 6 to 8 weeks duration during summer vacation						

Open Elective–II

S.No.	Course Code	Course Name	Offered by the Dept.
1	23BTCE19a	Disaster Management	CIVIL
2	23BTCE19b	Sustainability In Engineering Practices	
3	23BTEE18T	Renewable Energy Sources	EEE
4	23BTME14T	Automation and Robotics	ME
5	23BTEC20T	Digital Electronics	ECE
6	23BTHS20T	Optimization Techniques for Engineers	Mathematics
7		Mathematical Foundation Of Quantum Technologies	
8	23BTHS21T	Physics Of Electronic Materials And Devices	Physics
9	23BTHS22T	Chemistry Of Polymers And Applications	Chemistry
10	23BTHS23T	Academic Writing and Public Speaking	Humanities

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

B.Tech-IV Year I Semester

S.No	Course Code	Title	L	T	P	Credits
1	23BTAI10T	Generative AI	3	0	0	3
2	23BTBA06T 23BTBA07T 23BTBA08T	**Management Course-II** 1.Business Ethics and Corporate Governance 2.E-Business 3.Management Science	2	0	0	2
3	23BTAI11a 23BTAI11b 23BTAI11c 23BTAI11d	**Professional Elective-IV** 1. Explainable AI & Model Interpretability 2. AI for Robotics 3. AI in Cyber security 4. AI-driven Software Engineering & DevOps	3	0	0	3
4	23BTAI12a 23BTAI12b 23BTAI12c 23BTAI12d	**Professional Elective-V** 1. AI for Smart Cities & IoT Systems 2. MLOps &AI Model Deployment 3. Data Wrangling 4. Healthcare AI	3	0	0	3
5		**Open Elective-III**	3	0	0	3
6		**Open Elective-IV**	3	0	0	3
7	23BTCS04S	**Skill Enhancement Course** Prompt Engineering	0	1	2	2
8		**Audit Course** Gender Sensitization	2	0	0	-
9	23BTCSEII	Evaluation of Industry Internship	-	-	-	2
Total			**19**	**1**	**02**	**21**

Open Elective–III

S.No	Course Code	Course Name	Offered by the Dept.
1	23BTCE23a	Building Materials and Services	CIVIL
2	23BTCE23b	Environmental Impact Assessment	
3	23BTEE23T	Smart Grid Technologies	EEE
4	23BTME24T	3D Printing Technologies	ME
5	23BTEC11T	Microprocessors and Microcontrollers	ECE
6	23BTHS24T	Wavelet transforms and its Applications	Mathematics
7	23BTHS25T	Smart Materials And Devices	Physics
8		Introduction to Quantum Mechanics	
9	23BTHS26T	Green Chemistry And Catalysis For Sustainable Environment	Chemistry
10	23BTHS27T	Employability Skills	Humanities

Open Elective–IV

S.No	Course Code	Course Name	Offered by the Dept.
1	23BTCE24a	Geo-Spatial Technologies	CIVIL
2	23BTCE24b	Solid Waste Management	
3	23BTEE24T	Electric Vehicles	EEE
4	23BTME25T	Total Quality Management	ME
5	23BTEC25T	Transducers and Sensors	ECE
6	23BTCS23	Introduction to Quantum Computing	CSE& Allied
7	23BTHS28T	Financial Mathematics	Mathematics
8	23BTHS29T	Sensors And Actuators For Engineering Applications	Physics
9	23BTHS30T	Chemistry of Nano Materials and Applications	Chemistry
10	23BTHS31T	Literary Vibes	Humanities

B.Tech-IV Year II Semester

S.No.	Course code	Title	Category	L	T	P	Credits
1	23BTAI13	Internship		-	-	-	4
2	23BTAI14	Project		-	-	-	8
Total							**12**

COURSES OFFERED FOR HONOURS DEGREE IN CSE-AI & ML

S.No	Course Code	Course Name	Contact Hours PerWeek			Credits
			L	T	P	
1	23BTAI01H	Advanced Machine Learning &AI Systems	3	0	0	3
2	23BTAI02H	Deep Learning &Neural Networks Architectures	3	0	0	3
3	23BTAI03H	Reinforcement Learning & Decision Making	3	0	0	3
4	23BTAI04H	AI for Robotics& Automation	3	0	0	3
5	23BTAI05H	AI Ethics, Fairness& Explainability	3	0	0	3
6	23BTAI06H	AI & Machine Learning Lab	0	0	3	1.5
7	23BTAI07H	Robotics & Autonomous Systems Lab	0	0	3	1.5

Course Code	Discrete Mathematics & Graph Theory (Common to CSE, CS& IT and CSE(AI))		L	T	P	C
23BTHS08T			3	0	0	3
Year	II	Semester	I			

Course Objectives:

Introduce the concepts of mathematical logic and gain knowledge in sets, relations and functions and Solve problems using counting techniques and combinatorics and to introduce generating functions and recurrence relations. Use Graph Theory for solving real world problems.

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

CO1: Apply mathematical logic to solve problems.
CO2: Applythe concepts and perform the operations related to sets, relations and functions. Also identify structures of algebraic nature.
CO3: Apply basic counting techniques to solve combinatorial problems.
CO4: Formulate problems and solve recurrence relations.
CO5: Apply Graph Theory in solving computer science problems.

UNIT I: Mathematical Logic

Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, Functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus.

UNIT II: Set theory

The Principle of Inclusion- Exclusion, Pigeonhole principle and its application, Functions composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties. Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups and Monoids, groups, sub groups, homomorphism, Isomorphism.

UNIT III: Elementary Combinatorics

Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems.

UNIT IV: Recurrence Relations

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generatingfunctions, The Method of Characteristic roots, Solutions of Inhomogeneous, Recurrence Relations.

UNIT V: Graphs

Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.

2. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.

ReferenceBooks:

1. Joe L. Mott, Abraham Kandel and Theodore P.Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science.

Course Code	Universal Human Values- Understanding Harmony and Ethical Human Conduct (Common to All Branches of Engineering)		L	T	P	C
23BTBA01T			2	1	0	3
Year	II	Semester	I			

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human being.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
- Forming basis of Universal Human Values and movement towards value-based living in a natural way.
  To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes: After completion of the course, students will be able to
CO1: Understand the concepts of value education and human aspirations.
CO2: Understand the harmony in the human beings
CO3: Understand the harmony in the family and society
CO4: Understand the harmony in the nature
CO5: Apply the ethics towards value-based life and profession.

UNIT – I: Introduction to Value Education

Introduction to Value Education (6 lectures and 3 tutorials for practice session)
Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT – II: Harmony in the Human Being

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT – III: Harmony in the Family and Society

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfill Human Goal

UNIT – IV: Harmony in the Nature/Existence

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfillments among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

UNIT – V: Implications of the Holistic Understanding

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence
Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Textbooks:

- R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amar kantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
  The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

Reference Books:

1. JeevanVidya: EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

Online Learning Resources:

- https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
- https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%20-Harmony%20in%20the%20Human%20Being.pdf
- https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
- https://fdpsi.aicteindia.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
- https://fdpsi.aicteindia.org/UHVII%20Class%20Notes%20&%20Handouts/UHV%20Handou%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
- https://fdpsi.aicteindia.org/download/FDPTeachingMaterial/3days%20FDPSI%20UHV%20Tehing%20Material/Day203%20Handouts/UHV%203D%20D3S2A%20Und%20Nature Existence.pdf
- https://fdpsi.aicteindia.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202325%20Ethics%20v1.pdf
- https://www.studocu.com/in/document/kietgroupofinstitutions/universalhumanvalues/chapter5-holistic-understanding-of-harmony-on-professional-ethics/62490385

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

B.Tech - Computer Science & Engineering (AI & ML)

Course Code	Artificial Intelligence		L	T	P	C
23BTAI01T			3	0	0	3
Year	II	Semester	I			

Course Objectives:

1. The student should be made to study the concepts of Artificial Intelligence.
2. The student should be made to learn the methods of solving problems using Artificial Intelligence.
3. The student should be made to introduce the concepts of Expert Systems.
4. To understand the applications of AI, namely game playing, theorem proving, and machine learning.
5. To learn different knowledge representation techniques

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

CO1: Understand foundational AI concepts like intelligent agents, rational decision-making and Environmental classifications.

CO2: Apply problem-solving techniques such as breadth-first search, depth- first search, A*,hill climbing, min max, and alpha-beta pruning.

CO3: Analyze knowledge representation methods like predicate logic, semantic nets, frames, and rules.

CO4: Evaluate inference mechanisms in propositional and first-order logic. Apply learning paradigms like inductive learning, decision trees, and reinforcement learning.

CO5: Design expert systems with knowledge acquisition, meta-knowledge, and heuristics. Evaluate expert systems such as MYCIN, DART, and XCON in practical applications and effectiveness.

UNIT - I

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT - II

Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

UNIT - III

Representation of Knowledge: Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and dempstershafer theory.

UNIT - IV

Logic concepts: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from

observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

UNIT - V

Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells.

AI Tools: VEED, Copy.AI, Mid Journey, Tabnine, Jasper, D-id

Textbooks:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education.
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.
4. Artificial Intelligence, SarojKaushik, CENGAGE Learning.

Online Learning Resources:

1. https://ai.google/
2. https://swayam.gov.in/nd1_noc19_me71/preview
3. https://www.veed.io/learn/best-ai-tools

Course Code	Data Structures & Design Analysis of Algorithm (Common to CSE, CS & IT and CSE(AI))		L	T	P	C
23BTCS03T			3	0	0	3
Year	II	Semester	I			

Course Objectives:

The main objectives of the course is to

- provide knowledge on advance data structures frequently used in Computer Science domain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

Course Outcomes: At the end of the Course, the student will be able to

CO1: Analyze the complexity of algorithms, apply asymptotic notations and apply advancedtree data structures and their operations.

CO2: Apply divide-and-conquer algorithms effectively for solving complex computational problems.

CO3: Develop greedy method and dynamic programming algorithms for solving various real time applications.

CO4: Illustrate how Backtracking and branch-and-bound algorithms are applied to solvecomplex computational problems.

CO5: Solve NP Hard and NP Complete problems in graph theory and scheduling domains.

UNIT – I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.

AVL Trees – Creation, Insertion, Deletion operations and Applications

Heap Trees (Priority Queues) – Min and Max Heaps, Operations and Applications

UNIT – II:

Graphs – Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications, Topological Sort.

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull Problem.

UNIT – III:

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths, General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees

Dynamic Programming: General Method, All pairs shortest paths.

UNIT – IV:

Dynamic Programming-II: 0/1 Knapsack, String Editing, Travelling Salesperson problem

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem

UNIT – V:

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem (Without Proof)
NP Hard Graph Problems: Clique Decision Problem (CDP), Traveling Salesperson Decision Problem (TSP)
NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Textbooks:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh, 2nd Edition Universities Press.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, 2nd Edition University Press.

Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley& Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. Data Structures using C & C++: Langsam, Augenstein&Tanenbaum, Pearson, 1995
5. Algorithms + Data Structures & Programs:, N.Wirth, PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni& Mehta, Galgottia Pub.
7. Data structures in Java:, Thomas Standish, Pearson Education Asia

Online Learning Resources:

1. https://www.tutorialspoint.com/advanced_data_structures/index.asp
2. http://peterindia.net/Algorithms.html
3. https://www.youtube.com/playlist?list=PLDN4rrl48XKpZkf03iYFl-O29szjTrs_O

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	Object Oriented Programming through Java		L	T	P	C
23BTCS04T	(Common to CSE, CS & IT and CSE(AI))		3	0	0	3
Year	II	Semester	I			

Course Objectives:

The learning objectives of this course are to:

- identify Java language components and how they work together in applications
- Learnthe fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- understand how to design applications with threads in Java
- understand how to use Java APIs for program development

Course Outcomes: At the end of the Course, the student will be able to

CO1: Apply fundamental concepts including Java data types, variables, operators, and control statements to develop robust and efficient Java programs.
CO2: Apply object oriented programming features and concepts for solving real world problem.
CO3: Develop Java programs using the concepts of inheritance and interfaces.
CO4: Build Java applications using packages, exceptions and I/O streams.
CO5: Implement multithreaded programming and to developGUI using JavaFX.

UNIT I

Object Oriented Programming: Basic concepts, Principles.

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements:Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to

Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT IV

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2).

UNIT V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2) Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, MonalisaSarma, Cambridge, 2023.
3) JAVA for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:

1) The complete Reference Java, 11thedition, Herbert Schild,TMH
2) Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

1) https://nptel.ac.in/courses/106/105/106105191/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Course Code	Advanced Data Structures & Algorithm Analysis Lab		L	T	P	C
23BTCS04P	(Common to CSE, CS & IT and CSE(AI))		0	0	3	1.5
Year	II	Semester	I			

Course Objectives:

The objectives of the course is to

- acquire practical skills in constructing and managing Data structures
- apply the popular algorithm design methods in problem-solving scenarios

Course Outcomes: At the end of the Course, the student will be able to

CO1: Implement heap and various tree structures like AVL, B-Tree and graphs.

CO2: Implement various Sorting Techniques.

CO3: Develop greedy method, dynamic programming, backtracking and branch & bound algorithms for various real-time applications.

Experiments covering the Topics:

- Operations on AVL trees, B-Trees, Heap Trees
- Graph Traversals
- Sorting techniques
- Finding Biconnected components in a graph
- Shortest path algorithms using greedy Method
- 0/1 Knapsack Problem using Dynamic Programming and Backtracking
- Travelling Salesperson problem using Branch and Bound
- N-Queens Problem using Backtracking
- Job Sequencing using Branch and Bound

Sample Programs:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.
2. Construct B-Tree an order of 5 with a set of 100 random elements stored in array. Implement searching, insertion and deletion operations.
3. Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.
4. Implement BFT and DFT for given graph, when graph is represented by
   a) Adjacency Matrix b) Adjacency Lists
5. Write a program for finding the biconnected components in a given graph.
6. Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).
7. Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists.
8. Implement Job sequencing with deadlines using Greedy strategy.
9. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
10. Implement N-Queens Problem Using Backtracking.
11. Use Backtracking strategy to solve 0/1 Knapsack problem.
12. Implement Travelling Sales Person problem using Branch and Bound approach.

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, SahniSartaj, Mehta, Dinesh, 2nd Edition, Universities Press
2. Computer Algorithms/C++ Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, 2nd Edition, University Press
3. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
4. An introduction to Data Structures with applications, Trembley& Sorenson, McGraw Hill

Online Learning Resources:

1. http://cse01-iiith.vlabs.ac.in/
2. http://peterindia.net/Algorithms.html

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	Object Oriented Programming through Java Lab		L	T	P	C
23BTCS05P	(Common to CSE, CS & IT and CSE(AI))		0	0	3	1.5
Year	II	Semester	I			

Course Objectives:
The aim of this course is to

- Practice object-orientedprogramming in the Java programming language
- ImplementClasses, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrateinheritance, Exception handling mechanism,JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FX GUI

Course Outcomes: At the end of the Course, the student will be able to

CO1: Demonstrate a comprehensive understanding of Java syntax and utilize it effectively to solve programming problems.

CO2: Apply fundamental Object-Oriented Programming (OOP) principles to design and implement software solutions.

CO3: Develop graphical user interface (GUI) applications using JavaFX and apply algorithmic thinking to solve computer science problems efficiently.

Experiments covering the Topics:

- Object Oriented Programming fundamentals- data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, JavaFX GUI

Sample Experiments:

Exercise – 1:
a) Write a JAVA program to display default value of all primitive data type of JAVA
b) Write a java program that display the roots of a quadratic equation $ax^2+bx=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.

Exercise - 2
a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
c) Write a JAVA program using String Buffer to delete, remove character.

Exercise - 3
a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
b) Write a JAVA program implement method overloading.
c) Write a JAVA program to implement constructor.
d) Write a JAVA program to implement constructor overloading.

Exercise - 4
a) Write a JAVA program to implement Single Inheritance
b) Write a JAVA program to implement multi-level Inheritance
c) Write a JAVA program for abstract class to find areas of different shapes

Exercise - 5

a) Write a JAVA program give example for "super" keyword.
b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
c) Write a JAVA program that implements Runtime polymorphism

Exercise - 6

a) Write a JAVA program that describes exception handling mechanism
b) Write a JAVA program Illustrating Multiple catch clauses
c) Write a JAVA program for creation of Java Built-in Exceptions
d) Write a JAVA program for creation of User Defined Exception

Exercise - 7

a) Write a JAVA program that creates threads by extending Thread class.First thread display "Good Morning "every 1 sec, the second thread displays "Hello "every 2 seconds and the third display "Welcome" every 3 seconds,(Repeat the same by implementing Runnable)
b) Write a program illustrating **is Alive** and **join ()**
c) Write a Program illustrating Daemon Threads.
d) Write a JAVA program Producer Consumer Problem

Exercise – 8

a) Write a JAVA program that import and use the user defined packages
b) Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX)
c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI
d) Write a Java program that demonstrates how to connect to a database using JDBC

References Books:

1. P. J. Deitel, H. M. Deitel, "Java for Programmers", Pearson Education, PHI, 4th Edition, 2007.
2. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, 2nd Edition, 2007
3. Bruce Eckel, "Thinking in Java", Pearson Education, 4th Edition, 2006.
4. SachinMalhotra, SaurabhChaudhary, "Programming in Java", Oxford University Press, 5th Edition, 2010.

Online Learning Resources:

https://java-iitd.vlabs.ac.in/
http://peterindia.net/JavaFiles.html

Course Code	Python Programming (Skill Enhancement Course)		L	T	P	C
23BTCS01S	(Common to All Branches of Engineering)		0	1	2	2
Year	II	Semester	I			

CourseObjectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these

Course Outcomes: At the end of the Course, the student will be able to

CO1: Design solutions to mathematicalproblems

CO2: Develop, run and manipulate python programs using core data structures, files andobject-oriented programming (OOP) principles.

CO3: Develop various applications using Python libraries and frameworks such as JSON, XML, NumPy, and pandas for efficient data manipulation and processing.

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators.
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.

9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list:
    i. Additionii. Insertioniii. slicing
12. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

18. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

24. Python program to check whether a JSON string contains complex object or not.
25. Python Program to demonstrate NumPy arrays creation using array () function.
26. Python program to demonstrate use of ndim, shape, size, dtype.
27. Python program to demonstrate basic slicing, integer and Boolean indexing.
28. Python program to find min, max, sum, cumulative sum of array
29. Create a dictionary with at least five keys and each key represent value as a list where

this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:

a) Apply head () function to the pandas data frame
b) Perform various data selection operations on Data Frame

30. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	Environmental Science		L	T	P	C
23BTCE01A	(Common to All Branches of Engineering)		2	0	0	0
Year	II	Semester	I			

CourseObjectives:

- To make the students to get awareness environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.
- Assess the sustainability of various human practices in terms of resource use and waste management.
- To apply theoretical knowledge to real-world environmental challenges through experiential learning opportunities

Course Outcomes: At the end of the Course, the student will be able to

CO1: Comprehend the concepts of environment and its importance in our daily life and develop and apply various water conservation methods and conservation of other natural resources also.
CO2: Identify the importance of environmental education for protection of life cycles of various bio systems which are essential for bio sphere.
CO3: Develop new innovative methods for controlling of environmental pollution which may affect the human health.
CO4: Analyse environmental issues related to society and find solutions for environmental problems.
CO5: Analyse the effects of increasing human population as well as health associated problems and develops measures to be taken to protect human health.

UNITI

Multidisciplinary Nature of Environmental Studies: – Definition, Scope, and Importance – NeedforPublicAwareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associatedproblems – Forest resources – Use and over – exploitation, deforestation, case studies – Timberextraction – Mining, dams and other effects on forest and tribal people – Water resources – Use andover utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefitsand problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies–Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems,waterlogging,salinity,casestudies.–Energyresources:

UNITII

Ecosystems: Concept of an eco system.–Structure and function of an ecosystem –Producers, consumers, and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids– Introduction, types, characteristic features , structure, and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem.
d. Aquatic eco systems(ponds, streams, lakes, rivers, oceans, estuaries)

BiodiversityanditsConservation:

Introduction, Definition: genetic, species and ecosystem diversity–Bio-geographical classification of India–Value of bio diversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and Local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitatloss, poaching

of wildlife, man-wildlife conflicts– Endangered and endemic species of India–Conservation of biodiversity: In-situandEx-situconservation of biodiversity.

UNITIII

Environmental Pollution: Definition, Cause, effects, and control measures of:

a. AirPollution.
b. Waterpollution
c. Soilpollution
d. Marinepollution
e. Noisepollution
f. Thermalpollution
g. Nuclearhazards

Solid Waste Management: Causes**,** effects, and control measures of urban and industrial wastes –Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNITIV

Social Issues and the Environment: From Unsustainable to Sustainable development– Urbanproblems related to energy – Water conservation, rain water harvesting, watershed management –Resettlement and rehabilitation of people; its problems and concerns.Case studies – Environmentalethics:Issues and possible solutions – Climate change,global warming, acid rain,ozone layerdepletion, nuclear accidents, and holocaust.Case Studies – Wasteland reclamation. – Consumerismand waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. –Water (PreventionandcontrolofPollution)Act– WildlifeProtectionAct–ForestConservationAct–Issues involved in enforcement of environmental legislation–Public awareness.

UNITV

Human Population and the Environment: Population growth, variation among nations.Populationexplosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education–HIV/AIDS–Women and Child Welfare–Role of information Technology in Environment and human health–Case studies.

FieldWork: Visit to a local area to document tenvironmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants,insects,and birds–river,hill slopes,etc.

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses ErachBharucha for University Grants Commission, Universities Press.
2. Palaniswamy,“Environmental Studies”,Pearson education
3. S.AzeemUnnisa,“Environmental Studies”Academic Publishing Company
4. K.RaghavanNambiar,“Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus”,Scitech Publications(India),Pvt.Ltd.

References:

1. Deeksha Dave and E.SaiBabaReddy,“Text book of Environmental Science”,Cengage Publications.
2. M.AnjiReddy, “Textbook of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma,Comprehensive Environmental studies,Laxmi publications.

4. J.Glynn Henry and Gary W.Heinke,"Environmental Sciences and Engineering", Prentice Hall of India Private limited
5. G.R.Chatwal, "AText Book of Environmental Studies"Himalaya Publishing House
6. Gilbert M.Masters and Wendell P.Ela,"Introduction to Environmental Engineering and Science,Prentice Hal lof India Private limited.

Web Materials:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

Course Code	OptimizationTechniques		L	T	P	C
23BTME10T	(Common to All Branches of Engineering)		2	0	0	2
Year	II	Semester	II			

Course Objectives:

The objectives of the course are to

- To provide the basic knowledge about Optimization, importance, application areas ofLinear Programmingin the industry.
- To impart different optimization models under typical situations in the businessorganization like transportation, assignment.
- To understand the process of sequencing in a typical industry.
- To describe different game strategies under cut-throat competitive businessenvironment
- To develop networks of activities of projects and to find out optimal modes ofcompleting projects using network modeling evaluation techniques.

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

CO1: Develop mathematical models of the real life situations and capable of formulating and obtaining best solutions for linear programming problems.

CO2: Formulate and Solve Transportation & Assignment Models.

CO3: Solve Job shop and Flow shop scheduling problems.

CO4: Appreciate various game models and determine optimum strategies and game value.

CO5: Construct project network and differentiate CPM and PERT techniques.

UNIT - I

Introduction: Meaning, Nature, Scope & Significance of Optimization – Typical applications. The Linear Programming Problem – Introduction, Formulation of Linear Programming problem, Limitations of L.P.P, Graphical method, Simplex method: Maximization and Minimization model(exclude Duality problems), Big-M method and Two Phase method.

UNIT - II

Transportation Problem: Introduction, Transportation Model, Finding initial basic feasible solutions, moving towards optimality, Unbalanced Transportation problems, Transportation problems with maximization, Degeneracy.

Assignment Problem – Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Hungarian Algorithm, Multiple Solution, Unbalanced Assignment problems, Maximization in Assignment Model.

UNIT - III

Sequencing – Job sequencing, Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, n jobs through m machines, Two jobs and m Machines Problems.

UNIT - IV

Game Theory: Concepts, Definitions and Terminology, Two Person Zero Sum Games, Pure Strategy Games (with Saddle Point), Principal of Dominance, Mixed Strategy Games (Game without Saddle Point), Significance of Game Theory in Managerial Application.

UNIT - V

Project Management: Network Analysis – Definition –objectives -Rules for constructing Network diagram- Determining Critical Path – Earliest & Latest Times – Floats – Application of CPM and PERT techniques in Project Planning and Control – PERT Vs CPM. (exclude Project Crashing).

Textbooks:

1. Operations Research / R.Pannerselvam, PHI Publications.
2. Operations Research / S.D.Sharma-Kedarnath
3. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/Pearson Education.
4. Engineering Optimization: Theory and practice / S.S.Rao, New Age International (P) Limited

Reference Books:

1. Quantitative Techniques in Management / ND Vohra, Tata McGraw Hill, 4th Edition,2011.
2. Introduction to O.R/Hiller &Libermann (TMH).
3. Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan&Lawrence Friedman. Pearson
4. Quantitative Analysis For Management/ Barry Render, Ralph M. Stair, Jr and Michael E. Hanna/
5. Operations Research / Wagner/ PHI Publications.

Online Learning Sources

https://onlinecourses.swayam2.ac.in/cec20_ma10/preview
https://onlinecourses.nptel.ac.in/noc20_ma23/preview
https://onlinecourses.nptel.ac.in/noc19_ma29/preview

Course Code	Probability & Statistics		L	T	P	C
23BTHS12T	(Common to CSE,CS & IT and CSE(AI))		3	0	0	3
Year	II	Semester	II			

Course Objective:

This course aims at providing the student with the knowledge on the theory of Probability and random variables and usage of statistical techniques like testing of hypothesis, testing of significance, chi-square test and basic concepts of Least square methods.

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

CO1: Analyze the data quantitatively or categorically using various statistical elementarytools.

CO2: Design mathematical models involving probability, random variables and the critical thinking in the theory of probability and its applications in real life problems.

CO3: Apply the theoretical probability distributions like binomial, Poisson, and Normal in the relevant application areas.

CO4: Analyze to test various hypotheses included in theory and types of errors for large samples.

CO5: Apply the different testing tools like t-test, F-test, chi-square test to analyze the relevant real life problems.

UNIT I: Descriptive statistics

Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Measures of Central tendency, Measures of Variability (spread or variance) Skewness, Kurtosis, correlation, correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines.

UNIT II:Probability

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation**.**

UNIT III: Probability distributions

Probability distributions: Binomial, Poisson and Normal-their properties (Chebyshevs inequality). Approximation of the binomial distribution to normal distribution.

UNITIV: Estimation and Testing of hypothesis, large sample tests

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT V: Small sample tests

Student-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Textbooks:

1. Millerand Freunds, **Probability and Statistics for Engineers**,7/e,Pearson,2008.
2. S.C. Gupta and V.K. Kapoor, **Fundamentals of Mathematical Statistics**, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

1. S.Ross, A **First Course in Probability**, Pearson EducationIndia, 2002.
2. W.Feller, **An Introduction to Probability Theory and its Applications**, 1/e, Wiley, 1968.
3. B.V.Ramana, **Higher Engineering Mathematics**, McGrawHillEducation.

Course Code	Machine Learning		L	T	P	C
23BTAI02T			3	0	0	3
Year	II	Semester	II			

Course Objectives:

The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.
- Perform feature engineering and dimensionality reduction techniques, such as feature extraction, feature selection, feature scaling.

Course Outcomes: At the end of the Course, the student will be able to

CO-1: Apply effective data pre-processing techniques and similarity measures to improve data quality and relevance in machine learning applications.

CO-2: Implement diverse machine learning paradigms and stages to address real-world problems effectively.

CO-3: Utilize supervised learning algorithms with performance metrics like Area under ROC curve for accurate classification and regression tasks.

CO-4: Apply fundamental supervised learning concepts to solve classification problems.

CO-5: Implement unsupervised learning techniques for clustering data sets to uncover patterns and insights without predefined class labels.

UNIT I:

Data: types of data, data quality, data pre-processing, measures of similarity and dissimilarity (Text Bok 2)

Exploring Data: Summary statistics (Text Bok 2)

UNIT II:

Evolution of Machine Learning, Paradigms, learning by rote, learning by deduction, learning by abduction, learning by induction, stages in machine learning, data acquisition, data representation, model selection, model learning, model evaluation, model prediction, model explanation, search and learning, data sets used.(Text Bok 1)

UNIT III:

Supervised Learning Algorithms 1:

Different classification algorithms based on distance measures, Nearest Neighbor Classifier, K-Nearest Neighbor Classifier, Weighted K-Nearest Neighbor Algorithm, Random distance based Nearest Neighbor Algorithm, Tree-based Nearest Neighbor Algorithm, Branch and Bound method, leader clustering, KNN Regression, performance measures, performance of classifies, performance of regression algorithms, Area under ROC curve for the Breast Cancer Data Set.

UNIT IV:

Supervised Learning Algorithms 2:

The Bayes classifier, probability, conditional probability and Bayes rule, conditional probability, total probability, Bayes rule and inference, Bayes rule and classification, Bayes classifier and its optimality, Multi-class classification, parametric and non-parametric schemes for density estimation, class conditional independence and Naive bayes classifier, estimation of probability structure, Naive Bayes Classifier.

UNIT V:

Unsupervised Learning Algorithms:

Clustering: Introduction, partitioning of data, data re-organization, data compression, summarization, matrix factorization, clustering of patterns, data abstraction, clustering algorithms, Divisive clustering, Agglomerative clustering, Partitional clustering, K-Means clustering, K-Means ++ clustering, Soft partitioning, soft clustering, Fuzzy- C-means clustering, Rough clustering, Rough K-Means clustering algorithm.

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy, V S AnanthaNarayana, Universities Press (India), 2024
2. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action",Peter Harrington, DreamTech

Course Code	Database Management Systems		L	T	P	C
23BTCS06T	(Common to CSE, CS & IT and CSE(AI))		3	0	0	3
Year	II	Semester	II			

Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

Course Outcomes: At the end of the Course, the student will be able to

CO1: Analyse a given database application scenario to use ER model for conceptual design of the database.

CO2: Apply the concepts of structured query language to create, query and manipulate database with the given constraint.

CO3: Design relational databases using SQL, optimizing data handling and retrieval through schema design, complex querying, and performance techniques.

CO4: Apply the concept of functional dependencies and normalization techniques to refine databases.

CO5: Apply transaction processing, concurrency control, and database recovery protocols within databases.

UNIT I:

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT II:

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL:Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT III:

SQL:Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries,

grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.

UNIT IV:

Schema Refinement (Normalization):Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependencyLossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNIT V:

Transaction Concept:Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Introduction to Indexing Techniques: B+ Trees, operations on B+Trees, Hash Based Indexing:

Text Books:

1) Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2) Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan,TMH (For Chapter 1 and Chapter 5)

Reference Books:

1) Introduction to Database Systems, 8thedition, C J Date, Pearson.
2) Database Management System, 6th edition, RamezElmasri, Shamkant B. Navathe, Pearson
3) Database Principles Fundamentals of Design Implementation and Management, 10th edition, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning, 2022

Web-Resources:

1) https://nptel.ac.in/courses/106/105/106105175/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672820224 56_shared/overview

Course Code	Digital Logic & Computer Organization		L	T	P	C
23BTEC07T			3	0	0	3
Year	II	Semester	II			

Course Objectives:

The main objectives of the course is to

- Provide students with a comprehensive understanding of digital logic design principles and computer organization fundamentals
- Describe memory hierarchy concepts
- Explain input/output (I/O) systems and their interaction with the CPU, memory, and peripheral devices

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

CO1: Analyze and implement basic logic functions using logic gates, including universal gates.
CO2: Design sequential circuits including flip-flops, binary counters, registers, shift registers, and ripple counters.
CO3: Apply fundamental concepts of processor organization and perform related arithmetic operations.
CO4: Analyze cache memory structures and performance considerations.
CO5: Analyze processor examples in the context of I/O operations.

UNIT – I:

Data Representation: Binary Numbers,Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes

Digital Logic Circuits-I: Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers

UNIT – II:

Digital Logic Circuits-II: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters

Basic Structure of Computers: Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations,Von- Neumann Architecture

UNIT – III:

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control

UNIT – IV:

The Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

UNIT – V:

Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

Textbooks:

1. Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 6th edition, McGraw Hill
2. Digital Design, 6th Edition, M. Morris Mano, Pearson Education.

Reference Books:

1. Computer Organization and Architecture, William Stallings, 11thEdition, Pearson.
2. Computer Systems Architecture, M.Moris Mano, 3rdEdition, Pearson
3. Computer Organization and Design, David A. Paterson, John L.Hennessy, Elsevier
4. Fundamentals of Logic Design, Roth, 5thEdition, Thomson

Online Learning Resources:

1. https://nptel.ac.in/courses/106/103/106103068/

Course Code	AI & ML Lab		L	T	P	C
23BTAI01P	(Common to CSE and CS & IT)		0	0	3	1.5
Year	II	Semester	II			

Course Objectives:

1. The student should be made to study the concepts of Artificial Intelligence.
2. The student should be made to learn the methods of solving problems using Artificial Intelligence.
3. The student should be made to introduce the concepts of Expert Systems and machine learning.
4. To learn about computing central tendency measures and Data preprocessing techniques
5. To learn about classification and regression algorithms
6. To apply different clustering algorithms for a problem.

Course Outcomes: At the end of the Course, the student will be able to

CO1: Apply mathematical and statistical perspectives of machine learning algorithms through Python programming.
CO2: Emphasize the importance of visualization in developing effective data analyticssolutions.
CO3: Utilize machine learning algorithms to derive actionable insights from data.
CO4: Demonstrate and evaluate the effectiveness of AI and ML algorithms in practical scenarios.
CO5: Compare the performance of different machine learning algorithms.

Software Required for ML: Python/R/Weka

List of Experiments

1. Pandas Library
   a) Write a python program to implement Pandas Series with labels.
   b) Create a Pandas Series from a dictionary.
   c) Creating a Pandas Data Frame.
   d) Write a program which makes use of the following Pandas methods
      i) describe () ii) head () iii) tail () iv) info ()
2. Pandas Library: Visualization
   a) Write a program which use pandas inbuilt visualization to plot following graphs:
      i. Bar plots ii. Histograms iii. Line plots iv. Scatter plots
3. Write a Program to Implement Breadth First Search using Python.
4. Write a program to implement Best First Searching Algorithm
5. Write a Program to Implement Depth First Search using Python.
6. Write a program to implement the Heuristic Search
7. Write a python program to implement A* and AO* algorithm. (Ex: find the shortest path)
8. Apply the following Pre-processing techniques for a given dataset.
   a. Attribute selection
   b. Handling Missing Values
   c. Discretization
   d. Elimination of Outliers
9. Apply KNN algorithm for classification and regression

10. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
11. Apply Random Forest algorithm for classification and regression
12. Demonstrate Naïve Bayes Classification algorithm.
13. Apply Support Vector algorithm for classification
14. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.

Online Learning Resources/Virtual Labs:

https://www.tensorflow.org/
https://pytorch.org/
https://github.com/pytorch
https://keras.io/
https://github.com/keras-team
http://deeplearning.net/software/theano/
https://github.com/Theano/Theano
https://caffe2.ai/
https://github.com/caffe2
https://deeplearning4j.org/Scikit-learn:
https://scikit-learn.org/stable/
https://github.com/scikit-learn/scikit-learn
https://www.deeplearning.ai/
https://opencv.org/
https://github.com/qqwweee/keras-yolo3
https://www.pyimagesearch.com/2018/11/12/yolo-object-detection-with-opencv/
https://developer.nvidia.com/cuda-math-library

Course Code	Database Management Systems Lab		L	T	P	C
23BTCS07P	(Common to CSE, CS & IT and CSE(AI))		0	0	3	1.5
Year	II	Semester	II			

Course Objectives:

This Course will enable students to

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers

Course Outcomes: At the end of the Course, the student will be able to

CO1: Apply SQL proficiently to address diverse query challenges and demonstrate effective database management.

CO2: Design database application scenarios using the ER model for conceptual design and apply normalization methods to optimize database structure.

CO3: Implement transaction processing, concurrency control, and database recovery protocols to ensure data integrity and system reliability.

Experiments covering the topics:

- DDL, DML, DCL commands
- Queries, nested queries, built-in functions,
- PL/SQL programming- control structures
- Procedures, Functions, Cursors, Triggers,
- Database connectivity- ODBC/JDBC

Sample Experiments:

1. Creation, altering and droping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)
5.
   i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
   ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.
13. Write a Java program that connects to a database using JDBC
14. Write a Java program to connect to a database using JDBC and insert values into it
15. Write a Java program to connect to a database using JDBC and delete values from it

Reference Books:

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle", PHI.
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education.
4. RamezElmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
5. Database Principles Fundamentals of Design Implementation and Management, 10th edition, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning, 2022

Online Learning Resources:

1. http://www.scoopworld.in
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

Course Code	Full Stack Development – 1(Skill Enhancement Course)		L	T	P	C
23BTCS02S	(Common to CSE and CSE(AI))		0	1	2	2
Year	II	Semester	II			

Course Objectives:

The main objectives of the course are to

- Make use of HTML elements and their attributes for designing static web pages
- Build a web page by applying appropriate CSS styles to HTML elements
- Experiment with JavaScript to develop dynamic web pages and validate forms

Course Outcomes: At the end of the Course, the student will be able to

CO1: Design Websites.
CO2: Apply Styling to web pages.
CO3: Make Web pages interactive.
CO4: Design Forms for applications.
CO5: Choose Control Structure based on the logic to be implemented.

Experiments covering the Topics:

- Lists, Links and Images
- HTML Tables, Forms and Frames
- HTML 5 and Cascading Style Sheets, Types of CSS
- Selector forms
- CSS with Color, Background, Font, Text and CSS Box Model
- Applying JavaScript - internal and external, I/O, Type Conversion
- JavaScript Conditional Statements and Loops, Pre-defined and User-defined Objects
- JavaScript Functions and Events

Sample Experiments:

1. Lists, Links and Images

a. Write a HTML program, to explain the working of lists.
   Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.
b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.
c. Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.
d. Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

2. HTML Tables, Forms and Frames

a. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)
b. Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.).

c. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).
d. Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame → image, second frame → paragraph, third frame → hyperlink. And also make sure of using "no frame" attribute such that frames to be fixed).

3. HTML 5 and Cascading Style Sheets, Types of CSS

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, , tags.
b. Write a HTML program, to embed audio and video into HTML web page.
c. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value).

4. Selector forms

a. Write a program to apply different types of selector forms
   i.Simple selector (element, id, class, group, universal)
   ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
   iii. Pseudo-class selector
   iv. Pseudo-element selector
   v. Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model

a. Write a program to demonstrate the various ways you can reference a color in CSS.
b. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.
c. Write a program using the following terms related to CSS font and text:
   i. font-size ii. font-weight iii. font-style
   iv. text-decoration v. text-transformation vi. text-alignment
d. Write a program, to explain the importance of CSS Box model using
   i.Content ii. Border iii. Margin iv. padding

6. Applying JavaScript - internal and external, I/O, Type Conversion

a. Write a program to embed internal and external JavaScript in a web page.
b. Write a program to explain the different ways for displaying output.
c. Write a program to explain the different ways for taking input.
d. Create a webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not

7. JavaScriptPre-defined and User-defined Objects

a. Write a program usingdocument object properties and methods.
b. Write a program using window object properties and methods.
c. Write a program usingarray object properties and methods.
d. Write a program usingmath object properties and methods.
e. Write a program usingstring object properties and methods.
f. Write a program usingregex object properties and methods.
g. Write a program usingdate object properties and methods.

h. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

8. JavaScriptConditional Statements and Loops

a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML text as "EQUAL NUMBERS".
b. Write a program to display week days using switch case.
c. Write a program to print 1 to 10 numbers using for, while and do-while loops.
d. Write aprogram to print data in object using for-in, for-each and for-of loops
e. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,13 + 53+ 33 = 153]
f. Write a program to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)

9. JavaScriptFunctions and Events

a. Design a appropriate function should be called to display
   i. Factorial of that number
   ii. Fibonacci series up to that number
   iii. Prime numbers up to that number
   iv. Is it palindrome or not
b. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display
   i. Factorial of that number
   ii. Fibonacci series up to that number
   iii. Prime numbers up to that number
   iv. Is it palindrome or not
c. Write a program to validate the following fields in a registration page
   i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
   ii. Mobile (only numbers and length 10 digits)
   iii. E-mail (should contain format like xxxxxxx@xxxxxx.xxx)

10. JavaScript Database Connectivity

a. Introduction to server-side JavaScript with Node.js
b. Connecting JavaScript applications to MySQL and Mongo DB databases

Text Books:

1. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.

Reference Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Online Learning Resources:

1. https://www.w3schools.com/html
2. https://www.w3schools.com/css
3. https://www.w3schools.com/js/

Course Code	Design Thinking & Innovation		L	T	P	C
23BTME09T	(Common to All branches of Engineering)		1	0	2	2
Year	II	Semester	II			

Course Objectives:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

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

CO1: Apply the basic principles of design thinking.

CO2: Apply the design thinking techniques for solving problems in various sectors.

CO3: Appreciate the difference between innovation and creativity.

CO4: Apply the techniques of product design to develop a new product.

CO5: Apply design thinking techniques for business models and start-ups.

UNIT I: Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design.Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT II: Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III: Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT IV:Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT V: Design Thinking in Business Processes

Design Thinking applied in Business &Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, Harper Bollins(2009)
2. IdrisMootee, Design Thinking for Strategic Innovation, 2013, JohnWiley&Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shruti N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design-Kritinaholden, Jill Butter.
4. Chesbrough.H, The Era of Open Innovation – 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/pre

Course Code	NATURAL LANGUAGE PROCESSING		L	T	P	C
23BTCS19c	(Professional Core)		3	0	0	3
Year	III	Semester	I			

Course Objectives

- Basics of NLP,Morphology,Tokenization,N-gramModels
- POS Tagging, Parsing, Tree banks, Ambiguity Handling
- Word Sense Disambiguation, Semantic Parsing, Sentiment Analysis
- Machine Translation, Transformers, BERT/GPT, Ethical NLP
- Speech Recognition, Feature Extraction, Discourse Analysis

Course Outcomes

CO1: Understand morphological processing and the structure of words and documents.

CO2: Analyze syntactic structures using various parsing algorithms.

CO3: Apply semantic parsing techniques to interpret natural language text.

CO4: Understand predicate-argument structures and meaning representation systems.

CO5: Applycross-lingual language models and speech recognition techniques in NLP applications

UNIT I: Introduction to NLP

Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.

UNIT II: Word-Level and Syntactic Analysis

Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Tree banks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.

UNIT III: Text Classification and Information Retrieval

Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information, Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.

UNIT IV: Machine Translation and Semantic Processing

Introduction to Machine Translation (MT), Language Divergence and Typology in MT Encoder- Decoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses

UNIT V: Speech Processing and Advanced NLP Models

Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

Text books (Core Learning Materials)

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books (Supplementary Learning)

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. AkshayKulkarni &AdarshaShivananda –Natural LanguageProcessingRecipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
   https://archive.nptel.ac.in/courses/106/106/106106211/

Course Code	COMPUTER VISION AND IMAGE PROCESSING (Professional Core)		L	T	P	C
23BTAI04T			3	0	0	3
Year	III	Semester	I			

Course Objectives:

- Introduce fundamental concepts of image processing and computer vision.
- Develop proficiency in applying algorithms for image analysis and interpretation.
- Explore techniques for feature extraction, object recognition, and scene understanding.
- Understand the integration of machine learning methods in computer vision applications.

Course Outcomes:

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

1. Understand image formation, representation, and apply basic image processing and frequency domain techniques for image enhancement and restoration.
2. Apply edge detection, segmentation, morphological, and texture analysis techniques for extracting features from images.
3. Analyze 3D vision and motion using techniques like stereo vision, optical flow, and camera calibration for scene understanding and depth estimation.
4. Evaluate object recognition approaches and machine learning models including traditional and deep learning techniques used in computer vision.
5. Implement advanced computer vision applications such as image compression, face recognition, and medical image analysis using case studies.

UNIT I: Introduction to Computer Vision and Image Processing

Overview of Computer Vision and Image Processing: Definitions and scope, Historical development and applications, Image Formation and Representation: Image acquisition methods, Sampling and quantization, Color spaces and models, Fundamentals of Image Processing : Point operations (brightness and contrast adjustments), Histogram processing, Spatial filtering techniques Fourier Transform and Frequency Domain Processing : Discrete Fourier Transform (DFT), Filtering in the frequency domain, Image restoration concept.

UNIT II: Image Analysis Techniques

Edge Detection and Feature Extraction : Gradient operators (Sobel , Prewitt), Canny edge detector, Corner and interest point detection, Image Segmentation : Thresholding methods, Region-based segmentation, Clustering techniques (K-means, Mean-Shift), Morphological Image Processing: Erosion and dilation, Opening and closing operations, Applications in shape analysis, Texture Analysis, Statistical methods (co-occurrence matrices), Transform-based methods (Gabor filters), Applications in pattern recognition

UNIT III: 3DVision and Motion Analysis

Stereo Vision: Epipolar geometry, Disparity mapping, Depth estimation techniques, Structure from Motion (SfM) : Feature tracking across frames, 3D reconstruction from motion, Applications in scene understanding, Optical Flow and Motion Analysis : Lucas-Kanade method, Horn-Schunck method, Motion segmentation, Camera Calibration and 3D Reconstruction : Intrinsic and extrinsic parameters, Calibration techniques, 3D point cloud generation

UNIT IV: Object Recognition and Machine Learning in Vision

Feature Descriptors and Matching: Scale-Invariant Feature Transform (SIFT), Speeded-Up Robust Features(SURF),Feature matching algorithms, Object Detection and Recognition : Template matching, Deformable part models, Convolutional Neural Networks (CNNs), Introduction to Machine Learning for Vision: Supervised and unsupervised learning, Support Vector Machines (SVM), Decision trees and random forests, Deep Learning Architectures: Auto encoders, Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs)

UNIT V: Applications and Advanced Topics

Image Compression: Lossy and lossless compression techniques, Standards (e.g., JPEG, PNG), Morphological Image Processing: Dilation, erosion, opening, and closing operations, Applications in shape analysis, Case Studies: Face recognition systems., Automated visual inspection, Medical image analysis.

Reference Books

1. Forsyth,D.A.,&Ponce,J.(2002).Computer Vision: A Modern Approach .Prentice Hall.
2. Shapiro,L.G., & Stockman,G.C.(2001).Computer Vision. Prentice Hall.

Textbooks:

1. Gonzalez,R.C.,&Woods,R.E.(2008).Digital Image Processing(3rded.).Pearson Prentice Hall.Stony Brook University
2. Szeliski,R.(2010).Computer Vision: Algorithms and Applications .Springer.

Online Learning Resources:

1. Coursera: Introduction to Computer Vision and Image Processing.Link Coursera
2. Stanford University: CS231n: Deep Learning for ComputerVision. Linkcs 231n.stanford.edu
3. MIT Open Course Ware: Introduction to Computer Vision .Link

Course Code	SYTEM SOFTWARE PROGRAMMING (Professional Core)		L	T	P	C
23BTAI03T			3	0	0	3
Year	III	Semester	I			

Course Objectives:

- To understand the architecture and design of system software including compilers, assemblers, linkers, loaders, and macro processors.
- To gain in-depth knowledge of programming tools, shell environments, and low-level system utilities.
- To apply principles of system programming in Unix/Linux environments.
- To explore process creation, inter-process communication, signal handling, and multi-threading using C/C++.
- To enable development of foundational tools like simple compilers, parsers, and loaders.

Course Outcomes:

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

1. Explain the architecture and functions of system software like assemblers, loaders, linkers, and macro processors.
2. Apply scanning and parsing techniques for programming language processing.
3. Develop and analyze assembly-level programs and understand compilation techniques.
4. Implement Unix/Linux system programming tasks such as process creation, pipes,signals, and thread management.
5. Demonstrate hands-on experience in shell scripting, debugging, and low-level system tools.

UNIT I: Language Processors and Assemblers

Language processing system overview, Phases of compilation and data structures, Assemblers–features, single pass and two-pass assembler, Intermediate code generation, Literal and symbol tables, Relocation and linking concepts

UNIT II: Macro Processors and Loaders

Macro instruction and features, Nested macros and macro expansion, Macro processing in two-pass assemblers, Design of macro processors, Loaders: absolute, relocating, and linking, dynamic loading and linking, bootstrap loader

UNIT III: Scanning, Parsing, and Compilers

Language grammars and ambiguity, Lexical analysis –regular expressions, token generation, Syntax analysis – parsing techniques (top-down, bottom-up), Semantic analysis and intermediate code generation, Code optimization techniques – constant folding, dead code elimination

UNIT IV: Linkers, Debuggers, and Shell Programming

Symbol resolution and relocation, Linking(static vs dynamic), relocation records, Debugging techniques and breakpoints, Unix/Linux shell environment, Shell commands, variables, redirection, pipes, control statements, Shell script functions and script-based automation

UNIT V: Unix/Linux System Programming

Introduction to system-level programming in C, File I/O system calls (open, read, write, close),Process creation using fork(),exec(),wait(), Inter-process communication(pipes, FIFO),Signal handling and POSIX threads(pthread_create, pthread_join),Case studies: background processes, daemon creation, mini shell

Textbooks:

1. **Leland L.Beck, D.Manjula**, System Software: An Introduction to Systems Programming, 3rd Edition, Pearson.
2. Silberschatz, Galvin, Gagne, Operating SystemConcepts,10th Edition,Wiley (selectively for system calls & programming).

Reference Books:

1. D.M. Dhamdhere, System Programming and Operating Systems, McGraw Hill.
2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.
3. Andrew S.Tanenbaum, Modern Operating Systems, Pearson Education.
4. Yashwant Kanetkar, Unix Shell Programming, BPB Publications.

Course Code	INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS (Qualitative Treatment)		L	T	P	C
23BTCS11T			3	0	0	3
Year	III	Semester	I			

Course Objectives:

- Introduce fundamental quantum concepts like superposition and entanglement.
- Understand theoretical structure of qubits and quantum information.
- Explore conceptual challenges in building quantum computers.
- Explain principles of quantum communication and computing.
- Examine real-world applications and the future of quantum technologies.

Course Outcomes (CO):

- Explain core quantum principles in a non-mathematical manner.
- Compare classical and quantum information systems.
- Identify theoretical issues in building quantum computers.
- Discuss quantum communication and computing concepts.
- Recognize applications, industry trends, and career paths in quantum technology.

Unit 1: Introduction to Quantum Theory and Technologies

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India‘s Quantum Mission, EU, USA, China

Unit 2: Theoretical Structure of Quantum Information Systems

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

Unit 3: Building a Quantum Computer – Theoretical Challenges and Requirements

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what‘s working and what remains elusive,The role of quantum software in managing theoretical complexities

Unit 4: Quantum Communication and Computing – Theoretical Perspective

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum

Parallelism (Many States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World Importance and Future Potential

Unit 5: Applications, Use Cases, and the Quantum Future
Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skill sets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

Reference Books:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.
8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	DATA VISUALIZATION		L	T	P	C
23BTAI05T	(Professional Elective-I)		3	0	0	3
Year	III	Semester	I			

Course Objectives:

- To understand the principles, techniques, and tools of data visualization.
- To develop the ability to transform data into visual insights using different types of charts and plots.
- To introduce the cognitive and perceptual foundations of effective data visualization.
- To apply tools and programming environments (like Python, Tableau, or Power BI) for creating interactive and dynamic visualizations.
- To analyze real-world datasets and effectively communicate data-driven findings visually.

Course Outcomes:

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

CO1: Interpret different types of data and recognize the appropriate visualization methods.

CO2: Design effective and interactive data visualizations using various tools.

CO3: Apply visual encoding and perceptual principles in presenting complex data.

CO4: Analyze and visualize real-world data sets using Python libraries and dashboards.

CO5: Create visual stories and dashboards for effective communication of insights.

UNIT I: Introduction to Data Visualization & Perception

Introduction to Data Visualization, Importance and Scope of Data Visualization, Data Types and Sources, Visual Perception: Pre-attentive Processing, Gestalt Principles, Data-Ink Ratio, Data Density, Lie Factor, Visualization Process and Design Principles, Tools Overview: Tableau, Power BI, Python Libraries

UNIT II: Visualization Techniques for Categorical & Quantitative Data

Charts for Categorical Data: Bar Charts, Pie Charts, Column Charts, Charts for Quantitative Data: Histograms, Line Charts, Boxplots, Scatter Plots, Bubble Charts, Heatmaps, Choosing the Right Chart Type, Best Practices in Labeling, Coloring, and Scaling.

UNIT III: Multidimensional, Temporal and Hierarchical Data Visualization

Visualizing Multivariate Data: Parallel Coordinates, Radar Charts, Time-Series Visualization: Time Plots, Animation over Time, Geographic Data Visualization: Maps, Choropleths, Hierarchical Data: Treemaps, Sunburst Charts, Network and Graph Visualization.

UNIT IV: Data Visualization Using Python and Dashboards

Introduction to Matplotlib, Seaborn, and Plotly, Creating Static and Interactive Charts, Pandas Visualization Capabilities, Dashboards with Dash, Streamlit, Power BI, Case Studies: Real-world Dataset Visualization.

UNIT V: Storytelling with Data and Ethical Visualization

Storytelling and Narrative Techniques in Visualization, Dashboards and Reporting, Misleading Visualizations and Bias, Ethical Principles in Data Visualization, Final Project: Create a Storytelling Dashboard with Real Data.

Textbooks:

1. Tamara Munzner, Visualization Analysis and Design, CRC Press, 2014.
2. Nathan Yau, Data Points: Visualization That Means Something, Wiley, 2013.

Reference Books:

1. Alberto Cairo, The Truthful Art: Data, Charts, and Maps for Communication, New Riders, 2016.
2. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015.
3. Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019.
4. Rohan Chopra, Hands-On Data Visualization with Bokeh, Packt Publishing, 2019.

Online Learning Resources:

1. NPTEL: Data Visualization - IIT Madras
2. Coursera: Data Visualization with Python by IBM

Course Code	SOFT COMPUTING		L	T	P	C
23BTCS12b	(Professional Elective-I)		3	0	0	3
Year	III	Semester	I			

Course Objectives:

- Understand the concepts of soft computing techniques and how they differ from traditional AI techniques.
- Introduce the fundamentals of fuzzy logic and fuzzy systems.
- Familiarize with artificial neural networks and their architectures.
- Learn genetic algorithms and their role in optimization.
- Explore hybrid systems integrating fuzzy logic, neural networks, and genetic algorithms.

Course Outcomes:

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

- Understand the components and applications of soft computing.
- Apply fuzzy logic concepts to real-world problems.
- Build and train various neural network models.
- Implement genetic algorithms for problem-solving and optimization.
- Design hybrid systems using soft computing techniques.

UNIT I: Introduction to Soft Computing and Fuzzy Logic

Introduction to Soft Computing: Definition, Components, Differences with Hard Computing, Applications of Soft Computing, Fuzzy Logic: Crisp Sets vs Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems: Mamdani and Sugeno Models, Defuzzification Techniques.

UNIT II: Artificial Neural Networks – I

Introduction to Neural Networks: Biological Neurons vs Artificial Neurons, Architecture of Neural Networks: Feedforward, Feedback, Learning Rules: Hebbian, Delta, Perceptron Learning Rule, Single Layer Perceptron and its Limitations, Multi-Layer Perceptron: Backpropagation Algorithm, Applications of Neural Networks

UNIT III: Artificial Neural Networks – II

Hopfield Networks and Associative Memories, Radial Basis Function Networks, Self-Organizing Maps (SOM), Recurrent Neural Networks (RNNs) – Basic Concepts, Convolutional Neural Networks (CNNs) – Overview and Applications, Practical Use Cases in Image and Pattern Recognition,

UNIT IV: Genetic Algorithms and Optimization

Introduction to Genetic Algorithms, GA Operators: Selection, Crossover, Mutation, Fitness Function and Evaluation, Schema Theorem, Elitism, Applications in Function Optimization, Scheduling, and Robotics, Introduction to Particle Swarm Optimization (PSO).

UNIT V: Hybrid Systems and Advanced Topics

Hybrid Systems: Neuro-Fuzzy Systems, Fuzzy-GA, GA-ANN, ANFIS: Architecture and Learning, Case Studies on Hybrid Systems, Introduction to Deep Learning in Soft Computing, Real-World Applications: Forecasting, Control Systems, Medical Diagnosis, Image Processing.

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, ―Principles of Soft Computing‖, Wiley India, 3rd Edition
2. Timothy J. Ross, ―Fuzzy Logic with Engineering Applications‖, Wiley, 4th Edition
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, ―Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications‖, PHI

Reference Books:

1. Laurene Fausett, ―Fundamentals of Neural Networks: Architectures, Algorithms and Applications‖, Pearson
2. David E. Goldberg, ―Genetic Algorithms in Search, Optimization and Machine Learning‖, Pearson
3. Simon Haykin, ―Neural Networks and Learning Machines‖, Pearson, 3rd Edition
4. Bart Kosko, ―Neural Networks and Fuzzy Systems‖, Prentice Hall

Online Learning Resources:

1. NPTEL – Soft Computing by Prof. S. Sengupta (IIT Kharagpur)
2. Coursera – Neural Networks and Deep Learning (Andrew Ng)

Course Code	EXPLORATORY DATA ANALYSIS WITH PYTHON		L	T	P	C
23BTAI06T	(Professional Elective-I)		3	0	0	3
Year	III	Semester	I			

Course Objectives:

- To introduce the principles and practices of Exploratory Data Analysis (EDA) using Python.
- To teach techniques for data cleaning, preprocessing, transformation, and visualization.
- To apply statistical techniques and visual methods to discover patterns and relationships.
- To gain experience using popular Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn.
- To prepare datasets for further machine learning and predictive modeling.

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

- Understand and apply key concepts of EDA and data preprocessing.
- Perform exploratory analysis using Python libraries and interpret results.
- Handle missing data, outliers, and categorical features effectively.
- Create meaningful visualizations to support data-driven insights.
- Use EDA as a foundation for data science workflows.

UNIT I – Introduction to EDA and Python Environment

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape)

UNIT II – Data Wrangling and Preprocessing

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting.

UNIT III – Univariate and Bivariate Analysis

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis

UNIT IV – Data Visualization Techniques

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview)

UNIT V – EDA Case Studies and Real-Time Datasets

Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

Textbooks:

1. **Jake VanderPlas**, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2016.
2. **Wes McKinney**, Python for Data Analysis, 2nd Edition, O'Reilly, 2018.

Reference Books:

1. **Joel Grus**, Data Science from Scratch, O'Reilly, 2019.
2. **Aurelien Geron**, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 2nd Edition, O'Reilly, 2019.
3. **Allen B. Downey**, Think Stats: Probability and Statistics for Programmers, O'Reilly, 2014.

Online Learning Resources:

1. NPTEL Course – Data Science for Engineers
2. Coursera – Applied Data Science with Python Specialization (University of Michigan)

Course Code	COMPUTATIONAL INTELLIGENCE		L	T	P	C
23BTAI07T	(Professional Elective-I)		3	0	0	3
Year	III	Semester	I			

Course Objectives:

- Understand the concepts and foundations of computational intelligence.
- Study neural networks, fuzzy logic systems, and evolutionary algorithms.
- Explore hybrid systems and their applications.
- Apply computational intelligence techniques to real-world problem-solving.
- Analyze the effectiveness of various computational intelligence approaches.

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

- Describe and differentiate neural networks, fuzzy logic, and evolutionary computation.
- Apply neural and fuzzy systems for real-time decision-making.
- Analyze complex problems using soft computing tools.
- Develop hybrid intelligent systems.
- Evaluate and compare the performance of CI-based systems.

UNIT I: Introduction to Computational Intelligence and Artificial Neural Networks
Definition and Scope of Computational Intelligence (CI), Components of CI: Neural Networks, Fuzzy Logic, Evolutionary Computation, Biological Neuron vs. Artificial Neuron, McCulloch-Pitts Model, Perceptron, Adaline and Madaline, Multilayer Feedforward Networks, Backpropagation Algorithm, Applications of ANN in Pattern Recognition and Classification.

UNIT II: Fuzzy Logic and Fuzzy Systems
Introduction to Fuzzy Logic and Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Inference Systems, Fuzzification and Defuzzification, Fuzzy Control Systems, Fuzzy Reasoning and Approximate Reasoning

UNIT III: Evolutionary Computation Techniques
Basics of Evolutionary Algorithms (EA), Genetic Algorithms (GA): Operators, Encoding, Fitness Function, Selection, Crossover and Mutation, Convergence Criteria, Genetic Programming (GP), Differential Evolution (DE), Applications of GA and GP

UNIT IV: Swarm Intelligence and Hybrid Systems
Swarm Intelligence: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Behavior of Swarms and Collective Intelligence, Comparison of Evolutionary Algorithms and Swarm Techniques, Hybrid Systems: Neuro-Fuzzy, Fuzzy-GA, ANN-GA Systems, Case Studies in Hybrid Systems

UNIT V: Applications of Computational Intelligence
CI in Image and Signal Processing, CI for Optimization Problems and Robotics, CI in Biomedical Engineering and Finance, Intelligent Agents and Decision-Making Systems, Real-time Applications and Emerging Trends in CI.

Textbooks:

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, PHI Learning.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India.

Reference Books:

1. S.N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson.
3. James Kennedy and Russell C. Eberhart, Swarm Intelligence, Morgan Kaufmann.
4. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley.

Online Learning Resources:

1. NPTEL - Computational Intelligence
2. Coursera – Computational Intelligence
3. YouTube: IIT Lectures on Soft Computing and CI

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	COMPUTER VISION & NLP LAB		L	T	P	C
23BTAI02P	(Professional Core)		0	0	3	1.5
Year	III	Semester	I			

Course Objectives:

- To provide hands-on experience in implementing image processing and computer vision algorithms.
- To familiarize students with natural language processing techniques using Python libraries.
- To enable the integration of CV and NLP for building intelligent applications.

Course Outcomes:

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

- Apply image processing techniques for feature extraction and classification.
- Implement NLP techniques such as tokenization, POS tagging, and sentiment analysis.
- Analyze visual and textual data using open-source tools.
- Develop applications that combine Computer Vision and NLP for real-world tasks.

List of Experiments:

1. Load and display an image using OpenCV and perform basic operations like resizing, cropping, and rotation.
2. Apply edge detection (Sobel, Canny) and thresholding techniques on grayscale and color images.
3. Implement image filtering operations: Gaussian, Median, and Bilateral filters.
4. Perform object detection using contour detection and bounding boxes.
5. Detect faces using Haar Cascade or DNN-based pre-trained models in OpenCV.
6. Implement color-based object tracking using HSV space and CamShift algorithm.
7. Preprocess text data (tokenization, stopword removal, stemming, lemmatization) using NLTK/spaCy.
8. Implement Part-of-Speech (POS) tagging and Named Entity Recognition (NER) using spaCy.
9. Build a simple sentiment analysis classifier using bag-of-words or TF-IDF and Naïve Bayes.
10. Perform topic modeling using Latent Dirichlet Allocation (LDA).
11. Extract text from an image using Optical Character Recognition (OCR) with Tesseract and perform text summarization.
12. Final Mini Project: Integrate CV and NLP (e.g., Read text from signboards or documents and translate/summarize it).

Lab Software Requirements:

- **Languages/Tools:** Python, OpenCV, NLTK, spaCy, Tesseract OCR, scikit-learn, NumPy, Pandas, Matplotlib
- **Platforms:** Jupyter Notebook / Google Colab / PyCharm / VS Code

Course Code	AI & SYSTEM PROGRAMMING LAB		L	T	P	C
23BTAI03P	(Professional Core)		0	0	3	1.5
Year	III	Semester	I			

Course Objectives:

- To provide practical exposure to foundational AI algorithms and system programming.
- To develop skills to write intelligent systems and low-level programs.
- To integrate concepts of AI and system programming for automation and optimization.

Course Outcomes:

- After successful completion of the lab, students will be able to:
- Implement search algorithms and logic programming using AI tools.
- Construct assemblers, macro processors, and shell scripts.
- Develop system utilities using C and integrate them with AI tools.
- Demonstrate real-time intelligent system automation using scripting and AI logic.

List of Experiments:

1. Write simple programs in Prolog for facts, rules, and queries.
2. Develop a Prolog-based expert system for medical diagnosis or animal identification.
3. Implement Depth-First Search (DFS) and Breadth-First Search (BFS) in Python.
4. Implement A* Search Algorithm using heuristics in Python.
5. Implement the Minimax algorithm for a simple game (e.g., Tic Tac Toe).
6. Design and implement a two-pass assembler in C.
7. Implement a Macro Processor using C for assembly language programs.
8. Develop a simple Linux Shell (command interpreter) using C.
9. Write shell scripts for file operations, process creation, and monitoring.
10. Demonstrate inter-process communication using pipes and signals in Linux.
11. Integrate AI logic (search/expert system) into a shell script or system utility for task automation.
12. **Final Mini Project**: Develop an AI-powered system utility (e.g., Intelligent File Manager, AI Bot for CLI commands).

Lab Software Requirements:

- Languages: Python, Prolog, C
- Tools: GCC, SWI-Prolog, Linux (Ubuntu/WSL), Shell, Lex/Yacc (optional)
- IDEs:Code::Blocks / VS Code / Geany / Terminal-based compilation

Course Code	FULL STACK DEVELOPMENT-II		L	T	P	C
23BTCS03S	(Skill Enhancement course)		0	1	2	2
Year	III	Semester	I			

Course Objectives: The main objectives of the course are to

- Make use of Modern- day JavaScript with ES6 standards for designing Dynamic web pages
- Building robust & responsive User Interfaces using popular JavaScript library React.js‘. Building robust backend APIs using _Express. js‘
- Establishing the connection between frontend (React) User interfaces and backend APIs (Express) with Data Bases (My SQL)
- Familiarize students with GitHub for remote repository hosting and collaborative development.

Course Outcomes:

CO1: Building fast and interactive UIs
CO2: Applying Declarative approach for developing web apps
CO3: Understanding ES6 features to embrace modern JavaScript
CO4: Building reliable APIs with Express. Js
CO5: Create and manage Git repositories, track changes, and push code to GitHub.

Experiments covering the Topics:

- Introduction to DOM (Document Object Model), Ecma Script (ES6) standards and features like Arrow functions, Spread operator, Rest operator, Type coercion, Type hoisting, String literals, Array and Object Destructuring.
- Basics of React. js like React Components, JSX, Conditional rendering

Differences between Real DOM and Virtual DOM.

- Important React.js concepts like React hooks, Props, React forms, Fetch API, Iterative rendering using JavaScript map() function.
- JavaScript runtime environment node. js and its uses, Express. js and Routing, Micro-Services architecture and MVC architecture, database connectivity using (My SQL)
- Introduction to My SQL, setting up MySQL and configuring, Databases, My SQL queries, subqueries, creating My SQL driver for database connectivity to Express. js server.
- Introduction to Git and GitHub and upload project& team collaboration

Sample Experiments:

1. Introduction to Modern JavaScript and DOM

a. Write a JavaScript program to link JavaScript file with the HTML page
b. Write a JavaScript program to select the elements in HTML page using selectors
c. Write a JavaScript program to implement the event listeners
d. Write a JavaScript program to handle the click events for the HTML button elements
e. Write a JavaScript program to With three types of functions
  i. Function declaration
  ii. Function definition
  iii. Arrow functions

2. Basics of React. js

a. Write a React program to implement a counter button using react class components
b. Write a React program to implement a counter button using react functional components
c. Write a React program to handle the button click events in functional component
d. Write a React program to conditionally render a component in the browser
e. Write a React program to display text using String literals

3. Important concepts of React. js

a. Write a React program to implement a counter button using React use State hook
b. Write a React program to fetch the data from an API using React use Effect hook
c. Write a React program with two react components sharing data using Props.
d. Write a React program to implement the forms in react
e. Write a React program to implement the iterative rendering using map() function.

4. Introduction to Git and GitHub

a. **Setup**
- o Install Git on local machine.
- o Configure Git (user name, email).
- o Create GitHub account and generate a personal access token.

b. **Basic Git Workflow**
- o Create a local repository using git init
- o Create and add files → git add .
- o Commit files → git commit -m "Initial commit"
- o Connect to GitHub remote → git remote add origin <repo_url>
- o Push to GitHub → git push -u origin main

c. **Branching and Collaboration**
- o Create a branch → git checkout -b feature1
- o Merge branch to main → git merge feature1
- o Resolve merge conflicts (guided)

5. Upload React Project to GitHub
- o Create a new React app using npx create-react-app myapp
- o Initialize a git repo and push to GitHub
- o Use .gitignore to exclude node_modules
- o Create multiple branches: feature/navbar, feature/form
- o Practice merge and pull requests (can use GitHub GUI)

6. Introduction to Node. js and Express. js

a. Write a program to implement the _hello world‘ message in the route through the browser using Express
b. Write a program to develop a small website with multiple routes using Express. js
c. Write a program to print the _hello world‘ in the browser console using Express. js
d. Write a program to implement the CRUD operations using Express. js
e. Write a program to establish the connection between API and Database using Express – My SQL driver

7. Introduction to My SQL

a. Write a program to create a Database and table inside that database using My SQL Command line client
b. Write a My SQL queries to create table, and insert the data, update the data in the table
c. Write a My SQL queries to implement the subqueries in the My SQL command line client
d. Write a My SQL program to create the script files in the My SQL workbench
e. Write a My SQL program to create a database directory in Project and initialize a database. sql file to integrate the database into API

8. Team Collaboration Using GitHub

- o Form groups of 2–3 students
- o Create a shared GitHub repo
- o Assign tasks and work in branches
- o Use Issues, Pull Requests, and Code Reviews
- o Document code with README.md

Textbooks:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.
3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.
4. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon
5. AZAT MARDAN, Full Stack Java Script: Learn Back bone. js, Node.jsand Mongo DB.2015

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush.
2. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
3. Tomasz Dyl ,KamilPrzeorski , MaciejCzarnecki, Mastering Full Stack React Web Development 2017

Online Learning Resources:

1. https://ict.iitk.ac.in/product/full-stack-developer-html5-css3-js-bootstrap-php-4/
2. https://www.w3schools.com/html
3. https://www.w3schools.com/css
4. https://www.w3schools.com/js/
5. https://www.w3schools.com/nodejs
6. https://www.w3schools.com/typescript
7. https://docs.github.com/
8. https://education.github.com/git-cheat-sheet-education.pdf

Course Code	TINKERING LAB		L	T	P	C
23BTEC09P			0	0	2	1
Year	III	Semester	I			

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives:

- Encourage Innovation and Creativity
- Provide Hands-on Learning and Impart Skill Development
- Foster Collaboration and Teamwork
- Enable Inter disciplinary Learning, Prepare for Industry and Entrepreneurship
- Impart Problem-Solving mind-set

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

List of experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Design and 3D print a Walking Robot
3) Design and 3D Print a Rocket.
4) Temperature & Humidity Monitoring System (DHT11 + LCD)
5) Water Level Detection and Alert System
6) Automatic Plant Watering System
7) Bluetooth-Based Door Lock System
8) Smart Dustbin Using Ultrasonic Sensor
9) Fire Detection and Alarm System
10) RFID-Based Attendance System
11) Voice-Controlled Devices via Google Assistant
12) Heart Rate Monitoring Using Pulse Sensor
13) Soil Moisture-Based Irrigation
14) Smart Helmet for Accident Detection
15) Milk Adulteration Detection System
16) Water Purification via Activated Carbon
17) Solar Dehydrator for Food Drying
18) Temperature-Controlled Chemical Reactor
19) Ethanol Mini-Plant Using Biomass
20) Smart Fluid Flow Control (Solenoid + pH Sensor)
21) Portable Water Quality Tester
22) AI Crop Disease Detection
23) AI-based Smart Irrigation
24) ECG Signal Acquisition and Plotting
25) AI-Powered Traffic Flow Prediction

26) Smart Grid Simulation with Load Monitoring
27) Smart Campus Indoor Navigator
28) Weather Station Prototype
29) Firefighting Robot with Sensor Guidance
30) Facial Recognition Dustbin
31) Barcode-Based Lab Inventory System
32) Growth Chamber for Plants
33) Biomedical Waste Alert System
34) Soil Classification with AI
35) Smart Railway Gate
36) Smart Bin Locator via GPS and Load Sensors
37) Algae-Based Water Purifier
38) Contactless Attendance via Face Recognition

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above.

- **Note:** A minimum of 8 to 10 experiments must be completed by the students.

Course Code	CLOUD COMPUTING FOR AI		L	T	P	C
23BTAI05T	(Professional Core)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

1. To introduce the concepts, models, and services of cloud computing and its role in AI.
2. To explore the architecture and deployment of AI applications on cloud platforms.
3. To equip students with skills in using cloud-based tools and services for AI/ML workloads.
4. To understand data storage, processing, and security in cloud for AI tasks.
5. To apply cloud computing principles to real-world AI-based solutions.

Course Outcomes:

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

1. Explain cloud computing architecture, services, and deployment models.
2. Utilize cloud platforms (AWS, GCP, Azure) for training and deploying AI models.
3. Handle large-scale data storage and processing in the cloud environment.
4. Integrate AI workflows using serverless and container-based architectures.
5. Analyze challenges in security, cost, scalability, and performance of cloud-based AI systems.

UNIT I: Introduction to Cloud Computing and AI Integration

Basics of Cloud Computing: Characteristics, Models, and Services, Cloud Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community, AI and Cloud Convergence: Benefits and Challenges, Use Cases of AI in Cloud: NLP, Vision, Analytics, Overview of Cloud Providers for AI: AWS, Azure, GCP.

UNIT II: Storage, Computing, and Data Processing in the Cloud

Cloud Storage Services: S3, Blob, BigQuery, Virtualization and Elastic Computing, Distributed Computing with Hadoop and Spark, Data Ingestion and Processing Pipelines, Data Lakes and Warehousing in the Cloud, Cost Optimization for Storage and Compute Resources.

UNIT III: Cloud-based Machine Learning and Deep Learning

ML Services on AWS (SageMaker), Azure ML, GCP Vertex AI, Training and Deploying Models on Cloud, AutoML and Custom ML Model Workflows, GPUs/TPUs for Model Training, Experiment Tracking and Model Evaluation, Integration of Notebooks (Jupyter, Colab) with Cloud Storage.

UNIT IV: Advanced Cloud Concepts for AI Applications

Containers and Docker for AI Applications, Kubernetes and Cloud-native AI Workflows, Serverless Computing: AWS Lambda, Azure Functions, CI/CD Pipelines for AI Models in Cloud, Scaling AI Applications using Load Balancers and Auto-Scaling. Monitoring and Logging in Cloud for AI Workflows.

UNIT V: Security, Ethics, and Case Studies in Cloud AI

Security and Privacy in Cloud-based AI, Identity and Access Management (IAM) in Cloud, Cost Management and Billing for AI Services, Ethical Issues and Fairness in Cloud AI, Case Study: AI in Healthcare Cloud Solutions, Case Study: Real-Time Analytics in Financial Cloud Services.

Textbooks:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill.
2. Judith Hurwitz et al., Cloud Computing for Dummies, Wiley.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Course Code	BIG DATA ANALYTICS & AI APPLICATIONS		L	T	P	C
23BTAI06T	(Professional Core)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

1. To introduce the fundamentals of big data and its role in AI-driven applications.
2. To explore big data tools and technologies such as Hadoop, Spark, and NoSQL databases.
3. To enable students to build scalable AI pipelines for data analytics.
4. To apply AI/ML algorithms for real-time and batch processing environments.
5. To demonstrate use cases of big data in domains like healthcare, finance, and IoT using AI.

Course Outcomes:

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

1. Understand the architecture and ecosystem of big data processing.
2. Analyze and manage large-scale datasets using Hadoop and Spark.
3. Apply AI/ML techniques to extract insights from big data.
4. Design and implement scalable data pipelines using distributed frameworks.
5. Solve real-world domain problems with AI-powered big data solutions.

UNIT I: Introduction to Big Data and Analytics Ecosystem

Definition and Characteristics of Big Data – Volume, Velocity, Variety, Veracity, Value, Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Big Data Challenges and Opportunities, Hadoop Ecosystem Overview: HDFS, MapReduce, YARN, NoSQL Databases: Key-Value, Columnar, Document, Graph Models, Data Lake vs. Data Warehouse.

UNIT II: Big Data Tools and Frameworks

Apache Spark Architecture and RDDs, Spark SQL, DataFrames, and Datasets, Spark Streaming for Real-Time Analytics, Kafka for Data Ingestion and Message Queues, Hive, Pig, and Impala for Big Data Querying, Comparative Analysis of Hadoop vs. Spark.

UNIT III: Machine Learning on Big Data

Introduction to MLlib and Scikit-learn, Data Preprocessing for Big Data ML Pipelines, Supervised Learning: Classification and Regression on Large Datasets, Unsupervised Learning: Clustering and Dimensionality Reduction, Model Evaluation and Validation Techniques, Distributed Training and Optimization Techniques.

UNIT IV: AI Applications on Big Data

Predictive Maintenance using Big Data & AI, Fraud Detection in Banking with Machine Learning, AI in Healthcare: Diagnosis, Genomics, Patient Monitoring, Retail and E-commerce Analytics, AI for Smart Cities and IoT Sensor Data Analysis, Evaluation of Real-Time AI Applications on Streaming Data.

UNIT V: Advanced Topics and Case Studies

Deep Learning on Big Data using TensorFlow on Spark, Explainable AI (XAI) in Big Data Environments, Ethical Issues and Data Governance in Big Data AI, Edge Computing and AI for Low Latency Applications, Case Study 1: AI-Powered Big Data in Healthcare, Case Study 2: Big Data AI Solution in Smart Manufacturing.

Textbooks:

1. Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi – Wiley
2. Learning Spark: Lightning-Fast Big Data Analysis by Jules S. Damji et al. – O'Reilly
3. Data Science and Big Data Analytics by EMC Education Services – Wiley

Reference Books:

1. Designing Data-Intensive Applications by Martin Kleppmann – O'Reilly
2. Machine Learning with Spark by Rajdeep Dua, Tathagata Das – Packt Publishing
3. Streaming Systems by Tyler Akidau – O'Reilly Media
4. Artificial Intelligence for Big Data by Anand Deshpande – Packt

Online Learning Resources:

- https://www.coursera.org/specializations/big-data – Coursera Big Data Specialization
- https://spark.apache.org/docs/latest/ – Apache Spark Documentation

Course Code	FULL STACK AI DEVELOPMENT		L	T	P	C
23BTAI07T	(Professional Core)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the concepts of full stack development with integration of AI capabilities.
- To provide practical exposure to frontend and backend frameworks suitable for AI applications.
- To build intelligent web applications using ML/DL models.
- To explore RESTful APIs, microservices, and deployment strategies for AI solutions.
- To develop skills for scalable, end-to-end AI-powered application development.

Course Outcomes:

- After successful completion of the course, students will be able to:
- Understand the architecture and components of full stack AI systems.
- Develop web interfaces and backend logic integrated with AI models.
- Use Python, JavaScript, and frameworks like Flask, Node.js, React for AI web solutions.
- Deploy machine learning models using RESTful APIs and containers.
- Build, test, and scale full-stack intelligent applications.

UNIT I: Introduction to Full Stack AI Development

Overview of Full Stack Development in AI Context, Components: Frontend, Backend, Database, AI Models, MVC, MVVM Architectures for AI Applications, Introduction to Web Technologies (HTML, CSS, JS, Bootstrap), Role of JavaScript Frameworks in AI Dashboards, Full Stack AI Development Life Cycle.

UNIT II: Frontend Technologies for AI Applications

React.js for Dynamic AI Interfaces, State Management in React (Hooks, Redux), Data Binding and Visualization with Chart.js, D3.js, Integration with AI Results (JSON APIs to UI), UI/UX Design for Intelligent Apps, Responsive Design and Accessibility.

UNIT III: Backend and AI Model Integration

Node.js and Express.js for Backend Services, Flask API Development for ML Models, REST API Creation and Consumption, Handling File Uploads, JSON Input, Streaming Output, Integration of Pre-trained Models (Sklearn, TensorFlow, PyTorch), Middleware, Error Handling, and Model Response Evaluation.

UNIT IV: Databases, Authentication, and AI Workflows

MongoDB and PostgreSQL for Storing AI Inputs/Outputs, User Authentication and Session Management (JWT, OAuth), CRUD Operations with AI Insights, Building AI Feedback Loops with Data Storage, Secure AI Application Workflows, Creating Intelligent Dashboards with Real-Time Data.

UNIT V: Deployment, Scaling & Case Studies

Containerization using Docker for AI Microservices, Deployment to Cloud (AWS, GCP, Azure), CI/CD Pipelines for AI Model Updates, Monitoring and Logging in AI Apps, Performance and Load Testing of AI APIs, Case Study: End-to-End Full Stack AI Project (Deployment + Demo).

Textbooks:
1. Full Stack Development with Flask and React by O. Olatunde – Packt Publishing
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron – O'Reilly
3. Flask Web Development by Miguel Grinberg – O'Reilly Media

Reference Books:
1. Node.js Design Patterns by Mario Casciaro – Packt
2. Building Machine Learning Powered Applications by Emmanuel Ameisen – O'Reilly
3. Mastering React by Adam Horton – Packt
4. MongoDB: The Definitive Guide by Kristina Chodorow – O'Reilly

Online Learning Resources:
- https://fullstackopen.com/en/ – Full Stack Open
- https://www.coursera.org/specializations/full-stack – Coursera Full Stack

Course Code	GRAPH NEURAL NETWORKS		L	T	P	C
23BTAI08a	(Professional Elective-II)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the fundamentals of graph theory and graph-structured data.
- To explore the concepts of neural networks extended to non-Euclidean domains.
- To understand architectures and algorithms behind various types of GNNs.
- To apply GNN models in real-world applications such as recommendation, social networks, and bioinformatics.
- To enable students to build and evaluate GNN models using frameworks like PyTorch Geometric and DGL.

Course Outcomes:

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

- Understand the basics of graph structures and their significance in machine learning.
- Learn and implement different types of GNN architectures.
- Apply GNNs to real-world structured data problems.
- Use modern libraries and tools to train and evaluate GNNs.
- Analyze the effectiveness and limitations of GNNs in different domains.

UNIT I: Fundamentals of Graph Theory and Machine Learning on Graphs

Introduction to Graphs: Nodes, Edges, Adjacency Matrix, Types of Graphs: Directed, Undirected, Weighted, Bipartite, Graph Traversal Algorithms (BFS, DFS), Graph Representations for ML (Adjacency List, Matrix, Laplacian), Node, Edge, and Graph-level Prediction Problems, Motivation and Challenges for Learning on Graphs.

UNIT II: Spectral and Spatial Methods for Graph Learning

Spectral Graph Theory Basics, Graph Convolution via Spectral Methods, Chebyshev and First-order Approximations, Spatial Graph Convolutions, Comparison of Spectral vs Spatial GNNs, Graph Laplacian and Eigenvalue Properties.

UNIT III: Graph Neural Network Architectures

Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), GraphSAGE: Sampling and Aggregation, Graph Isomorphism Networks (GIN), Message Passing Neural Networks (MPNNs), Inductive vs Transductive GNN Learning.

UNIT IV: Applications of GNNs

Node Classification (e.g., Cora, Citeseer), Link Prediction (e.g., Recommender Systems), Graph Classification (e.g., Molecule Property Prediction), Traffic Forecasting and Social Network Modeling, GNNs in Healthcare and Bioinformatics, Explainability and Interpretability in GNNs.

UNIT V: Implementation, Optimization, and Recent Advances

Overview of PyTorch Geometric and DGL, Data Loading and Preprocessing for Graph Datasets, Model Training, Loss Functions, and Evaluation Metrics, Hyperparameter Tuning in GNNs, Recent Research Trends and Architectures (e.g., Heterogeneous GNNs, Graph Transformers), Challenges and Future Directions in GNNs.

Textbooks:

1. Zonghan Wu, Shirui Pan, Fengwen Chen, Guodong Long, Chengqi Zhang, Philip S. Yu, A Comprehensive Survey on Graph Neural Networks, IEEE Transactions on Neural Networks and Learning Systems, 2021.
2. Yao Ma, Jiliang Tang, Deep Learning on Graphs, Cambridge University Press, 2021.
3. William L. Hamilton, Graph Representation Learning, Morgan & Claypool Publishers, 2020.

Reference Books:

1. Barrett, Jure Leskovec, Mining of Massive Datasets, Cambridge University Press.
2. Thomas Kipf, GCN and related papers and tutorials (arXiv).
3. Petar Veličković, Graph Attention Networks (original paper and slides).
4. Michael Bronstein et al.,Geometric Deep Learning: Grids, Groups, Graphs, Geodesics, and Gauges (arXiv preprint).

Online Learning Resources:

1. https://pytorch-geometric.readthedocs.io/ – PyTorch Geometric Docs
2. https://cs.stanford.edu/people/jure/ – Stanford GNN Projects
3. https://www.coursera.org/learn/graph-neural-networks – Coursera GNN Course by Stanford

Course Code	RECOMMENDER SYSTEMS (Professional Elective-II)		L	T	P	C
23BTAI08b			3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To provide students with basic concepts and its application in various domain
- To make the students understand different techniques that a data scientist needs to know for analysing big data
- To design and build a complete machine learning solution in many application domains.

Course Outcomes:

- After completion of the course, students will be able to
- Aware of various issues related to Personalization and Recommendations.
- Design and implement a set of well-known Recommender System approaches used in E commerce and Tourism industry.
- Develop new Recommender Systems for a number of domains especially, Education, Health-care.

UNIT-I : An Introduction to Recommender Systems, Neighborhood-Based Collaborative Filtering

Introduction, Goals of Recommender Systems, Basic Models of Recommender Systems, Domain Specific Challenges in Recommender Systems. Advanced Topics and Applications. Introduction, Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood-Neighborhood-Based Collaborative Filtering: Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, Graph Models for Neighborhood-Based Methods, A Regression Modelling View of Neighborhood Methods.

UNIT-II Model-Based Collaborative Filtering, Content-Based Recommender Systems

Introduction, Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models. Content-Based Recommender Systems: Introduction, Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, Using Content-Based Models for Collaborative Filtering, Summary.

UNIT-III Knowledge-Based Recommender Systems, Ensemble Based and Hybrid Recommender Systems

Introduction, Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems, Summary. Introduction, Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Meta-Level Hybrids, Feature Combination Hybrids, Summary.

UNIT-IV Evaluating Recommender Systems, Context-Sensitive Recommender Systems

Introduction, Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures, Limitations of Evaluation Measures. Introduction, The Multidimensional Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Modelling.

UNIT-V Time- and Location-Sensitive Recommender Systems

Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Location-Aware Recommender Systems Location-Aware Recommender Systems, Summary.

Textbooks:

1. Charu C. Aggarwal, ―Recommender Systems‖, Springer,2016.

Reference Books:

1. Francesco Ricci, LiorRokach, ―Recommender Systems Handbook‖, 2nd ed., Springer, 2015 Edition

Online Learning Resources:

1. Recommendation System -Understanding The Basic Concepts (analyticsvidhya.com)
2. Recommender Systems | Coursera

Course Code	PREDICTIVE ANALYTICS		L	T	P	C
23BTAI08c	(Professional Elective-II)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the fundamental concepts and techniques of predictive analytics.
- To apply statistical models and machine learning algorithms for prediction.
- To interpret model performance using evaluation metrics.
- To explore feature engineering, model tuning, and cross-validation.
- To implement predictive solutions for real-world business and research problems.

Course Outcomes:

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

- Understand the principles and importance of predictive analytics.
- Apply regression and classification models for predictive tasks.
- Perform data preprocessing, feature selection, and transformation.
- Evaluate and validate models using standard metrics.
- Design predictive solutions to solve domain-specific challenges.

UNIT I: Introduction to Predictive Analytics

Introduction to Predictive Analytics and Business Intelligence, Types of Predictive Models: Classification, Regression, Time Series, Supervised vs Unsupervised Learning, Predictive Modeling Workflow, Applications in Marketing, Finance, Healthcare, Challenges in Predictive Analytics.

UNIT II: Data Preparation and Feature Engineering

Data Cleaning: Handling Missing, Noisy, and Inconsistent Data, Feature Selection and Dimensionality Reduction (PCA, LDA), Feature Scaling: Normalization, Standardization, Encoding Categorical Variables, Feature Extraction and Construction, Dealing with Imbalanced Datasets.

UNIT III: Predictive Modeling with Regression and Classification

Linear Regression and Polynomial Regression, Logistic Regression for Binary Classification, Decision Trees and Random Forest, k-Nearest Neighbors (k-NN) and Naïve Bayes, Support Vector Machines (SVM), Model Selection and Comparison.

UNIT IV: Model Evaluation and Validation

Training, Testing, and Validation Sets, Cross-Validation Techniques (k-Fold, Stratified, LOOCV), Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC, Confusion Matrix and Classification Report, Bias-Variance Trade-off and Overfitting, Hyperparameter Tuning: Grid Search, Random Search.

UNIT V: Advanced Topics and Applications

Ensemble Learning: Bagging, Boosting (AdaBoost, XGBoost), Predictive Analytics with Time Series (ARIMA, Prophet), Deep Learning for Predictive Modeling (ANNs, LSTM), Use of Predictive Analytics in IoT, Retail, and Healthcare, Ethics and Privacy in Predictive Analytics, Building and Deploying End-to-End Predictive Systems.

Textbooks:

1. **Dean Abbott**, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 2014.
2. **John D. Kelleher, Brendan Tierney**, Data Science: Predictive Analytics and Data Mining, MIT Press, 2018.

Reference Books:

1. **Galit Shmueli et al.**, Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, Wiley, 2017.
2. **Eric Siegel**, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
3. **Trevor Hastie, Robert Tibshirani, Jerome Friedman**, The Elements of Statistical Learning, Springer, 2009.

Online Learning Resources:

- https://www.coursera.org/specializations/predictive-analytics–Coursera Specialization
- https://www.edx.org/course/data-science-and-machine-learning-capstone–edXPredictive Analytics Courses
- https://www.kaggle.com/learn/intro-to-machine-learning – Kaggle Tutorials

Course Code	BLOCK CHAIN FOR AI (Professional Elective-II)		L	T	P	C
23BTAI08d			3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To understand the foundational concepts of blockchain technology and its architecture.
- To explore smart contracts, consensus algorithms, and distributed ledger technology.
- To investigate the integration of AI with blockchain for secure, decentralized applications.
- To develop blockchain-enabled AI solutions for real-world use cases.
- To understand the ethical, security, and scalability challenges in Blockchain-AI ecosystems.

Course Outcomes:

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

- Explain the fundamentals of blockchain and its components.
- Analyze the role of consensus mechanisms in maintaining trust and decentralization.
- Apply blockchain for secure data sharing in AI systems.
- Develop and deploy smart contracts using Ethereum/Solidity.
- Evaluate blockchain-based AI applications in healthcare, finance, and supply chains.

UNIT I: Blockchain Fundamentals and Architecture

Introduction to Blockchain Technology, Components: Blocks, Hashing, Merkle Trees, Types of Blockchains: Public, Private, Consortium, Distributed Ledger Technology (DLT) and P2P Networks, Blockchain Structure and Mining, Use Cases and Evolution of Blockchain.

UNIT II: Smart Contracts and Consensus Mechanisms

Smart Contracts: Definition, Features, Use Cases, Ethereum and Solidity Basics, Consensus Algorithms: PoW, PoS, DPoS, PBFT, Gas, Transactions, and Events in Ethereum, Hyperledger Fabric: Architecture and Chaincode, Deployment and Testing of Smart Contracts.

UNIT III: Integration of Blockchain and AI

Motivation for Integrating Blockchain with AI, Decentralized AI Models and Federated Learning, Secure Model Sharing and Provenance, Blockchain for Data Integrity in AI Systems, AI for Blockchain (e.g., optimizing consensus), Case Study: Decentralized AI Marketplace.

UNIT IV: Applications of Blockchain in AI Systems

Blockchain for Explainable and Trusted AI, Applications in Healthcare and Genomics, Blockchain for Autonomous Vehicles and IoT, Financial AI Systems with Smart Contracts, Supply Chain and Logistics Intelligence, NFT-based AI Applications (Digital Identity, IP).

UNIT V: Security, Privacy and Challenges in Blockchain-AI

Security Challenges: Sybil Attacks, 51% Attacks, Privacy Preservation and Zero Knowledge Proofs, Scalability and Energy Concerns in Blockchain-AI, Ethical and Legal Concerns in AI with Blockchain, Interoperability of Blockchain Platforms, Future Trends: Quantum-Resistant Blockchain-AI.

Textbooks:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, Packt, 2020.
2. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
3. Joseph Holbrook, Architecting AI Solutions on Blockchain, Packt Publishing, 2020.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, VPT, 2017.
2. Karamjit Singh, Blockchain for AI: Use Cases and Implementation, Springer, 2023.
3. Roger Wattenhofer, The Science of the Blockchain, 2016.

Online Learning Resources:

- Coursera: Blockchain Specialization – University at Buffalo
- edX: Blockchain Fundamentals – UC Berkeley
- Coursera: AI and Blockchain – IBM

Course Code	AI FOR FINANCE		L	T	P	C
23BTAI09a	(Professional Elective-III)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the role of Artificial Intelligence (AI) in financial applications and decision-making.
- To understand financial data types, sources, and processing methods.
- To apply machine learning and deep learning models in various finance sectors.
- To analyze risk, fraud detection, credit scoring, and portfolio management using AI.
- To evaluate ethical and regulatory challenges in AI-enabled finance.

Course Outcomes:

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

- Describe the fundamentals of AI techniques applicable to finance.
- Analyze financial time series data using AI-based models.
- Apply machine learning for fraud detection and credit risk analysis.
- Build predictive models for stock prices, trading, and customer segmentation.
- Evaluate the limitations and ethical implications of AI in financial systems.

UNIT I: Introduction to Finance and AI Applications

Introduction to Financial Markets and Instruments, Overview of AI Techniques in Finance, Types of Financial Data: Market, Transactional, Customer, Financial Statements and Key Indicators, AI Use Cases in Banking, Insurance, and Investment, FinTech and the Rise of Robo-Advisors.

UNIT II: Machine Learning in Finance

Supervised Learning for Credit Scoring, Unsupervised Learning for Customer Segmentation, Feature Engineering for Financial Data, Handling Imbalanced Datasets in Fraud Detection, Time Series Forecasting with Regression and ARIMA, Model Validation and Backtesting in Finance.

UNIT III: Deep Learning and NLP in Finance

Introduction to Deep Learning for Finance, Stock Price Prediction using LSTM and RNNs, Sentiment Analysis from Financial News and Tweets, NLP for Document Classification: Earnings Reports, Chatbots and Virtual Assistants in Banking, Reinforcement Learning for Portfolio Optimization.

UNIT IV: AI-Driven Financial Applications

Fraud Detection Systems using ML and DL, Credit Risk and Loan Default Prediction, AI in Algorithmic and High-Frequency Trading, Robo-Advisors: Architecture and Optimization, Blockchain and AI Integration for Financial Security, Case Studies: AI in Wealth Management & Insurance.

UNIT V: Ethics, Regulation, and Future of AI in Finance

Regulatory Frameworks in AI-based Finance, Explainability and Interpretability of Financial Models, Ethical Issues: Bias, Fairness, Transparency, Data Privacy and GDPR in Financial AI, Responsible AI Practices in Finance, Emerging Trends: Quantum AI, Decentralized Finance (DeFi).

Textbooks:

1. Yves Hilpisch, Artificial Intelligence in Finance: A Python-Based Guide, O'Reilly, 2020.
2. Yves Hilpisch, Python for Finance: Mastering Data-Driven Finance, O'Reilly, 2018.
3. Markus Loecher, Machine Learning for Finance, Packt Publishing, 2021.

Reference Books:

1. A. W. Lo, The Evolution of Technical Analysis, Wiley Finance, 2010.
2. Tony Guida, Big Data and Machine Learning in Quantitative Investment, Wiley, 2019.
3. Tucker Balch, AI for Trading – Georgia Tech Specialization, Coursera.

Online Learning Resources:

- Coursera: AI for Trading – by NYIF and Google Cloud
- edX: Artificial Intelligence in Finance – NYIF
- Udemy: Machine Learning and AI in Finance
- DataCamp: Financial Trading with Python
- YouTube: AI for Finance by Sentdex, Two Minute Papers, and DataProfessor

Course Code	INTRODUCTION TO QUANTUM COMPUTING		L	T	P	C
23BTAI09b	(Professional Elective-III)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the principles and mathematical foundations of quantum computation.
- To understand quantum gates, circuits, and computation models.
- To explore quantum algorithms and their advantages over classical ones.
- To develop the ability to simulate and write basic quantum programs.
- To understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

Course Outcomes:

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

- Explain the fundamental concepts of quantum mechanics used in computing.
- Construct and analyze quantum circuits using standard gates.
- Apply quantum algorithms like Deutsch-Jozsa, Grover‘s, and Shor‘s.
- Develop simple quantum programs using Qiskit or similar platforms.
- Analyze applications and challenges of quantum computing in real-world domains.

UNIT I: Fundamentals of Quantum Mechanics and Linear Algebra

Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems.

UNIT II: Quantum Gates and Circuits

Quantum Logic Gates: Pauli, Hadamard, Phase, Controlled Gates and CNOT, Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits.

UNIT III: Quantum Algorithms and Complexity

Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover‘s Search Algorithm, Shor‘s Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA.

UNIT IV: Quantum Programming and Simulation Platforms

Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware.

UNIT V: Applications and Future of Quantum Computing

Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization, Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions.

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.

Online Learning Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing

Course Code	SOCIAL NETWORK ANALYSIS		L	T	P	C
23BTAI09c	(Professional Elective-III)		3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To introduce the fundamentals and key concepts of social network theory and graph theory.
- To analyze the structure and properties of large-scale social networks.
- To apply centrality, influence, and community detection measures.
- To model information diffusion and network dynamics.
- To implement real-world social network analysis using tools and datasets.

Course Outcomes:

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

1. Understand basic network models and social network structures.
2. Analyze key properties like centrality, clustering, and small-world effect.
3. Apply community detection algorithms and influence maximization.
4. Interpret diffusion models for viral marketing and information spread.
5. Use tools such as Gephi, NetworkX, or SNAP for real-world SNA.

UNIT I: Introduction to Social Networks and Graph Theory

Basic Concepts: Graphs, Nodes, Edges, Directed/Undirected Graphs, Real-world Examples: Facebook, Twitter, LinkedIn, Adjacency Matrix and Graph Representation, Types of Social Networks: Ego, Bipartite, Multilayer, Degree Distribution, Path Length, and Connectivity, Random Graph Models: Erdős–Rényi and Watts-Strogatz.

UNIT II: Structural Properties of Networks

Network Centrality Measures: Degree, Closeness, Betweenness, Eigenvector Centrality and PageRank, Network Clustering and Community Detection Basics, Triadic Closure and Clustering Coefficient, Small-world Phenomenon and Milgram‘s Experiment, Homophily, Influence, and Structural Balance.

UNIT III: Community Detection and Subgroup Analysis

Girvan–Newman Algorithm and Modularity, Label Propagation and Louvain Method, Clique Detection and k-Core Decomposition, Overlapping Communities and Fuzzy Clustering, Cohesive Subgroups and Structural Equivalence, Evaluation Metrics: NMI, Modularity Score.

UNIT IV: Information Diffusion and Influence in Networks

Models of Diffusion: Linear Threshold and Independent Cascade, Influence Maximization and Viral Marketing, Contagion Models and Epidemic Spreading, Rumor Propagation and Cascade Models, Information Bottlenecks and Bridges, Measuring Influence and Reach.

UNIT V: Tools, Applications, and Ethics in SNA

SNA Tools: Gephi, Pajek, NetworkX, SNAP, Case Study: Twitter and Hashtag Analysis, LinkedIn Network Mining and Graph Features, Applications in Marketing, Security, and Epidemiology, Ethical Issues in Social Network Data Mining, Building and Visualizing Your Own Social Graph.

Textbooks:

1. Wasserman, S., & Faust, K., **Social Network Analysis: Methods and Applications**, Cambridge University Press, 1994.
2. Easley, D., & Kleinberg, J., **Networks, Crowds, and Markets: Reasoning About a Highly Connected World**, Cambridge University Press, 2010.
3. Newman, M., **Networks: An Introduction**, Oxford University Press, 2010.

Reference Books:

1. Borgatti, S. P., Everett, M. G., & Johnson, J. C., **Analyzing Social Networks**, SAGE Publications, 2018.
2. Barabási, A.-L., **Linked: How Everything Is Connected to Everything Else**, Basic Books, 2014.
3. Hansen, D., Shneiderman, B., & Smith, M. A., **Analyzing Social Media Networks with NodeXL**, Elsevier, 2020.

Online Learning Resources:

- Coursera – Social Network Analysis (University of Michigan)
- [YouTube – NetworkX and Gephi Tutorials (freeCodeCamp, TheNetNinja)]
- edX – Networks: Friends, Money, and Bytes (University of California, Berkeley)

Course Code	CYBER SECURITY & AI-DRIVEN THREAT DETECTION (Professional Elective-III)		L	T	P	C
23BTAI09d			3	0	0	3
Year	III	Semester	II			

Course Objectives:

- To provide a foundational understanding of cyber security principles and threat landscapes.
- To explore the application of AI and machine learning techniques in detecting cyber threats.
- To analyze malware behavior, intrusion patterns, and anomaly detection using intelligent systems.
- To evaluate and build automated systems for real-time security analytics.
- To understand the ethical, legal, and societal implications of AI-driven security systems.

Course Outcomes:

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

1. Understand cyber security frameworks, threat types, and vulnerabilities.
2. Apply AI/ML techniques for cyber threat identification and classification.
3. Analyze patterns in malware, network traffic, and security logs.
4. Design and evaluate intelligent intrusion detection and prevention systems.
5. Explore ethical hacking practices and policy aspects in AI-based security.

UNIT I: Fundamentals of Cybersecurity

Introduction to Cybersecurity: CIA Triad, Threats & Vulnerabilities, Types of Attacks: Malware, Phishing, DDoS, Insider Threats, Security Policies and Access Controls, Risk Assessment and Vulnerability Management, Cryptography Basics: Symmetric, Asymmetric, Hash Functions, Cybersecurity Frameworks: NIST, ISO 27001, OWASP.

UNIT II: Machine Learning for Cyber Threat Detection

Supervised and Unsupervised Learning in Security Contexts, Feature Engineering for Security Data, Classification Models for Intrusion Detection (SVM, RF, KNN), Clustering Techniques for Anomaly Detection, Evaluation Metrics: Accuracy, Precision, ROC, F1 Score, Case Study: AI for Email Phishing Detection.

UNIT III: Deep Learning in Threat Intelligence

Deep Neural Networks for Cybersecurity, RNNs and LSTMs for Log and Sequence Data, Autoencoders for Anomaly Detection, CNNs for Malware Classification using Binary Analysis, Adversarial Attacks on AI-based Security Systems, Case Study: Threat Detection using Deep Learning.

UNIT IV: Real-Time Threat Detection and SIEM Systems

Security Information and Event Management (SIEM), Log Analysis and Real-Time Alerting, Threat Intelligence Platforms (TIPs), Integration of AI in SIEM Tools (Splunk, ELK Stack), Network Traffic and Packet Inspection using ML, SOC Operations and Automation using AI

UNIT V: Ethical Hacking, Privacy, and Legal Aspects

Penetration Testing & Ethical Hacking with AI Tools, Red Team vs. Blue Team Simulation, Data Privacy Regulations: GDPR, HIPAA, Cyber Laws, AI Bias and Fairness in Security Decision-Making, Case Study: Ethical Dilemmas in AI Security Systems, Future Trends: Zero Trust, AI SOC, Federated Threat Detection.

Textbooks:

1. Stallings, W., Network Security Essentials: Applications and Standards, Pearson Education.
2. Shon Harris & Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill.
3. Emmanuel Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishing.
4. Clarence Chio & David Freeman, Machine Learning and Security, O'Reilly Media.

Reference Books:

1. John Paul Mueller, Luca Massaron, Machine Learning for Dummies, Wiley.
2. Mark Stamp, Information Security: Principles and Practice, Wiley.
3. Bruce Schneier, Secrets and Lies: Digital Security in a Networked World, Wiley.
4. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning, Cambridge University Press.

Online Learning Resources:

- Coursera – AI for Cybersecurity (IBM)
- edX – Cybersecurity Fundamentals by Rochester Institute of Technology
- MIT OpenCourseWare – Computer and Network Security
- [YouTube – Cybersecurity & AI Tutorials by Simplilearn, Great Learning]
- Udemy – Machine Learning for Cybersecurity
- Splunk Documentation – AI & Threat Detection

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

B.Tech - Computer Science & Engineering (AI & ML)

Course Code	BIG DATA & CLOUD COMPUTING LAB		L	T	P	C
23BTAI04P	(Professional Core)		0	0	3	1.5
Year	III	Semester	II			

Course Objectives:

- To provide hands-on experience in working with big data tools and cloud computing environments.
- To equip students with practical skills in data ingestion, transformation, analysis, and visualization using Hadoop and Spark ecosystems.
- To enable deployment and management of cloud services using AWS, Azure, or GCP.
- To expose students to cloud-native storage, computing, and container orchestration techniques.
- To integrate big data workflows with cloud infrastructure for scalable, distributed data processing.

Course Outcomes:

1. Students will be able to implement big data pipelines and cloud-based solutions using tools like Hadoop, Spark, and cloud platforms such as AWS, Azure, or GCP.
2. Students gain proficiency in managing distributed data processing, scalable storage, cloud service provisioning, and deploying applications using containers and orchestration platforms.
3. Students will understand the synergy between big data technologies and cloud computing to solve real-world problems efficiently.

List of Lab Experiments:

1. Installation and Configuration of Hadoop Cluster (Single Node & Multi-node)
   Hadoop HDFS setup, NameNode & DataNode configuration
2. Working with HDFS: File Operations
   Upload, read, delete, and replicate files in HDFS
3. MapReduce Programming Basics
   Word count, sorting, and filtering examples in Java/Python
4. Apache Hive & Pig for Querying Large Datasets
   Creation of tables, data loading, and running queries
5. Apache Spark Basics: RDDs and DataFrames
   Implement Spark transformations and actions
6. Data Preprocessing and Machine Learning using PySpark MLlib
   Classification or regression using MLlib pipelines
7. Introduction to Cloud Computing and AWS/Azure/GCP Console
   Creating virtual machines, basic compute and storage services
8. Cloud Storage and Database Services
   Using S3 (AWS), Blob (Azure), or GCP buckets and Cloud SQL/NoSQL
9. Deploying Big Data Workloads on Cloud (EMR, HDInsight, Dataproc)
   Running Hadoop/Spark jobs in cloud-managed services
10. Cloud Function/Serverless Deployment
11. Building and deploying a serverless function (e.g., AWS Lambda) Containerization with Docker
12. Building, running, and managing Docker containers Orchestration with Kubernetes in the Cloud Deploy and manage a containerized application using GKE/EKS/AKS

Text Books:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. Rajkumar Buyya et al., Mastering Cloud Computing, McGraw-Hill Education.
3. Holden Karau et al., Learning Spark: Lightning-Fast Big Data Analysis, O'Reilly Media.

Reference Books:

1. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing.
2. Benjamin Bengfort, Data Analytics with Hadoop, O'Reilly.
3. Srinivasan &J.Shrinivasan, Cloud Computing – A Hands-on Approach, Wiley India

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	FULL STACK AI LAB		L	T	P	C
23BTAI05P	(Professional Core)		0	0	3	1.5
Year	III	Semester	II			

Course Objectives:

- Enable students to build end-to-end AI-powered web applications.
- Integrate frontend, backend, database, and AI models in real-time.
- Provide hands-on experience with Flask, Express, MongoDB, React, and ML models.
- Develop and deploy AI applications using industry-standard practices.

Course Outcomes:

1. Design frontend interfaces using React/HTML/CSS.
2. Build backend logic using Flask or Node.js APIs.
3. Integrate and deploy ML models with web services.
4. Store and retrieve data using MongoDB/MySQL.
5. Test, debug, and deploy AI-based web applications.

List of Lab Experiments:

Lab Experiments (12 Total)

1. Setup Flask or Node.js server with React/HTML frontend.
2. Create login/signup system with Express/Flask and MongoDB.
3. Train and save ML model (e.g., Naive Bayes, Logistic Regression).
4. Build API to serve ML model predictions via Flask.
5. Integrate ML predictions in frontend using fetch/AJAX.
6. Create dynamic dashboard using Chart.js/Plotly.
7. Implement JWT tokens or sessions for authentication.
8. Add file upload functionality (image/text for prediction).
9. Store interactions/predictions in database and visualize history.
10. Create CI/CD pipeline using GitHub Actions/Heroku.
11. Build mini-project: News Classifier / Spam Detector / Fake News Detector.
12. Final Demo & Deployment on Render/Heroku/Vercel/localhost.

Text Books:

1. **"Full Stack Deep Learning"** by Emmanuel Ameisen, O'Reilly, 2020
2. **"Flask Web Development"** by Miguel Grinberg, O'Reilly, 2018
3. **"Python Machine Learning"** by Sebastian Raschka, Packt Publishing

Reference Books:

1. **"Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow"** by Aurélien Géron
2. **"MongoDB: The Definitive Guide"** by Kristina Chodorow
3. **"Node.js Design Patterns"** by Mario Casciaro

Online Courses:

1. Full Stack Web Development with Flask an Python- Udemy

Course Code	SOFT SKILLS		L	T	P	C
23BTS	(Skill Enhancement course)		0	1	2	2
Year	III	Semester	II			

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking and problem-solving skills
- To enhance healthy relationship and understanding within and outside an organization
- To function effectively with heterogeneous teams

Course Outcomes:

1. List out various elements of soft skills
2. Describe methods for building professional image
3. Apply critical thinking skills in problem solving
4. Analyse the needs of an individual and team for well-being
5. Assess the situation and take necessary decisions

UNIT I: Soft Skills & Communication Skills

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques

Activities: Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity (The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT II: Critical Thinking

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities: Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT III: Problem Solving & Decision Making

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities: Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.Case Study & Group Discussion

UNIT – IV Emotional Intelligence & Stress Management

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – SelfRegulation – Stress factors – Controlling Stress – Tips

Activities:
Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation,Organizing Debates.

UNIT – V Corporate Etiquette
Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette,benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phoneetiquette - Dining etiquette - Netiquette - Job interview etiquette - Corporate grooming tips -Overcoming challenges
Activities
Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

NOTE-:
1. The facilitator can guide the participants before the activity citing examples from the lives of thegreat, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to theprescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of KingLear.

Prescribed Books:
1. Mitra Barun K, *Personality Development and Soft Skills*, Oxford University Press, Pap/Cdredition 2012
2. Dr Shikha Kapoor, *Personality Development and Soft Skills: Preparing for Tomorrow*, K I2018, esuoH gnihsilbuP lanoitanretnI

Reference Books:
1. Sharma, Prashant, *Soft Skills: Personality Development for Life Success*, BPB Publications2018.
2. Alex K,*Soft Skills*S.Chand& Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan& Sangeetha Sharma,*Soft Skills: An Integrated Approach toMaximise Personality*Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, *Soft Skills and Employability Skills*, Cambridge UniversityPress, 2018
5. Dr. Rajiv Kumar Jain, Dr. Usha Jain,*Life Skills*(Paperback English)Publisher : Vayu Education of India, 2014

Online Learning Resources:
1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0Ey-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7.https://www.businesstrainingworks.com/training-resource/five-free-businessetiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9.https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Course Code	TECHNICAL REPORT WRITING & IPR		L	T	P	C
			2	0	0	0
Year	III	Semester	II			

Course Objectives:

- To enable the students to practice the basic skills of research paper writing
- To make the students understand the importance of IP and to educate them on the basic conceptsof Intellectual Property Rights.
- To practice the basic skills of performing quality literature review
- To help them in knowing the significance of real life practice and procedure of Patents.
- To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

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

1. Identify key secondary literature related to their proposed technical paperwriting
2. Explain various principles and styles in technical writing
3. Use the acquired knowledge in writing a research/technical paper
4. Analyse rights and responsibilities of holder of Patent, Copyright,Trademark, International Trademark etc.
5. Evaluate different forms of IPR available at national & international level
6. Develop skill of making search of various forms of IPR by using modern tools and techniques.

UNIT – I:

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language –highlighting your findings discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

UNIT – II:

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature Problems and Framing Research Questions- Synopsis

UNIT – III:

Process of research: publication mechanism: types of journals- indexing-seminars-conferences-proof reading – plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules

UNIT – IV:

Introduction to Intellectual property: Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT – V:

Law of copy rights: Fundamentals of copy right law, originality of material, rights of re production, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

Textbooks:

1. Deborah. E. Bouchoux, *Intellectual Property Rights*, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. *Technical Communication: Principles and practices.*Oxford.

Reference Books:

1. R.Myneni, *Law of Intellectual Property*, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli,*Intellectual Property Rights* Tata Mcgraw Hill, 2001
3. P.Naryan,*Intellectual Property Law*, 3rd Ed ,Eastern Law House, 2007.
4. Adrian Wallwork. *English for Writing Research Papers*Second Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, *Technical Writing Style*

Online Resources

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

Course Code	GENERATIVE AI & PROMPT ENGINEERING		L	T	P	C
23BTAI10T	(Professional Core)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- Understand the foundations and working of Generative AI models.
- Explore various generative models like GANs, VAEs, and LLMs.
- Learn prompt engineering techniques to effectively interact with language models.
- Design applications using LLMs with precise control through prompting.
- Understand ethical and societal implications of using Generative AI.

Course Outcomes (COs):

1. Explain the fundamentals of Generative AI, compare model architectures (GANs, VAEs, Transformers), and evaluate their use in generating text, images, and other media.
2. Apply prompt engineering techniques including few-shot learning, output formatting, and debugging to control and guide generative model outputs.
3. Analyze the architecture and capabilities of large language models (LLMs), and build NLP applications using prompt engineering and fine-tuning techniques.
4. Design complex multi-step prompting workflows using tools like LangChain and LlamaIndex, and generate structured or multimodal outputs safely and effectively.
5. Assess the ethical, legal, and societal implications of generative AI, and evaluate its responsible use across fields like healthcare, education, and law.

Unit I: Introduction to Generative AI

Overview of Generative AI and Applications, Generative vs Discriminative Models, Latent Space and Data Generation Concepts, Architectures: GANs, VAEs, Autoregressive Models, Generative AI in Text, Image, Audio, and Video, LLMs: Pretrained Transformers as, Generators, Training Challenges and Evaluation of Generative Models, Case Studies: Image Synthesis, Text Generation.

Unit II: Prompt Engineering Fundamentals Introduction to Prompt Engineering, Prompt Formats: Zero-shot, One-shot, Few-shot, Prompt Tuning vs Prompt Programming, In-Context Learning & Chain-of-Thought Prompting, Role of Instructions and Examples in Prompts, Controlling Output Style, Tone, and Format, Prompt Failure Cases and Debugging, Prompt Engineering for Coding, Text Completion, Q&A

Unit III: Generative Models in NLP

Transformer Architecture Recap (BERT, GPT), GPT-3/4, PaLM, Claude, and LLaMA Architectures, Text Generation Pipelines and APIs (OpenAI, HuggingFace), Prompt Engineering with GPT Models, Fine-tuning vs Instruct Tuning, Retrieval-Augmented Generation (RAG), Evaluation Metrics: BLEU, ROUGE, Perplexity, Building LLM-based Apps with LangChain.

Unit IV: Advanced Prompt Engineering & Tools

Role of Temperature, Top-k, Top-p Sampling, Structured Outputs: Tables, JSON, Function Calls, Agentic Prompting and Multi-step Reasoning, Prompt Chaining and Memory Handling, Prompt Templates for Automation (LangChain, LlamaIndex), Prompt Engineering for Multimodal Models (DALL·E, Gemini, Sora), Safety Layers & Guardrails in Prompting,AutoGPT, BabyAGI, and Agentic Workflow Building.

Unit V: Ethics, Risks, and Applications of Generative AI

Risks: Hallucination, Toxicity, Bias, Deepfakes and Misinformation Challenges, Copyright, IP, and Data Privacy in Generated Content, Evaluation of Responsible AI Outputs, Red Teaming and Safety Testing, Applications in Education, Medicine, Art, and Law, Regulatory Landscape for Generative AI, Future Trends and Research Directions

Textbooks

1. "Deep Learning with Python", François Chollet, Manning, 2nd Edition
2. "Generative Deep Learning", David Foster, O'Reilly, 2nd Edition
3. "Building Systems with ChatGPT", Emmanuel Ameisen (O'Reilly Short Reads)
4. "The Art of Prompt Engineering", Nathan Hunter (Free online eBook)

Reference Books & Papers

1. Vaswani et al., Attention is All You Need
2. OpenAI Technical Reports on GPT Models
3. Papers from NeurIPS, ACL, ICML related to XAI and LLMs
4. LangChain Documentation

Course Code	BUSINESS ETHICS AND CORPORATE GOVERNANCE		L	T	P	C
23BTBA06T	(Management Course-II)		2	0	0	2
Year	IV	Semester	I			

Course Objectives: The objectives of this course are

- To make the student understand the principles of business ethics
- To enable them in knowing about the ethics in management
- To facilitate the student‘ role in corporate culture
- To impart knowledge about the fair-trade practices
- To encourage the student in knowing about the corporate governance

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

1. Understand the Ethics and different types of Ethics,
2. Understand business ethics and ethical practices in management
3. Apply the knowledge of professional ethics & technical ethics
4. Analyze corporate law, ethics, codes & principles
5. Evaluate corporate governance & corporate scams

UNIT-I: ETHICS

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior. Value systems -Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management -Corporate Social Responsibility – Issues of Management – Crisis Management.

LEARNING OUTCOMES: After completion of this unit student will

- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Analyze issues & crisis of management

UNIT-II: ETHICS IN MANAGEMENT

Introduction- Ethics in production, finance, Human resource management and Marketing Management -The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures - Culture and Individual Ethics – professional ethics and technical ethics.

LEARNING OUTCOMES: After completion of this unit student will

- Understand the meaning of Ethics in various areas of management
- Compare and contrast professional ethics and technical ethics
- Develop ethical values in self and organization

UNIT-III: CORPORATE CULTURE

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, sharedvalues, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change.

LEARNING OUTCOMES: After completion of this unit student will

- Define corporate culture
- Understand the key elements of corporate culture
- Analyze organization leadership and corporate culture

UNIT- IV: LEGAL FRAME WORK

Law and Ethics -Agencies enforcing Ethical Business Behavior - Legal Impact – Environmental Protection, Fair Trade Practices, legal Compliances, Safeguarding Health and wellbeing of Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

LEARNING OUTCOMES: After completion of this unit student will

- Understand Law and Ethics
- Analyze Different fair trade practices
- Make use of Environmental Protection and Fair Trade Practices

UNIT -V: CORPORATE GOVERNANCE

Introduction - Meaning – Corporate governance code, transparency & disclosure -Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory frame work - Corporate scams -Committees in India and abroad, corporate social responsibility. BoDs composition, Cadbury Committee - Various committees - Reports - Benefits and Limitations.

LEARNING OUTCOMES: After completion of this unit student will

- Understand corporate governance code
- Analyze role of auditors, board of directors and shareholders in corporate governance
- Implementing corporate social responsibility in India.

Text books:

1. Murthy CSV: Business Ethics and Corporate Governance, HPH July 2017
2. Bholananth Dutta, S.K. Podder – Corporation Governance, VBH. June 2010

Reference books

1. Dr. K. Nirmala, KarunakaraReaddy. *Business Ethics and Corporate Governance*, HPH
2. H.R.Machiraju: *Corporate Governance*, HPH, 2013
3. K. Venkataramana, *Corporate Governance*, SHBP.
4. N.M.Khandelwal. *Indian Ethos and Values for Managers*

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_mg46/
2. https://archive.nptel.ac.in/courses/110/105/110105138/
3. https://onlinecourses.nptel.ac.in/noc21_mg54/
4. https://onlinecourses.nptel.ac.in/noc22_mg54/
5. https://archive.nptel.ac.in/courses/109/106/109106117/

Course Code	E-BUSINESS (Management Course-II)		L	T	P	C
23BTBA07T			2	0	0	2
Year	IV	Semester	I			

Course Objectives: The Objectives of this course are

- To provide knowledge on emerging concept on E-Business related aspect.
- To understand various electronic markets & business models.
- To impart the information about electronic payment systems & banking.
- To create awareness on security risks and challenges in E-commerce.
- To the students aware on different e-marketing channels & strategies.

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

CO1: Understand E-market-Models which are practicing by the organizations.
CO2: Apply the concepts of E-Commerce in the present globalized world.
CO3: Analyze the various E-payment systems & importance of net banking.
CO4: Evaluate market research strategies & E-advertisements.
CO5: Understand importance of E-security & control.

Unit-I: Electronic Business

Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC)-Advantages & Disadvantages of E-Commerce –E Commerce and E-Business, Internet Services, Online Shopping- E-Commerce Opportunities for Industries.

Learning Outcomes: -After completion of this unit student

- Understand the concept of E-Business
- Contrast and compare E-Commerce & E-Business
- Evaluate opportunities of E-commerce for industry

Unit-II: Electronic Markets and Business Models

Introduction –E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals – Advantagesof Portals -Business Models- Business to Business (B2B)-Business to Customers(B2C) - Business to Government(B2G)-Auctions-B2B Portals in India

Learning Outcomes: -After completion of this unit student will

- Understand the concept of business models
- Contrast and compare Vertical portal and Horizontal portals
- Analyze the B2B,B2C and B2G model

Unit-III: Electronic Payment Systems:

Introduction to electronic payment systems (EPS) -Types of electronic payments - Credit/debit cards, e- wallets, UPI, and crypto currencies -Smart cards and digital wallets: Features and usage -Electronic Fund Transfer (EFT): Role in business transactions -Infrastructure requirements and regulatory aspects of e-payments

Learning Outcomes: -After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and smart cards
- Analyze debit card and credit cards

Unit-IV: E-Security

Security risks and challenges in electronic commerce - Cyber threats - Phishing, hacking, identity theft,and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL,TLS) -Firewalls in securing e-business platforms.

Learning Outcomes: -After completion of this unit student will

- Understand E-Security
- Contrast and compare security protocols and public network
- Evaluate on Digital signature

Unit-V: E-Marketing:

Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research– – E-marketing planning: Online branding, social media marketing, and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM) E-supply chain management (e-SCM)

Learning Outcomes: -After completion of this unit student will

- Understand the concept of online marketing
- Apply the knowledge of online marketing
- Compare e-CRM and e-SCM

Text Books:

1. Arati Oturkar&Sunil Khilari. *E-Business*. Everest Publishing House, 2022
2. P.T.S Joseph. *E-Commerce*, Fourth Edition, Prentice Hall of India, 2011

References:

1. Debjani, Kamalesh K Bajaj. *E-Commerce*, Second Edition Tata McGraw-Hill‘s, 2005
2. Dave Chaffey.*E-Commerce E-Management*, Second Edition, Pearson, 2012.
3. Henry Chan. *E-Commerce Fundamentals and Application*, RaymondLeathamWiley India 2007
4. S. Jaiswal. *E-Commerce* GalgotiaPublication Pvt Ltd., 2003.

Online Resources:

https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771
https://www.slideshare.net/VikramNani/e-commerce-business-models
https://www.slideshare.net/RiteshGoyal/electronic-payment-system
https://www.slideshare.net/WelingkarDLP/electronic-security
https://www.slideshare.net/Ankitha2404/emarketing-ppt

Course Code	MANAGEMENT SCIENCE		L	T	P	C
23BTBA08T	(Management Course-II)		2	0	0	2
Year	IV	Semester	I			

Course Objectives: The objectives of this course are

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in modern management

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

CO1: Understand the knowledge of Work-study principles & Quality Control techniques in industry

CO2: Apply the process of Recruitment & Selection in organization

CO3: Analyze the concepts of HRM & different training methods.

CO4: Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT

CO5: Create awareness on contemporary issues in modern management & technology.

UNIT- I INTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor‘s Scientific Theory-Henry Fayol‘s principles - Elton Mayo‘sHuman relations - **Organizational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the concept of management and organization
- Apply the concepts & principles of management in real life industry.
- Analyze the organization chart & structure of an enterprise.

UNIT - II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), WorkStudy - Statistical Quality Control- **Material Management** - Objectives - Inventory-Functions - Types,Inventory Techniques - EOQ-ABC Analysis - **Marketing Management** - Concept - Meaning – NatureFunctions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the core concepts of Operations Management
- Apply the knowledge of Quality Control, Work-study principles in real life industry.
- Evaluate Materials departments & Determine EOQ
- Analyze Marketing Mix Strategies for an enterprise.
- Create and design advertising and sales promotion

UNIT - III HUMAN RESOURCES MANAGEMENT (HRM)

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis – HumanResource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

LEARNING OUTCOMES: At the end if the Unit, the students will be able to

- Understand the concepts of HRM, Recruitment, Selection, Training & Development
- Analyze the need of training
- Evaluate performance appraisal
- Design the basic structure of salaries and wages

UNIT - IV STRATEGIC & PROJECT MANAGEMENT

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis.

Project Management - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand Mission, Objectives, Goals & strategies for an enterprise
- Apply SWOT Analysis to strengthen the project
- Analyze Strategy formulation and implementation
- Evaluate PERT and CPM Techniques

UNIT - V CONTEMPORARY ISSUES IN MANAGEMENT

Customer Relations Management (CRM) - Total Quality Management (TQM) - Six Sigma Concept -Supply Chain Management (SCM) - Enterprise Resource Planning (ERP) - Performance Management – employee engagement and retention - Business Process Re-engineering and Bench Marking - Knowledge Management – change management – sustainability and corporate social responsibility.

LEARNING OUTCOMES At the end if the Unit, the students will be able to

- Understand modern management techniques
- Apply Knowledge in Understanding in TQM, SCM
- Analyze CRM, BPR
- Evaluate change management & sustainability

Text Books:

1. Frederick S. Hillier, Mark S. Hillier. *Introduction to Management Science*, October 26, 2023
2. A.R Aryasri, *Management Science*, TMH, 2019

References:

1. Stoner, Freeman, Gilbert.*Management*, Pearson Education, New Delhi, 2019.
2. Koontz & Weihrich, *Essentials of Management*, 6/e, TMH, 2005.
3. Thomas N.Duening & John M.Ivancevich, *Management Principles and Guidelines*, Biztantra.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
5. Samuel C.Certo, *Modern Management*, 9/e, PHI, 2005

VEMU INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
B.Tech - Computer Science & Engineering (AI & ML)

Course Code	EXPLAINABLE AI & MODEL INTERPRETABILITY		L	T	P	C
23BTAI11a	(Professional Elective-IV)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- To introduce the principles of interpretability and explain ability in AI/ML models.
- To analyze the trade-offs between model accuracy and interpretability.
- To explore popular post-hoc and intrinsic explain ability techniques.
- To examine fairness, accountability, and transparency in AI systems.
- To develop hands-on skills with interpretability tools and libraries.

Course Outcomes:

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

1. Understand the need for explain ability in modern AI systems.
2. Differentiate between black-box and white-box models.
3. Apply interpretability techniques such as SHAP, LIME, and PDPs.
4. Evaluate the fairness and transparency of AI systems.
5. Use explain ability tools for model auditing and deployment in high-stakes domains.

UNIT I: Foundations of Explainable AI

Introduction to Explainability and Interpretability, Importance of XAI in Healthcare, Finance, and Law , White-box vs Black-box Models, Desiderata: Fairness, Accountability, Transparency, Human-Centered AI and Trust ,Taxonomy of XAI Techniques (Global vs Local, Post-hoc vs Intrinsic), Regulatory and Ethical Implications (GDPR, AI Bill of Rights), Model Simplicity vs Predictive Power.

UNIT II: Model-Specific Explainability Techniques

Decision Trees and Rule-based Models, Linear Models and Feature Importance, Generalized Additive Models (GAMs), Visualization of Weights and Coefficients, Logistic Regression Coefficient Interpretation, Case Study: Credit Scoring using Transparent Models,Comparison of Interpretable ML Models, Use Cases and Trade-offs.

UNIT III: Model-Agnostic Explainability Techniques

Local Interpretable Model-agnostic Explanations (LIME), SHAP Values (SHapley Additive exPlanations), Partial Dependence Plots (PDPs), Individual Conditional Expectation (ICE) Plots,Anchors and Counterfactual Explanations, Feature Interaction and Permutation Importance, Comparative Analysis of SHAP, LIME, PDP, Model Debugging with XAI.

UNIT IV: Deep Learning Explainability

Visualizing CNNs: Filters, Feature Maps, Saliency Maps and Grad-CAM, Integrated Gradients, Explaining RNNs and LSTM Outputs, Concept Activation Vectors (TCAV), Attention-based Interpretability in Transformers, Explaining Language Models (BERT, GPT) Evaluation of Deep Model Explanations.

UNIT V: Fairness, Bias & Tools for XAI

Fairness Metrics: Demographic Parity, Equal Opportunity, Sources of Bias in Data and Models, Discrimination Detection and Mitigation Strategies, Introduction to AIF360, What-If Tool, Fairlearn, Case Study: Bias in Hiring Algorithms, Explainability in ML Pipelines (MLFlow, Skater), XAI in Federated and Privacy-Preserving AI, Designing Interpretable AI Systems from Scratch.

Textbooks:

1. Christoph Molnar, ―Interpretable Machine Learning‖, Leanpub.
2. Sameer Singh et al., ―Explainable AI: Interpreting, Explaining and Visualizing Deep Learning‖, Springer.
3. Dan Roth, Zachary Lipton, and Been Kim, ―Explainable AI: Foundations, Developments, Prospects‖, MIT Press (Online forthcoming).

Reference Books:

1. Marco Tulio Ribeiro et al., ―Why Should I Trust You?‖ (LIME) – Research Paper
2. Scott Lundberg et al., ―A Unified Approach to Interpreting Model Predictions‖ (SHAP) – NIPS
3. A. Barredo Arrieta et al., ―Explainable Artificial Intelligence (XAI): Concepts, Taxonomies, Opportunities and Challenges‖, Information Fusion Journal.
4. Zachary C. Lipton, ―The Mythos of Model Interpretability‖ – Communications of the ACM

Online Learning Resources:

Coursera – Explainable AI with Google Cloud
Udacity – AI for Everyone by Andrew Ng
HarvardX – Data Science: Machine Learning Interpretability

Course Code	AI FOR ROBOTICS		L	T	P	C
23BTAI11b	(Professional Elective-IV)		3	0	0	3
Year	IV	Semester	I			

Course Objectives

- Introduce the fundamental principles of robotics and artificial intelligence integration.
- Understand robot perception, localization, mapping, motion planning, and control using AI algorithms.
- Apply machine learning and deep learning techniques in robotic environments.
- Explore the use of reinforcement learning, behavior-based AI, and neural networks in autonomous robots.
- Enable students to build intelligent robots that can perceive, learn, and adapt to dynamic environments.

Course Outcomes

1. Demonstrate an understanding of how AI techniques are applied in robot control and autonomy.
2. Apply vision, perception, and sensor fusion techniques for real-time robotic applications.
3. Implement path planning and navigation algorithms in dynamic environments.
4. Analyze and apply learning-based models such as reinforcement learning and deep neural networks in robotics.
5. Evaluate AI-enabled robotic systems based on their performance, efficiency, and adaptability.

UNIT I – Fundamentals of Robotics and AI

Introduction to Robotics: Types and Components, Overview of Artificial Intelligence and Machine Learning, Relationship between Robotics and AI, Sensors and Actuators in Robotics, Embedded Systems and Microcontrollers in Robotics, Architecture of Autonomous Robots, Programming Tools: ROS (Robot Operating System), Python, C++, Applications of AI in Robotics – Overview

UNIT II – Perception and Sensor Fusion

Computer Vision for Robotics: Basics and Techniques, Depth Sensing, RGB-D Cameras, LIDAR, and Ultrasonic Sensors, Feature Extraction and Object Recognition, Kalman Filter and Extended Kalman Filter, Particle Filter and Sensor Fusion Techniques, SLAM (Simultaneous Localization and Mapping) – Concepts, Visual SLAM and LiDAR-based SLAM, 3D Mapping and Scene Reconstruction.

UNIT III – Motion Planning and Navigation

Path Planning Algorithms – Dijkstra, A*, RRT, Obstacle Detection and Avoidance, Robot Kinematics and Dynamics, Trajectory Generation and Optimization, Localization Techniques – GPS, Wi-Fi, Odometry, Autonomous Navigation in Indoor and Outdoor Environments, Multi-Robot Coordination and Swarm Intelligence, Integration of Perception and Planning Systems

UNIT IV – AI Techniques in Robotics

Supervised and Unsupervised Learning for Robotics, Neural Networks and Deep Learning Models for Robot Vision, Reinforcement Learning – Q-Learning and Deep Q Networks, Policy Gradient and Actor-Critic Methods, Behavior-Based Robotics and Finite State Machines, Imitation Learning and Learning from Demonstration, Transfer Learning for Robotic Tasks, Safety and Generalization in AI Models for Robots

UNIT V – Advanced Applications and Ethical Considerations

Humanoid and Service Robots with AI, AI in Industrial, Healthcare, and Assistive Robotics, Edge AI and Real-Time Inference in Robots, Human-Robot Interaction and Social Intelligence, Autonomous Vehicles and Delivery Drones, AI in Robotics Competitions (RoboCup, DARPA), Ethical Issues in AI-Enabled Robotics, Future Trends: Neuromorphic and Quantum Robotics

Textbooks

1. "Artificial Intelligence for Robotics" by Robin R. Murphy
2. "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, Dieter Fox
3. "Introduction to Autonomous Robots" by Nikolaus Correll, Bradley Hayes, et al.

Reference Books

1. "Robot Operating System (ROS) for Absolute Beginners" by Lentin Joseph
2. "Modern Robotics: Mechanics, Planning, and Control" by Kevin M. Lynch and Frank C. Park
3. "Learning for Adaptive and Reactive Robot Control" by Aude Billard, Jean-Jacques Slotine
4. IEEE Transactions and Springer Journals on Robotics and Intelligent Systems

Online Courses

1. AI for Robotics – Udacity (by Sebastian Thrun)
2. Modern Robotics: Mechanics, Planning, and Control – Coursera (Northwestern University)

Course Code	AI IN CYBER SECURITY		L	T	P	C
23BTAI11c	(Professional Elective-IV)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- To introduce the fundamental concepts of AI and their applications in cyber security.
- To understand AI-driven techniques for threat detection, classification, and mitigation.
- To explore machine learning and deep learning methods used for malware and intrusion detection.
- To equip students with skills in building intelligent security systems.
- To examine ethical, legal, and privacy aspects in AI-driven cyber security.

Course Outcomes:

1. Understand AI principles and their relevance in cyber security.
2. Apply machine learning techniques to detect and respond to threats.
3. Analyze security incidents using intelligent tools and models.
4. Evaluate and implement AI models for malware detection and anomaly analysis.
5. Design AI-based cyber security frameworks for real-world scenarios.

UNIT I: Introduction to AI in Cyber security

Role of AI in Modern Cyber security, Overview of Cyber Threats and Attack Vectors, Fundamentals of Machine Learning for Security, AI vs Traditional Security Techniques, AI-Based Cyber Defense Lifecycle, Threat Intelligence with AI, Cyber security Data Types and Challenges, Case Studies of AI-Driven Attacks and Defenses

UNIT II: Machine Learning for Cyber Threat Detection

Supervised Learning for Intrusion Detection, Unsupervised Learning for Anomaly Detection, Feature Engineering from Network Traffic, Classification Algorithms: SVM, Decision Trees, Random Forests, Clustering Techniques: K-Means, DBSCAN, Ensemble Models and Model Evaluation Metrics, Real-Time Threat Detection Pipelines, Data Imbalance and Adversarial Sampling

UNIT III: Deep Learning in Cyber security

Neural Networks for Threat Classification, CNNs for Malware Detection from Binary Files, RNNs/LSTMs for Sequential Log Analysis, Autoencoders for Anomaly Detection,GANs in Malware Evasion and Defense,Transfer Learning for Threat Signature Extraction, Deep Learning vs Traditional Models: A Comparative Study,Real-World Use Cases and Limitations

UNIT IV: AI for Specific Security Domains

AI for Phishing and Spam Detection, AI in Cloud Security and Edge Devices, Botnet and DDoS Attack Detection**,** AI-Driven Endpoint Security, Natural Language Processing for Threat Intelligence, Behavioral Biometrics and Fraud Detection, AI in Social Engineering Attack Prevention, Security Information and Event Management (SIEM) with AI

UNIT V: Challenges, Ethics & Future of AI in Cyber security

Explainable AI (XAI) in Cyber security, Adversarial Attacks and Defenses in AI Systems, Data Privacy and Federated Learning, Legal and Ethical Issues in AI Security Solutions, AI Model Bias and Fairness in Security Decisions, Securing AI Models Against Manipulation, Building Scalable AI-Powered SOCs, Future Trends: Autonomous Security, AI-Augmented Threat Hunting

Textbooks:

1. Clarence Chio & David Freeman, ―Machine Learning and Security‖, O'Reilly Media.
2. Xiaofeng Chen et al., ―Artificial Intelligence and Big Data Analytics for Cybersecurity‖, Springer.
3. Mark Stamp, ―Information Security: Principles and Practice‖, Wiley.

Reference Books:

1. Sumeet Dua & Xian Du, ―Data Mining and Machine Learning in Cybersecurity‖, CRC Press.
2. Shai Shalev-Shwartz & Shai Ben-David, ―Understanding Machine Learning‖, Cambridge University Press.
3. Zhiwei Lin & Yang Xiang, ―Cyber Security Intelligence and Analytics‖, Springer.
4. Bhavani Thuraisingham, ―Data Mining for Malware Detection‖, CRC Press.

Online Learning Resources:

- Coursera – ―AI for Cybersecurity‖ by University of Colorado
- Udemy – ―Machine Learning for Cybersecurity‖
- edX – ―Cybersecurity MicroMasters‖ by RIT

Course Code	AI-DRIVEN SOFTWARE ENGINEERING & DEVOPS		L	T	P	C
23BTAI11d	(Professional Elective-IV)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- To introduce the principles and practices of AI-driven software engineering and DevOps.
- To explore how AI techniques can automate and optimize software development workflows.
- To study intelligent tools for code generation, testing, monitoring, and deployment.
- To equip students with skills in AI-powered CI/CD pipelines and operations.
- To foster an understanding of ethical implications and reliability in intelligent software systems.

Course Outcomes:

1. Understand AI's role in modern software development and operations.
2. Apply machine learning techniques to automate software engineering tasks.
3. Design and manage intelligent CI/CD and DevOps workflows.
4. Evaluate AI tools in software testing, refactoring, and monitoring.
5. Implement AI-based solutions for predictive maintenance and decision support in DevOps.

UNIT I: Foundations of AI in Software Engineering

Overview of Traditional vs AI-driven Software Development, AI Opportunities in Software Lifecycle Phases, Introduction to ML/DL Models in Engineering Tasks, Code Representation and Learning from Code, NLP for Source Code Understanding, Software Knowledge Graphs and Reasoning, Datasets and Benchmarks for Software Engineering AI, Case Studies of AI-Enhanced Development Tools

UNIT II: AI in Code Generation and Refactoring

Program Synthesis and Code Completion Models, Large Language Models (e.g., Codex, CodeBERT) in IDEs, Code Clone Detection and Automated Refactoring, Learning-Based Bug Detection and Code Smell Identification, AI in Software Architecture Recommendations, Embedding Techniques for Source Code, Prompt Engineering for Software Tasks, Reliability and Safety in Generated Code

UNIT III: Intelligent Testing, QA, and Debugging

Test Case Generation Using AI, Automated Unit Testing, Regression Testing with ML, Learning Bug Patterns from Repositories, AI-Based Static and Dynamic Code Analysis, Fault Localization and Automated Debugging, Quality Assurance Metrics Enhanced by AI, Reinforcement Learning for Test Prioritization, Ethics and Bias in AI-Driven Testing – (E)

UNIT IV: AI in DevOps Automation and CI/CD

DevOps Fundamentals and Integration with AI, Intelligent CI/CD Pipeline Design, Predictive Build Failure and Log Analysis, AI in Infrastructure-as-Code and Deployment Orchestration, Self-Healing Systems and AIOps Concepts, Log Analytics and Anomaly Detection in Production, AI in Monitoring, Tracing, and Feedback Loops, DevSecOps and AI for Security Automation

UNIT V: Advanced Topics and Ethical Considerations
Explainability and Transparency in AI-Driven Tools, Ethical and Legal Aspects in Automated Engineering**,** Human-AI Collaboration in Software Teams, Risk Management in Autonomous Code Deployment, AI for Technical Debt Prediction and Management, AI for Developer Productivity Analytics, Research Trends and Challenges in AI for SE, Capstone: Building a Smart DevOps Workflow

Textbooks:
1. Tim Menzies, Diomidis Spinellis, and Thomas Zimmermann, ―Perspectives on Data Science for Software Engineering‖, Morgan Kaufmann.
2. André van der Hoek, Reid Holmes, ―Software Engineering for Machine Learning‖, Springer.
3. Len Bass, Ingo Weber, Liming Zhu, ―DevOps: A Software Architect's Perspective‖, Addison-Wesley.

Reference Books:
1. Carlos Eduardo Parnin et al., ―AI for Software Engineering: Foundations, Advances, and Trends‖, Springer.
2. Luciano Baresi et al., ―Machine Learning Techniques for Software Quality Evaluation‖, Springer.
3. Gene Kim, Jez Humble, and Nicole Forsgren, ―Accelerate: The Science of Lean Software and DevOps‖, IT Revolution.

Online Learning Resources:
- Coursera – ―AI for Software Engineering‖ by DeepLearning.AI
- edX – ―DevOps for Developers‖ by Microsoft
- GitHub Copilot and OpenAI Codex documentation
- PapersWithCode – AI for Software Engineering benchmarks
- MIT OCW – ―Software Systems‖ and ―DevOps and CI/CD‖
- Udemy – ―AI-Powered DevOps Pipelines and Automation‖

Course Code	AI FOR SMART CITIES & IOT SYSTEMS		L	T	P	C
23BTAI12a	(Professional Elective-V)		3	0	0	3
Year	IV	Semester	I			

Course Objective:

- To understand the foundational concepts of smart cities and IoT architectures integrated with AI technologies.
- To explore AI-driven solutions for urban mobility, transportation, and traffic management systems.
- To apply AI and IoT techniques for efficient energy, waste, and water management in smart urban environments.
- To examine AI applications in smart healthcare, surveillance, and public safety systems.
- To design, deploy, and evaluate AIoT systems with an understanding of real-time processing, governance, and future challenges.

Course Outcomes:

1. Describe the architecture and components of smart cities and explain how AI and IoT integrate to optimize urban planning and services.
2. Apply AI models in transportation systems to improve traffic flow, public mobility, and autonomous vehicle operations.
3. Develop AI and IoT solutions for sustainable energy, waste, and water management in smart city ecosystems.
4. Analyze AI-based healthcare, surveillance, and emergency response applications, considering privacy and ethical aspects.
5. Design and deploy AIoT systems using edge/cloud platforms and evaluate them using appropriate governance and performance metrics.

Unit I: Introduction to AI in Smart Cities and IoT Systems

Smart City Concepts: Components, Infrastructure, and Urban Needs, Overview of IoT and AI Integration, Smart City Frameworks (India, Singapore, EU, etc.), IoT Architecture: Sensing, Network, Processing, and Application Layers, Role of AI in Urban Planning and Resource Optimization, Case Studies on AI in Smart Cities, Edge, Fog, and Cloud Computing Concepts for Smart Systems

Unit II: AI Applications in Smart Transportation and Mobility

Traffic Monitoring and Congestion Prediction using AI, Intelligent Traffic Signal Control using Reinforcement Learning, Autonomous Vehicles and AI Algorithms, Vehicle Detection and License Plate Recognition using CV, Public Transport Optimization using Predictive Analytics, Smart Parking and Navigation Systems, Use of Drones and AI for Traffic Surveillance

Unit III: AI and IoT for Smart Energy, Waste, and Water Management

AI for Smart Grids and Energy Consumption Prediction, Load Balancing and Demand Forecasting using ML, Waste Segregation and Collection Automation using CV, Water Quality Monitoring Systems using IoT Sensors, Leak Detection and Anomaly Detection Models, Smart Metering and Energy Theft Detection, Sustainability and Carbon Monitoring AI Models

Unit IV: Smart Healthcare, Surveillance, and Public Safety
IoT-based Health Monitoring and Alert Systems, Predictive Healthcare and Disease Outbreak Detection, AI for CCTV Surveillance, Crowd Monitoring, and Violence Detection, NLP for Emergency Response and Chatbot Assistance, Smart Ambulance Routing and Response Optimization, COVID-19 Contact Tracing and Monitoring via AI & IoT, Data Privacy, Security & Ethical Issues in Surveillance Systems

Unit V: A IoT System Design, Deployment, and Governance
AI Model Deployment on Edge Devices (Raspberry Pi, Jetson Nano), Smart City Dashboards and Data Visualization, Real-time Streaming and Analytics Platforms (Apache Kafka, Spark), Cloud Integration: AWS IoT, Google Cloud AI, Azure IoT Suite, Governance Frameworks, Data Privacy, and Policy Standards, Evaluation Metrics for Smart City Projects, Future Trends in AIoT and Smart Urban Living

Text Books:
1. Pethuru Raj & Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Janaka Ekanayake, Smart Grid: Technology and Applications, Wiley.
3. Rajkumar Buyya, Fog and Edge Computing: Principles and Paradigms, Wiley.
4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley.

Reference Books:
1. Mahalik N. P., Sensor Networks and Applications, McGraw Hill.
2. Kim F. Taylor, Urban Artificial Intelligence and Governance, Springer.
3. Dastbaz, J. & Pattinson, C., Smart Cities: Innovation and Sustainability, Springer.
4. Research papers from IEEE Smart Cities, AIoT Journal, and Springer Urban Tech.

Online Courses:
1. Coursera – Smart Cities: Management of Smart Urban Infrastructures (EPFL)
2. edX – Internet of Things (IoT) Program – Curtin University

Course Code	ML OPS & AI MODEL DEPLOYMENT		L	T	P	C
23BTAI12b	(Professional Elective-V)		3	0	0	3
Year	IV	Semester	I			

Course Objective:

- To understand the principles and best practices of operationalizing machine learning models in production environments.
- To explore the life cycle of AI model development, deployment, monitoring, and maintenance using modern MLOps frameworks.
- To develop skills in CI/CD for ML, reproducibility, model versioning, and containerization using Docker and Kubernetes.
- To deploy machine learning models using cloud-native services and track their performance using real-time metrics.
- To address scalability, reliability, and ethical considerations in ML model deployment.

Course Outcomes:

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

1. Illustrate the lifecycle and pipeline components of MLOps and implement basic version control and orchestration for ML workflows.
2. Package ML models using appropriate tools and deploy them using Docker and Kubernetes environments with effective resource management.
3. Develop and deploy machine learning models as APIs using FastAPI/Flask and configure for real-time or batch inference scenarios.
4. Monitor and log ML systems using modern tools and detect data/model drift with strategies for continuous evaluation and feedback.
5. Implement end-to-end MLOps solutions using cloud platforms and CI/CD tools, and analyze deployment challenges in real-world use cases.

UNIT I: Introduction to MLOps and Deployment Pipelines

Definition and need of MLOps, ML system lifecycle and pipeline components, DevOps vs. MLOps: key differences, CI/CD for ML projects, Data versioning and model lineage, Introduction to DVC, Git, and MLFlow, Workflow orchestration using Apache Airflow, Automated testing in ML pipelines

UNIT II: Model Packaging and Environment Management.

Packaging ML models using Pickle, Joblib, ONNX, Python virtual environments, Conda, Pipenv, Introduction to Docker for ML workloads, Building Dockerfiles for ML apps, Using Kubernetes for orchestration, Security, logging, and resource management, Docker Compose and Helm charts for deployment, Hands-on: Containerize and deploy a scikit-learn model

UNIT III: Model Serving and APIs

RESTful API design for ML models, Model deployment using FastAPI and Flask, TensorFlow Serving, TorchServe basics, Introduction to gRPC for ML deployment, Asynchronous inference and batch vs real-time serving, Load testing and benchmarking, Authentication and authorization in model APIs, Deploying models on edge devices

UNIT IV: Monitoring, Logging, and Continuous Evaluation
Importance of monitoring and alerting in MLOps, Data drift and model drift detection, Logging prediction results and metadata, Prometheus, Grafana, and ELK Stack, A/B testing and canary deployments, Shadow deployments and rollback strategies, Feedback loops for continuous learning, Integration with external monitoring tools

UNIT V: Cloud-native MLOps and Case Studies
ML deployment on AWS SageMaker, Azure ML, Google AI Platform, CI/CD using GitHub Actions, Jenkins, and GitLab CI, AutoML and model registry, Real-world case study: End-to-end MLOps pipeline, Challenges and limitations in enterprise ML deployment, Responsible AI in production systems, Future trends in MLOps, Capstone Project Planning

Text Books:
1. Introducing MLOps: How to Scale Machine Learning Projects with DevOps Tools – Mark Treveil, Alok Shukla, O'Reilly Media.
2. Machine Learning Engineering – Andriy Burkov, TrueShelf Publishing.
3. Designing Machine Learning Systems – Chip Huyen, O‘Reilly Media.

Reference Books:
1. Practical MLOps – Noah Gift, O‘Reilly Media
2. Kubeflow for Machine Learning – Trevor Grant et al., O'Reilly
3. Hands-On MLOps: Implement Machine Learning in Production – Munn, Meza, Vohra, Packt Publishing
4. Research papers from arXiv, MLSys Conference, and ICML Industry Track

Online Courses:
1. Coursera – MLOps Specialization by DeepLearning.AI
2. Google Cloud – MLOps: Continuous Delivery and Automation Pipelines
3. Udemy – MLOps: ML Pipelines, CI/CD, and Model Deployment

Course Code	DATA WRANGLING		L	T	P	C
23BTAI12c	(Professional Elective-V)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- To introduce the fundamental techniques for acquiring, cleaning, transforming, and manipulating data.
- To enable students to handle real-world messy data for analysis and machine learning.
- To teach efficient use of libraries like Pandas, NumPy, and SQL for data wrangling.
- To promote understanding of handling missing values, outliers, and inconsistent formats.
- To expose students to automation, reproducibility, and workflow design in data preprocessing.

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

1. Understand and apply core data wrangling techniques.
2. Clean, transform, and reshape data using Python and SQL.
3. Handle missing values, data inconsistencies, and outliers.
4. Merge and join multiple datasets from different sources.
5. Automate data pipelines and preprocessing workflows for analytics and ML.

UNIT I: Introduction to Data Wrangling and Data Acquisition

Introduction to Data Wrangling: Importance and Use Cases, Types of Data: Structured, Semi-Structured, Unstructured, Data Acquisition Techniques: APIs, Web Scraping, Reading Data from CSV, Excel, JSON, XML, Using Python libraries: pandas, requests, BeautifulSoup, Working with Databases using SQLAlchemy and pandas, Loading Large Datasets and Chunking, Exploratory Analysis Before Cleaning.

UNIT II: Handling Missing, Noisy, and Inconsistent Data

Identifying and Understanding Missing Data, Techniques for Imputing Missing Values, Handling Inconsistent Data: Dates, Texts, Units, Removing Duplicates and Irrelevant Data, Detecting and Treating Outliers, Normalization and Standardization Techniques, Regular Expressions for Text Cleaning, Visualizing Missing/Outlier Data.

UNIT III: Data Transformation and Feature Engineering

Data Type Conversion and Parsing , Feature Extraction from Text, Dates, and Strings, One-Hot Encoding, Label Encoding, Binning and Discretization, Data Aggregation and Grouping, Pivoting, Melting, and Reshaping Data, Handling Imbalanced Data, Creating Derived Features and Feature Selection.

UNIT IV: Data Integration, Joining, and Workflows

Merging and Joining Datasets (Inner, Outer, Left, Right), Concatenation and Appending DataFrames, Data Consistency and Referential Integrity, Resolving Schema Mismatches, Designing Reusable Data Wrangling Functions, Automating Workflows with Functions and Pipelines, Data Lineage and Documentation, Case Study: End-to-End Data Wrangling Pipeline.

UNIT V: Tools, Libraries, and Case Studies in Data Wrangling
Pandas and NumPy Advanced Techniques, Pyjanitor, Dask, and Polars for Efficient Wrangling, Using OpenRefine for Data Cleaning, SQL vs NoSQL in Data Wrangling, Real-world Wrangling Case Studies (Finance, Healthcare, Retail), Best Practices and Common Pitfalls in Data Wrangling, Reproducibility and Versioning in Data Pipelines, Final Capstone: Build and Evaluate a Clean Dataset for ML/

Textbooks:
1. M. Heydt – Data Wrangling with pandas, O'Reilly Media.
2. Hadley Wickham – R for Data Science (Data Wrangling Chapters), O'Reilly.
3. J. VanderPlas – Python Data Science Handbook, O'Reilly Media.

Reference Books:
1. Wes McKinney – Python for Data Analysis, O'Reilly.
2. Cathy O'Neil and Rachel Schutt – Doing Data Science, O'Reilly.
3. David Mertz – Cleaning Data for Effective Data Science, Packt.

Online Learning Resources:
1. Data Wrangling with pandas (Datacamp): https://www.datacamp.com/courses/data-manipulation-with-pandas
2. Coursera: Data Wrangling, Analysis and AB Testing with SQL – *https://www.coursera.org/learn/data-wrangling-analysis-abtesting*
3. edX: Data Wrangling with R – https://online.rice.edu/courses/data-wrangling-r

Course Code	HEALTHCARE AI		L	T	P	C
23BTAI12d	(Professional Elective-V)		3	0	0	3
Year	IV	Semester	I			

Course Objectives:

- To provide a foundational understanding of AI applications in healthcare.
- To familiarize students with medical data types, preprocessing, and ethical considerations.
- To explore ML and DL algorithms tailored for diagnosis, prognosis, and treatment recommendations.
- To expose students to real-world healthcare systems and AI solutions like predictive modeling, EHRs, and medical imaging.
- To enable students to design, evaluate, and deploy AI-driven healthcare applications.

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

1. Understand the scope, challenges, and benefits of AI in healthcare.
2. Apply data preprocessing and modeling techniques specific to biomedical data.
3. Analyze the performance of ML/DL models in clinical contexts.
4. Develop AI-driven applications for tasks like disease diagnosis, drug discovery, and patient monitoring.
5. Evaluate ethical, legal, and societal implications of AI in healthcare.

UNIT I: Introduction to AI in Healthcare

Overview of Healthcare Systems and Data Ecosystem , AI in Clinical Decision Support Systems (CDSS), Types of Medical Data: EHRs, Imaging, Genomic, Sensor Data, Applications of AI in Diagnosis, Prognosis, and Monitoring, Use Cases: Radiology, Pathology, Oncology, Cardiology, Limitations and Challenges of AI in Healthcare, AI for Telemedicine and Remote Patient Monitoring.

UNIT II: Medical Data Preprocessing and Feature Engineering

Data Cleaning, Imputation, and Normalization for Clinical Data, Handling Missing Values, Outliers, and Bias, Feature Engineering from EHRs and Time-Series Data, Text Mining for Medical Notes using NLP, Encoding Diagnosis and Procedure Codes (ICD, CPT), Temporal Pattern Extraction from Clinical Sequences, Data Privacy, Anonymization, and HIPAA Compliance.

UNIT III: Machine Learning & Deep Learning in Healthcare Supervised Learning for Risk Prediction and Classification, Unsupervised Learning for Patient Segmentation, Deep Learning for Medical Imaging: CNNs, Transfer Learning, Recurrent Neural Networks for Time-series Clinical Data, Survival Analysis and Time-to-Event Prediction, Model Evaluation Metrics: Sensitivity, Specificity, AUC, Handling Imbalanced Datasets in Healthcare, Interpretability in Medical ML Models (LIME, SHAP)

UNIT IV: Specialized Healthcare AI Applications

AI for Disease Diagnosis: Diabetes, Cancer, Heart Disease, AI in Medical Imaging: X-ray, MRI, CT Scan Analysis, Predictive Modeling for ICU Admission & Mortality Risk, AI in Genomics and Personalized Medicine, Drug Discovery and Repurposing with AI, Chatbots and Virtual Health Assistants, Remote Monitoring using IoT & Wearables + AI.

UNIT V: Ethics, Regulation, and Future Directions in Healthcare AI
Ethical AI in Healthcare: Bias, Fairness, and Accountability, Regulatory Landscape: FDA Approval, CE Marking, Explainable AI and Clinical Trust, Federated Learning for Privacy-Preserving AI, Clinical Trials and AI Decision-Support Tools, Case Studies: Google DeepMind, IBM Watson Health, PathAI, Responsible Deployment of AI in Healthcare Settings.

Textbooks:
1. Jiang, Fei et al. – Artificial Intelligence in Healthcare: Past, Present and Future.
2. Kevin Frick – Introduction to Healthcare AI.
3. Eric Topol – Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again.

Reference Books:
1. Mathias Goyen – AI in Medical Imaging.
2. Bertalan Meskó – The Guide to the Future of Medicine: Technology and The Human Touch.
3. Peter Szolovits – Artificial Intelligence in Medicine (Morgan Kaufmann).

Online Learning Resources:
1. Coursera: AI for Medicine Specialization (offered by DeepLearning.AI) https://www.coursera.org/specializations/ai-for-medicine
2. HarvardX: Data Science in Healthcare (edX) https://online-learning.harvard.edu/course/data-science-healthcare

Course Code	PROMPT ENGINEERING		L	T	P	C
23BTCS04S	(Skill Enhancement Course)		0	1	2	2
Year	IV	Semester	I			

Course Objective:
This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance. Understanding Prompt Engineering is a comprehensive course designed to equip learners with the knowledge and skills to effectively generate and utilize prompts in natural language processing (NLP) and machine learning (ML) applications. This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance.

Course Out comes: After the successful completion of this course, the student will be able to
CO1: Understanding the fundamentals and evolution of prompt engineering.
CO2: Gaining the ability to craft effective closed-ended, open-ended, and role-based prompts.
CO3: Learning to probe and stress-test AI models for bias and robustness.
CO4: Applying prompt optimization techniques and performance evaluation methods.
CO5: Mitigating bias and promoting ethical prompting practices in NLP/ML systems.

Module 1: Introduction to Prompt Engineering
- *Lesson 1: Foundations of Prompt Engineering*
  o Overview of prompt engineering and its significance in NLP and ML.
  o Historical context and evolution of prompt-based approaches.

Module 2: Types of Prompts and Their Applications
- *Lesson 2: Closed-Ended Prompts*
  o Understanding and creating prompts for specific answers.
  o Applications in question- answering systems.
- *Lesson 3: Open-Ended Prompts*
  o Crafting prompts for creative responses.
  o Applications in language generation models.

Module 3: Strategies for Effective Prompting
- *Lesson 4: Probing Prompts*
  o Designing prompts to reveal model biases.
  o Ethical considerations in using probing prompts.
- *Lesson 5: Adversarial Prompts*
  o Creating prompts to stress-test models.
  o Enhancing robustness through adversarial prompting.

Module 4: Fine-Tuning and Optimizing with Prompts
- *Lesson 6: Fine-Tuning Models with Prompts*
  o Techniques for incorporating prompts during model training.
  o Balancing prompt influence and generalization.
- *Lesson 7: Optimizing Prompt Selection*
  o Methods for selecting optimal prompts for specific tasks.
  o Customizing prompts based on model behavior.

Module 5: Evaluation and Bias Mitigation

- *Lesson 8: Evaluating Prompt Performance*
  o Metrics and methodologies for assessing model performance with prompts.
  o Interpreting and analyzing results.
- *Lesson 9: Bias Mitigation in Prompt Engineering*
  o Strategies to identify and address biases introduced by prompts.
  o Ensuring fairness and inclusivity in prompt-based models.

Module 6: Real-World Applications and Case Studies

- Lesson 10: Case Studies in Prompt Engineering
- Exploration of successful implementations and challenges in real-world scenarios.
- Guest lectures from industry experts sharing their experiences.

Text books:

1. "Prompt Engineering in Action" – *Danny D. Sullivan*
2. "The Art of Prompt Engineering with Chat GPT: A Hands-On Guide" – *Nathan Hunter.*

Reference Books:

1. "Prompt Engineering in Practice" – *Michael F. Lewis*
2. "Mastering AI Prompt Engineering: The Ultimate Guide for Chat GPT Users" – *Adriano Damiao*
3. "Writing AI Prompts For Dummies" – *Stephanie Diamond and Jeffrey Allan*
4. "Prompt Engineering Guide" (Online Resource) – *promptingguide.ai*

Online Resource Link:

https://www.udemy.com/course/understanding-prompt-engineering/?couponCode=NVDINCTA35TRT

Course Code	GENDER SENSITIZATION Audit Course		L	T	P	C
			0	0	2	0
Year	IV	Semester	I			

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men
- To familiarize them about constitutional safeguard for gender equality
- To expose the students to debates on the politics and economics of work
- To help students reflect critically on gender violence
- To make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider community and the workplace.

Course Outcomes (CO):

CO1: Understand the basic concepts of gender and its related terminology
CO2: Identify the biological, sociological, psychological and legal aspects of gender.
CO3: Use the knowledge in understanding how gender discrimination works in our society and how to counter it.
CO4: Analyze the gendered division of labour and its relation to politics and economics.
CO5: Appraise how gender-role beliefs and sharing behaviour are associated with more well-being in all culture and gender groups
CO6: Develop student's sensibility with regard to issues of gender in contemporary India.

Unit-1 UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-ExploringAttitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

Unit-2 GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences- Declining Sex Ratio- Demographic Consequences-Gender Spectrum

Unit-3 GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- ―My Mother doesn'tWork. ―Share the Load.‖-Work: Its Politics and Economics -Fact and Fiction-Unrecognizedand Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

Unit-4 GENDER-BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence

Unit-5 GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive LanguageJust Relationships

Prescribed Books

1. A.Suneetha, Uma Bhrugubanda, et al. *Towards a World of Equals: A Bilingual Textbookon Gender*‖, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. UK Paperback Edn. March 1990

Reference Books

1. Wtatt, Robin and Massood, Nazia, *Broken Mirrors: The dowry Problems in India,*London : Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), *Women in Developing Countries, Assessing Strategiesfor Empowerment,* London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., *Gender and Governance*, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, *Women and Politics World Wide*, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, *Gender Sensitization: Issues and Challenges* (English, Hardcover), Raj Publications, 2019
6. A.Revathy& Murali, Nandini, *A Life in Trans Activism*(Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Online Resources:

1. Understanding Gender

Chromeextension://kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/
kamla-gender1.pdf
https://onlinecourses.swayam2.ac.in/nou24_hs53/preview

2. Gender Roles and Relations

https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are gender-roles-and-stereotypes
https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our relationships-7499408
https://onlinecourses.swayam2.ac.in/cec23_hs29/preview

3. Gender and Labour

https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-andhow-can-it-be-redressed
https://onlinecourses.nptel.ac.in/noc23_mg67/preview

4. Gender-Based Violence

https://eige.europa.eu/gender-based-violence/what-is-gender-basedviolence?language_content_entity=en
https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and girls
https://onlinecourses.swayam2.ac.in/nou25_ge38/preview

5. **Gender and Culture**

https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/
https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/
https://archive.nptel.ac.in/courses/109/106/109106136/
Abdulali Sohaila. ―I Fought For My Life…and Won.‖Available online (at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/