



Mahatma Gandhi Mission's
COLLEGE OF ENGINEERING
Near Airport, Off Hingoli Road, Nanded-431605.
(An Autonomous Institute, Accredited by NAAC & NBA)

Department of Artificial Intelligence & Machine Learning

Curriculum for Second Year B.Tech Program

w.e.f.

Academic year 2026-27

(NEP- 2020 Compliant)

Dr. Archana Rajurkar
Head of the Department

Dr. Archana Rajurkar
Dean Academics

Dr. Geeta S. Lathkar
Director



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Program Outcomes [PO]

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and



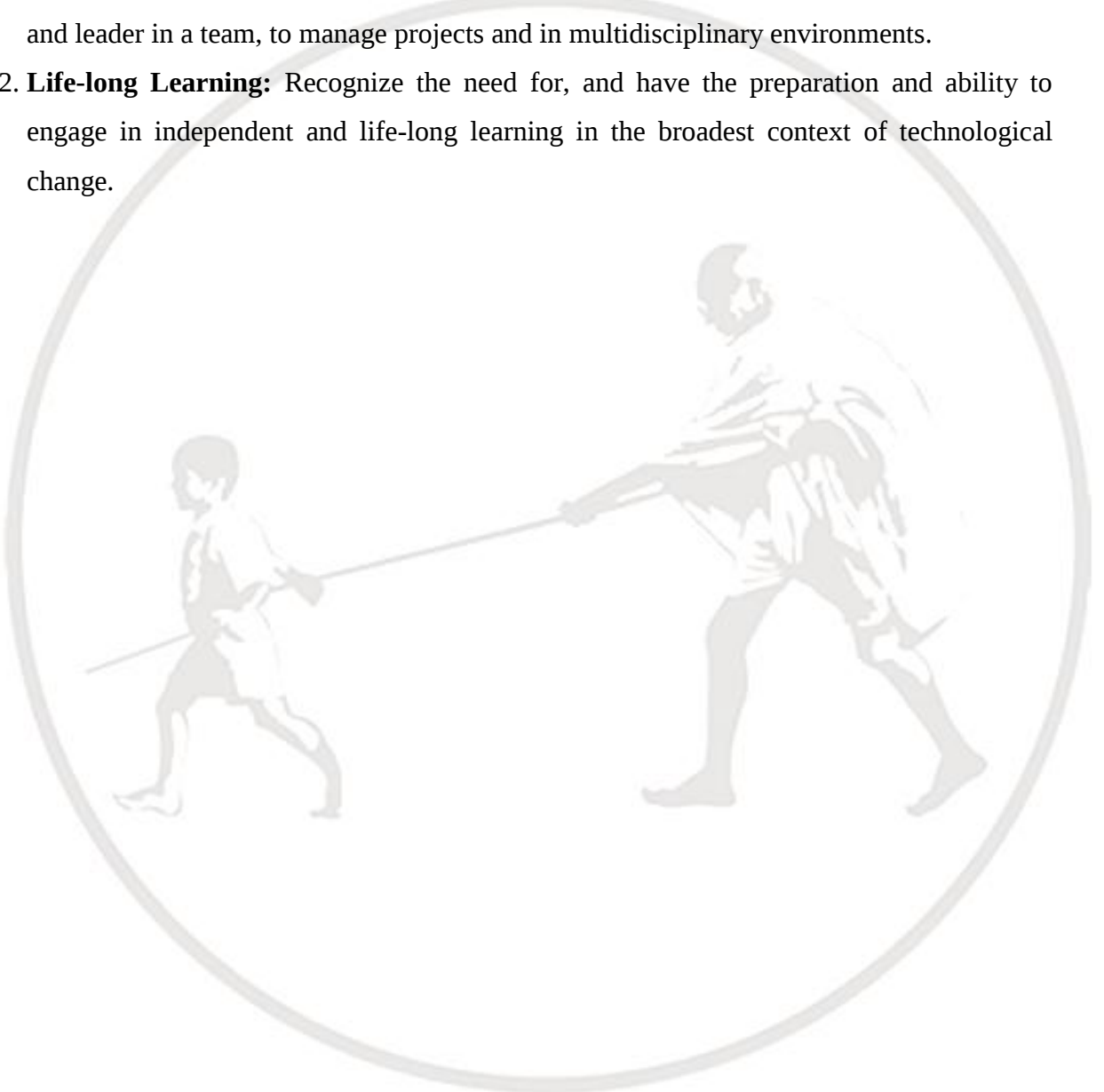
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write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.





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Curriculum of B. Tech in Artificial Intelligence & Machine Learning

Semester wise Credit distribution structure for Four Year UG Engineering Program -

One Major, One Minor

Course Category	Subcategory	Semesters								TOTAL Credits
		I	II	III	IV	V	VI	VII	VIII	
Basic Science Course	BSC/ESC	7	7							14
Engineering Science Course		8	11	3						22
Program Core Course (PCC)	Program courses			12	13	13	11	8		57
Program Elective Course (PEC)						2	5	5	6	18
Multi Disciplinary Minor (MDM)	Multi Disciplinary Courses			As per the respective MDM courses taken by the students. This is mandatory.						16
Open Electives (OE)				3	2	3				8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	2			1	1	1	2		7
AEC	Humanities /Social Science & Management (HSSM)	3				4	2			9
Entrepreneurship/Economics/Management Courses					2					2
Indian Knowledge System (IKS)			2							2
Value Education Course (VEC)				2	2					4
Research Methodology	Experiential Learning Courses						1			1
Community Engagement Project (CEP) / Field Project (FP)			2(OA)							0
Project							2	2		4
Internship/On Job Training					2(OA)		2(OA)		6	6
LLC/CC	Liberal Learning Courses	2	2	2						6
Total		22	22	22	20	23	22	17	12	160+16=176

(OA)These courses will be considered over and above 176 credit requirements of the degree.



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Department of Artificial Intelligence & Machine Learning

Semester wise Curriculum

(Effective from Academic Year 2026-2027)

Third Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	ESC	ESC-AIML-201	Mathematical Concepts for AI	3	-	20	30	50	100	3
2	PCC	PCC-AIML-202	Discrete Mathematics	3	-	20	30	50	100	3
3	PCC	PCC-AIML-203	Data Structure and Algorithms	3	-	20	30	50	100	3
4	PCC	PCC-AIML-204	Digital Systems & Microprocessor	3	-	20	30	50	100	3
5	MDM	MDM-AIML-205	Multidisciplinary Minor							
6	OE	MGM-OE-233	Open Elective-I	3	-	20	30	50	100	3
7	VEC	MGM-VEC-UHV-231	Universal Human Values-II	2	-	20	30	50	100	2
8	PCC Lab	PCCL-AIML-206	Object Oriented Programming using Java Lab (PBL)	-	2	50	-	50	100	1
9	PCC Lab	PCCL-AIML-207	Data Structure and Algorithms Lab	-	2	50	-	50	100	1
10	PCC Lab	PCCL-AIML-208	Digital Systems & Microprocessor Lab	-	2	50	-	50	100	1
11	CC	MGM-CC-AEL-232	Asian -European Languages A. German B. Spanish C. French D. Japanese E. Sanskrit	2	-	20	30	50	100	2
12	Internship	INT-FY-162	Internship-I (Social Internship)	-	-	50	-	50	100	2(OA)*
Total				19	6	340	210	550	1100	22

Note: PBL: Project Based Learning



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Fourth Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	PCC	PCC-AIML-251	Computer Networks	3	-	20	30	50	100	3
2	PCC	PCC-AIML-252	Introduction to Machine Learning	3	-	20	30	50	100	3
3	PCC	PCC-AIML-253	Database Systems	3	-	20	30	50	100	3
4	PCC	PCC-AIML-255	Data Analytics and Visualization	2	-	20	30	50	100	2
5	MDM	MDM-AIML-254	Multidisciplinary Minor							
6	OE	MGM-OE-283	Open Elective -II	2	-	20	30	50	100	2
7	VEC	MGM-VEC-CI-281	Constitution of India	2	-	20	30	50	100	2
8	PCC Lab	PCCL-AIML-256	Database system Lab	-	2	50		50	100	1
9	PCC Lab	PCCL-AIML-257	Computer Networks Lab	-	2	50		50	100	1
10	VSEC	VSECL-AIML-258	Python programming with ML Tools Lab(PBL)	-	2	50		50	100	1
11	HSSM	MGM-HSSM-ED-282	Entrepreneurship Development	2	-	20	30	50	100	2
12	INT	INT-AIML-259	Internship -II	-	-	-	-	-	-	2(OA)*
Total				17	6	290	210	500	1000	20

MDM: Multidisciplinary Minor, OE: Open Elective, OA: Over & Above, PBL: Project Based Learning

*Note: Student is expected to work for (two to four weeks, minimum four to five hours per day) in Industries /NGO/Govt. organizations on understanding/solving their problems/awareness programs (understanding the HR Processes, Products, Services and other issues related to program of study).



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(Effective from Academic Year 2027-2028)

Fifth Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	PCC	PCC-AIML-301	Artificial Intelligence	3	-	20	30	50	100	3
2	PCC	PCC-AIML-302	Operating Systems	3	-	20	30	50	100	3
3	PCC	PCC-AIML-303	Modern Computer Architecture	2	-	20	30	50	100	2
4	PCC	PCC-AIML-304	Software Engineering with MLOP	3	-	20	30	50	100	3
5	PEC	PEC-AIML-305	Program Elective -1	2	-	20	30	50	100	2
6	MDM	MDM-AIML-306	Multidisciplinary Minor							
7	OE	MGM-OE-332	Open Elective -III	3	-	20	30	50	100	3
8	PCC Lab	PCCL-AIML-307	Operating system Lab	-	2	50	-	50	100	1
9	PCC Lab	PCCL-AIML-308	Software Engineering with MLOP Lab	-	2	50	-	50	100	1
10	VSEC	VSECL-AIML-309	Forward Deployed Engineering Lab (PBL)	-	2	50	-	50	100	1
11	AEC	MGM-AEC-332	AI Tools & Prompt Engineering	1	2	50	-	50	100	2
12	AEC	MGM-AEC-QACT-331	Quantitative Aptitude, Data Interpretation and Logical Reasoning	2	-	20	30	50	100	2
13	INT	INT-AIML-259	Internship -II	-	-	50	-	50	100	2(OA)*
Total				19	8	390	210	600	1200	23

Note: PBL: Project Based Learning

Program Elective - I	PEC-AIML-305 A	Vector Databases
	PEC-AIML-305 B	Big Data Analytics
	PEC-AIML-305 C	Quantum Computing



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Sixth Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	PCC	PCC-AIML-351	AI Ethics & Responsible AI	3	-	20	30	50	100	3
2	PCC	PCC-AIML-352	Cryptography and Network Security	3	-	20	30	50	100	3
3	PCC	PCC-AIML-353	Deep Learning	3	-	20	30	50	100	3
4	PEC	PEC-AIML-354	Program Elective -II	3	-	20	30	50	100	3
5	PEC	PEC-AIML-355	Program Elective-III	2	-	20	30	50	100	2
6	VSEC	VSECL - AIML-357	Competitive Programming Lab	-	2	50	-	50	100	1
7	PCC Lab	PCCL- AIML-358	Cryptography and Network Security Lab	-	2	50	-	50	100	1
8	PCC Lab	PCCL- AIML-359	Deep Learning lab (PBL)	-	2	50	-	50	100	1
9	Project	PRO-AIML-360	Minor-Project	-	4	50	-	50	100	2
10	MDM	MDM-AIML-356	Multidisciplinary Minor							
11	AEC	MGM-AEC-VARD-381	Verbal Ability and Reading Comprehension	2	-	20	30	50	100	2
12	RM	RM-AIML-361	Seminar	-	-	50	-	50	100	1
13	INT	INT-AIML-362	Internship-III	-	-					2(OA)*
Total				16	10	370	180	550	1100	22

Note: PBL: Project Based Learning, OA: Over and Above

*Note: Student is expected to work for (two to four weeks, minimum four to five hours per day) in Industries /NGO/Govt. organizations on understanding/solving their problems/awareness programs (understanding the HR Processes, Products, Services and other issues related to program of study).

Program Elective - II	PEC-AIML-354 A	Natural Language Processing
	PEC-AIML-354 B	Social Network Analysis
	PEC-AIML-354 C	Robotics and Embedded AI
Program Elective - III	PEC-AIML-355 A	Block chain & AI
	PEC-AIML-355 B	Quantum Machine Learning
	PEC-AIML-355 C	Computer Vision and Image Processing



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Seventh Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	PCC	PCC-AIML-401	Cloud Computing for AI	3	-	20	30	50	100	3
2	PCC	PCC-AIML-402	Generative AI and LLM	3	-	20	30	50	100	3
3	PEC	PEC-AIML-403	Program Elective - IV	3	-	20	30	50	100	3
4	PEC	PEC-AIML-404	Program Elective - V	2	-	20	30	50	100	2
5	PCC Lab	PCCL-AIML-405	Cloud Computing & DevOps Lab	-	2	50		50	100	1
6	PCC Lab	PCCL-AIML-406	Generative AI and LLM Lab	-	2	50		50	100	1
7	VSEC	VSECL - AIML-407	API development (Flask/fast API) Lab (PBL)	1	4	50		50	100	2
8	Project	PRO-AIML-408	Major Project- I	-	4	50		50	100	2
9	INT	INT-AIML-362	Internship-III	-	-	50		50	100	2(OA)*
Total				12	12	330	120	450	900	17

Note: PBL: Project Based Learning

Program Elective - IV	PEC-AIML-403 A	Reinforcement learning
	PEC-AIML-403 B	High Performance Computing
	PEC-AIML-403 C	Cyber Physical Systems
Program Elective - V	PEC-AIML-404 A	Cyber security for AI Systems
	PEC-AIML-404 B	Edge AI & Tiny ML
	PEC-AIML-404 C	Financial AI and Algorithmic Trading



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Semester wise Curriculum

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Eighth Semester										
Sr. No.	Course Categories	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	PEC	PEC-AIML-451	Program Elective – VI (NPTEL)	3	-	20	30	50	100	3
2	PEC	PEC-AIML-452	Program Elective – VII(NPTEL)	3	-	20	30	50	100	3
3	Internship	INT-AIML-453	Internship-IV / Major Project-II	-	12	50	-	50	100	6
Total				6	12	90	60	150	300	12

Program Elective - VI	PEC-AIML-451 A.	Autonomous System
	PEC-AIML-451 B	Artificial Intelligence Search Methods for problem solving
	PEC-AIML-451 C	AI in Health care
Program Elective - VII	PEC-AIML-452 A	Pattern Recognition and Application
	PEC-AIML-452 B	Bio-Informatics: Algorithms and Applications
	PEC-AIML-452 C	Machine Learning For Soil And Crop Management



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Open Electives		
Course Code	Course Name	Semester
MGM-OE-233	Open Elective-I A. Product Design & Engineering B. Energy Conservation & Management C. Disaster Risk Detection and Management D. Agriculture Entrepreneurship Development E. Medical Informatics	III
MGM-OE-283	Open Elective-II A. Economics B. Biology for Engineers C. Sustainable Development Goals D. Industrial Safety E. Organizational Behavior	IV
MGM-OE-332	Open Elective-III A. Project Management B. Electric Vehicle Technology C. Drone Technologies D. Financial Accounting E. Introduction to Operation Research	V



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SEMESTER III



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Second Year Artificial Intelligence and Machine Learning (2026 Course)			
Semester III			
Course Title	Mathematical Concepts for AI		
Course Code	ESC-AIML-201		
Category	Engineering Science Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Prerequisite Courses, if any: Engineering Mathematics-I, Engineering Mathematics-II			
Course Objectives: 1. To learn linear algebra and advanced mathematical concepts for AI. 2. To understand the theory of uncertainty using probability. 3. To apply statistical and probabilistic methods for data analysis. 4. To develop analytical skills for solving AI and Machine Learning problems. 5. To understand mathematical models used in Machine Learning algorithms.			
Course Outcomes: After successful completion of the course, learner will be able to: CO1. Define linear independence, basis, dimensions and rank, and use these concepts to assess whether a system has a unique solution. CO2. Compute permutation and combination and use Bayes' theorem to update beliefs given new evidence. CO3. Apply the Binomial, Poisson and Normal Distributions. CO4. Compute descriptive statistics and use least-squares linear and multiple regression to relate input variable to output response. CO5. Examine mathematical techniques used in supervised and unsupervised learning problems. CO6. Design AI solutions using mathematical foundations and analytical thinking.			



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Unit No.	Unit Title & Contents	Hours
1	Linear Algebra Introduction to Vector Spaces, Subspaces, Linear Dependence and Linear Independence of vectors, Basis and dimensions of Vector spaces, Introduction to linear Transformation, Matrix representation relative to standard basis, kernel and range of Linear Transformation, Rank-Nullity Theorem, Diagonalization, LU Decomposition.	7
2	Probability Introduction to Permutation and Combination, Basic concepts of probability and its properties, Conditional Probability, Independent Events, Bayes' Theorem.	8
3	Probability Distributions Random Variables - Discrete and Continuous, Probability Mass Functions, Mathematical Expectation, Variance and PDF, Probability Distribution: Binomial, Poisson and Normal Distributions.	7
4	Statistics Measures of Central tendency – Mean Median, Mode, Measures of dispersion – Standard Deviation, Variance, Linear Regression, Curve fitting, Method of least square, Multivariate data analysis, Hypothesis Test: z-test, t-test, Chi-Square test.	7
5	Mathematical Foundations of Machine Learning Regression Models, Classification Concepts, Loss Functions, Bias-Variance Tradeoff, Distance Measures, Similarity Metrics, Principal Component Analysis (PCA), Dimensionality Reduction.	8
6	Advanced Mathematical Concepts for AI Information Theory, Entropy, Markov Chains, Graph Theory Basics, Fuzzy Logic, Mathematical Concepts in Deep Learning and Reinforcement Learning, Real-world AI Case Studies.	8



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Learning Resources

Text Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Mathematics for Machine Learning	M. P. Deisenroth, A. A. Faisal, and C. S. Ong	Cambridge, U.K.: Cambridge University Press	First	2020
2	Introduction to Probability and Statistics for Engineers and Scientists	S. M. Ross	Amsterdam, Netherlands: Elsevier/Academic Press	Sixth	2021
3	Linear Algebra	David Poole	Cengage Learning	Fourth	2002

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	The Elements of Statistical Learning: Data Mining, Inference, and Prediction	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	Second Edition	2009
2	Introduction to Probability and Statistics for Engineers and Scientists	Sheldon M. Ross	Elsevier / Academic Press	Sixth Edition	2021
3	Convex Optimization	Stephen Boyd, Lieven Vandenberghe	Cambridge University Press	First Edition	2004
4	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	First Edition	2012

MOOC/NPTEL Courses:

MOOC/NPTEL Courses:

1. NPTEL – Mathematics for Machine Learning
<https://nptel.ac.in/courses/106106213>
2. NPTEL – Probability and Statistics
<https://nptel.ac.in/courses/111105041>



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Second Year Artificial Intelligence and Machine Learning (2026 Course)			
Semester III			
Course Title	Discrete Mathematics		
Course Code	PCC-AIML-202		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Course Objectives: 1. To understand the fundamental mathematical concepts for Computer Science and Engineering. 2. To develop analytical thinking and logical reasoning skills for solving engineering and computational problems. 3. To apply mathematical structures such as sets, relations, functions, graphs and trees in computer science application. 4. To analyze the role of discrete mathematical concepts in algorithms, automata theory, cryptography and data structures. 5. To solve computational problems using combinatorics, recurrence relations and Boolean algebra techniques.			



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Course Outcomes:

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

- CO1.** Describe propositions, predicates, quantifiers and proof techniques used in discrete mathematical reasoning.
- CO2.** Apply sets, relations, functions and algebraic structures to solve discrete and computational problems.
- CO3.** Analyze graphs and trees for representing connectivity, traversal, and network-related problems in computer science.
- CO4.** Solve combinatorial problems using counting techniques, recurrence relations, and generating functions in algorithmic applications.
- CO5.** Interpret Boolean algebra and discrete mathematical structures for applications in digital logic, automata theory, cryptography, and data structures.

Unit No.	Unit Title & Contents	Hours
1	The Foundations: Logic and Proofs Propositional Logic, Compound Propositions, Logical Connectives, Propositional Equivalences, Converse, Contra-positive and Inverse, Tautology, Contradiction and Contingency, Predicates and Quantifiers, Rules of Inference, Introduction to proofs, Mathematical Induction, Normal Forms.	08
2	Basic Structures: Sets, Functions and Relations Sets: Introduction, Set Operations, Venn Diagrams. Cardinality of set, Power Set, Subsets. Functions: Introduction, Types of functions, Inverse Function, Composition of functions. Relations: Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Ordering, Hasse Diagram, Lattice.	08
3	Graph Theory Introduction to Graphs, Representation of Graphs, Types of Graphs,	08



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	Graph Isomorphism, Connectivity, Euler's and Hamilton Path and Circuits, Shortest Path Problems, The Travelling and Salesman Problem, Planner Graph, Graph Coloring, Applications of Graphs.	
4	Trees Introduction to Trees, Applications of Trees, Binary Tree, Tree Traversal, Spanning Trees: Breadth First Search and Depth First Search, Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Forest.	07
5	Counting Techniques Basics of Counting, The Pigeonhole Principle, Inclusion-Exclusion Principle, Recurrence Relations, Permutation and Combinations, Binomial Coefficient, Generating Functions.	07
6	Boolean Algebra and Algebraic Structures Boolean Algebra: Boolean Functions, Representing Boolean Functions, Boolean Rings. Algebraic Structures: Introduction, The structure of Algebras, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism, Rings and Fields.	07

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Discrete Mathematics and its Applications	Kenneth H. Rosen	Tata McGraw-Hill	Seventh	2012
2	Elements of Discrete Mathematics: A Computer Oriented Approach	C. L. Liu and D. P. Mohapatra	McGraw Hill	Fourth	2017



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Schaum's Outline of Discrete Mathematics	S. Lipschutz and M. Lipson	McGraw-Hill Education	Third	2007
2	Discrete Mathematical Structures with Applications to Computer Science	J. P. Tremblay and R. Manohar	McGraw-Hill Education	Second	2004
3	Discrete Mathematics for Computer Scientists and Mathematicians	J. L. Mott, A. Kandel, and T. P. Baker	Prentice Hall	Second	2005

MOOC/NPTEL Courses:

Discrete Mathematics by Prof. Sudarshan Iyengar, IIT Ropar.

Link : https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs137



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Second Year Artificial Intelligence and Machine Learning			
Semester III			
Course Title	Data Structure and Algorithms		
Course Code	PCC-AIML-203		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Course Objectives: 1. To explain fundamental algorithm design, analysis, and performance evaluation concepts using asymptotic notations 2. To solve computational problems by applying algorithmic paradigms such as divide-and-conquer, greedy, dynamic programming 3. To Implement algorithms for searching, sorting, shortest path, matrix operations, and combinatorial optimization, and evaluate their time and space complexity. 4. To compare algorithmic strategies for problem-solving and justify the choice of technique based on efficiency and problem constraints. 5. To classify problems into complexity classes P, NP, and NP-complete.			
Course Outcomes: After successful completion of the course, learner will be able to: CO1 : Formulate the algorithms and compute the time and space complexity of an Algorithm. CO2 : Apply linear data structures to build the applications. CO3 : Design the data structures to implement trees and graph. CO4 : Understand searching and sorting algorithms. CO5 : Apply principle of Dynamic Programming and Greedy Algorithms to solve optimization problems. CO6 : Classify problems into complexity classes P, NP and NP complete.			



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Unit No.	Unit Title & Contents	Hours
1	Introductory Concepts: Algorithm definition ,properties Algorithm Analysis, Time Complexity, Space Complexity, Asymptotic Notation Big O, Big θ Big Ω : Best, average, and worst-case analysis. Introduction to Data structures: Types of data structures, Abstract Data Types (ADTs).	08
2	Linear Data Structures Linear data structures,1D array, list and vector, 2D matrices and tables of objects, Linked lists and its various operations, Stack, Stack operations, Stack Applications, Queue and its operations.	07
3	Trees and Graph Binary trees: Representation and operations. Variations of binary tree: Binary search tree, Height balanced search tree, Heap tree. Graph: Structure, representation and operations, Graph Traversal: Breadth First Search, Depth First Search.	08
4	Searching and Sorting Divide and Conquer, Recurrence, masters method. Searching: Binary Search, Hashing. Sorting: Insertion Sort, Merge-sort, Quick sort, Heap sort.	07
5	Algorithm techniques: Dynamic Programming: Elements of dynamic Programming, Longest common sub sequence Problem, Matrix Chain multiplication, Bellmen –Ford Algorithm. Greedy Algorithms: Elements of the greedy strategy, Huffman coding, Activity selection problem, Knapsack problem, Primes Algorithm, Kruskals Algorithm.	08
6	NP complexity theory: P, NP, NP-hard and NP-complete class of problems, NP complete theory, Cliques problem.	07



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Learning Resources

Text Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Classic Data Structures	Debasis Samanta	Prentice Hall India	Second	2008
2	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein	The MIT press, Cambridge, Massachusetts, London	Fourth	2022

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Algorithm Design – Foundation, Analysis & Internet Examples,	Michel Goodrich, Roberto Tamassia	John Wiley	First	2001
2	Algorithms in a Nutshell, A Practical Guide	George T. Heineman, Gary Pollice, Stanley Selkow,	O'Reilly Media,	Second	2016

MOOC/NPTEL Courses:

Data Structure and Algorithms

https://onlinecourses.nptel.ac.in/e-learning/preview/noc_cs162



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Digital Systems & Microprocessor		
Course Code	PCC-AIML-204		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Course Objectives: 1. To acquaint the students with the fundamental principles of two-valued logic and various devices to implement logical operations on variables. 2. To understand the principles of asynchronous counters and design them to meet specific counting requirements 3. To provide a foundation for analyzing and addressing practical problems in arithmetic operations, code conversion, counter applications, and diverse digital logic scenarios. 4. To understand how to interface microprocessors with memory and peripheral devices. 5. To design microprocessor-based systems for measurement and control applications			



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Course Outcomes:

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

- CO1.** Comprehend and simplify Boolean expressions using logic gates, and analyze number systems and codes.
- CO2.** Design and implement arithmetic circuits (adders, subtractors), multiplexers, flip-flops, registers, and counters.
- CO3.** Outline the internal architecture, pin configurations, and bus operations of standard processors. (8086).
- CO4.** Write assembly language programs, understand addressing modes, and utilize the instruction set to execute mathematical and logical operations.
- CO5.** Design systems by interfacing microprocessors with external peripheral chips (e.g., 8255 PPI, 8253 Timer) and memory modules.

Unit No.	Unit Title & Contents	Hours
1	Introduction Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, Number Systems: binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.	08
2	Combinational Digital Circuits Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions, Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, parity checker / generator.	07
3	Sequential circuits and systems 1-bit memory, the clocked SR flip flop, J-K, T and D-types of flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter,	08



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	ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, applications of counters.	
4	Fundamentals of Microprocessors Fundamentals of Microprocessor, Comparison of 8-bit, (8085) 16-bit (8086), and 32-bit microprocessors (80386), The 8086 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, 8086 Pin configuration, 8086 Modes: Minimum & Maximum mode.	08
5	Microprocessor Interfacing Even & Odd Memory Banks, Memory Segmentation, Memory Interfacing, I/O Interfacing, Interrupts in 8086.	07
6	Microprocessor Instruction Set & Programming 8086 Instruction Set and Programming: Addressing modes, Instruction timings, Instruction types: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instruction, Assembly language programs, Assemblers and compilers, Programming and debugging tools.	07

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Modern Digital Electronics	R.P. Jain	McGraw-Hill	Fifth	2021
2	Microprocessor Architecture, Programming and Applications	Ramesh S Gaonkar	Penram International Publishing	Sixth	2013



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Digital logic and Computer design	M. M. Mano	Pearson Education India	Third	2016
2	Fundamentals of Digital Circuits	A. Anandkumar	Prentice Hall of India	Third	2016
3	Microprocessors and Interfacing	Douglas Hall	McGraw-Hill Publication	Revised Second Edition	2006



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Second Year Artificial Intelligence and Machine learning			
Semester III			
Course Title	Universal Human Values		
Course Code	MGM-VEC-UHV-231		
Category	Value Education Course		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To understand value education, self-exploration, happiness, prosperity, and basic human aspirations. 2. To distinguish the needs of the self and body and achieve harmony between them. 3. To understand Harmony in family and society through trust and respect in human relationships. 4. To understand Interrelationship among the four orders of nature for sustainable and peaceful coexistence. 5. To understand Human values in professional ethics, decision-making, and value-based living.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand the overview of value education. CO2: Explore the concept of harmony in human being as self and body. CO3: Acquire the depth knowledge of harmony in the Family and society. CO4: Identify harmony in the nature/existence. CO5: Analyze professional ethics to present the sustainable solutions CO6: Apply universal human values and ethics for responsible and sustainable living.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Value Education Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity, the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations.	05
2	Harmony in the Human Being Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to Ensure self-regulation and Health.	05
3	Harmony in the Family and Society Harmony in the Family, the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.	05
4	Harmony in the Nature (Existence) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, and The Holistic Perception of Harmony in Existence.	05
5	Foundations of Holistic Understanding and Human Values Implications of Holistic Understanding – A Look at Professional Ethics, Natural Acceptance of Human Values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order.	05



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6	Professional Ethics and Value-Based Practices Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies on Professional Ethics and Human Values ,Strategies for Transition towards a Value-Based Life and Profession	05
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Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books	Second	2019

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	JeevanVidya: EkParichaya	A Nagaraj	JeevanVidya Prakashan, Amarkantak	Fourth	1999
2	Human Values	A.N. Tripathi	New Age Intl. Publishers, New Delhi	Third	2004

MOOC/NPTEL Courses:

• Universal Human Values for Higher Education (Monograph & Course Content) https://uhv.org.in/highereducation • AICTE UHV-II: Understanding Harmony and Ethical Human Conduct https://uhv.org.in/UHV-II_Course_Material
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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Object Oriented Programming using JAVA Lab (Project Based Learning)		
Course Code	PCCL-AIML-206		
Category	Program Core Course Lab		
Scheme and Credits	L	P	No. of Credits
		2	1
Prerequisite Courses: Programming Fundamentals, Basic C Programming			
Course Vision (Project-Based Learning Approach) This laboratory course is designed using a Project-Based Learning (PBL) methodology where students progressively build Java applications through hands-on practical assignments and mini-projects. The course emphasizes problem-solving, object-oriented software development, GUI application design, and real-world programming practices using Java technologies. Students will work individually and in teams to design, implement, test, and present Java-based applications integrating OOP concepts, exception handling, multithreading, file handling, and GUI development.			



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Course Objectives:

The course aims to enable students to:

1. Understand and apply object-oriented programming concepts using Java.
2. Design and implement Java programs using classes, objects, inheritance, polymorphism, interfaces, packages, and collections.
3. Develop GUI-based applications and apply exception handling, multithreading, and event-driven programming concepts.
4. Implement file handling techniques and develop robust Java applications following good programming practices.
5. Develop mini-projects using Java technologies to enhance problem-solving, debugging, teamwork, and software development skills through project-based learning.

Course Outcomes:

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

- CO1:** Develop Java programs using basic object-oriented programming concepts such as classes, objects, constructors, and methods.
- CO2:** Implement inheritance, polymorphism, interfaces, and packages in Java applications.
- CO3:** Apply exception handling, multithreading, and file handling techniques in Java programs.
- CO4:** Design GUI-based applications using Java Swing and event handling concepts.
- CO5:** Develop real-world Java mini-projects using object-oriented software development practices.



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Java and Development Environment Introduction to Java, features of Java, JVM, JDK, JRE, installation and configuration of Java environment, IDE setup, structure of Java program, data types, variables, operators, input/output operations, control structures, introduction to classes and objects. Practical Activities 1. Installation and configuration of JDK and IDE. 2. Programs on operators and control statements. 3. Programs using classes and objects.	04
2	Constructors, Methods, and Encapsulation Constructors, constructor overloading, methods, method overloading, static keyword, this keyword, access modifiers, encapsulation, packages, arrays and strings in Java. Practical Activities 1. Programs on constructors and method overloading. 2. Programs using arrays and strings. 3. Package creation and usage.	04
3	Inheritance, Interfaces, and Polymorphism Inheritance types, method overriding, runtime polymorphism, abstract classes, interfaces, dynamic method dispatch, packages and reusability concepts. Practical Activities 1. Programs on inheritance. 2. Interface and abstract class implementation. 3. Runtime polymorphism applications.	05
4	Exception Handling and File Handling Types of exceptions, try-catch-finally block, throw and throws keywords, user-defined exceptions, file handling using File classes, byte streams and	05



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	character streams. Practical Activities 1. Exception handling programs. 2. User-defined exception programs. 3. File handling applications.	
5	Multithreading and GUI Programming Introduction to threads, thread lifecycle, thread creation methods, synchronization, Java Swing components, layouts, event handling, listeners, GUI application development. Practical Activities 1. Multithreading programs. 2. Synchronization examples. 3. GUI applications using Swing. 4. Event handling programs.	06
6	Mini Project Development using Java Project planning, requirement analysis, modular programming, GUI integration, exception handling integration, file/database connectivity basics, testing and debugging, project documentation and presentation. Practical Activities 1. Mini-project design and implementation. 2. Project testing and debugging. 3. Project presentation and report preparation. Suggested Mini Projects • Library Management System • Student Attendance System • Online Quiz Application • Inventory Management System • Hospital Management System • Banking Application	06



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	Employee Management System Team-based real-world Java application development with presentation and demonstration.	
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Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Java: The Complete Reference	Herbert Schildt	McGraw-Hill Education	Twelfth	2021
2	Programming with Java	E. Balagurusamy	McGraw-Hill Education India	Sixth	2019

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Core Java Volume I – Fundamentals	Cay S. Horstmann	Pearson Education	Twelfth	2021
2	Head First Java	Kathy Sierra and Bert Bates	O'Reilly Media	Third	2022
3	Java How to Program	Paul Deitel and Harvey Deitel	Pearson	Eleventh	2018
4	Introduction to Java Programming and Data Structures	Y. Daniel Liang	Pearson Education	Twelfth	2019

MOOC/NPTEL Courses:

1. Programming in Java — By Debasis Samanta, Indian Institute of Technology Kharagpur through NPTEL / SWAYAM. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs36 2. Programming in Java — Archived NPTEL Course by Debasis Samanta. Course Link: https://onlinecourses-archive.nptel.ac.in/noc19_cs07/preview 3. NPTEL – Programming in Java https://nptel.ac.in/courses/106105191?utm_source



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Virtual LAB Links:

1. <https://java-iitd.vlabs.ac.in/List%20of%20experiments.html>
2. <https://oop-amrt.vlabs.ac.in/List%20of%20experiments.html>

Laboratory Requirements:

Students shall perform all laboratory assignments using Java Development Kit (JDK) and an Integrated Development Environment (IDE) such as Eclipse, NetBeans, or IntelliJ IDEA. The laboratory work involves object-oriented programming, packages, inheritance, interfaces, exception handling, file handling, multithreading, and GUI development using Java Swing.

During the first laboratory session, students shall form project groups, identify a suitable application domain, and initiate the design and development of a mini-project. The mini-project shall be progressively enhanced by incorporating the concepts learned through the practical assignments performed during the semester. Students are expected to maintain proper documentation, source code, and project reports for evaluation.

List of All Practical Assignments to be Performed

1. Install and configure the Java Development Kit (JDK) and Integrated Development Environment (IDE) for Java application development.
2. Develop Java programs demonstrating the concepts of classes and objects.
3. Implement Java programs using constructors and method overloading techniques.
4. Develop Java applications to demonstrate different types of inheritance and method overriding.
5. Implement programs using abstract classes and interfaces to achieve abstraction in Java.
6. Create and use packages in Java programs for modular and reusable application development.
7. Develop Java programs using exception handling mechanisms such as try, catch, finally, throw, and throws.
8. Implement file handling applications using byte streams and character streams in Java.
9. Develop multithreading applications demonstrating thread creation, synchronization,

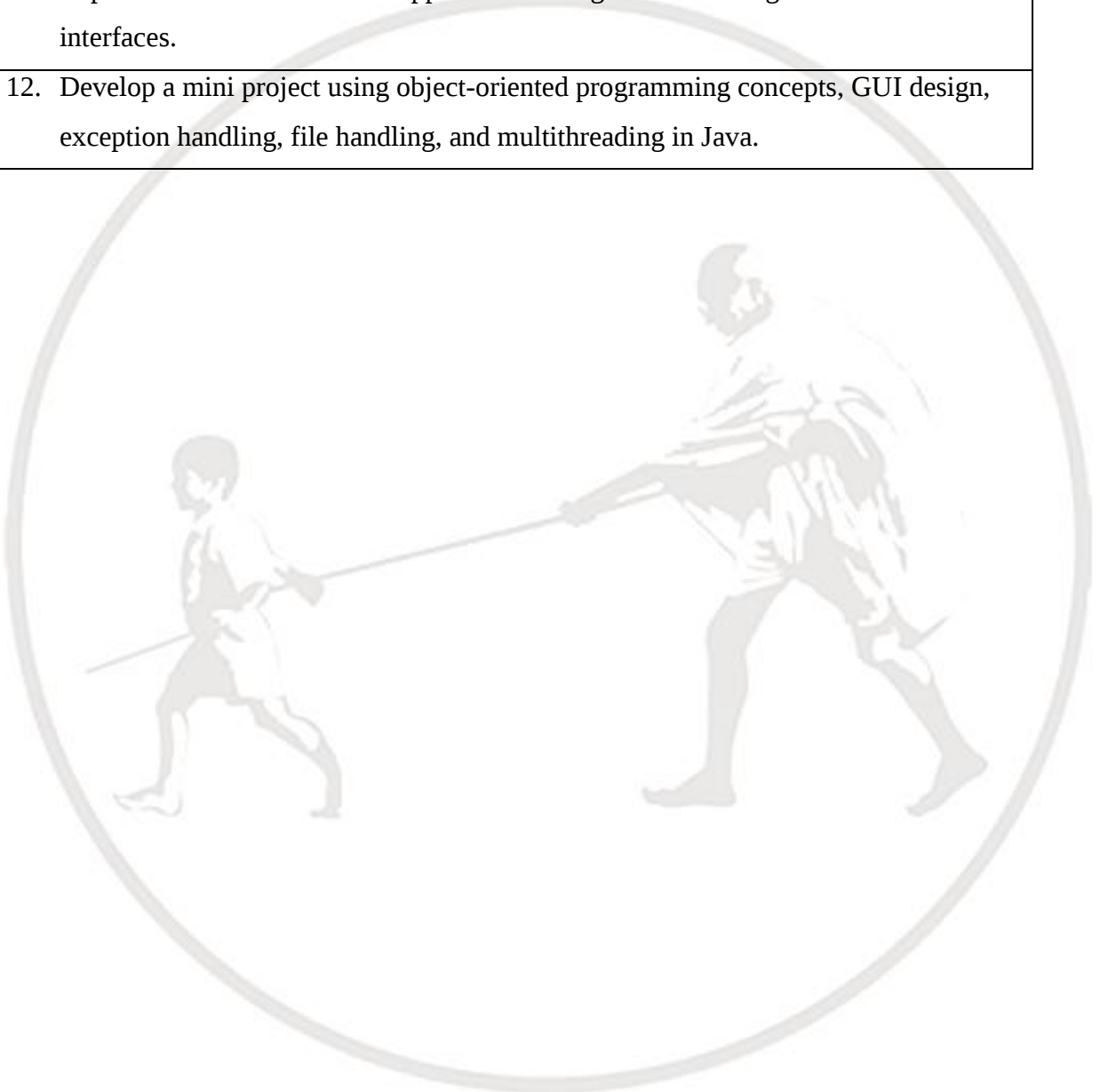


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and thread lifecycle management.
10. Design and develop GUI-based applications using Java Swing components and layout managers.
11. Implement event-driven Java applications using event handling and listener interfaces.
12. Develop a mini project using object-oriented programming concepts, GUI design, exception handling, file handling, and multithreading in Java.





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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Data Structure and Algorithms Lab		
Course Code	PCCL-AIML-207		
Category	Program Core Course Lab		
Scheme and Credits	L	P	No. of Credits
	-	2	1
Prerequisite Course(s), if any: Programming for Problem Solving using C			
Companion Course, if any: Data Structures and Algorithms (Theory)			
Course Objectives: The course aims to enable students to: 1. Understand and implement fundamental linear and non-linear data structures for efficient data storage and manipulation. 2. Develop problem-solving skills using various searching, sorting, and graph traversal techniques. 3. Apply appropriate algorithm design strategies such as Divide and Conquer, Dynamic Programming, and Greedy Methods to solve computational problems. 4. Analyze the performance and efficiency of data structures and algorithms in terms of time and space complexity. 5. Design and implement practical solutions to real-world problems using suitable data structures and algorithmic approaches.			



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Course Outcomes (COs)

- CO1:** Demonstrate the operations of fundamental linear data structures such as arrays, stacks, queues, and linked lists for efficient data storage and manipulation.
- CO2:** Construct non-linear data structures including binary trees and binary search trees, and perform tree traversals for efficient data organization and retrieval.
- CO3:** Develop solutions using stack applications and graph traversal techniques for solving computational problems.
- CO4:** Analyze searching and sorting algorithms to improve computational efficiency and problem-solving capabilities.
- CO5:** Apply algorithm design techniques such as Dynamic Programming, Greedy Methods, and Graph Algorithms to solve optimization and shortest-path problems.

Laboratory Requirements

Students shall perform all laboratory assignments using C. The laboratory exercises involve Implementation of linear data structures such as linked list stack, queues and nonlinear data structures like binary tree and graph. It also involves implementation of algorithm techniques such as dynamic programming, greedy methods and graph algorithms. During the laboratory session, students shall perform practical assignment listed below.

List of Practical Assignments to be Performed

Any ten practical assignments shall be performed from the list given below.

1	1-D and 2-D arrays and its operations
2	Stack operations and queue
3	Stack applications Infix to post-fix
4	Queue and queue operations
5	Linked lists and its operations
6	Binary trees and tree traversal
7	Breadth First Search / Depth First search for given graph
8	Binary search tree
9	Merge sort/ Quick sort



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10	Heap sort
11	Longest Common Subsequence by dynamic programming
12	Huffman Coding by Greedy algorithms
13	Prim's algorithm for MST /Kruskals algorithm for MST
14	Bellman-Ford algorithm for single source shortest path.
15	Disjktra's Algorithm

Virtual Lab Links
1. Data Structures – I: https://ds1-iiith.vlabs.ac.in/
2. Data Structures – II: https://ds2-iiith.vlabs.ac.in/
3. Design and Analysis of Algorithms Virtual Lab: https://daa-dei.vlabs.ac.in/



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Digital Systems & Microprocessor Lab		
Course Code	PCCL-AIML-208		
Category	Program Core Course Lab		
Scheme and Credits	L	P	No. of Credits
	-	2	1
Prerequisite Courses, if any: A foundational understanding of electronic circuits, Computer Fundamentals and Low Level Programming.			
Companion Course ,if any: Digital Electronics & Microprocessor(PCC-CSE-204)			
Course Objectives: The course aims to enable students to: 1. Understand basic electronic components, logic gates, and Boolean simplification. 2. Learn to analyze and design combinational and sequential circuits on breadboard. 3. Explore the internal organization, pin configurations, and registers of standard microprocessors. 4. Develop assembly language programs and interface microprocessors with memory.			
Course Outcomes: After successful completion of the course, students will be able to: CO1. Identify digital Integrated Circuits (ICs), test their parameters, and verify truth tables. CO2. Construct, build, and troubleshoot combinational blocks such as adders, multiplexers, and decoders. CO3. Analyze and verify the behavior of sequential circuits including flip-flops and counters. CO4. Write, debug, and execute basic assembly language programs.			



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Laboratory Requirements:

Students should perform eight to ten experiments from the list using Digital ICs, Breadboards, Connecting Wires, LEDs, Power Supply and computers equipped with assembler/emulator software for assembly language programming.

List of experiments to be performed

1. Study of gates – AND; OR; NOT; NAND; NOR; EX-OR; EX-NOR
2. Verification of Boolean Theorems using basic gates- De-Morgan's Theorem for 2 variables.
3. Design and implement the Half Adder and Full Adder using basic logic gates.
4. Logic Function Generator using Multiplexer & Decoder
5. To verify the truth tables of S-R; J-K; T and D type flip flops.
6. Design, and Verify the 4- Bit Synchronous Counter.
7. Design, and Verify the 4-Bit Asynchronous Counter.
8. Study of 8086 Instruction Set
9. Write a assembly language program to implement the addition of series of numbers
10. Write a assembly language program to implement to find out no of even and odd nos. / positive and negative nos. from a series of 16-bit nos.
11. Write a assembly language program to implement Moving a block of 50 words from data segment to extra segment
12. Write a assembly language program to implement arrange a series of 16-bit nos. in ascending/ descending order.
13. Write a assembly language program to implement Convert 0-9 BCD to equivalent 7-segment code using look up table.

Virtual LAB Links:

<https://de-iitr.vlabs.ac.in/>



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Asian-European Language : German		
Course Code	MGM-CC-AEL-232A		
Category	CC		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To introduce the students to Germany as an education hub and career destination. 2. To introduce the basic structure of German Language. 3. To make the students understand the character set of German. 4. To understand the German culture. 5. To understand basic vocabulary. 6. To understand basic grammar.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand the basic info about Germany for job/ higher education. CO2: Understand basic German alphabets. CO3: Know additional symbols and alphabet combinations. CO4: Learn German phonetic rules and exceptions. CO5: Learn basic vocabulary, grammar, and self-introduction in German.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to German Language Definition and importance of language, Structure of German Language, Basic Info about Germany, German Alphabet – 1.	06
2	Alphabets and Greetings German Alphabet – 2, Vocabulary- 1 basic Greetings, Self introduction, Vocabulary 2, Weekdays , months etc, Grammar 1 The articles.	06
3	Basic Vocabulary and Numbers Vocab – Family, Professions, Numbers -1, Numbers- 2, Ordinal numbers.	06
4	Basic Grammar and Reading Time reading, Grammar – Personal Pronouns, Vocab – Job, modes of Transport, Vocab – Colours.	06
5	Sentence Formation Sentence structure, Declarative sentences, Interrogative -A – WH Questions, Interrogative -B – yes/no questions.	06

Learning Resources

Text Books :

Sr. No.	Title	Authors	Publisher	Edition	Year
1	Studio D A1	Bettermann, Christel; Demme, Silke; Funk, Hermann; Kuhn, Christina; Werner, Regina	Goyal Publishers & Distributors, ISBN-13 : 9783464207321	NA	2005
2	Netzwerk1 A1	Stefanie Dengler	Goyal Publishers & Distributors, ISBN-10: 8183076963	NA	2012



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Tech Yourself	Paul Coggle, Heiner Schenke	Teach Yourself, ISBN-10 : 1444177362	NA	2012
2	Towards Germany	Deutscher Sachverständiger	Lingo Mastery, ISBN-10: 1951949552	NA	2022

MOOC/NPTEL Courses:

Sr.No.	NPTEL Courses Name	Instructor	Host Institute
1	Introduction to German Language	Jenny	Lingoni German (Youtube) https://youtu.be/gz9JbZcfnrk?si=GnMsop4du_UrtJlh



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Asian-European Language: Spanish		
Course Code	MGM-CC-AEL-232B		
Category	CC		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To introduce the students to Spain as an education hub and career destination. 2. To introduce the basic structure of Spanish language. 3. To make the students understand the character set of Spanish. 4. To understand the Spanish culture. 5. To understand basic vocabulary. 6. To understand basic grammar.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand the basic info about Spain for job/ higher education. CO2: Understand basic Spanish Alphabets. CO3: Know additional symbols and alphabet combinations. CO4: Learn Spanish phonetic rules and exceptions. CO5: Learn basic vocabulary, grammar, and self-introduction in Spanish.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Spanish Language Use and importance of language, Basic information about Spain, Sentence structure of Spanish Language, Informal introduction.	06
2	Alphabet and Basic Grammar Spanish alphabet – 1:Salutation and expression, Subject pronouns, Verb Ser.	06
3	Basic Vocabulary and Asking Questions Negation,Vocabulary, Professions, Asking question using '¿Qué?', Asking and telling first-name and last-name.	06
4	Genders and Articles Use of the question ¿Quién es? / ¿Qué hace? etc., Cardinal numbers 1-20, Noun: Gender and number, Articles: Definite.	06
5	Adjectives and Numbers Adjective: Gender and number, Nationality and Country name, Numbers 21-100, Adjective: Demonstrative.	06

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Aula-1	Jaime Corpas, Eva Garcia, Agustin Garmendia	Goyal Publishers & Distributors Pvt Ltd , ISBN13: 9788415640097	Level: A1	2021
2	Chicoschicas 1	Maria Angeles Palomino	Edelsa, ISBN-10 : 8477117728	NA	2002



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Spanish made easy	Alex Martinez	Goyal Publishers & Distributors Pvt Ltd , ISBN-13: 9788183070942	NA	2002

MOOC/NPTEL Courses:

Sr No.	NPTEL Courses Name	Instructor	Host Institute
1	Basics of Spanish Language and Culture-I	Mr. Vikash Kumar Singh	Indira Gandhi National Open University https://onlinecourses.swayam2.ac.in/e-learning/preview/nou22_lg12



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Asian-European Language: French		
Course Code	MGM-CC-AEL-232C		
Category	CC		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To introduce the students to French as an education hub and career destination. 2. To introduce the basic structure of French language. 3. To make the students understand the character set of French. 4. To understand the French culture. 5. To understand basic vocabulary. 6. To understand basic grammar.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand the basic info about French for job/ higher education. CO2: Understand basic French Alphabets. CO3: Know additional symbols and alphabet combinations. CO4: Learn French phonetic rules and exceptions. CO5: Learn basic vocabulary, grammar, and self-introduction in French.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to French Language Definition and importance of language, Structure of French Language, Basic Info about French, French Alphabets.	06
2	Greeting and Self Introduction Basic Greetings, Self introduction, Weekdays , months etc, Grammer 1 The articles.	06
3	Basic Vocabulary and Numbers Vocab – Family, Professions, Numbers , Ordinal numbers.	06
4	Basic Grammar and Reading Time reading, Grammar – Personal Pronouns, Vocab – Job, modes of Transport, Vocab – Colours.	06
5	Sentence Formation Sentence structure, Declarative sentences, Interrogative -A – WH Questions, Interrogative -B – yes/no questions.	06

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Alter Ego A1 & Alter Ego D'Activites	Hachette	Goyal Publishers & Distributors Pvt Ltd, ISBN-10: 8183075452	Level:A1	2013
2	Saison Method de Francais 1 A1	Marie-Noëlle Cocton Anneline Dintilhac Anouchka Oliveira Delphine Ripaud Dorothee Dupleix	Didier Publisher, ISBN : 9782278112708	Level:A1	2024



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Echo Method de Francais A1	Jacques Pecheur & Jacky Girardet	Goyal Publishers & Distributors Pvt Ltd, ISBN-13: 9782090385885	Level:A1	2013
2	A Propos Livre de l'eleve	Christine Andant	French and European Publications Inc, ISBN 13: 9782706122866	Level:A1	2015

MOOC/NPTEL Courses:

Sr. No.	NPTEL Courses Name	Instructor	Host Institute
1	Foundations of French	Ramya Jagannathan	IIM Bangalore https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg88



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Asian-European Language: Japanese		
Course Code	MGM-CC-AEL-232D		
Category	CC		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To introduce learners to basic Japanese language structure, vocabulary, and sentence formation. 2. To develop beginner-level listening, speaking, reading, and writing skills in Japanese. 3. To enable students to understand and use common daily expressions and greetings in Japanese. 4. To familiarize learners with Hiragana, Katakana, and essential Kanji characters required for JLPT N5. 5. To prepare students for elementary-level Japanese communication and the JLPT N5 examination.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand and use basic Japanese greetings, expressions, and sentence patterns in daily Communication. CO2: Read and write Hiragana, Katakana, and simple Kanji characters accurately. CO3: Apply elementary Japanese grammar rules to form correct sentences. CO4: Comprehend short Japanese conversations and simple written passages. CO5: Demonstrate beginner-level proficiency required for the JLPT N5 examination.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Japanese Language and Scripts Hiragana & Katakana - Reading Writing, and Basic Pronunciation, Greetings, Self-Introduction, Numbers, Days of the Week, Months.	06
2	Basic Grammar and Sentence Formation Particles {wa, ga, no ,ni}, Basic usage and sentence structure, Introduction to basic verbs, Present tense and negative form.	06
3	Numbers and Basic Vocabulary Describing things: Nouns + 1/0, Using negative/positive, Basic shopping vocabulary.	06
4	Types of Grammar Describing people and objects using adjectives, Types Grammar: Question words {nan, itsu, doko, donna} and asking questions.	06
5	Asking Questions and Practice Grammar: Question words {nan, itsu, doko, donna} and asking questions, Verb conjugation: Dictionary form and (te) form, Mock tests, Speaking practice, revision, mini quiz and vocabulary drills.	06

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Minna no Nihongo 1-1	3A Corporation	Goyal Publishers, ISBN-10: 8183071708	First	2007
2	Genki I: An Integrated Course in Elementary Japanese	Eri Banno, Yoko Ikeda, Yutaka Ohno, Chikako Shinagawa, Kyoko Tokashiki	Japan Times Publishing, Ltd., ISBN-13 : 978-4789017305	Third	2020



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MOOC/NPTEL Courses:

Sr. No.	NPTEL Courses Name	Instructor	Host Institute
1	Introduction to Japanese Language and Culture	Prof. Vatsala Misra, IIT Kharagpur	https://nptel.ac.in/courses/121104005





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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Asian-European Language: Sanskrit		
Course Code	MGM-CC-AEL-232E		
Category	CC		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: To make students understand: 1. The historical, cultural, and literary heritage preserved in ancient Sanskrit texts such as the Vedas, Upanishads, Ramayana, Mahabharata, and Puranas. 2. Develop fundamental knowledge of Sanskrit language, grammar, vocabulary, and sentence construction. 3. Acquire proficiency in reading, reciting, comprehending, and interpreting Sanskrit texts, verses, and stories. 4. Apply Sanskrit grammatical principles, number systems, and verb conjugations in written and spoken communication. 5. Enhance Sanskrit writing skills using traditional and modern scripts while appreciating the relevance of Sanskrit literature in contemporary knowledge systems.			



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Course Outcomes:

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

- CO1:** Explain the cultural, literary, and philosophical contributions of major Sanskrit texts including Ramayana, Mahabharata, Vedas, Upanishads, and Puranas.
- CO2:** Read, recite, comprehend, and summarize simple Sanskrit texts, verses, stories, and literary passages with proper pronunciation and accent.
- CO3:** Apply Sanskrit grammar, numbers, time expressions, noun forms, and verb conjugations to construct grammatically correct sentences.
- CO4:** Analyze and interpret selected Sanskrit literary works such as Panchatantra, Hitopadesha, and various forms of Kāvya to derive moral and cultural insights.
- CO5:** Demonstrate Sanskrit writing skills by composing simple texts, messages, and letters using appropriate grammatical structures and writing conventions.

Unit No.	Unit Title & Contents	Hours
1	Cultural Aspect Overview of आर्षमहाकाव्यम् – रामायणम् and महाभारतम्, Overview of वेद, ब्राह्मण, उपनिषद and वेदाङ्ग, Overview of पुराण – अष्टादशपुराणानि, Read and comprehend from simple texts/paragraphs, Summarizing the main points of the given texts.	06
2	Sanskrit numbers and sentence structure संस्कृतवर्णानां परिचयः– माहेश्वरसूत्राणि, उच्चारणस्थानानि, Apply सङ्ख्या (Numbers) and समयम् (Time) in sentence, Introduction to नामरूपाणि – Words related to Engineering – स्वरान्तशब्द, Introduction to verb conjugation (लट्, लङ्, लृट्, लोट्, विधिलिङ्) -1,4,6,10 गण – धातुरूपाणि	06



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3	Sanskrit grammar Introduction to Sanskrit Alphabets, word and sentence, Writing simple text, short messages, letters on given topics, Correct errors in given texts, Solving grammar exercises to get elementary level sentence structure in Sanskrit.	06
4	Enhancing proficiency in Sanskrit reading through उपजीव्यसाहित्य Overview of various kinds of काव्यम् – नीतिकाव्यम्, गीतिकाव्यम्, स्तोत्रसाहित्यम्, चम्पूकाव्यम्, Overview of कथासानहृत्यम् – बृहत्कथा, कथासररत्सागर, पञ्चतन्त्रम्, हितोपदेशः etc., पञ्चतन्त्रम् सूक्तिसुधा। Selected verses from पञ्चतन्त्रम्, Discover story behind the selected verse of पञ्चतन्त्रम् and नहतोपदेशः, Read Sanskrit verses and paragraphs in appropriate accent.	06
5	Sanskrit writing skills Introduction to नामधातुरूपाणि – Related to Engineering – व्यञ्जनान्तशब्दाः, Application of verb conjugation (लट्, लङ्, लृट्, लोट्, विधिलिङ्)-(2,3,5,7,8,10 गण- धातुरूपाणि), Basic rules for Sanskrit writing, Sanskrit Writing Traditions: Devanagari, Roman (IAST).	06

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Saṃskṛta Vyākaraṇakaumudī	Dora Ghanashyam	PCCOE Publication, Pune 2025	NA	2025
2	सुगम संस्कृत	ओक अंजली	पीसीसीओ, पुणे	NA	2025
3	संस्कृत-व्याकरणशास्त्र-प्रवेश	मुळे रवीन्द्र	ज्ञानेंद्र अंबादास मुळे प्रकाशित	NA	2004
4	कौमुदी विहार-सुबन्त - कारक प्रकरणम्	सोमलवार नीला	कौमुदी प्रकाशित	NA	2014



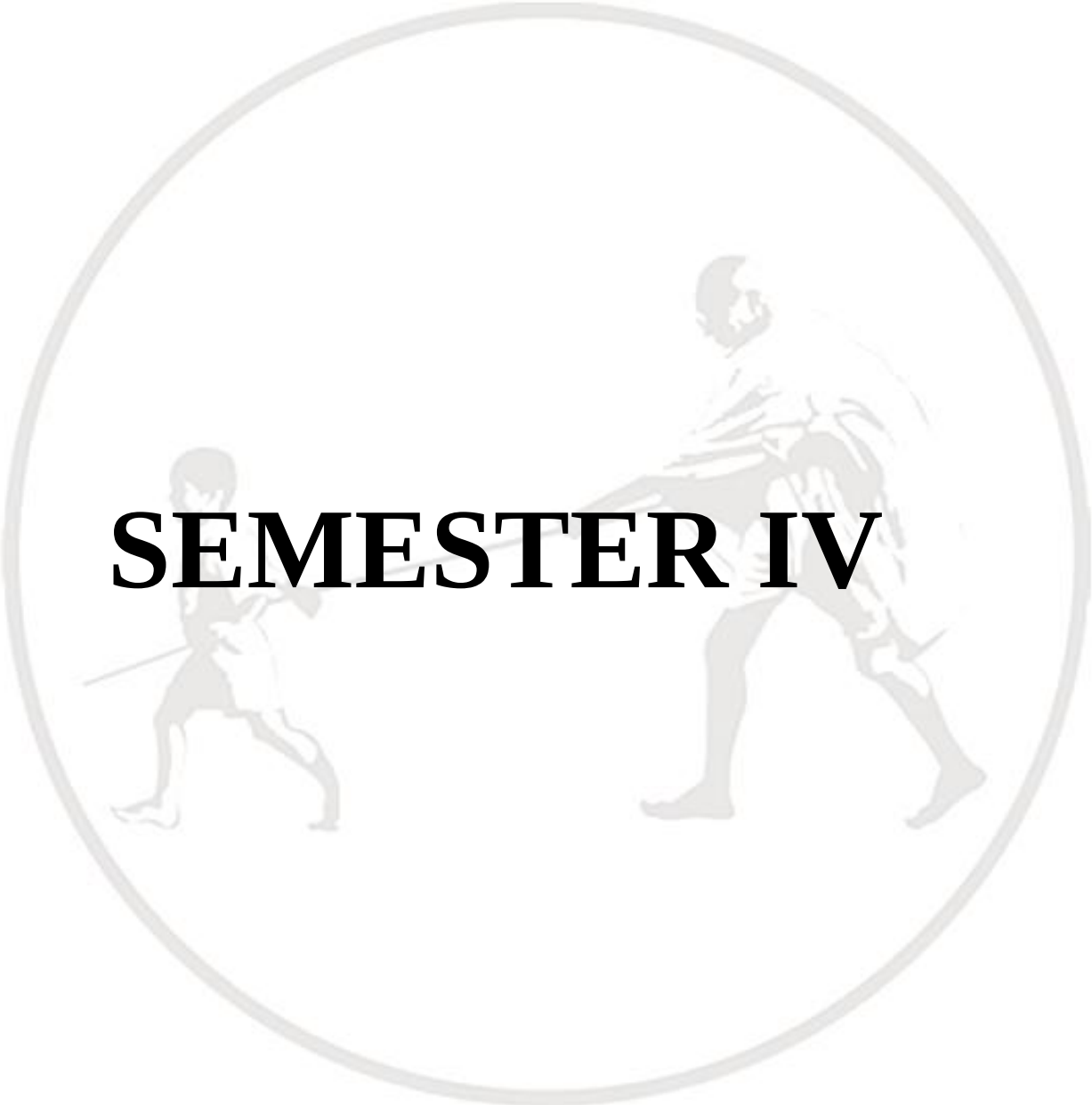
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MOOC/NPTEL Courses:

Sr. No.	NPTEL Courses Name	Instructor	Host Institute
1	Introduction to Basic Spoken Sanskrit and Intermediate Level of Spoken Sanskrit	Prof. Anuradha Choudry	IIT Kharagpur, https://nptel.ac.in/courses/109105135
2	Advanced Level of Spoken Sanskrit	Prof. Anuradha Choudry	IIT Kharagpur, https://nptel.ac.in/courses/109105189



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SEMESTER IV



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Second Year Artificial Intelligence and Machine Learning			
Semester IV			
Course Title	Computer Networks		
Course Code	PCC-AIML-251		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Course Objectives: 1. To know about Foundations of Computer Network Layering, Protocols OSI Models. 2. To Know about Computer Network devices like Switches, LAN, Routers. 3. To get acquainted with Internetworking Protocols, Transport layer Protocols and Application layer Protocols.			
Course Outcomes: After successful completion of the course, learner will be able to: CO1. Understand the Foundations of Computer Network Layering, Protocols OSI Models. CO2. Compare various framing protocols and Multi-access Networks. CO3. Comprehend Internetworking Protocols and Switches. CO4. Compare various routing protocols. CO5. Apply principles of End to End protocols for socket programming. CO6. Understand application layer Protocols.			



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Unit No.	Unit Title & Contents	Hours
1	Foundation: Applications: Problem: Building a Network, Classes of Applications. Requirements: Stakeholders, Scalable Connectivity, Cost-Effective Resource Sharing, Support for Common Services, Manageability. Architecture: Layering and Protocols, Encapsulation, Multiplexing and Demultiplexing, Seven-Layer OSI Model, Internet Architecture. Software: Application Programming Interface (Sockets), Example Application. Performance: Bandwidth and Latency, Delay $\times$ Bandwidth Product, High-Speed Networks, Application Performance Needs.	08
2	Data Links: Problem: Connecting to a Network, Technology Landscape, Encoding. Framing: Byte-Oriented Protocols (PPP), Bit-Oriented Protocols (HDLC), Clock-Based Framing (SONET), Error Detection, Internet Checksum Algorithm, Cyclic Redundancy Check, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels. Multi access Networks: Physical Properties, Access Protocol, Longevity of Ethernet, Wireless Networks, Basic Issues, IEEE 802.11/Wi-Fi, Bluetooth (802.15.1), Access Networks, Passive Optical Networks, and Cellular Network.	08
3	Internetworking: Problem: Not All Networks Are Directly Connected Switching Basics: Datagrams, Virtual Circuit Switching, Source Routing. Switched Ethernet: Learning Bridges, Implementation, Spanning Tree Algorithm, Broadcast and Multicast, Virtual LANs (VLANs). Internet (IP): Service Model, Global Addresses, Datagram Forwarding in IP, Sub-netting and Classless Addressing, Address Translation	08



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	(ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.	
4	Routing: Network as a Graph, Distance-Vector (RIP), Link State (OSPF), Metrics, Implementation, Software Switch, Hardware Switch, Software-Defined Networks. Advanced Internetworking: Global Internet, Routing Areas: Interdomain Routing (BGP). IP Version 6: Historical Perspective, Addresses and Routing, Packet Format, Advanced Capabilities. Multicast: Multicast Addresses, Multicast Routing (DVMRP, PIM, MSDP), Multiprotocol Label Switching, Routing Among Mobile Devices.	07
5	End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), Remote Procedure Call, Transport for Real-Time (RTP). Congestion Control: Issues in Resource Allocation, Queuing Disciplines, TCP Congestion Control, Advanced Congestion Control, Quality of Service.	07
6	Applications : Problem: Applications Need Their Own Protocols. Traditional Applications: Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Web Services. Multimedia Applications: Session Control and Call Control (SDP, SIP, H.323), Resource Allocation for Multimedia Applications. Infrastructure Applications: Name Service (DNS), Network Management (SNMP, OpenConfig).	07



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Learning Resources

Text Books

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Computer Networks, a systems approach	Larry L. Peterson and Bruce S. Davie,	Morgan Kaufmann Publisher, Elsevier	Sixth	2021

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Computer Networks	Andrew Tanenbaum	PHI Publication	Fifth	2011.
2	Data Communications and Networking	George T. Heineman, Gary Pollice, Stanley Selkow	McGraw Hill Publication	Fifth	2013

MOOC/NPTEL Courses:

Computer Networks by Prof. Neminath Hubballi, IIT Indore, Link: https://onlinecourses.nptel.ac.in/e-larning/preview/noc26_cs99
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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Introduction to Machine Learning		
Course Code	PCC-AIML-252		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Prerequisites : Mathematical Concepts of AI and Python Programming			
Course Objectives: To make students understand 1. Fundamentals of Machine Learning and data-driven decision making. 2. Various supervised and unsupervised learning techniques. 3. Model development, evaluation, and performance analysis methods. 4. Neural networks and modern machine learning applications. 5. Real-world implementation of Machine Learning in intelligent systems			
Course Outcomes: After successful completion of the course, learner will be able to: CO1: Explain the concepts, workflow, and applications of Machine Learning. CO2: Apply supervised learning algorithms for prediction and classification problems. CO3: Analyze unsupervised learning techniques for pattern discovery and clustering. CO4: Develop and evaluate machine learning models using suitable performance metrics. CO5: Examine neural networks, deep learning concepts, and real-world AI applications.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Machine Learning Introduction to Machine Learning, Types of Machine Learning, AI vs. ML vs. Deep Learning, Machine Learning Pipeline, Data Collection and Data Preparation, Feature Engineering, Applications of Machine Learning, Challenges in Machine Learning.	07
2	Data Preprocessing and Model Evaluation Data Cleaning, Handling Missing Values, Data Transformation, Feature Selection, Training and Testing Data, Cross Validation, Overfitting and Underfitting, Bias-Variance Tradeoff, Performance Evaluation Metrics.	07
3	Supervised Learning Techniques Regression Concepts, Linear Regression, Multiple Linear Regression, Logistic Regression, Decision Trees, K-Nearest Neighbor (KNN), Naïve Bayes Classification, Applications of Supervised Learning.	08
4	Unsupervised Learning Techniques Clustering Concepts, K-Means Clustering, Hierarchical Clustering, Association Rule Mining, Dimensionality Reduction, Principal Component Analysis (PCA), Applications of Unsupervised Learning.	07
5	Ensemble Learning and Model Optimization Ensemble Learning Concepts, Bagging, Boosting, Random Forest, Gradient Boosting, Hyper parameter Tuning, Model Selection Techniques, Introduction to Reinforcement Learning.	07
6	Neural Networks and Advanced Machine Learning Artificial Neural Networks, Perception Model, Multilayer Perception, Deep Learning Fundamentals, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Machine Learning Applications in Healthcare, Finance, Agriculture, and Data Science.	08



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Learning Resources

Text Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	Fourth Edition	2020
2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media	Third Edition	2022
3	Machine Learning	Tom M. Mitchell	McGraw-Hill Education	First Edition	1997
4	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	First Edition	2006

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	First Edition	2012
2	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	First Edition	2016
3	Machine Learning: An Algorithmic Perspective	Stephen Marsland	CRC Press	Second Edition	2014
4	Foundations of Machine Learning	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar	MIT Press	Second Edition	2018



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MOOC/NPTEL Courses:

1. NPTEL – Machine Learning https://nptel.ac.in/courses/106106139
2. NPTEL – Introduction to Machine Learning https://onlinecourses.nptel.ac.in/noc25_cs97/preview
3. Coursera – Machine Learning Specialization by Andrew Ng https://www.coursera.org/specializations/machine-learning-introduction
4. MIT OpenCourseWare – Introduction to Machine Learning https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/



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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Database Systems		
Course Code	PCC-AIML-253		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	3	-	3
Course Objectives: 1. To understand the fundamentals, architecture, and applications of database management systems. 2. To apply relational data models, relational algebra, and relational calculus for database query formulation. 3. To develop SQL skills including query writing, database definition, transactions, and advanced SQL programming concepts. 4. To explore NoSQL databases, JSON-based data models, and modern database connectivity techniques. 5. To design efficient relational databases using ER modeling, normalization, functional dependencies, and indexing techniques. 6. To understand transaction processing, concurrency control, recovery mechanisms, and ACID properties in database systems.			



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Course Outcomes:

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

CO1: Demonstrate the understanding of concepts of database management system.

CO2: Apply relational algebra and relational calculus to formulate and analyze database queries.

CO3: Apply basic and advanced SQL queries for the given context in relational database.

CO4: Analyze advanced SQL and NoSQL concepts including database connectivity, triggers, procedures, JSON, and MongoDB for modern applications.

CO5: Examine data modeling, database design, normalization, functional dependencies, and indexing techniques to develop efficient and well-structured relational databases.

CO6: Analyze the techniques of indexing, transaction management, concurrency control and recovery on database.

Unit No.	Unit Title & Contents	Hours
1	Introduction Database Systems Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture.	07
2	Relational Data Model, Relational Algebra and Calculus Structure of Relational Databases, Database Schema, Keys Relational algebra. Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Calculus: Tuple relational calculus, Domain relational calculus, calculus vs algebra, computational capabilities.	08
3	Introduction to SQL Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database	08



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	Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization.	
4	Advanced SQL and Introduction to NoSQL Advanced SQL: Assessing SQL from Programming Languages, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers. Introduction to NoSQL: Difference between SQL and NoSQL, Key-Value Stores and Semi-structured Data using JSON and MongoDB.	07
5	Relational Database Design and File Organization, Indexing Data Modeling using the Entity Relationship Model. ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Reduction of an ER diagrams to tables. Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, and Database Design Process. File Organization, Ordered Indices, B+ tree Index files, B Tree Index File.	08
6	Transaction Processing Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, ACID Properties, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols, Recovery System.	07



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Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Database System Concepts	Silberschatz, Korth and Sudarshan	McGraw-Hill	Seventh	2021

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Database Management Systems	Raghu Ramakrishnan, Johannes Gehrke	McGraw-Hill	Third	2003
2	Database Management Systems	RP Mahapatra	Khanna Publishing House	First Reprint	2026

MOOC/NPTEL Courses:

1. Introduction to Database Systems –IIT Madras (Prof. Sreenivasa Kumar)
<https://nptel.ac.in/courses/106106220>
2. Database Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay IIT Kharagpur
https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs91
3. Indexing and Searching Techniques in Databases, IIT Kanpur (Dr. Arnab Bhattacharya)
<https://nptel.ac.in/courses/106104021>



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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Data Analytics and Visualization		
Course Code	PCC-AIML-255		
Category	Program Core Course		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To understand the fundamentals of data analytics and the data analysis process. 2. To provide insights into data collection, preprocessing, wrangling, cleaning, and sampling techniques. 3. To apply exploratory data analysis methods for understanding and exploring datasets. 4. To analyze statistical learning techniques for extracting patterns and knowledge from data. 5. To evaluate descriptive and predictive models for data-driven decision making. 6. To create effective visualizations and communicate analytical results for meaningful interpretation and presentation.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand the fundamentals of data analytics, data collection, and data visualization concepts. CO2: Use data preprocessing, wrangling, cleaning, and sampling techniques to prepare datasets. CO3: Apply exploratory data analysis and visualization methods to examine the datasets. CO4: Analyze descriptive and predictive models for extracting insights from data. CO5: Evaluate analytical models and interpret their performance for different data-driven tasks. CO6: Create effective visualizations and communicate analytical findings using real-world datasets.			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Data Analytics and Data Collection Introduction to Data Analytics, Types of Data and Data Sources, Data Analytics Lifecycle, Data science workflow, Automated methods for data collection, Data and Data Visualization Models.	06
2	Data Preprocessing and Data Wrangling Data wrangling and cleaning, Exploratory data analysis. Data preprocessing techniques, Handling noisy and real-life datasets, Data sampling methods, Dimensionality Reduction techniques, Feature extraction and transformation methods.	06
3	Modeling and Analysis Techniques Building and evaluation of models for Association Analysis, Recommendation Systems, Time-series data, Text Analysis, Model validation and performance evaluation.	06
4	Visualization Foundations and Design Visualization Software and Tools, Visualization Design, Multidimensional Data, Graphical Perception, Interaction dynamics for Visual Analysis.	06
5	Advanced Visualization Techniques Using Space Effectively, Stacked Graphs, Geometry & Aesthetics, Networks, Graph Visualization and navigation in Information Visualization.	06
6	Cartography and Text Visualization Mapping & Cartography, Text Visualization, Visualization of analytical results, Interpretation and communication of insights using visualization techniques.	06



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Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj	Wiley	Second	2013
2	Visualization Analysis and Design	Tamara Munzner	A K Peters/CRC Press	First	2014

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Interactive Data Visualization: Foundations, Techniques, and Applications	Matthew O. Ward, Georges Grinstein, Daniel Keim	CRC Press	Second	2015

MOOC/NPTEL Courses:

Data Analytics with Python by A. Ramesh , IIT Roorkee.

Link : <https://nptel.ac.in/courses/106107220>



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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Constitution of India		
Course Code	MGM-VEC-CI-281		
Category	Value Education Course		
Scheme and Credits	L	P	No. of Credits
	2	-	2
Course Objectives: 1. To understand the basic features and philosophy of the Indian Constitution. 2. To develop awareness about Fundamental Rights, Duties, and Directive Principles of State Policy. 3. To understand the structure and functioning of Parliament and Judiciary in India. 4. To understand the role of the Election Commission, electoral process, and welfare commissions for SC/ST/OBC and women. 5. To understand Union–State relations and key constitutional bodies in India. 6. To examine Dr. B. R. Ambedkar's role in promoting social justice, women empowerment, and labour welfare.			



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Course Outcomes:

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

CO1: Explain the historical background, philosophy, and salient features of the Indian Constitution.

CO2: Describe Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties.

CO3: Understand the structure and functions of Parliament and Judiciary in India.

CO4: Describe the functions of the Election Commission, electoral process, and welfare commissions for SC/ST/OBC and women.

CO5: Describe Union–State relations and the functions of key constitutional bodies in India.

CO6: Discuss Dr. B. R. Ambedkar's contribution to social justice, women empowerment, and labour welfare.

Unit No.	Unit Title & Contents	Hours
1	Introduction to the Constitution of India Historical Background of the Constitution, Constituent Assembly, Making of the Constitution, Preamble and Philosophy of the Constitution, Salient Features of the Constitution, Federal Structure and Parliamentary Democracy.	05
2	Fundamental Rights, DPSP and Fundamental Duties Fundamental Rights: Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Directive Principles of State Policy and role of Government, Fundamental Duties of Citizens of India.	05
3	Parliament and Judiciary of India Union Government and its Administration Structure: President and Vice President: Election, qualification, powers, and the process of impeachment. Prime Minister: Election, qualification, powers. Lok Sabha, Rajya Sabha, Legislative Process and Passing of Bills. Supreme	05



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	Court and High Courts: Composition, appointment of judges, jurisdiction, powers, functions, Judicial Review and impeachment Process.	
4	Election Commission of India Election Commission: Role and responsibilities of Chief Election Commissioner, Electoral Process and Democratic Governance, State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women.	05
5	Relations between the Union and the States Legislative relation, administrative relation, financial Relations, Emergency provision, freedom of trade commerce, controller and auditor general of India, public service commission, special provisions relating to certain classes, amendment of the Constitution.	05
6	Dr. B. R. Ambedkar and Social Transformation Women Empowerment: Advocacy for Gender Equality, Hindu Code Bill, Women's Rights in Education and Employment, Constitutional Safeguards for Women. Labour Empowerment: Labour Welfare Policies, Reduction of Working Hours, Maternity Benefits, Minimum Wages and Social Security, Reservation Policy and Inclusive Development.	05

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Introduction to the Constitution of India	D. D. Basu	LexisNexis Butterworths Wadhwa	Twenty sixth	2021
2	Our Constitution	Subhash C. Kashyap	National Book Trust, India	—	2019



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Constitution of India	P. M. Bakshi	Universal Law Publishing Co.	–	2023
2	Indian Constitutional Law	M. P. Jain	LexisNexis Butterworths Wadhwa, Nagpur	Eighth	2018
3	Framing of India's Constitution	B. Shiva Rao	Universal Law Publishing Co.	Reprint Edition	2012
4	The Indian Constitution: Cornerstone of a Nation	Granville Austin	Oxford University Press	Reprint Edition	1999

MOOC/NPTEL Courses:

Constitution Law and Public Administration in India By Prof. Sairam Bhat|National Law School of India University
https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_lw02



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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Database system Lab		
Course Code	PCCL-AIML-256		
Category	Programme Core Course		
Scheme and Credits	L	P	No. of Credits
	-	2	1
Course Objectives: The course aims to enable students to: 1. Design database schemas and entity relationships for real-world applications. 2. Apply SQL and PL/SQL commands to create, manipulate, and retrieve data from relational databases. 3. Analyze database operations using joins, subqueries, set operations, functions, and normalization techniques. 4. Examine transaction management, concurrency control concepts, and database recovery mechanisms. 5. Develop database-driven applications using relational database management systems to solve real-world problems.			
Course Outcomes (CO) Upon successful completion of the course, students will be able to: CO1: Design and implement relational database schemas with appropriate entities, relationships, and integrity constraints for real-world applications. CO2: Create, modify, and manage database objects and perform data manipulation using SQL and PL/SQL constructs. CO3: Apply advanced SQL techniques including joins, subqueries, aggregate functions, set operations, triggers, and cursors to solve database problems. CO4: Analyze database normalization, transaction schedules, serializability, recoverability, and concurrency control mechanisms to ensure data consistency. CO5: Develop and deploy a mini-project using a relational database system that performs CRUD operations and demonstrates practical database application development.			



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Laboratory Requirements

Students shall perform all laboratory assignments using Oracle Database Express Edition, MySQL, draw.io, Lucidchart. The laboratory exercises involve schema design, SQL queries, PL/SQL programming, triggers, cursors, normalization, transaction management, and development of database applications.

During the first laboratory session, students shall form project groups and select a real-world problem domain for their mini-project. Students will be able to commence the design and development of the mini-project after completing the third practical. The project will subsequently be refined and extended through the practical assignments conducted throughout the semester.

List of Practical Assignments to be Performed	
1	Designing and defining database schemas for real-world applications (e.g., University database, Student Management, Hospital Management, Library Management, Inventory Management, Online Course Management, and Placement Management Systems).
2	Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), and Data insertion into a table.
3	Grouping data, aggregate functions, and Oracle functional, character functions.
4	Sub-queries, Set operations, Joins.
5	Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6	Assignment on Triggers & Cursors.
7	Normal Forms: First, Second, Third and Boyce Codd's Normal Forms.
8	Large objects – CLOB, NCLOB, BLOB and BFILE.
9	Pen-and-paper exercises on transaction schedules, conflict serializability, recoverability, and related concurrency control concepts.
10	Develop a mini project using a relational database that performs CRUD operations for applications such as student management, hospital management, or inventory management.



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1. Relax Relational algebra calculator: <https://dbis-uibk.github.io/relax/landing>
2. B+-tree visualization: <https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html>
3. Database Security Virtual Lab <https://ds-amrt.vlabs.ac.in/>





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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Computer Networks Lab		
Course Code	PCCL-AIML-257		
Category	PCC Lab		
Scheme and Credits	L	P	No. of Credits
	-	2	1
Course Objectives			
The course aims to enable students to:			
1. Identify and examine networking devices, transmission media, and network infrastructure components used in computer networks. 2. Apply Linux networking commands and network analysis tools for monitoring and troubleshooting network communication. 3. Analyze network protocols and packet exchanges using packet-sniffing tools such as tcpdump and Wireshark. 4. Implement TCP and UDP socket programming for client-server communication using Java. 5. Evaluate network traffic and protocol behavior through packet capture and analysis of ARP, ICMP, TCP, UDP, SSH, and FTP communications.			



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Course Outcomes

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

- CO1:** Identify and describe the functions of networking devices, transmission media, and network architectures used in an organizational network.
- CO2:** Use Linux networking commands and packet analysis tools to monitor, diagnose, and troubleshoot network-related issues.
- CO3:** Analyze packet-level communication of network protocols including ARP, ICMP, TCP, UDP, SSH, and FTP using tcpdump and Wireshark.
- CO4:** Develop client-server applications using TCP and UDP socket programming in Java for network communication.
- CO5:** Interpret captured network traffic and evaluate protocol behavior, multiplexing, and de-multiplexing mechanisms in computer networks.

Laboratory Requirements

Students shall perform laboratory assignments using tcpdump and wireshark using JAVA. First assignment is study of all hardware switches, routers, transmission media (cables, Wi-Fi access points). Students are expected to study particular model through manual of these devices. Students are expected to write UDP and TCP Sockets for any applications such as DNS name for UDP and FTP for TCP sockets.

List of Practical Assignments to be Performed

1	Know your institute Network : switches , routers, transmission media (cables ,Wi-Fi access points) ,etc.
2	Basic network commands in Linux.
3	Get acquainted with tcpdump and wireshark (packet sniffers)
4	Multiplexing and De-multiplexing with tcpdump and wireshark
5	Generate ARP packets and observe it using tcpdump and wireshark
6	Generate various ICMP packets (query and error reporting) observe it using tcpdump and wireshark
7	Socket Programming : Create UDP (datagram) socket in JAVA or C
8	Socket Programming : Create TCP (datagram) socket in JAVA or C



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9	Observe TCP and UDP packets using tcpdump and wireshark.
10	SSH and FTP packets using tcpdump and wireshark.
References : 1. https://www.tcpdump.org/ 2. https://www.wireshark.org/download.html	





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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Python Programming with ML Tools Lab (PBL)		
Course Code	VSECL-AIML-258		
Category	VSEC Lab		
Scheme and Credits	L	P	No. of Credits
	-	2	1
Prerequisite Courses: Engineering Mathematics, Programming Fundamentals			
Course Vision(Project-Based Learning): To develop proficiency in Python programming and Machine Learning tools through Project-Based Learning, enabling students to analyze data, build predictive models, and develop intelligent solutions for real-world applications.			
Course Objectives: To make students understand 1. Python programming concepts required for Machine Learning applications. 2. Data preprocessing and visualization techniques using Python libraries. 3. Implementation of Machine Learning algorithms using modern ML tools. 4. Development of intelligent systems through hands-on experimentation. 5. Real-world AI and Machine Learning problem-solving skills through project-based learning			



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Course Outcomes:

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

CO1: Apply Python programming concepts for data analysis and Machine Learning tasks.

CO2: Perform data preprocessing, visualization, and feature engineering using Python libraries.

CO3: Implement supervised and unsupervised Machine Learning algorithms using ML tools.

CO4: Evaluate Machine Learning models using appropriate performance measures.

CO5: Develop real-world AI and ML applications through project-based learning.

Laboratory Requirements:

Computer systems with Python, Anaconda, Jupyter Notebook, NumPy, Pandas, Matplotlib, Seaborn, Scikit-Learn, TensorFlow, Keras, Git/GitHub, Internet connectivity, and access to cloud platforms such as Google Colab. The laboratory shall follow a **Project-Based Learning (PBL)** approach, emphasizing hands-on experimentation, real-world datasets, collaborative problem-solving, and AI/ML project development.



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List of Practical Experiments

(Students shall perform at least 10 practicals from the following list and complete one Mini Project.)

1. Installation and configuration of Python, Jupyter Notebook, Anaconda, NumPy, Pandas, Matplotlib, Scikit-Learn, TensorFlow, and Keras.
2. Write Python programs using variables, operators, conditional statements, loops, functions, and modules.
3. Implement programs using NumPy for array creation, manipulation, matrix operations, and statistical computations.
4. Perform data analysis using Pandas Data Frames including data loading, cleaning, filtering, and aggregation.
5. Visualize datasets using Matplotlib and Seaborn libraries with various charts and plots.
6. Implement data preprocessing techniques such as handling missing values, normalization, encoding, and feature scaling.
7. Perform Exploratory Data Analysis (EDA) on real-world datasets.
8. Implement Linear Regression using Scikit-Learn and evaluate model performance.
9. Develop Logistic Regression models for classification problems.
10. Implement K-Nearest Neighbors (KNN) algorithm and analyze results using different values of K.
11. Develop Decision Tree and Random Forest models for classification tasks.
12. Implement Naïve Bayes classifier and compare performance with other algorithms.
13. Perform K-Means Clustering and visualize cluster formation.
14. Apply Principal Component Analysis (PCA) for dimensionality reduction.
15. Develop a simple Artificial Neural Network (ANN) using Tensor Flow/Keras.
16. Mini Project: Design and implement a Machine Learning solution using real-world datasets for healthcare, agriculture, finance, education, or smart systems applications.



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Suggested Machine Learning Tools and Platforms

1. Python
2. Jupyter Notebook
3. Google Colaboratory (Google Colab)
4. Anaconda Distribution
5. Scikit-Learn
6. TensorFlow
7. Keras
8. Pandas
9. NumPy
10. Matplotlib

Suggested Mini Project Areas

1. Student Performance Prediction System
2. House Price Prediction
3. Crop Recommendation System
4. Disease Prediction using Machine Learning
5. Customer Segmentation using Clustering
6. Sentiment Analysis using Machine Learning
7. Spam Email Detection
8. Smart Attendance Prediction System
9. Recommendation System
10. Traffic Flow Prediction System



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Virtual Labs:

1. Virtual Labs – Artificial Intelligence Laboratory
<https://aivilab.vlabs.ac.in/>
2. Virtual Labs – Machine Learning Laboratory
<https://ml-iitkgp.vlabs.ac.in/>
3. Virtual Labs Portal (Ministry of Education, Government of India)
<https://www.vlab.co.in/>
4. Google Colaboratory
<https://colab.research.google.com/>
5. Kaggle Learn – Machine Learning Courses and Datasets
<https://www.kaggle.com/learn>
6. TensorFlow Tutorials
<https://www.tensorflow.org/tutorials>



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Department of Artificial Intelligence & Machine Learning			
Second Year Artificial Intelligence and Machine learning			
Semester IV			
Course Title	Entrepreneurship Development		
Course Code	MGM-HSSM-ED-282		
Category	Humanities/Social Science & Management		
Scheme and Credits	L	P	No. of Credits
	2		2
Course Objectives: 1. To introduce the fundamental principles of entrepreneurship, forms of business organizations, and the startup ecosystem. 2. To identify, evaluate, and select viable business opportunities using structured techniques. 3. To explore business models, financial planning, and market validation strategies. 4. To study key marketing strategies, customer acquisition techniques, and branding essentials for startups. 5. To develop entrepreneurial mindset and ability to communicate and pitch business ideas effectively using structured storytelling techniques.			
Course Outcomes: After successful completion of the course, learner will be able to: CO1: Describe the role of entrepreneurship in economic growth and the startup ecosystem. CO2: Apply creative techniques to viable business ideas based on customer needs. CO3: Develop a basic business model using tools like the Business Model Canvas through market research. CO4: Implement basic marketing strategies for startups. CO5: Identify Customer acquisition strategies. CO6: Deliver a concise business pitch using storytelling and effective communication techniques.			



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Unit No.	Unit Title and Contents	Hours
1	Introduction to Entrepreneurship Entrepreneurship: Definition and evolution, Role of entrepreneurship in economic development. Role of entrepreneurship in economic development – Role in job creation, GDP, and innovation. Characteristics of an Entrepreneur: Key traits: Risk-taking, innovation, pro-activeness, Leadership, perseverance, and resilience Types of Entrepreneurships: Startup entrepreneurship, Social entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Lifestyle and small business entrepreneurship Forms of Business Organization – Sole proprietorship, partnership, private limited, public limited. Entrepreneurial Mindset: Growth mindset and adaptability, Creativity and problem-solving, Opportunity recognition and initiative-taking Overview of the Startup Ecosystem: Key stakeholders: Incubators, accelerators, angel investors, VCs, Government support schemes (Startup India, Atal Innovation Mission, etc.), Global vs. Indian startup ecosystems Case Study: 1. Ritesh Agarwal – Founder of OYO Rooms (India) 2. FalguniNayar – Founder of Nykaa (India) 3. Nandan Nilekani – Co-founder of Infosys & Architect of Aadhaar (India) etc.	07
2	Idea Generation & Opportunity Recognition Creativity Techniques for Idea Generation: Definition and importance of creativity in entrepreneurship. Brainstorming, MindMapping: Visual idea structuring using central themes and branches. Tools (manual and digital) for mind mapping. Understanding Customer Needs and Pain Points, Problem-solution fit: Linking pain points to possible solutions. Observational techniques, user interviews, and empathy mapping, Evaluating Opportunities: Difference between an “idea” and an “opportunity.” Basic filters: Desirability, feasibility, and viability. Tools: SWOT Analysis,	07



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	Opportunity Matrix, Industry trends, market gaps. Feasibility Analysis Basics, Scalability Check: Geographically or vertically growth of the idea, Barriers to scaling. Introduction to the “Lean Canvas”. Case Study : Analyzing how “Dunzo” or “BigBasket” identified urban pain points and How “Zerodha” scaled in India with a digital-first approach	
3	Business Model Development Introduction to Business Model Canvas: Definition and purpose of a business model, Overview of the Business Model Canvas by Osterwalder, Benefits of using BMC for startups. Key Components of BMC: Value Proposition: Defining what unique value the product/service offers. Customer Segments, Creating customer personas, Revenue Models: Direct sales, subscriptions, freemium, licensing, etc. Basic Market Research for Validation: Importance of market research in early-stage business development. Designing effective surveys and customer feedback forms. Conducting basic interviews and analyzing responses. Introduction to MVP (Minimum Viable Product) and feedback loops. Case study: Map the BMC for a well-known startup (e.g., Uber or Zomato).	06
4	Marketing Strategies Brand – Elements of brand identity: name, logo, voice, tone, and values. Positioning – How to create a unique space in the customer’s mind. Positioning maps, Value-based positioning vs. competitor-based positioning Startup Branding Challenges – Limited budget, building trust, clarity in messaging. Costing & Pricing Strategies – Fixed vs. variable costs, break-even analysis. Introduction to Digital Marketing: Distribution Channels: Traditional vs. digital distribution. Social Media Marketing: Platforms overview (Instagram, LinkedIn, Facebook, X/Twitter) Creating a content strategy and calendar Organic vs. paid reach Search Engine Optimization (SEO): Basics of how search engines work, Keyword research and content optimization, On-page vs. off-page SEO Importance of Digital Presence – Website essentials,	03



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	blogs, and analytics tools.	
5	Customer Acquisition Strategies Understanding the Customer Journey – Awareness, interest, decision, action. Early-Stage Customer Acquisition Tactics: Word-of-mouth & referrals, Influencer marketing (micro-influencers), Email marketing basics, building a landing page and collecting leads Retention vs. Acquisition – Importance of building long-term customer relationships. Case Studies : 1. Zomato – Branding & Positioning in a Competitive Market 2. Mamaearth – Digital-First Customer Acquisition 3. Nykaa – Customer Segmentation and Channel Strategy	03
6	Pitching & Business Communication Crafting an Elevator Pitch: Definition and purpose, Key elements: Problem, solution, value proposition, target audience, Delivery tips: Clarity, brevity, confidence Storytelling & Communication: Importance of Storytelling in Business, Structure of a Business Story: Setup, Conflict, Resolution. Communication Skills: Verbal and Non-verbal Overview of Funding Sources: Public & private capital sources, venture capital, debt financing. Bootstrapping: Meaning, benefits, and risks, Angel investors: Role, expectations, approach, Brief on incubators, government schemes, crowdfunding. Case study: 1. Shark Tank India – Pitch Analysis (Any Season) 2. Airbnb – The Original Pitch Deck 3. Dropbox – Storytelling Through Demonstration 4. Dunzo – Investor Pitch Evolution	04



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Learning Resources
Textbooks:

Sr. No.	Title	Authors	Publisher	Edition	Year
1	Entrepreneurship	Andrew Zacharakis, Andrew C. Corbett, William D. Bygrave	Wiley	Sixth	2025
2	Innovation and Entrepreneurship: Practice and Principles	Drucker, Peter F	Harper Business	Reprint	2006
3	Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers	Osterwalder, Alexander & Pigneur, Yves	Wiley	First	2010

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Crown	First	2011

MOOC/NPTEL Courses:

1. Entrepreneurship Essentials By Prof. Manoj Kumar Mondal IIT Kharagpur.
https://onlinecourses.nptel.ac.in/noc20_ge08/preview
2. "Entrepreneurship" by Prof. C Bhaktavatsala Rao, IIT Madras
https://onlinecourses.nptel.ac.in/noc21_mg70/preview
3. Creating jobs, changing lives
<https://www.youtube.com/@wadhvani-foundation/videos>



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Department of Artificial Intelligence & Machine Learning

Criteria for Honors Degree

- In addition to the prescribed 176 credits of the B.Tech. Program (Major discipline), a student may opt for an Honors program in the same discipline/branch or in an approved emerging area related to the parent discipline.
- To earn the Honors degree, a student shall complete an additional 18 credits, distributed across Semesters III to VIII.
- Thus, the total credit requirement for the award of B.Tech. Honors shall be 194 credits (176 + 18) for students admitted in the first year.
- Students shall compulsorily pursue the Honors program within the same discipline/branch of their parent B.Tech. program.
- The Honors degree shall be awarded only after successful completion of all prescribed credits of the regular B.Tech. program along with the additional 18 Honors credits.
- For lateral entry students (admitted directly to the second year after Diploma), the minimum credit requirement shall be 132 credits for the regular program, in addition to 18 Honors credits.



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Department of Artificial Intelligence & Machine Learning

Course Structure - Honors Degree in "Cyber Security"

Sr. No.	Semester	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
				L	P	CA	MSE	ESE	Total	
1	III	HON-AIML-501	Information Theory for Cyber Security	3	2	20	30	50	100	4
2	IV	HON-AIML-502	Data Encryption	3	2	20	30	50	100	4
3	V	HON-AIML-503	Steganography and Digital Watermarking	3	0	20	30	50	100	3
4	VI	HON-AIML-504	Security Assessment and Risk Analysis	3	0	20	30	50	100	3
5	VII	HON-AIML-505	Database Security and Access Control	3	2	20	30	50	100	4
TOTAL				15	6	100	150	250	500	18

Reference: AICTE Model Curriculum

https://www.aicte.gov.in/sites/default/files/Minor%20Degree_Dec_2020.pdf

Course Coding Nomenclature:

- CBS denotes that minor degree in "Cyber Security".
- Sr. No. 01, 02, 03, 04 and 05 are the courses to be taken in order in different semesters. Multiple courses may also be taken in the same semester (if required).



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Second Year Artificial Intelligence & Machine Learning			
Semester III			
Course Title	Information Theory for Cyber Security		
Course Code	HON-AIML-501		
Category	Honors		
Scheme and Credits	L	P	No. of Credits
	3	2	4
Course Objectives: 1. To Fundamentals of information theory, entropy, and information-theoretic security. 2. To study secrecy, authentication, secret sharing, and key agreement mechanisms. 3. To learn quantum cryptography, coding techniques, and masking methods for secure communication. 4. To analyze modern cryptographic algorithms and security attacks. 5. To explore privacy-preserving techniques, digital forensics, and advanced cryptographic systems.			



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Course Outcomes:

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

- CO1:** Explain the concepts of information theory, entropy, information leakage, and security models.
- CO2:** Apply secrecy, authentication, secret sharing, and secret key agreement techniques in secure communication systems.
- CO3:** Demonstrate the use of quantum cryptography, coding techniques, and masking methods for data protection.
- CO4:** Analyze information-theoretic security, Diffie–Hellman key exchange, AES, and side-channel attacks.
- CO5:** Evaluate secrecy metrics, secure source coding, differential privacy, and distributed channel synthesis techniques.
- CO6:** Design secure solutions using digital forensics, PKI, lightweight cryptography, and elliptic curve cryptography.

Unit No.	Unit Title & Contents	Hours
1	Fundamentals of Information theory Shannon's foundation of Information theory, Random variables, Probability Distribution factors, Uncertainty/entropy information measures, Leakage, Quantifying Leakage and Partitions, Lower bounds on key size: secrecy, authentication and secret sharing. provable security, computationally-secure.	06
2	Secret Key Agreement Symmetric cipher, Secrecy, Authentication, Secret sharing, Optimistic results on perfect secrecy, Secret key agreement, Unconditional Security.	06
3	Quantum Cryptography Quantum Cryptography, Randomized Ciphers, Types of codes: block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques.	06



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4	AES Information-theoretic security and cryptograph, basic introduction to Diffie-Hellman, AES, and side-channel attacks.	06
5	Secrecy Metrics and Privacy-Preserving Techniques Secrecy metrics: strong, weak, semantic security, partial secrecy, Secure source coding: rate-distortion theory for secrecy systems, side information at receivers, Differential privacy, Distributed channel synthesis.	06
6	Public Key Infrastructure Digital and network forensics, Public Key Infrastructure, Light weight cryptography, Elliptic Curve Cryptography and applications.	06

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Network Information Theory	Abbas El Gamal, Young-Han Kim	Cambridge University Press	First Edition	2011
2	Entropy and Information Theory	Robert M. Gray	Springer	Second Edition	2011

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1.	Elements of Information Theory	Thomas M. Cover and Joy A. Thomas	Wiley	Second Edition	2006
2.	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson	Eighth Edition	2023
3.	Quantum Computation and Quantum Information	Michael A. Nielsen and Isaac L. Chuang	Cambridge University Press	Tenth Edition	2010



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MOOC/NPTEL Courses:

1. https://swayam.gov.in/nd2_nou20_cs01/preview

Virtual Lab Links:

1. https://vlabs.iitkgp.ac.in/vlt/?utm_source

2. https://vlabs.iitkgp.ac.in/vlt/?utm_source



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Second Year Artificial Intelligence & Machine Learning			
Semester IV			
Course Title	Data Encryption		
Course Code	HON-AIML-502		
Category	Honors		
Scheme and Credits	L	P	No. of Credits
	3	2	4
Course Objectives: 1. To understand fundamental concepts of cryptography and data encryption. 2. To learn symmetric and asymmetric encryption algorithms. 3. To apply encryption techniques for securing AI datasets and machine learning models. 4. To implement cryptographic protocols for secure communication. 5. To analyze modern security threats and encryption-based defenses. 6. To explore AI applications in cryptography and cyber security.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Explain fundamental cryptographic concepts and security principles. CO2: Implement symmetric and asymmetric encryption algorithms. CO3: Apply hashing and digital signature techniques for authentication. CO4: Secure AI/ML datasets and models using modern encryption methods. CO5: Design secure communication systems using cryptographic protocols. CO6: Analyze emerging trends in AI-driven cyber security and privacy preservation			



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Unit No.	Unit Title & Contents	Hours
1	Introduction to Security and Cryptography Need for Information Security, Security Approaches and Principles, CIA Triad (Confidentiality, Integrity, Availability), Types of Security Attacks (Passive and Active Attacks), Cryptography Fundamentals Plaintext and Cipher text, Encryption and Decryption Process Substitution and Transposition Techniques Key Range, Key Size and Cryptographic Strength.	06
2	Symmetric and Asymmetric Cryptography Symmetric Key Cryptography, Block and Stream Ciphers, DES, 3DES and AES Algorithms Differential and Linear Cryptanalysis, Asymmetric Key Cryptography, RSA Algorithm Diffie-Hellman Key Exchange, Knapsack Algorithm & Digital Signatures and Applications.	06
3	Cryptographic Applications and Network Security Case Studies in Cryptography, IP Spoofing Attacks ,Conventional Encryption and Message Confidentiality, Key Distribution Techniques, Public Key Cryptography Principles & Message Authentication Concepts.	06
4	Data Compression Fundamentals Need for Data Compression, Communication Model, Compression Ratio and Performance Measures, Requirements of Data Compression, Classification of Compression Techniques, Lossless Compression, Lossy Compression ,Applications of Data Compression in AI and Multimedia Systems.	06
5	Data Compression Techniques Entropy Encoding Concepts, Repetitive Character Encoding, Run Length Encoding (RLE), Zero/Blank Encoding, Statistical Encoding Methods, Huffman Coding, Arithmetic Coding, Lempel-Ziv (LZ77, LZ78, LZW) Techniques, Performance Comparison of Compression Methods.	06



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6	Encryption in AI, Cloud and Modern Applications Data Privacy in Artificial Intelligence, Encryption of AI Training Data, Secure Data Sharing and Storage, Homomorphism Encryption, Privacy-Preserving Machine Learning, Federated Learning Security, Cloud Data Encryption, SSL/TLS Security Protocols, AI-Based Threat Detection and Future Trends in Cryptography.	06
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List of Practical
1. Implementation of Caesar Cipher.
2. Implementation of Vigenère Cipher.
3. AES Encryption and Decryption using Python.
4. RSA Algorithm Implementation.
5. SHA-256 Hash Generation.
6. Digital Signature Generation and Verification.
7. Huffman Coding Implementation.
8. Run Length Encoding (RLE).
9. Secure Dataset Encryption for AI Applications.
10. Mini Project: Secure AI Data Sharing System.

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Computer Security: Principles and Practice	William Stallings, Lawrie	Pearson Education	Fourth Edition	2018
2	Introduction to Modern Cryptography	Jonathan Katz, Yehuda Lindell	CRC Press, Taylor & Francis	Second Edition	2015



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Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Network Security Essentials: Applications and Standards	William Stallings	Pearson Education	Seventh Edition	2022
2	The Data Compression Book	Mark Nelson, Jean-Loup Gailly	BPB Publications	Second Edition	2010
3	Network Security Essentials: Applications and Standards	William Stallings	Pearson Education	Seventh Edition	2022

MOOC/NPTEL Courses:

1. Introduction to Cyber Security, https://swayam.gov.in/nd2_nou20_cs01/preview
2. Cyber Security, https://swayam.gov.in/nd2_cec20_cs09/preview

Virtual Lab Links:

1. https://cpy-amrt.vlabs.ac.in/?utm_source
2. https://cse29-iiith.vlabs.ac.in/?utm_source



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Department of Artificial Intelligence & Machine Learning

Multiple Exit Policy

- Students shall have the flexibility to enter the program in odd semesters and exit the program after the successful completion of the First Year, Second Year, or Third Year, based on their academic and career requirements.

A student opting for exit shall:

- Earn the minimum prescribed credits as specified for the respective exit level.
 - Have no active backlogs at the time of exit.
 - Submit a formal exit request to the Chairman, Academic Council through the Chairman, Board of Studies (BoS), within two weeks from the date of declaration of results.
- In addition to the minimum academic credits, students shall compulsorily earn an additional 8 credits through vocational training, internships, apprenticeship, skill-based courses, mini-projects, or similar activities during the summer vacation, within two months from the approval of the exit request.
 - Exit options with appropriate awards shall be provided at the end of:
 - Second Semester – UG Certificate
 - Fourth Semester – UG Diploma
 - Sixth Semester – B.Voc. / B.Sc. Degree
 - Students who continue and successfully complete the four-year program shall be awarded the Bachelor's Degree in Engineering/Technology as per the prescribed program structure and credit requirements.



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Exit option after Second or Fourth Semester

(As per Ref: NEP GR, Government of Maharashtra)

Exit Level	Minimum Duration Completed	Minimum Credits Earned	Qualification Awarded
Level 1 Exit	After 1st Year (2 nd Semesters)	Approximately 44 Credits	Undergraduate Certificate
Level 2 Exit	After 2nd Year (4 th Semesters)	Approximately 88 Credits	Undergraduate Diploma
Level 3 Exit	After 3rd Year (6 th Semesters)	Approximately 124 Credits	B.Voc. / B.Sc. Degree

FY B.Tech. (AIML) Exit Program after Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
			L	P	CA	MSE	ESE	Total	
1	EXP2-AIML-601	Office Automation and Internet	-	8	20	30	50	100	4
2	EXP2-AIML-602	Basic User Interface and User Experience (UI/UX) Design certificate course	-	4	20	30	50	100	2
3	EXP2-AIML-603	Mini project	-	4	50	-	50	100	2
TOTAL				16	90	60	150	300	8



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First Year Artificial Intelligence and Machine learning			
Semester II			
Course Title	Office Automation and Internet		
Course Code	EXP2-AIML-601		
Category	Multiple Exit Policy		
Scheme and Credits	L	P	No. of Credits
	-	8	4
Course Objectives: 1. To understand the basics of computers, hardware, software, and operating systems. 2. To learn Information Technology concepts and applications. 3. To understand networking and internet communication. 4. To use office automation tools effectively. 5. To develop practical skills through laboratory activities. 6. To work with MS-Windows, Linux, and MS-Word for everyday tasks.			
Course Outcomes: After successful completion of the course, students will be able to: CO1: Understand basic computer concepts, hardware, software, and operating systems. CO2: Explain Information Technology and its applications in various fields. CO3: Understand networking, internet, and data communication concepts. CO4: Use office automation tools for communication and documentation. CO5: Perform practical tasks using office automation software. CO6: Use MS-Windows, Linux, and MS-Word for basic computing tasks.			



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Unit No.	Unit Title & Contents	Hours
1	Computer Fundamental Introduction to computer system, input devices and output devices, primary storage and secondary storage devices, number systems, Boolean algebra and logic circuits, computer software, programming languages and program development, operating systems, popular operating system.	08
2	Principal of Information Technology Introduction to information technology, information system, computer and system, software and data, IT in business& industry, IT in banking, IT in insurance, IT in marketing, IT in BPO services, IT in home & at play, IT in education, workplace and training, IT in library, IT in education, IT in entertainment & arts, IT in a business and industry.	08
3	Internet and Advance Communication Introduction to networks, open systems interconnection, network interface layer, internet layer, transport layer, advantages and Disadvantages of modems, digital subscriber line, cable TV systems, data link control- OSI model, formatting data for transmission, flow control, error control, point-to-point protocol (PPP), network control protocol (NCP), dynamic medium access control: random access, Channelization.	08
4	Office Automation Office automation, better accuracy, better services, demanding for timeliness, prevention of fraud, reduction in paper work, improved communication environment, Characteristics of office automation system, computer mail systems.	08
5	Office Automation – Lab Office automation lab, Aim of the activity, pre-requisite knowledge, and materials required, procedure, observations.	08



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6	Operating Systems MS-Windows and Linux Operating system (OS), batch operating system, multi-tasking/time-sharing operating system, real time OS, distributed operating system, network operating system, mobile OS, MS- word: word wrap, page formatting, paragraph formatting, text formatting, text editing.	08
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Learning Resources

MOOC/NPTEL Courses:

1. **NPTEL:** Computer Fundamentals-
https://nptel.ac.in?utm_source=chatgpt.com
2. Microsoft Office Training-
https://support.microsoft.com/training?utm_source=chatgpt.com
3. **SWAYAM Platform:**
https://support.microsoft.com/training?utm_source=chatgpt.com



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First Year Artificial Intelligence & Machine Learning			
Semester II			
Course Title	Basic User Interface and User Experience (UI/UX) Design certificate course Lab		
Course Code	EXP2-AIML-602		
Category			
Scheme and Credits	L	P	No. of Credits
	-	4	2
Course Objectives: To make students understand 1. To understand the basics broad concepts and contexts for user interfaces. 2. To develop web application using UX/UI.			
Course Outcomes: After successful completion of the course, learner will be able to: CO1: Understand the basics broad concepts and contexts for user interfaces. CO2: Develop a clickable prototype. CO3: Develop a user experience process. CO4: Design the visual mockups.			

Course Contents		
Unit No.	Unit Title & Contents	Hours
1	Visual Elements of User Interface Design Basic broad concepts and contexts for user interfaces, Formal elements of interface design, Active elements of interface design, Composing the elements of interface design.	8
2	UX Design Fundamentals Developing a clickable prototype , Develop the look and feel of it, Building a wireframe of our interface	8
3	Web Design: Strategy and Information	7



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	Architecture The user experience process, five phases of UX design: Strategy, Outline of Scope, Sitemap, Wireframes, and Visual Mockups.	
4	Web Design: Wireframes to Prototypes Designing the visual mockups of just the homepage, wireframe to prototypes. Build prototype using UX/UI.	7

Learning Resources

1. Basic User Interface and User Experience (UI/UX)

Link : Coursera: <https://www.coursera.org/specializations/ui-ux-design#courses>



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Second Year Artificial Intelligence & Machine Learning (2026 Course)			
Semester II			
Course Title	Mini Project		
Course Code	EXP2-AIML-603		
Category	Exit Program		
Scheme and Credits	L	P	No. of Credits
	-	4	2
Course Objectives: 1. To help students identify a real-world problem suitable for an AI/ML-based mini project. 2. To develop understanding of how AI/ML techniques can be applied to solve practical problems. 3. To enable students to collect, preprocess, and analyze data required for model building. 4. To guide students in designing and developing a basic AI/ML solution using suitable tools and libraries. 5. To develop hands-on skills in implementing and evaluating AI/ML models for mini projects. 6. To improve students' ability to document, present, and demonstrate their AI/ML project effectively.			



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Course Outcomes:

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

- CO1:** Identify problem statement based on economic, environmental and social context.
- CO2:** Design solution for the identified problem using software development life cycle.
- CO3:** Use modern tools and techniques to develop solution.
- CO4:** Exhibit effective leadership with team & individual work abiding by professional ethics.
- CO5:** Demonstrate ideas, concepts & results in written and oral form.

Project Guidelines

Students are expected to complete the following tasks as part of the project work:

1. Identify a problem statement or project idea that addresses a real-world problem.
2. Conduct a comprehensive literature survey to understand existing solutions, technologies, and research related to the selected problem.
3. Analyze the problem and design an appropriate solution, including system architecture, workflow, and methodology.
4. Implement the proposed solution using relevant and up-to-date technologies, tools, and frameworks.
5. Prepare a project report of 35–40 pages using LaTeX, covering the problem statement, literature survey, system design, implementation, results, and conclusions.
6. Present and demonstrate the developed solution before the faculty evaluation committee.
7. The selected project topic must incorporate and demonstrate the knowledge, concepts, tools, and technologies learned during the previous semesters/years of the program.



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SY BTech. (AIML) Exit Program after Semester IV

Sr. No.	Course Code	Course Name	Teaching Scheme		Examination Scheme				Credits
			L	P	CA	MSE	ESE	Total	
1	EXP4-AIML-601	Data Analytics with python (Swayam+)	-	8	20	30	50	100	4
2	EXP4-AIML-602	LLM Course with Programming	-	4	20	30	50	100	2
3	EXP4-AIML-603	Minor Project	-	4	50	-	50	100	2
TOTAL				16	90	60	150	300	8



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Second Year Artificial Intelligence & Machine Learning (2026 Course)			
Semester IV			
Course Title	Data Analytics with Python		
Course Code	EXP4-AIML-601		
Category	Exit Program		
Scheme and Credits	L	P	No. of Credits
	-	8	4
Course Objectives: 1. To understand the fundamentals of Data Analytics and Python programming. 2. To apply probability concepts and statistical techniques for data analysis. 3. To use Python libraries and tools for data collection, preprocessing, and analysis. 4. To apply data visualization techniques to represent and communicate data effectively. 5. To develop analytical thinking and problem-solving skills for real-world data-driven applications. 6. To analyze basic machine learning techniques used in data analytics and predictive modeling.			



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Course Outcomes:

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

- CO1:** Understand the fundamental concepts, lifecycle, scope, and significance of Data Science in solving real-world problems.
- CO2:** Use appropriate tools and techniques for data collection, cleaning, preprocessing, transformation, and management.
- CO3:** Apply statistical and exploratory data analysis methods to summarize and interpret datasets.
- CO4:** Analyze datasets to discover patterns, trends, correlations, and insights for informed decision-making.
- CO5:** Evaluate the effectiveness of analytical approaches and basic machine learning models for data-driven problem solving.
- CO6:** Create meaningful data visualizations and predictive solutions to communicate insights and support decision-making.

Unit No.	Unit Title & Contents	Hours
1	Introduction to Data Analytics and Python Fundamentals Introduction to Data Analytics, Analytics Life Cycle, Applications of Data Analytics, Python Basics, Variables and Data Types, Operators, Control Statements, Functions, Introduction to NumPy and Pandas.	08
2	Probability and Sampling Techniques Basic Probability Concepts, Conditional Probability, Random Variables, Probability Distributions, Normal Distribution, Sampling Methods, Sampling Distribution, Central Limit Theorem.	07
3	Statistical Analysis and Hypothesis Testing Descriptive Statistics, Measures of Central Tendency, Measures of Dispersion, Confidence Intervals, Hypothesis Testing, Z-Test, T-Test, ANOVA.	08
4	Regression Analysis Correlation Analysis, Simple Linear Regression, Multiple Regression	07



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	(Basics), Model Building Concepts, Logistic Regression (Introduction), Model Evaluation Basics.	
5	Data Visualization and Exploratory Data Analysis Data Cleaning and Preparation, Exploratory Data Analysis, Data Visualization using Matplotlib, Seaborn Basics, Line Charts, Bar Charts, Histograms and Scatter Plots.	07
6	Clustering and Classification Techniques Introduction to Machine Learning, Chi-Square Test, Cluster Analysis, K-Means Clustering, Classification Concepts, Decision Trees, CART, Applications and Case Studies	08

Learning Resources

Text Books :

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Python for Data Analysis	Wes McKinney	O'Reilly Media	Third	2022
2	Data Analytics Using Python	Bharti Motwani	Wiley India	First	2020
3	Python Data Science Handbook	Jake VanderPlas	O'Reilly Media	First	2016

Reference Books:

Sr.No.	Title	Authors	Publisher	Edition	Year
1	Practical Statistics for Data Scientists	Peter Bruce, Andrew Bruce and Peter Gedeck	O'Reilly Media	Second	2020
2	Think Python	Allen B. Downey	Allen B. Downey	Second	2015



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MOOC/NPTEL Courses:

1. Data Analytics with Python by A. Ramesh

Link : https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs86

2. Programming, Data Structures and Algorithms using Python by Madhv Mukund

Link : https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs78

