Indira College of Engineering and Management

an Autonomous Institute of

Savitribai Phule Pune University, Pune

Maharashtra, India

National Education Policy 2020 compliant Curriculum

Second Year B. Tech (AI and DS)

(With effect from 2025-26)

Indira Chanakya Campus(ICC)

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Semester-III

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total		TAE	CAE	ESE	INT	EXT	
24UAIL301	Data Engineering	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-		75
24UAIP301	Data Engineering	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UAIL302	Data Structure	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UAIP302	Data Structure	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UAIL303	Agile Engineering and Project Management	Program Core Course (PCC)	3	-	-	3	3	-	-	50	-	-	50
24UAIXXXX	Minor-I	Multidisciplinary Minor-I	2	-	-	2	2	10	15	25	-	-	50
24UXXXXXX	Open Elective-I	Open Elective(OE)	3	-	-	3	3	10	15	50	-	-	75
24UXXXXXX	Open Elective-I	Open Elective(OE)	-	-	2	2	1	-	-	-	25	-	25
24UESP305	Entrepreneurship Essentials I	Entrepreneurship	-	-	4	4	2	-	-	-	25	-	25
24UVEP306	VEC –I (Understanding India)	Value Education (VEC-I)	-	-	4	4	2	-	-	-	25	-	25
24UAIP303	Animated AI	Field Project-I	-	-	4	4	2	-	-	-	25	25	50
	Total		**12**	**-**	**20**	**32**	**22**	**40**	**60**	**225**	**100**	**75**	**500**

Dr. Manjusha Tatiya
BOS Chairman

Dr. Nilesh Uke
Director

Dr. Saurabh Gupta
Dean Academics

Dr. Neha Sharma
VC Nominee

Semester-IV

Course Code	Name of Course	Course Category (As per NEP)	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total		Theory			Practical		Total Marks
								TAE	CAE	ESE	INT	EXT	
24UAIL401	Feature Engineering (ML)	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UAIP401	Feature Engineering (ML)	Program Core Course (PCC)	-	-	4	4	2	-	-	-	-	25	25
24UAIL402	Industrial IoT	Program Core Course (PCC)	2	-	-	2	2	10	15	50	-	-	75
24UAIP402	Industrial IoT	Program Core Course (PCC)	-	-	2	2	1	-	-	-	-	25	25
24UAIP403	Statistics and Probability	Program Core Course (PCC)	2	1	-	3	3	10	15	50	-	-	75
24UAIXXXX	Minor –II	Multidisciplinary Minor-II	2	-	-	2	2	10	15	25	-	-	50
24UXXXXXX	Open Elective -II	Open Elective(OE)	2	-	-	2	2	10	15	25	-	-	50
24UAIP404	SEC-III (CI/CD)	Vocational & Skill Enhancement Course (VSC)	-	-	4	4	2	-	-	-	25	-	25
24UBSP407	Modern Office (Life Skill) Management	Ability Enhancement Course (AEC-I)	-	-	4	4	2	-	-	-	25	-	25
24UESP408	Entrepreneurship Essentials II	Entrepreneurship	-	-	4	4	2	-	-	-	25	-	25
24UVEP409	VEC II (Environment Awareness)	Value Education Course (VEC)	-	-	4	4	2	10	15	-	25	-	50
	Total		**10**	**1**	**22**	**33**	**22**	**60**	**90**	**200**	**100**	**50**	**500**

Dr. Manjusha Tatiya
BOS Chairman

Dr. Saurabh Gupta
Dean Academics

Dr. Nilesh Uke
Director

INDIRA COLLEGE OF ENGINEERING & MANAGEMENT, PUNE
AI & DS

Dr. Neha Sharma
VC Nominee

Semester III

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Data Engineering			**Code**	24UAIL301	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/50	

Prerequisite: Basic knowledge of python programming
Basic understanding of data structure

Course Objective:

1	To introduce fundamental concepts of databases, including relational and NoSQL databases.
2	To enable students to write SQL queries for data retrieval and manipulation.
3	To familiarize students with ETL (Extract, Transform, Load) processes and data pipelines.
4	To introduce distributed data processing using Hadoop and Spark.
5	To prepare students for applying data engineering techniques in AI and ML applications.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Describe database fundamentals, relational models, and NoSQL databases.	Understand (L2)
CO2	Construct SQL queries for data retrieval, filtering, and manipulation	Apply (L3)
CO3	Develop relational and NoSQL database models for structured and unstructured data.	Create (L6)
CO4	Evaluate distributed data processing techniques using Hadoop and Spark.	Evaluate (L5)
CO5	Apply data engineering concepts in AI/ML pipelines.	Apply (L3)

Unit-1	**Introduction to Databases and SQL**	**(6 Hours)**
	Basics of Data, Databases, and Data Models, Introduction to Relational Databases (RDBMS), Entity-Relationship (ER) Modeling, SQL Basics: Creating, Inserting, Updating, Deleting Data, SQL Queries: Filtering, Aggregations, Joins, **Hands-on:** Writing Basic SQL Queries on MySQL/PostgreSQL,	
Unit-2	**NoSQL Databases and Data Storage**	**(6 Hours)**
	Limitations of Relational Databases, Introduction to NoSQL Databases: Document, Key-Value, Columnar, Graph MongoDB: Data Model, CRUD Operations, Indexing	
Unit- 3	**Data Engineering & ETL Pipelines**	**(6 Hours)**
	Introduction to Data Engineering and Data Pipelines ETL vs ELT: Concepts and Implementations Tools for ETL: Apache NiFi, Apache Airflow, Talend Data Cleaning and Transformation Techniques Hands-on: Building ETL Pipeline using Python (Pandas & SQL Alchemy)	
Unit- 4	**Big Data and Distributed Processing**	**(6 Hours)**
	Introduction to Big Data and Distributed Computing Apache Hadoop: HDFS, Map Reduce Apache Spark: Architecture, RDDs, Data Frames	
Unit- 5	**Data Engineering for AI & ML**	**(6 Hours)**
	Data Engineering for Machine Learning: Feature Engineering & Data Preprocessing Data Pipelines for AI/ML Models MLOps: Automating AI Pipelines	

Reference Book
1. C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
2. Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
3. Yupo Chan, John Talburt, and Terry M. Talley, “Data Engineering: Mining, Information and Intelligence”, ISBN-10: 1441901750, ISBN-13: 978-1441901750.
Text Book
1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled”, Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626
4. Joe Reis and Matt Housley **,** “Fundamentals of Data Engineering: Plan and Build Robust Data Systems" O'Reilly, ISBN-10: 1098108302, ISBN-13: 978-1098108304.
E Book
1. "The Big Book of Data Engineering" by Databricks
2. "Fundamentals of Data Engineering" by Joe Reis and Matt Housley
E-Links
1. http://www.nptelvideos.com/lecture.php?id=6518

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Data Engineering			**Code**	24UAIP301	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical INT/**EXT**
		Th/week				/25

Prerequisite: Basic knowledge of python programming

Course Objective:

1	**To introduce students to structured query language (SQL) and NoSQL databases** for data manipulation and retrieval.
2	To equip students with practical skills in database design, data extraction, transformation, and loading (ETL) processes.
3	**To enable students to write and execute advanced SQL and PL/SQL queries** using control structures, joins, subqueries, and exception handling.
4	**To familiarize students with MongoDB for working with unstructured and semi-structured data**, including CRUD, aggregation, indexing, and map-reduce operations.
5	**To develop an understanding of data engineering tools** like Pandas, SQLAlchemy, and Apache Spark for building efficient data pipelines and preparing data for machine learning.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Apply SQL and PL/SQL concepts to design, create, manipulate, and query relational databases.	Apply (Level 3)
CO2	Develop and execute MongoDB queries using CRUD operations, aggregation, indexing, and map-reduce.	Apply & Analyze (L3-L4)
CO3	Implement data preprocessing, cleaning, and transformation using Python and Pandas.	Apply (Level 3)
CO4	Build end-to-end data pipelines and demonstrate automation using SQLAlchemy and Python libraries.	Analyze & Create (L4-L6)
CO5	Utilize Apache Spark RDDs and DataFrames to perform large-scale data processing on cloud platforms.	Analyze (Level 4)

List of Assignments/Practical's	
1	SQL Queries: Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc.
2	Write at least 10 SQL queries on the suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like Insert, Select, Update, Delete with operators, functions, and set operator etc. SQL Queries – all types of Join, Sub-Query and View:
3	Write at least10 SQL queries for suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like all types of Join, Sub-Query and View
4	MongoDB Queries: Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators etc.). ETL Vs ELT Exporting and importing data
5	Design and develop SQL DML statements to demonstrate exporting tables to external files of different file formats ex. CSV, XLSX, TXT, etc.
6	Design and develop SQL DML statements to demonstrate importing data from external files of different file formats ex. CSV, XLSX, TXT, etc Unnamed PL/SQLcode block: Use of Control structure and Exception handling is mandatory. Suggested Problem statement:
7	Consider Tables: 1. Borrower (Roll_no, Name, Date_of_Issue, Name_of_Book, Status) Table 2. Fine (Roll_no, Date, Amt) • Accept Roll_no and Name_of_Book from user. • Check the number of days (from Date_of_Issue). • If days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day and for days less than 30, Rs. 5 per day. • After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. • Also handles the exception by named exception handler or user define exception handler. MongoDB – Aggregation and Indexing:
8	Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB. MongoDB – Map-reduce operations:

9	Implement Map-reduce operation with suitable example using MongoDB.
10	Extracting CSV Data, Cleaning it with Pandas, and Loading it into SQLite using SQL Alchemy
11	Building a Mini Data Warehouse Pipeline using Python, Pandas & SQLAlchemy Introduction to Apache Spark –
12	Word Count using RDDs on Google Colab.
13	Analyzing Structured Data Using Spark DataFrames on Google Colab Feature Engineering & Data Preprocessing for ML Models
14	Preparing Titanic Dataset for Machine Learning using Scikit-learn Pipelines.
15	End-to-End AI/ML Pipeline for Iris Dataset with Joblib Model Saving.

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Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Data Structure			**Code**	24UAIL302	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/50	

Prerequisite: Basic knowledge of programming c, cpp, python

Course Objective:

1	To understand the fundamental concepts of **data structures** and their role in solving problems in **AI and Data Science**
2	To analyze and implement **linear** and **non-linear** data structures and evaluate their performance using **time and space complexity**
3	To develop the ability to design and apply **advanced data structures** for **data manipulation, storage, and retrieval** in AI-driven applications
4	To apply **graph and tree-based structures** to solve real-world problems, including searching, sorting, and optimization in AI models
5	**To integrate** data structure knowledge in AI/ML pipelines and big data environments.

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	**Understand and analyze** the need for **data structures** in AI and Data Science applications.	Understand (L2)
CO2	**Implement** and **evaluate** basic **linear data structures** (arrays, linked lists, stacks, and queues) with efficiency.	Apply (L3)
CO3	**Design and apply non-linear data structures** (trees, graphs, and heaps) to solve complex AI problems.	Create (L6)
CO4	**Optimize and manipulate** large datasets using advanced **hashing** and **dynamic programming** techniques.	Evaluate (L5)

Unit-1	**Introduction to Data Structures and Complexity Analysis**	**(6 Hours)**
	Introduction to data structures and their use in AI and Data Science. Classification of data structures: Linear vs. Non-Linear, Static vs. Dynamic. Time and space complexity. Introduction to Big O notation. Simple analysis of best, worst, and average case.	CO1, CO2
Unit-2	**Arrays, Linked Lists, and Applications**	**(6 Hours)**
	Arrays: 1D and 2D arrays; applications in data representation (Tensors). Linked Lists: Singly and Doubly Linked List – basic operations (insert, delete, traverse). Simple real-world examples like student records or dynamic lists.	CO2, CO3
Unit- 3	**Stack and Queue Structures**	**(6 Hours)**
	Stacks (LIFO): push, pop, peek operations; use in expression evaluation (e.g., postfix). Queues (FIFO): enqueue, dequeue, and circular queue. Applications: Job scheduling, call center queue simulation.	CO2, CO3
Unit- 4	**Introduction to Trees and Graphs**	**(6 Hours)**
	Binary Trees and Binary Search Trees – insert, delete, search. Graph basics: Representation using adjacency matrix and list. Simple traversals: DFS and BFS on small graphs. Basic applications: Finding friends on social media, tree-like data organization.	CO1, CO3
Unit- 5	**Searching, Sorting & AI-Oriented Structures**	**(6 Hours)**
	Searching: Linear Search and Binary Search. Sorting: Bubble Sort, Merge Sort, Quick Sort – with step-by-step examples. Intro to Sparse Matrices and Tensors in Python (NumPy basics). Simple use case: Preprocessing data for machine learning models.	CO2, CO4

Text Books

1. Reema Thareja, “Data Structures Using C”, Oxford University Press.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, University Press.

Reference Books

1. Robert Sedgewick and Kevin Wayne, “Algorithms”, Addison-Wesley.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms (CLRS)”, MIT Press

3. Benjamin Baka, "Python Data Structures and Algorithms", Packt Publishin

4. Ellis Horowitz, Sartaj Sahni **, "Fundamentals of Data Structures in C"** –

E Book

1. Brad Miller and David Ranum, "Problem Solving with Algorithms and Data Structures using Python" – Available at: https://runestone.academy/runestone/books/published/pythonds/index.html
2. Allen B. Downey, "Think Data Structures: Algorithms and Information Retrieval in Java" – Available at: https://greenteapress.com/wp/think-data-structures/

E-links

1. NPTEL Course – Data Structures and Algorithms https://nptel.ac.in/courses/106/102/106102064/
Video lectures by Prof. Naveen Garg (IIT Delhi)
2. https://www.geeksforgeeks.org/data-structures/
Step-by-step tutorials, problems, and visualizations.
3. https://www.khanacademy.org/computing/computer-science/algorithms
Interactive visuals and beginner-friendly algorithms.
4. NumPy: https://numpy.org/learn/

W3Schools DSA in Python: https://www.w3schools.com/dsa/index.php

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Data Structure			**Code**	24UAIP302	
Credits	1	**Pr/week**	2	**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/**EXT**
		Th/week				-/25

Prerequisite: Basic knowledge of Python programming and understanding of core programming logic.

Course Objective:

1	To provide hands-on experience in implementing data structures using Python.
2	To understand the role of data structures in AI/ML workflows and Big Data environments.
3	To analyze and implement efficient algorithms for solving real-world problems.
4	To simulate linear and non-linear data structures for AI-relevant tasks.
5	To explore performance analysis and memory optimization of AI-specific data structures.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Implement and simulate linear and non-linear data structures in Python.	Apply (Level 3)
CO2	Apply stack, queue, and linked list concepts to AI-relevant tasks.	Apply & Analyze (L3-L4)
CO3	Implement data preprocessing, cleaning, and transformation using Python and Pandas.	Analyze (Level 3)
CO4	Use advanced data structures like heaps, tries, graphs, and hash tables in real-world scenarios.	Evaluate (Level 5)
CO5	Utilize Apache Spark RDDs and DataFrames to perform large-scale data processing on cloud platforms.	Analyze (Level 4)

List of Assignments/Practical's (Any 8)

Sr. No.	Title of Practical
1.	Implement basic array operations (insert, delete, update, search)
2.	Represent a matrix or table using a 2D array and perform basic operations.
3.	Create and traverse a singly linked list.
4.	Implement a stack and perform push, pop, and peek operations.
5.	Implement insert and traversal operations in a doubly linked list.
6.	Implement a queue with enqueue and dequeue operations.
7.	Implement a circular queue.
8.	Create a binary search tree (BST) and perform in-order traversal.
9.	Represent a graph and perform Breadth-First Search (BFS).
10.	Implement DFS traversal for an undirected graph.
11.	Implement and compare linear and binary search on an integer list.
12.	Implement and compare bubble sort and merge sort with count of comparisons.
13.	Store and print a sparse matrix efficiently using lists.
14.	Implement a simple disjoint set using union and find operations
15.	Implement quick sort to check the number of comparisons
16.	Perform reshape, slicing, and basic matrix operations on NumPy arrays.

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Agile Engineering and Project Management			**Code**	24UAIL303	
Credits	3	**Pr/week**		**Evaluation Scheme**	Theory TAE/CAE/**ESE**	Practical INT/EXT
		Th/week	3		-/-/50	

Prerequisite: Basic understanding of Fundamental programming

Course Objective:

1	To introduce the fundamental concepts and principles of Agile methodology.
2	To develop an understanding of Agile planning, roles, and estimation techniques.
3	To equip with skills for tracking Agile projects using tools and metrics
4	To apply Agile engineering practices such as CI/CD and DevOps.
5	To analyze the implementation of Agile in real-world AI/ML and software projects

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Explain Agile values, principles, and frameworks	Understand (L2)
CO2	Apply Agile roles, ceremonies, and estimation techniques.	Apply (L3)
CO3	Use tracking tools and interpret Agile project metrics.	Applying(L3), Analyzing (L4)
CO4	Implement Agile engineering practices such as TDD and CI/CD.	Applying(L3), Creating(L6)
CO5	Analyze and evaluate Agile practices in real-world applications.	Analyzing (L4), Evaluating(L5)

Unit-1	**Fundamentals of Agile Methodology**	**(9 Hours)**
	Evolution and need for Agile, Agile Manifesto and 12 Principles Agile vs Traditional (Waterfall) approach, Overview of Agile Frameworks: Scrum, Kanban, Benefits and limitations of Agile	
Unit-2	**Agile Planning and Estimation**	**(9 Hours)**
	Scrum roles: Product Owner, Scrum Master, Development Team, Agile ceremonies: Sprint planning, Daily stand-up, Review, Retrospective, Writing user stories, epics, themes, Estimation techniques: Planning Poker, T-shirt sizing	
Unit- 3	**Project Tracking and Metrics in Agile**	**(9 Hours)**
	Product and Sprint Backlogs, Task Boards and Kanban Boards, Sprint Burn-down, Burn-up Charts, Velocity, capacity, and tracking, Agile Project Management Tools: JIRA, Azure DevOps	
Unit- 4	**Agile Engineering Practices**	**(9 Hours)**
	Test Driven Development (TDD), Pair Programming, Continuous Integration / Continuous Deployment (CI/CD),DevOps culture in Agile, Refactoring and Technical Debt, Agile design and documentation practices	
Unit- 5	**Agile Project Management in Real-world Applications**	**(9 Hours)**
	Agile for AI/ML and Data Science Projects, Case studies of Agile in startups and large enterprises, Hybrid Agile frameworks (Agile + PMBOK/PRINCE2),Managing distributed and remote Agile teams, Capstone Group Activity: Build and present a mini Agile project	

Reference Book

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide)" by Project Management Institute (PMI)
2. S K Chang, “Handbook of Software Engineering and Knowledge Engineering”, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Springer, ISBN 13:9788173192715.

Text Book

1. Roger Pressman, “Software Engineering: A Practitioner‘s Approach”, McGraw Hill, ISBN 0–07–337597–7
2. “Project Management: The Managerial Process" by Erik W. Larson and Clifford F. Gray
3. "Project Management for Engineering, Business, and Technology" by John M. Nicholas & Herman Steyn
4. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner

E Book
1. https://ebookpdf.com/roger-s-pressman-software-engineering
2. https://www.atlassian.com/work-management/project-management
E-Links
1. https://www.atlassian.com/project-management
2. https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3. https://onlinecourses.nptel.ac.in/noc24_mg01/preview

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Minor I - Fundamentals of RPA			**Code**	24UAIL3M11	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Basic knowledge of mathematics

Course Objective:

1	**Understand** core RPA concepts, its evolution, and significance in streamlining business operations.
2	**Examine** RPA's role in digital transformation and its applications across industries (e.g., finance, healthcare, logistics).
3	**Differentiate** RPA from related technologies like AI, machine learning, and Business Process Management (BPM).
4	**Explore** RPA architecture, components, and leading tools (e.g., UiPath, Automation Anywhere, Blue Prism).
5	**Identify** stages of the RPA lifecycle, including process discovery, development, deployment, and maintenance.
6	**Discuss** ethical implications, security challenges, and governance frameworks for sustainable RPA adoption

Course Outcomes:

CO1	**Analyze** business processes using methodologies like process mining to pinpoint automation opportunities.
CO2	**Design, develop, and deploy** basic RPA bots using industry-standard tools (e.g., workflow automation, screen scraping).
CO3	**Implement** robust error handling, exception management, and logging in automation workflows.
CO4	**Integrate** RPA solutions with external systems (e.g., ERP, CRM) via APIs or scripting.
CO5	**Apply** best practices for testing, debugging, and maintaining bots to ensure scalability and reliability.
CO6	**Evaluate** RPA's impact on organizational metrics such as cost reduction, accuracy, and efficiency.
CO7	**Develop** governance frameworks to address compliance, security, and scalability in RPA projects.

CO8	**Collaborate** with stakeholders to manage change, optimize workflows, and align automation with business goals.

Unit 1	**Introduction – Robotic Process Automation**	**(5 Hours)**
	History and evolution of RPA, Benefits & challenges of RPA,RPA vs traditional automation, use cases for RPA, RPA Tools and Platforms, Overview of popular RPA tools (e.g., UiPath, Automation Anywhere, Blue Prism, Power Automate),Components of RPA tools, Licensing and pricing models, Installation and setup of RPA tools	
Unit- 2	**RPA Lifecycle Stages of the RPA lifecycle:**	**(5 Hours)**
	Process identification and assessment Process design and development Testing and deployment Monitoring and maintenance, Best practices for each stage	
Unit- 3	**Process Identification and Assessment**	**(5 Hours)**
	Identifying automation opportunities, Criteria for selecting processes for automation, Process documentation and analysis, Feasibility and ROI analysis, RPA Development Basics, Understanding workflows and flowcharts, Recording and playback functionality, Variables, arguments, and data types, Control structures (loops, conditions, decision-making), Error handling and debugging	
Unit- 4	**Working with RPA Tools**	**(5 Hours)**
	User interface and features of RPA tools, Creating and managing bots, Working with activities/commands, Data manipulation and file handling, Integration with other applications (e.g., Excel, databases, APIs)	
Unit- 5	**Advanced RPA Concepts**	**(5 Hours)**
	Screen scraping and OCR (Optical Character Recognition),Working with unstructured data, Exception handling and recovery, Bot scheduling and orchestration, Cognitive automation and AI integration	
Unit- 6	**Testing and Deployment**	**(5 Hours)**
	Types of testing (unit, integration, user acceptance),Test case development and execution, Deployment strategies, Version control and change management	

Reference Book
1. Mikell P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education Asia.
2. N.Viswanadham and Y.Narahari, Performance Modeling of Automated Manufacturing Systems, Prentice Hall India Pvt. Ltd.
3. K. Ogata, "Modern Control Engineering", Pearson India, 3rd Edition.
4. Norman Nise, "Control System Engineering", Prentice Hall India, Fourth Edition 3 Anand Kumar, "Control System Theory", Prentice-Hall India.
5. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
Text Book
1. The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems **First Edition by Tom Taulli (Author**)

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective I - DMS administration			Code	24UAIL304A	
Credits	3	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	3		10/15/50	

Prerequisite: Basic knowledge of Database Management Systems, programming languages, computer system fundamentals,

Course Objective:

1	Understand database management system (DMS) administration principles.
2	Learn database security and performance optimization techniques.
3	Explore database backup and recovery strategies.
4	Develop practical skills in database administration tools and technologies

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1:	Explain the fundamental principles of AI and ML	Level 2 :Understand
CO2:	Apply database security and performance tuning techniques.	Level 3:Apply
CO3:	Implement backup and recovery mechanisms.	4 :Analyze
CO4	Use industry-standard database administration tools effectively.	Level 5: Evaluate

Unit 1	**Introduction to DMS Administration**	**(9 Hours)**
	Database Architecture and Components: Overview of DBMS, Components of DBMS DBMS Engine, Query Processor, Storage Manager, Transaction Manager, Database Schema, DBMS Models, Ensuring data integrity, security, user management, and performance optimization. Database Installation and Configuration	CO1, CO2
Unit-2	**Database Security and Performance Optimization**	**(9 Hours)**
	User Management and Access Control: Authentication and Authorization, Privilege Management, Indexing and Query Optimization: Indexes, Query Optimization, Execution Plans, Performance Monitoring and Tuning: DBMS Performance Metrics, Optimization Techniques	CO2, CO3
Unit- 3	**Backup and Recovery Strategies**	**(9 Hours)**

		CO3,CO4
	Types of Backups and Recovery Methods: Backup Types, Backup Strategies, Recovery Techniques, Database Failure and Crash Recovery Techniques: Failure Scenarios, Crash Recovery, Disaster Recovery Planning: Theoretical Concepts of Disaster Recovery, Recovery Time Objective (RTO) and Recovery Point Objective (RPO).	
Unit- 4	**Advanced Database Administration**	**(9 Hours)**
	Automating Administrative Tasks: Automation Principles, Scripting for DBAs, High Availability and Clustering: High Availability Concepts, Database Clusters, Troubleshooting and Log Analysis: Log File Management, Troubleshooting Methodologies	CO1, CO3
Unit- 5	**Industry Practices and Case Studies**	**(9 Hours)**
	Cloud Database Administration: Cloud-Based Databases, Scalability and Cost Management, Emerging Trends in Database Management: NoSQL Databases, Database as a Service (DBaaS), Artificial Intelligence and Databases, Case Studies on Real-World Database Administration: Real-World Scenarios, Challenges and Solutions.	CO2, CO4

Reference Book
1. "Database Systems: The Complete Book" by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom.
2. "Fundamentals of Database Systems" by Ramez Elmasri, Shamkant B. Navathe.
3. "SQL and Relational Theory" by C.J. Date.
Text Book
1. “Database System Concepts” by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
2. “Database Administration: The Complete Guide to Practices and Procedures” by Craig S. Mullins
3. “SQL Server 2019 Administration Inside Out” by Randolph West, William Assaf, and others
4. “Cloud Database Development and Management” by Lee Chao
E Book
1. Database Administration: The Complete Guide to DBA Practices and Procedures- https://ptgmedia.pearsoncmg.com/images/9780321822949/samplepages/0321822943.pdf.
2.Oracle Database Administrator's Guide- https://docs.oracle.com/en/database/oracle/oracle-database/18/admin/database-administrators-guide.pdf
3.Database Administration- https://www.ibm.com/docs/en/SSEPH2_13.1.0/com.ibm.ims13.doc.pdf/dfsdagk1.pdf
E-Links
1. https://www.mongodb.com/resources/basics/databases/nosql-explained
2. https://aws.amazon.com/training/
3. https://skillsbuild.org/

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	DMS administration			Code	24UAIP304 A	
Credits	1	**Pr/week**	2	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25/

Prerequisite: Operating Systems (Basics)

Course Objective:

1	To enable students to understand and implement core database administration tasks using SQL.
2	To familiarize students with user access control, role-based permissions, and database security.
3	To apply database scripting techniques for automating administrative tasks.
4	To integrate key database operations such as constraints, indexing, and backups in practical scenarios.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Design and create database schemas using appropriate data types and constraints.	Level 3: Apply
CO2	Implement user roles, permissions, and access control mechanisms in a database system.	Level 4: Analyze
CO3	Automate administrative tasks like user creation and backups using SQL or scripting languages.	Level 5: Evaluate
CO4	Integrate multiple administrative operations in comprehensive database management solutions.	Level 4: Analyze

	List of Assignments/Practical's	
1	Write SQL scripts to create a database, tables, and insert records with appropriate data types.	CO1
2	Write SQL to apply primary key, foreign key, NOT NULL, UNIQUE, and CHECK constraints.	CO1, CO2
3	Write SQL to create users, assign privileges (GRANT, REVOKE) and view user roles.	CO2
4	Script to create multiple roles (admin, manager, viewer) and assign database objects with varying permissions.	CO2, CO3
5	Use SQL script or Python to automate creation of multiple database users from a CSV file.	CO1, CO3
6	Combine table creation, constraints, indexing, user access, and backup into one integrated assignment.	CO1, CO2, CO3, CO4

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective I - Analytics using Data Science			Code	24UAIL304B	
Credits	3	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	3		10/15/50	

Prerequisite: Basic Programming Skills, Basic Statistics, Data Structures and Algorithms
Course Objective:

1	Understand the fundamental concepts of data science and analytics.
2	Explore various data preprocessing and visualization techniques.
3	Learn about statistical and machine learning methods for data analysis.
4	Apply data science techniques to real-world applications.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1:	Explain the basic concepts of data science and analytics.	Level 2: Understanding
CO2:	Perform data preprocessing and visualization.	Level 3: Applying
CO3:	Implement statistical and machine learning techniques for data analysis.	Level 4: Analyzing
CO4	Apply data science methodologies to solve real-world problems	Level 5: Evaluating

Unit 1	**Introduction to Data Science**	**(9 Hours)**
	Overview of Data Science and its applications: Understanding the role of data science in various industries such as healthcare, finance, e-commerce, and social media. Data Science process and lifecycle: Exploration of the key stages in data science, including data collection, cleaning, analysis, visualization, and interpretation. Basics of Python and R for data science: Introduction to programming languages widely used in data science, covering libraries such as Pandas, NumPy, and Matplotlib.	CO1, CO2
Unit-2	**Data Preprocessing and Visualization**	**(9 Hours)**

	Data collection, cleaning, and transformation: Methods for acquiring raw data, handling missing values, and transforming data into suitable formats. Handling missing data and outliers: Techniques such as imputation, interpolation, and removal of anomalies to improve data quality. Exploratory Data Analysis (EDA) using visualization tools: Understanding data distribution, relationships, and trends using Matplotlib, Seaborn, and Tableau.	CO2, CO3
Unit- 3	**Statistical and Machine Learning Techniques**	**(9 Hours)**
	Descriptive and inferential statistics: Measures of central tendency, variance, hypothesis testing, and confidence intervals. Regression and classification models: Implementation of Linear Regression, Logistic Regression, Decision Trees, and Support Vector Machines. Clustering techniques and dimensionality reduction: K-Means, Hierarchical Clustering, Principal Component Analysis (PCA), and t-SNE for data simplification and pattern recognition.	CO3, CO4
Unit- 4	**Big Data and Cloud Analytics**	**(9 Hours)**
	Introduction to Big Data and Hadoop: Basics of big data processing and Hadoop ecosystem, including HDFS, MapReduce, and Apache Spark. Cloud-based data analytics platforms: Overview of cloud-based services such as AWS, Google Cloud, and Microsoft Azure for scalable data analytics. Case studies in data analytics: Real-world applications of big data analytics in domains like retail, fraud detection, and personalized recommendations.	CO1, CO3
Unit- 5	**Applications of Data Science**	**(9 Hours)**
	Real-world applications in finance, healthcare, and e-commerce: Implementation of data science techniques in fraud detection, medical diagnosis, and recommendation systems. Ethical and privacy concerns in data analytics: Discussion on data privacy laws, ethical AI, and responsible data handling practices. Future trends in data science: Emerging technologies, including AutoML, Edge AI, and AI-driven automation in analytics.	CO2, CO4

Reference Book
1."The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
2."Machine Learning Yearning" by Andrew Ng
3."Big Data: Principles and Best Practices" by Jules Berman
Text Book
1."Data Science from Scratch" by Joel Grus
2."Introduction to Machine Learning with Python" by Andreas C. Müller and Sarah Guido

3. "Big Data in Practice" by Bernard Marr
4. "Cloud Analytics with Google Cloud Platform" by S. P. T. Nair
E Book
1. Data Science: Theories, Models, Algorithms, and Analytics- https://srdas.github.io/Papers/DSA_Book.pdf?utm_source=chatgpt.com.
2. Data Science from Scratch -https://jcer.in/jcer-docs/E-Learning/Digital%20Library%20/E-Books/Data%20Science%20from%20Scratch%20by%20Joel%20Grus.pdf?utm_source=chatgpt.com
3.Practitioner's Guide to Data Science- https://scientistcafe.com/ids/IDS.pdf?utm_source=chatgpt.com
E-Links
1. https://www.edx.org/learn/data-science
2. https://365datascience.com/
3. https://www.datacamp.com/

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Analytics using Data Science			Code	24UAIP304 B	
Credits	1	**Pr/week**	2	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25/

Prerequisite: Basic Programming Skills, Introduction to Statistics or Applied Mathematics

Course Objective:

1	To introduce students to essential tools and libraries for data analysis using Python/R.
2	To guide students through the data science lifecycle using real-world datasets.
3	To implement statistical and analytical techniques for deriving insights from data.
4	To apply basic machine learning models and explore deployment using cloud-based tools.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Apply data science tools and frameworks (Pandas, NumPy, Spark) for data handling and analysis.	Level 3: Apply
CO2	Use visualization and statistical techniques to understand and interpret datasets.	Level 4: Analyze
CO3	Perform basic statistical analysis and model evaluation techniques.	Level 3: Apply
CO4	Develop and deploy basic recommendation models and demonstrate cloud-based analytics workflows.	Level 5: Evaluate

	List of Assignments/Practical's	
1	Install Python/R, explore Pandas, NumPy, and load sample datasets.	CO1
2	Demonstrate the stages of data science lifecycle using a small dataset.	CO1
3	Use statistical techniques and visualizations to detect outliers.	CO2
4	Calculate mean, median, standard deviation, and perform t-tests.	CO3
5	Perform data transformation and basic analysis on a Spark dataset.	CO1, CO4
6	Use Google Colab or AWS SageMaker to deploy a trained model.	CO1, CO2, CO3, CO4
7	Analyze user behavior data and generate product/movie recommendations.	CO4

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective I - Generative AI (Gen AI)			Code	24UAIL304 C	
Credits	3	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	3		10/15/50	

Prerequisite: Basic Programming Skills, Basic Statistics, Data Structures and Algorithms

Course Objective:

1	Understand the fundamentals of Generative AI and its applications.
2	Learn various Generative AI models such as GANs, VAEs, and Transformers.
3	Explore real-world applications of Generative AI in different industries.
4	Analyze the ethical considerations and future trends in Generative AI.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1:	Explain the basic principles and working of Generative AI.	Level 2: Understand
CO2:	Identify and utilize different models of Generative AI for various applications.	Level 3: Apply
CO3:	Develop and implement Generative AI models for creative and industrial use cases.	Level 6: Create
CO4	Analyze ethical concerns, biases, and future advancements in Generative AI.	Level 5:Analyze

Unit 1	**Introduction to Generative AI**	**(9 Hours)**
	Overview of AI and Generative AI: Differences between traditional AI and Generative AI, definition, and scope of Generative AI, Fundamentals of Machine Learning & Deep Learning: Understanding supervised, unsupervised, and reinforcement learning, Mathematical Foundations: Basics of probability, linear algebra, and optimization techniques used in Generative AI, Generative AI vs. Traditional AI Models: Key distinctions, advantages, and challenges.	CO1, CO2
Unit-2	**Generative AI Models and Architectures**	**(9 Hours)**
	Generative Adversarial Networks (GANs): Introduction to	CO2, CO3

	GANs, architecture, training process, and applications in image generation, Variational Autoencoders (VAEs): Concept, encoder-decoder architecture, and use in generative tasks, Transformers and Large Language Models (LLMs): Working principles of GPT, BERT, and T5, Comparison of Different Generative AI Models: Strengths and limitations of various approaches.	
Unit- 3	**Applications of Generative AI**	**(9 Hours)**
	Image and Video Generation: Deepfake technology, style transfer, AI-generated artwork (e.g., DALL·E, Stable Diffusion),Text Generation & Natural Language Processing (NLP): Chatbots, text summarization, AI-assisted writing tools, Speech and Audio Synthesis: AI-powered voice cloning, music composition, and audio enhancement. Healthcare and Drug Discovery: AI-generated molecular structures, medical imaging synthesis.	CO3, CO4
Unit- 4	**Implementation of Generative AI Models**	**(9 Hours)**
	Programming for Generative AI: Introduction to Python libraries (TensorFlow, PyTorch, OpenAI APIs). Data Preprocessing for Generative Models: Data collection, augmentation, and preprocessing techniques. Training and Fine-tuning Generative Models: Understanding hyperparameters, evaluation metrics, and model fine-tuning. Deploying Generative AI Applications: Integration of Generative AI models into real-world applications.	CO1, CO3
Unit- 5	**Ethical Considerations and Future of Generative AI**	**(9 Hours)**
	Bias and Fairness in Generative AI: Addressing issues of AI bias, fairness, and diversity in generated content, Deepfake Detection and Security Concerns: Methods to identify AI-generated content and prevent misuse. Regulatory and Legal Aspects: AI policies, copyright issues, and responsible AI usage. Future Trends in Generative AI: AI creativity, multimodal models, and the role of AGI (Artificial General Intelligence). Case Studies: Industry applications of Generative AI in media, entertainment, healthcare, and research.	CO2, CO4

Reference Book
1."Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
2."Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3."Pattern Recognition and Machine Learning" by Christopher Bishop

Text Book
1. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" David Foster O'Reilly Media, 2nd Edition, 2022
2. "Hands-On Generative Adversarial Networks with Keras" Rafael Valle Packt Publishing, 2019
3. "Artificial Intelligence: A Guide for Thinking Humans" Melanie Mitchell Penguin, 2019
4. "Deep Learning" Ian Goodfellow, Yoshua Bengio, and Aaron Courville MIT Press, 2016
E Book
1. Mastering Generative AI and Prompt Engineering - https://datasciencehorizons.com/pub/Mastering_Generative_AI_Prompt_Engineering_Data_Science_Horizons_v2.pdf
2. eBook: Generative AI for Beginners- https://www.scribd.com/document/767437768/eBook-Generative-AI-for-Begginner
3. Learn Python Generative AI: Journey from Autoencoders to Transformers to Large Language Models - https://dokumen.pub/learn-python-generative-ai-journey-from-autoencoders-to-transformers-to-large-language-models.html
E-Links
1. https://vlab.spit.ac.in/ai/
2. https://azure.microsoft.com/en-us/blog/introducing-azure-ai-foundry-labs-a-hub-for-the-latest-ai-research-and-experiments-at-microsoft/
3. https://course.fast.ai/

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Generative AI (Gen AI)			Code	24UAIP304 C	
Credits	1	**Pr/week**	2	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25/

Prerequisite: Basic Programing

Course Objective:

1	To provide foundational knowledge of traditional AI models and contrast them with generative AI approaches.
2	To introduce students to generative models such as GANs, VAEs, and Transformer-based architectures.
3	To implement hands-on projects in image, text, and audio generation using pre-trained and custom-trained models.
4	To explore real-world applications of generative AI across domains like NLP, computer vision, and creative industries.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Compare traditional AI models with generative AI models and demonstrate key differences in architecture and output.	Level 4: Analyze
CO2	Implement and evaluate basic generative models like GANs and VAEs for image generation tasks.	Level 3: Apply
CO3	Apply pre-trained generative models in tasks like text generation, style transfer, and summarization.	Level 4: Analyze
CO4	Design and fine-tune generative AI systems for creative and domain-specific applications like music synthesis and chatbots.	Level 5: Evaluate

	List of Assignments/Practical's (Any 7)	
1	**Experiment 1: AI vs. Generative AI** **Objective:** Implement a simple AI model and compare its performance to a basic generative model (e.g., a simple linear regression vs. a basic GAN model).	CO1, CO2

	Tools: Python, TensorFlow, PyTorch **Outcome:** Understand the core differences in architecture and output between traditional AI and generative AI models.	
2	**Supervised vs. Unsupervised Learning** **Objective:** Implement simple models for supervised learning (e.g., classification using decision trees) and unsupervised learning (e.g., clustering using k-means). **Tools:** Python, Scikit-learn **Outcome:** Understand the differences in data processing and learning mechanisms for supervised and unsupervised learning models.	CO1, CO2
3	**GANs - Image Generation** **Objective:** Build and train a simple GAN to generate images from random noise (e.g., generate handwritten digits using MNIST dataset). **Tools:** Python, TensorFlow, Keras **Outcome:** Learn the architecture and training process of Generative Adversarial Networks (GANs).	CO2
4	**Variational Autoencoders (VAEs)** **Objective:** Implement a Variational Autoencoder for image generation or compression. **Tools:** Python, TensorFlow, Keras **Outcome:** Learn the encoder-decoder architecture and its application in generative tasks.	CO2, CO3
5	**Transformer Models for Text Generation** **Objective:** Use pre-trained Transformer models (e.g., GPT-2) to generate text based on a seed input. **Tools:** Python, Hugging Face's Transformers library **Outcome:** Understand the working principles of Transformer models like GPT, BERT, and T5.	CO1, CO3
6	**Image Style Transfer using Pre-trained Models** **Objective:** Use a pre-trained neural network (e.g., VGG16) to perform image style transfer and generate artistic versions of images. **Tools:** Python, TensorFlow, Keras **Outcome:** Understand the application of generative models in artistic content generation.	CO3, CO4
7	**Text Summarization using Pre-trained GPT Models** **Objective:** Implement a text summarization task using a pre-trained GPT model (e.g., GPT-3 or GPT-2). **Tools:** Python, Hugging Face's Transformers library **Outcome:** Explore applications of Generative AI in natural language processing (NLP).	CO3, CO4
8	**AI-generated Music Composition** **Objective:** Use an AI tool (e.g., Magenta) to generate a music composition based on a given style or theme.	CO3,CO4

	Tools: Python, Magenta library **Outcome:** Understand the use of Generative AI in the creative industry for music and audio synthesis.	
9	**Fine-tuning a Pre-trained Model (e.g., GPT-3 for Chatbots)** **Objective:** Fine-tune a pre-trained model like GPT-3 on a specific dataset to create a domain-specific chatbot. **Tools:** Python, Hugging Face's Transformers, OpenAI API **Outcome:** Learn how to fine-tune generative models for specialized applications.	CO1, CO3

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Entrepreneurship Essentials I			**Code**	24UESP305	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25/-

Prerequisite: Basic understanding of business concepts & a strong interest in entrepreneurship

Course Objective:

1	To provide students with a foundational understanding of entrepreneurship and the entrepreneurial process.
2	To develop the ability to identify and evaluate business opportunities and create viable business models
3	To equip students with knowledge of financial planning, marketing strategies, and operational processes in a startup.
4	To foster entrepreneurial thinking and the ability to navigate challenges faced by new ventures.
5	To impart knowledge about business plan preparation and funding options.

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	Understand the characteristics of successful entrepreneurs and the phases of the entrepreneurial journey.	Understand (L2)
CO2	Analyze opportunities and evaluate the feasibility of business ideas.	Apply (L3)
CO3	Design and plan a business model including marketing, operations, and financial aspects.	Create (L6)
CO4	Identify various sources of funding and develop an investor pitch.	Evaluate (L5)
CO5	Demonstrate the ability to create and present a comprehensive business plan.	Apply (L3) & Evaluate (L5)

Sr. No.	List of Assignments
1	Study and analysis of a successful entrepreneur's journey
2	Generate and shortlist business ideas using brainstorming techniques
3	Evaluate business opportunities using an opportunity matrix
4	Design customer personas and create empathy maps
5	Develop a Business Model Canvas for a new venture
6	Conduct a feasibility study (technical, market, financial) for a startup idea
7	Plan an MVP (Minimum Viable Product) for a selected business idea
8	Develop a basic digital marketing strategy for a startup
9	Create a 1-year financial plan and perform break-even analysis
10	Create a startup pitch deck and deliver an investor pitch
11	Identify legal structure and IPR needs for a startup
12	Perform a SWOT analysis and design a startup risk mitigation plan
13	Participate in a startup launch simulation or business model competition

Reference Books

1. Thomas W. Zimmerer, Norman M. Scarborough – *Essentials of Entrepreneurship and Small Business Management*, Pearson Education.
2. **Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd** – *Entrepreneurship*, McGraw-Hill Education.
3. **Alexander Osterwalder, Yves Pigneur** – *Business Model Generation*, John Wiley & Sons.
4. **Eric Ries** – *The Lean Startup*, Crown Publishing.
5. Timmons, Spinelli – *New Venture Creation: Entrepreneurship for the 21st Century*, McGraw Hill.

E Book

1. "The Startup Owner's Manual" by Steve Blank and Bob Dorf (Available on Amazon and Internet Archive)
2. "Zero to One: Notes on Startups" by Peter Thiel
3. "Entrepreneurship Development and Small Business Enterprises" by Poornima M. Charantimath (Available on academic e-libraries)

4. **Heidi M. Neck, Christopher P. Neck, Emma L. Murray** – *Entrepreneurship: A Practice-Based Approach*, Sage Publications.

5. **Harvard Business Review** – *The HBR Entrepreneur's Handbook*, Harvard Business Press.

E- Links

1. **NPTEL – Entrepreneurship Development Programme**
   https://nptel.ac.in/courses/110/107/110107094
2. **Startup School by Y Combinator**
   https://www.startupschool.org
3. **Strategyzer – Business Model Canvas and Value Proposition Tools**
   https://www.strategyzer.com
4. **Startup India – Legal and Regulatory Resources**
   https://www.startupindia.gov.in
5. **Creately – SWOT Analysis Templates**
   https://creately.com/diagram-community/popular/t/swot
6. **Plan Projections – Break-even Analysis and Financial Forecasting Tools**
   https://www.planprojections.com

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Understanding India – Introduction to Indian Constitution			**Code**	24UVEP306 A	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: Basic understanding of Indian history and political science.

Course Objective:

1	To provide a foundational understanding of the Indian Constitution's structure and significance.
2	To elucidate the roles and functions of the Union and State governments
3	To highlight the importance of Fundamental Rights, Duties, and Directive Principles.
4	To foster an appreciation for the constitutional values that guide India's democratic governance.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Comprehend the historical context and development of the Indian Constitution.	Understand (L2)
CO2	Analyze the structure and functions of Union and State governments.	Analyzing (L4)
CO3	Interpret the Fundamental Rights, Duties, and Directive Principles.	Understand (L2), Analyzing (L4)
CO4	Apply constitutional principles to contemporary socio-political and legal issues..	Applying (L3)

List of Assignments:

Week	Topic to be covered	Activity
1	Introduction to the Constitution & Historical Background	Group activity: Timeline creation of constitutional milestones, video documentary review, quiz competition.
2	Constituent Assembly & Government Acts	Debate: "Impact of 1935 Act on Indian Polity" – with student panel discussions and written reflections.
3	Silent Features & Preamble Analysis	Create digital posters/presentations explaining Preamble keywords using Canva/AI tools.
4	Citizenship Laws & Changes (CAA etc.)	Role play/simulation: Citizenship criteria judgment with mock court or panel format.
5	Fundamental Rights	Case study analysis: Real cases like Right to Education, Freedom of Speech – discussion and write-up.
6	Directive Principles & Fundamental Duties	Chart-making activity: DPSPs vs Fundamental Rights – A comparative analysis + skit presentation.
7	Union Government – President, PM, Parliament	Infographic assignment: Powers of the President, Prime Minister, Lok Sabha, Rajya Sabha.
8	State Government & Centre-State Relations	Simulation: Formation of a state government, mock legislative session.
9	Constitutional Amendments	Group presentation: Landmark amendments and their impact.
10	Emergency Provisions & Case Studies	Dramatization: 1975 Emergency – Research and perform with character roles (Indira Gandhi, JP, etc.).
11	Judicial Review and Basic Structure	Case discussion: Kesavananda Bharati vs State of Kerala – in teams with legal argument mapping.
12	Mini Project Presentation (Group wise)	Project: Digital handbook/podcast on “Constitution and AI Ethics” or “Constitutional Values in Tech World.”
13	Documentation Review and Viva Prep	Students submit reports, review peer work, prepare for oral presentations and viva.
14	Viva and Term Work Assessment	Internal/external examiners assess based on project + activities + viva.

Text Book
1. Basu, D.D. Introduction to the Constitution of India. LexisNexis.
2. Pylee, M.V. India's Constitution. S. Chand & Company.
3. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. Oxford University Press.
E-Links
1. National Portal of India: https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text
2. Samvidhaan: The Making of the Constitution of India (Rajya Sabha TV Series): https://www.youtube.com/playlist?list=PLVOgwA_DiGzoFR3j1mSGn5Z_OQLxgodQi
3. Ministry of Law and Justice: https://legislative.gov.in/constitution-of-india

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Understanding India – Political Structure and Governance			**Code**	24UVEP306 B	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: Basic understanding of Indian history, civics, and interest in governance, policy, and law.

Course Objective:

1	To introduce the fundamentals of the Indian political system and constitutional framework.
2	To develop an understanding of the roles and responsibilities of Union, State, and Local Governments.
3	To evaluate the working of democratic institutions, electoral processes, and citizen participation.
4	To apply knowledge of governance to analyze current political and administrative challenges.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Comprehend the historical context and development of the Indian Constitution.	Remembering (L1)
CO2	Analyze the structure and functions of Union and State governments.	Analyzing (L4)
CO3	Interpret the Fundamental Rights, Duties, and Directive Principles.	Understand (L2),
CO4	Apply constitutional and governance principles to contemporary issues.	Applying (L3)

List of Assignments:

Week	Topic to be covered	Mode
1	Constitution Timeline: Create an interactive digital timeline of key events in the making of the Indian Constitution.	Individual
2	Mock Parliament: Conduct a roleplay simulation of Lok Sabha/Rajya Sabha discussing a current bill.	Group
3	Government Structure Mapping: Visual presentation on structure and powers of Union and State Governments.	Pair
4	Fundamental Rights in Real Life: Case study analysis of landmark Supreme Court judgments.	Individual
5	Directive Principles Debate: Conduct a structured debate on relevance of Directive Principles today.	Group
6	Civic Survey: Conduct a mini-survey on citizen awareness of fundamental duties and governance.	Group
7	Digital Poster: Design a digital awareness campaign on democratic rights and voter participation.	Individual
8	Capstone Project: Presentation & documentation on a current governance challenge and policy solution	Group

Text Book
1. M. V. Pylee – *An Introduction to the Constitution of India*.
2. Subhash Kashyap – *Our Constitution*
E-Links
1. PRS Legislative Research
2. India Code – Ministry of Law and Justice
3. SWAYAM – Political Science Courses

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Understanding India – Socio-cultural Diversity			**Code**	24UVEP306 C	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite:

1. Basic understanding of Indian history and geography.
2. Familiarity with fundamental sociological concepts

Course Objective:

1	To provide an in-depth understanding of India's socio-cultural diversity.
2	To explore the historical and contemporary factors contributing to this diversity.
3	To analyze the impact of socio-cultural diversity on India's development.
4	To foster appreciation and respect for various cultural practices and social structures within India.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Demonstrate comprehensive knowledge of India's diverse cultural and social landscapes.	Understand (L2)
CO2	Critically analyze the historical contexts that have shaped India's socio-cultural fabric.	Analyzing (L4)
CO3	Assess the implications of cultural diversity on national unity and development.	Evaluating (L5)
CO4	Engage respectfully with various cultural practices and contribute to inclusive practices in professional and personal lives.	Applying (L3)

List of Assignments:

Week	Topic to be covered	Tools/Methods
1	Workshop: Introduction to Indian Diversity – Group Mapping of Religion, Region, Language, Gender	Flipcharts, Maps, Google Forms
2	Activity: Demographic Analysis using Census or Government data	Google Sheets / Tableau / Python
3	Creative Task: Create Infographic or Timeline on Religious and Linguistic Evolution	Canva / Figma / Poster Making
4	Panel Discussion: Religion and Language in Unity vs Division	Moderator-led group sessions
5	Debate: "Caste and Class in Modern India" – Students research and argue various perspectives	Research and Debate Format
6	Case Study: Analysis of Government Scheme (e.g., Reservations, Scholarships) related to caste/class	Report + PPT Presentation
7	Interview Project: Interact with individuals from different regions and present their traditions & culture	Video Interviews / Voice Notes
8	Photo Essay: Regional Diversity (Students submit visuals and short write-ups on cultural practices)	Google Docs / Slides
9	Roleplay: Impact of Globalization – Urban Youth vs Rural Tradition	Skit / Short Film
10	Campaign Creation: Design a digital media campaign on “Cultural Inclusion in Technology Spaces”	Social Media + Poster Creation
11	Mini Project Work: Group activity - “One India, Many Stories” – Combine content from above assignments	Collaborative Docs/Slides
12	Presentation and Reflection: Showcase mini-project and submit individual reflection journals	Viva + Report Submission

Reference Book
1. "Cultural Diversity and Social Discontent: Anthropological Studies on Contemporary India" by R.S. Khare
2. "The Routledge Handbook of Contemporary India" edited by Knut A. Jacobsen.
3. "India: A Country Study" by James Heitzman and Robert L. Worden.
4. "When Cultures Collide: Leading Across Cultures" by Richard D. Lewis.
Text Book
1. "Indian Society and Ways of Living" by David G. Mandelbaum.
2. "Understanding India: Cultural Diversity" by R.S. Khare.
E-Links
1. Pondicherry University - "Understanding India" Syllabus
2. Don Bosco College - "Culture and Society" Syllabus

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Animated AI			**Code**	24UAIP303	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT/EXT**
		Th/week				25/25

Prerequisite: Basic understanding of Fundamental programming

Companion Course: Agile Engineering and Project Management

Course Objective:

1	To develop an understanding of Agile principles and apply them in project execution.
2	To foster teamwork and real-world problem-solving through AI-driven animations or games.
3	To explore AI tools, platforms, and libraries suitable for building intelligent animated applications.
4	To implement project management practices using tools like Jira, or GitHub Projects.
5	To design and deliver a complete AI-based mini project with proper documentation and presentation

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Understand Agile methodologies and project management tools.	Understand (L2)
CO2	Apply Agile roles, ceremonies, and iterations in project execution.	Apply (L3)
CO3	Build AI-based animated/game-based applications using AI tools/libraries.	Applying(L3), Creating(L6)
CO4	Document sprint planning, progress, testing, and retrospectives..	Analyzing (L4), Evaluating(L5)
CO5	Demonstrate a working mini project with clear technical and management documentation.	Creating(L6), Evaluating(L5)

	List of Assignments/Practical's
1	Introduction to Agile: Create a project backlog and user stories for your Animated AI idea.
2	Sprint 1 Planning: Design user stories, define tasks, and assign roles in the team.
3	AI Tool Exploration: Hands-on with AI animation/game libraries like Unity ML Agents, Pygame, or Godot AI.
4	Create basic game/animated prototype integrated with AI logic (navigation, dialogue, prediction).
5	Mid Sprint Review: Perform testing and gather peer/user feedback.
6	Sprint 2: Enhance AI logic (e.g., behavior trees, decision-making, or recommendation engine).
7	CI/CD Setup or Version Control Workflow using GitHub/GitLab
8	Final Sprint Execution: Integrate visuals, audio, and narrative using animation/game logic.
9	Final Testing & Bug Fixing: Prepare demo and fix feedback-based issues.
10	Documentation and sprint retrospective: Prepare project report and team reflection.
11	Final Presentation and Evaluation: Team demo, oral viva, and report submission.

Semester IV

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Feature Engineering(ML)			**Code**	24UAIL401	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/50	

Prerequisite: MSOffice skill Introduction to Machine Learning, Python Programming

Course Objective:

1	Grasp the significance of feature engineering in enhancing ML model performance.
2	Develop skills to preprocess raw data for feature extraction and transformation.
3	Master techniques to handle missing data, outliers, and categorical variables.
4	Apply dimensionality reduction and feature selection to optimize models
5	Incorporate sustainability, risk, and ethical considerations into engineering investment evaluations.
6	Implement end-to-end feature engineering pipelines in real-world projects.

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

CO1	Explain how feature engineering impacts model accuracy, efficiency, and interpretability
CO2	Clean, preprocess, and transform raw data into ML-ready features.
CO3	Handle missing data and outliers using statistical and algorithmic methods.
CO4	Engineer features for structured, text, time-series, and image data.
CO5	Apply feature selection techniques (filter, wrapper, embedded) to reduce overfitting
CO6	Build automated ML pipelines using tools like Scikit-learn, FeatureTools, and PCA.
CO7	Demonstrate feature engineering impact through capstone projects

Unit 1	**Introduction to Feature Engineering**	(8 Hours)
	Role of features in ML pipelines vs. model selection. Bias-variance tradeoff and feature relevance. Case studies: Impact of features in Kaggle competitions. **Lab**:-Exploratory Data Analysis (EDA) on a dataset (e.g., Titanic, Housing Prices). **Key Tools**: Pandas, Matplotlib.	
Unit 2	**Data Preprocessing**	(7 Hours)
	Handling missing data: Deletion, mean/median imputation, KNN imputation, Outlier detection: Z-score, IQR, Isolation Forest. Categorical encoding: One-hot, label, frequency, target encoding. **Lab**:-Preprocess a dataset with missing values and outliers. **Key Tools**: Scikit-learn, Missing no.	
Unit 3	**Feature transformation**	(8 Hours)
	Scaling: Min-Max, Standardization, Robust scaling. Non-linear transforms: Log, Box-Cox, binning. Interaction terms and polynomial features. **Lab**:-Transform skewed data and create interaction features. **Key Tools**: Scikit-learn, SciPy.	
Unit 4	**Feature Construction**	(8 Hours)
	Domain-specific features: Text (TF-IDF, n-grams), time-series (lag, rolling stats). Automated feature engineering: FeatureTools, PCA, t-SNE Feature aggregation: Customer behavior metrics, geospatial features. **Lab**:-Generate features from text/time-series data (e.g., Twitter sentiment). **Key Tools**: Feature Tools, NLTK.	
Unit 5	**Feature Selection**	(4 Hours)
	Filter methods: Correlation, mutual information. Wrapper methods: Forward/backward selection, recursive feature elimination. Embedded methods: Lasso regularization, tree-based importance. **Lab**:-Compare feature selection methods on a high-dimensional dataset. **Key Tools**: Scikit-learn, XGBoost.	

Reference Book
1. *"Decision Support Systems for Business Intelligence"* by Vicki L. Sauter.
2. *"Engineering Economics for Capital Investment Analysis"* by Ted Eschenbach.

3. *"Multi-Criteria Decision Analysis: Methods and Software"* by Alessio Ishizaka
Text Book
1. Feature Engineering and Selection: A Practical Approach for Predictive Models* (2019) by Max Kuhn and Kjell Johnson
2. Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists* (2018) by Alice Zheng and Amanda Casari
3. Feature Engineering Bookcamp (2022) by Sinan Ozdemir
4. The Art of Feature Engineering: Essentials for Machine Learning* by Pablo Duboue
5. Python Feature Engineering Cookbook* (2020): A cookbook that provides practical recipes for feature engineering in Python

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Feature Engineering(ML)			**Code**	24UAIP401	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/**EXT**
		Th/week				-/25

Prerequisite:

Course Objective:

1	Understand the importance of feature engineering in machine learning.
2	Learn techniques for data preprocessing, feature extraction, and feature selection.
3	Apply feature engineering methods to real-world datasets.
4	Evaluate the impact of feature engineering on model performance.

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

CO1	Identify and handle missing values, outliers, and data inconsistencies.
CO2	Apply data normalization, scaling, and encoding techniques.
CO3	Extract relevant features from text, image, and time-series data.
CO4	Select the most informative features using filter, wrapper, and embedded methods.
CO5	Evaluate the impact of feature engineering on model performance and interpret results.
CO6	Apply feature engineering techniques to solve real-world problems in classification, regression, and clustering.

List of Assignments:

1	Handling Missing Values: Identify missing values in a dataset. Impute missing values using mean, median, or imputation techniques.
2	Data Normalization: Normalize numerical features using Min-Max Scaler or Standard Scaler. Compare the impact of normalization on model performance.
3	Feature Scaling: Scale features using techniques like Log Scaling or Power Transform. Evaluate the effect of feature scaling on model performance.
4	Encoding Categorical Variables: One-Hot Encode categorical variables. Use Label Encoding or Ordinal Encoding for categorical variables.
5	Feature Extraction: Extract relevant features from text data using techniques like TF-IDF or word embeddings. Extract features from image data using techniques like CNNs.
6	Feature Selection: Use correlation analysis to select relevant features. Apply recursive feature elimination (RFE) or mutual information to select features.
7	Handling Imbalanced Data: Use oversampling, undersampling, or SMOTE to balance classes. Evaluate the impact of handling imbalanced data on model performance.
8	Creating New Features: Create new features through feature interactions (e.g., multiplying two features). Use domain knowledge to create new features.

Some popular datasets for feature engineering assignments

1. Titanic Dataset: A classic dataset for binary classification.
2. House Prices Dataset: A regression dataset for predicting house prices.
3. IMDB Dataset: A text classification dataset for sentiment analysis.

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Industrial IoT				24UAIL402	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical INT/EXT
		Th/week	2		10/15/50	

Prerequisite: Basics of Electronics and Communication, Fundamentals of Computer Science

Course Objective:

1	To understand the fundamental concepts, architecture, and applications of Industrial IoT.
2	To explore communication protocols, data acquisition methods, and analytics in IIoT environments.
3	To analyze the implementation of IIoT solutions and the role of edge and cloud computing.
4	To evaluate security and privacy challenges in Industrial IoT applications.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1:	Explain the fundamental concepts, architecture, and applications of Industrial IoT.	Level: 2 (Understand)
CO2:	Describe communication protocols, data acquisition techniques, and data analytics in IIoT.	Level :2 (Understand)
CO3:	Implement IIoT solutions using edge and cloud computing frameworks.	Level: 3 (Apply)
CO4	Assess the security challenges and mitigation strategies in Industrial IoT environments.	Level: 5 (Evaluate)

Unit-1	**Introduction to Industrial IoT**	**(7 Hours)**
	Overview of IoT and Industrial IoT: Definition of IoT and IIoT, Evolution of Industrial IoT, Key Technologies and Applications: Smart Manufacturing, Predictive Maintenance, Digital Twins, Asset Tracking and Monitoring , IIoT vs. Traditional IoT: Industrial Automation vs. Consumer Applications, Real-Time Processing Requirements, Scalability and Interoperability ,Industrial IoT Architecture: Layered Architecture (Edge, Fog, Cloud),IIoT Devices and Sensors, Data Processing and Analytics Layer, Benefits and Challenges of IIoT, Improved Operational Efficiency, Cost Reduction, Data Management and Security Issues	CO1

Unit-2	**IIoT Protocols and Standards**	**(7 Hours)**
	Communication Protocols for IIoT: MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol),OPC-UA (Open Platform Communications - Unified Architecture),DDS (Data Distribution Service), Data Acquisition Techniques, Sensor Integration and Data Collection, Signal Conditioning and Calibration, Real-Time Data Acquisition Systems, 2.3 Edge and Cloud Data Processing, Data Filtering and Aggregation, Edge Analytics for Low Latency, Cloud-Based Data Management, Protocol and Data Mapping, Matching Protocols to Industrial Scenarios, Real-World Examples and Case Studies	CO2,CO3
Unit-3	**Data Analytics in IIoT**	**(7 Hours)**
	Role of Data Analytics in IIoT: Predictive Maintenance, Quality Control and Optimization, Performance Monitoring, Data Acquisition and Processing, Data Sources: Sensors and Machines, Data Preprocessing and Cleaning, Data Storage Solutions (Cloud, Edge),Edge and Cloud Analytics: Edge Computing for Real-Time Processing, Cloud Computing for Data Aggregation, Hybrid Edge-Cloud Models,Machine Learning Techniques for Predictive Maintenance, Anomaly Detection, Failure Prediction Models, Data-Driven Decision Making,Real-Time Data Analysis: Stream Processing Frameworks, Visualization of IIoT Data, Dashboards and Reporting	CO3, CO4
Unit- 4	**Implementing IIoT Solutions**	**(7 Hours)**
	Sensor Integration and Data Acquisition: Sensor Types and Selection, Signal Conditioning and Data Acquisition Systems, Calibration and Maintenance, IIoT Gateways and Connectivity: Gateway Functions and Protocol Translation, Data Aggregation and Filtering, Secure Data Transmission, Software Platforms for IIoT Development: Open-Source IIoT Platforms, Proprietary Solutions (AWS IoT, Azure IoT),Middleware for Data Integration, Implementation Case Studies: Smart Manufacturing Systems, Predictive Maintenance in Factories, Digital Twins for Equipment Monitoring, Challenges in IIoT Implementation: Interoperability Issues, Data Management and Storage, Resource Constraints	CO3,CO4
Unit- 5	**Security and Privacy in IIoT**	**(6 Hours)**
	Security Challenges in IIoT Environments: Device Vulnerabilities, Network Attacks and Intrusions, Data Breach and Leakage, Industrial Cybersecurity Standards: ISA/IEC 62443, NIST Cybersecurity Framework, ISO/IEC 27001 for Information Security, Threat Detection and Risk Mitigation: Intrusion Detection Systems (IDS),Network Traffic Analysis, Anomaly Detection Techniques, Privacy Considerations and Data Protection: Data Encryption Techniques, Access Control Mechanisms, Privacy Policies and Compliance,	CO4

	Best Practices for Secure IIoT Deployment: Regular Security Audits, Secure Firmware and Software Updates, Role-Based Access Control (RBAC)	

Reference Book
1. "Industrial Internet of Things: Cybermanufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat
2. "Industrial IoT: Concepts and Practice" by Shyam Varan Nath, Pethuru Raj, Preetham Kamidi
3. *Industrial IoT Security: Challenges, Solutions, and Future Directions* by David T. M. S. and R. K. Gupta
Text Book
1. "Industrial IoT: Challenges, Design Principles, Applications, and Security" by Ismail Butun
2. "The Industrial Internet of Things: Volume II: Concepts and Applications" by Alasdair Gilchrist
3. Industrial Internet of Things: Cybermanufacturing Systems by Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat
4. Big Data Analytics with IoT: Data Processing and Analysis for the Internet of Things by Rajkumar Buyya, S. Thamarai Selvi
E Book
1. Industrial Internet of Things: Cybermanufacturing Systems- https://aitskadapa.ac.in/e-books/AI%26DS/IOT/Industrial%20Internet%20of%20Things_%20Cybermanufacturing%20Systems%20%28%20PDFDrive%20%29.pdf
2. Internet of Things: A Hands-On Approach- https://www.academia.edu/82991439/Internet_of_Things_A_Hands_On_Approach
3. Industrial Internet of Things: Challenges, Design Principles, Applications, and Security- https://dokumen.pub/industrial-iot-challenges-design-principles-applications-and-security-1nbsped-3030424995-9783030424992.html
E-Links
1. Industrial Internet of Things (IIoT) - Coursera- https://www.coursera.org/learn/industrial-internet-of-things?utm_source=chatgpt.com
2. Applied Industrial Internet of Things – Coursera - https://www.coursera.org/learn/applied-industrial-internet-of-things?utm_source=chatgpt.com
3. https://www.coursera.org/specializations/developing-industrial-iot

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Industrial IoT			Code	24UAIP402	
Credits	1	**Pr/week**	2	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical INT/**EXT**
		Th/week				/25

Prerequisite: Basics of Programming and Embedded Systems, Fundamentals of Cloud Computing

Course Objective:

1	To Understand the architecture and components of Industrial IoT systems, including hardware, sensors, and communication protocols.
2	To Implement IoT communication protocols to facilitate data transmission between devices and the cloud.
3	To Develop cloud-based applications to visualize, store, and analyze sensor data in real-time.
4	To Apply data analytics and machine learning techniques to gain insights from IoT data and enhance system decision-making.
5	To Implement security measures (encryption, authentication) to ensure secure communication and protect IoT systems from vulnerabilities.

Course Outcomes:

CO1	Explain the key components and architecture of an Industrial IoT system, including microcontrollers, sensors, actuators, and communication protocols	Level 2: Understand
CO2	Design and implement communication systems using IoT protocols such as MQTT to facilitate data transfer from sensors to cloud platforms.	Level 3: Apply
CO3	Connect IoT devices to cloud platforms (e.g., ThingSpeak, AWS IoT) for real-time data visualization and storage.	Level 3: Apply
CO4	Analyze IoT data using tools such as Python and machine learning techniques to extract insights, detect patterns, and make predictions.	Level 4: Analyze
CO5	Secure IoT systems by implementing encryption, authentication, and secure communication protocols to protect data integrity and prevent unauthorized access.	Level 5: Evaluate

	List of Assignments	
1	Understand IoT fundamentals by setting up a simple IoT device using an Arduino or Raspberry Pi. Implement a simple blink an LED Program, basic functionality.	CO1
2	Set up a basic IoT device using a Raspberry Pi or Arduino, and monitor sensor readings like temperature or humidity	CO1,CO2
3	Interface a DHT11/DHT22 sensor with Arduino/Raspberry Pi, display data on a screen, and control an actuator based on threshold values	CO1,CO2
4	Use an Arduino with a temperature sensor to log temperature readings into a CSV file, storing it for later analysis or use in cloud storage.	CO2,CO3
5	Use a button to turn an LED on and off, simulating basic IoT control through a user interface.	CO1,CO2
6	Use the Blynk app to control and monitor IoT devices.	CO2,CO3
7	Set up an MQTT broker and use an Arduino to send temperature readings to the broker. On the cloud side, a simple application can display these readings.	CO2,CO5
8	Send temperature and humidity data from Arduino or Raspberry Pi to ThingSpeak and visualize it on a live dashboard.	CO3
9	Collect temperature data using an IoT device (Arduino/Raspberry Pi), then use Python to calculate the average temperature and plot the data using Matplotlib.	CO4

Reference Book

1. Balan, K., "Internet of Things (IoT): Architecture and Applications"***Notion Press, 2021***
2. Pethuru Raj, Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases"***CRC Press, 2017***
3. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" ***Apress, 2016***

Text Book

1. Raj Kamal, "Internet of Things: Architecture and Design" ***McGraw-Hill Education, 2017***
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach" ***Universities Press, 2014***
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols" ***Wiley, 2nd Edition, 2016***
4. Michael Margolis and Brian Jepson, "Arduino Cookbook" ***O'Reilly Media, 2nd Edition, 2020***

E Book

1. https://jcer.in/jcer-docs/E-Learning/Digital%20Library%20/E-Books/Internet-of-things-a-hands-on-approach-%20Arshadeep.pdf
2. https://juniorfall.wordpress.com/wp-content/uploads/2011/11/arduino-cookbook.pdf

3. https://pg.its.edu.in/sites/default/files/KCA043%20Internet%20of%20things%20-IoT%20by%20Raj%20Kamal%20Text%20Book.pdf
E-Links
1. Instructables: IoT Projects with Raspberry Pi and Arduino- https://www.instructables.com/IoT-Raspberry-Pi-Arduino-Automation/
2. DroneBot Workshop: Arduino and Raspberry Pi Tutorials- https://dronebotworkshop.com/
3. Sixfab Blog: IoT Projects with Raspberry Pi and Arduino- https://sixfab.com/blog/

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Statistics & Probablity			**Code**	24UAIL403	
Credits	3	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
Tutorial	1	**Th/week**	2		10/15/50	

Prerequisite: Basic knowledge of mathematics

Course Objective:

1	To introduce the core concepts of statistics and probability
2	To enable students to describe and summarize data.
3	To help students understand probability models and distributions.
4	To teach basic techniques in statistical inference and hypothesis testing

Course Outcomes:

	Upon successful completion of this course, students will be able to:
CO1	Understand and apply basic statistical measures
CO2	Solve problems using rules of probability.
CO3	Interpret and work with data distributions.
CO4	Perform basic inferential statistics and hypothesis tests.

Unit-1	**Introduction to statistics**	**(7 Hours)**
	Definition and scope of statistics, Types of Data: qualitative and quantitative, Scales of measurement :nominal, ordinal, interval, ratio Data collection and presentation: tables and graphs	CO1
Unit-2	**Measures of central tendancy and dispersion**	**(7 Hours)**
	Mean, median, mode Range, variance, standard deviation Quartile and interquartile range Introduction to skewness and kurtosis	CO2
Unit- 3	**Probability theory**	**(8 Hours)**
	Basic concepts of probability Addition and multiplication rules Conditional probability and independence	CO3, CO4

	Baye's Theorem.	
Unit- 4	**Random variables and distributions**	**(9 Hours)**
	Discrete and continuous random variables Probability mass and density functions Bionomial, poisson, and normal distributions Exception and variance of random variables	CO3
Unit- 5	**Statisticalo inference**	**(9 Hours)**
	Sampling and sampling distributions Estimation : point and interval estimates Hypothesis testing: z-test, t-test Chi-square test for independence and goodness of fit.	CO4

Text Books
1. "Fundamentals of mathematical statistics" by S.C. Gupta and V.K. kapoor.
2. " probability and statistics" By Murray Spiegel(schaum's outline series).
3. "Introduction to practice of statistics" by David S. Moore, McCabe, Bruce A. Craig.
Reference Book
1. "statistics" by Robert S. Witte and John S. Witte.
2. "probability and statistics for engineers" by Jay L. Devore.
E-Links
https://youtu.be/IoRamPPXrCs
https://youtu.be/IoRamPPXrCs?si=62b4wFic2UTVIRed

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Minor II Introduction to Data Analytics			Code	24UAIL3M21	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Basic programming (Python/R), introductory statistics

Course Objective:

1	**Build Foundational Knowledge**: Introduce core concepts of data analytics, including data types, lifecycle, and applications in real-world scenarios.
2	**Methodological Understanding**: Explore methodologies for data collection, preprocessing, analysis, and interpretation.

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

CO1	**Data Handling**: Collect, clean, and preprocess raw data for analysis.
CO2	**Analytical Techniques**: Apply descriptive, diagnostic, predictive, and prescriptive methods to derive insights.
CO3	**Technical Proficiency**: Familiarize learners with tools and techniques for descriptive, diagnostic, predictive, and prescriptive analytics.
CO4	**Ethical and Practical Application**: Emphasize data management ethics, privacy considerations, and effective communication of insights
CO5	**Ethical Practice**: Adhere to data privacy standards and ethical guidelines in analytics workflows

Unit 1	**Introduction to Data Analysis**	**(5 Hours)**
	Topics: Definition, scope, and importance of data analytics; types of data (structured, unstructured); data lifecycle (collection, storage, processing). **Key Focus**: Role of analytics in decision-making and industry applications	
Unit 2	**Data Collection and Preprocessing**	**(5 Hours)**
	Topics: Data sources (surveys, sensors, databases); data cleaning (handling missing values, outliers); transformation (normalization, aggregation). **Key Focus**: Techniques to ensure data quality and readiness for analysis.	
Unit-3	**Descriptive and Diagnostic Analytics**	**(5 Hours)**
	Topics: Summarizing data (mean, median, variance); exploratory data analysis (EDA); identifying patterns and correlations; root-cause analysis. **Key Focus**: Tools like Excel, SQL, and Python libraries (Pandas, NumPy). .	
Unit-4	**Predictive Analytics**	**(5 Hours)**
	Topics: Regression models, classification algorithms (decision trees, logistic regression), time-series forecasting. **Key Focus**: Introduction to machine learning workflows and validation techniques.	
Unit- 5	**Prescriptive Analytics and Optimization**	**(5 Hours)**
	Decision modeling, optimization techniques (linear Programming), simulation methods. Using analytics to recommend actionable strategies.	
Unit 6	**Data Visualization and Reporting**	**(5 Hours)**
	Topics: Principles of effective visualization (charts, dashboards); tools like Tableau, Power BI; storytelling with data. **Key Focus**: Communicating insights to stakeholders	

Reference Book
1. **Python for Data Analysis** by Wes McKinney – A must-read for learning data manipulation with Python.
2. **Business Analytics: The Science of Data-Driven Decision Making** by U. Dinesh Kumar – Focuses on analytics in business contexts.
3. **Data Analytics: Principles, Tools, and Practices** by Dr. Gaurav Aroraa & Chitra Lele – A comprehensive guide to advanced analytics techniques.
4. **Data Analytics: Models and Algorithms for Intelligent Data Analysis** by Thomas A. Runkler – A deep dive into data analytics methodologies.
Text Book
1. **Data Analytics Made Accessible** by Dr. Anil Maheshwari – A beginner-friendly book that covers key concepts with real-world examples and case studies.
2. **Data Science for Business** by Foster Provost and Tom Fawcett – Focuses on data mining and analytic thinking, making it ideal for professionals.
3. **Python for Data Analysis** by Wes McKinney – A practical guide to using Python for data manipulation and analysis.
4. **The Elements of Statistical Learning** by Hastie, Tibshirani, and Friedman – A more advanced book covering machine learning techniques.
5. **Big Data: Principles and Best Practices** by Jules J. Berman – Explores big data concepts and their applications.

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Minor II Data Analytics using Advanced Excel tool				24UAIL4M22	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Msoffice skills , introductory statistics

Course Objective:

1	Master advanced Excel tools for engineering data analysis (Power Query, PivotTables, Power Pivot)
2	Develop skills to clean, transform, and visualize large engineering datasets
3	Apply statistical methods, forecasting, and scenario analysis to solve engineering problems
4	Automate workflows using Excel macros and VBA scripting.
5	Prepare students to handle large-scale datasets (IoT, sensor data) and communicate insights effectively
6	Integrate Excel with Power BI for engineering dashboards and reporting.

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

1	Clean and preprocess engineering datasets (e.g., sensor logs, manufacturing data) using Power Query
2	Analyze data with advanced functions (XLOOKUP, INDEX-MATCH), PivotTables, and dynamic dashboards
3	Apply statistical tools (regression, ANOVA) using Excel's Data Analysis ToolPak.
4	Automate repetitive tasks (data imports, reports) using macros and VBA.
5	Design predictive models for engineering scenarios (e.g., failure prediction, resource optimization).
6	Create interactive dashboards in Excel/Power BI to communicate insights to stakeholders

Unit 1	**Introduction to Advanced Excel for Engineering**	**(5 Hours)**
	Topics: Excel interface refresher: Worksheets, formulas, and cell referencing. Engineering data types: Time-series, IoT sensor data, quality control logs. Overview of advanced tools: Power Query, Power Pivot, Data Model. Case Study: Excel's role in engineering industries (automotive, aerospace). Learning Objectives: Navigate Excel's advanced features and recognize their engineering applications. Assessment:*Quiz*: Identify data types and tools for given engineering scenarios.	
Unit 2	**Data Cleaning & Transformation with Power Query**	**(5 Hours)**
	Topics: Importing data from CSV, SQL, and IoT sources. Removing duplicates, handling missing values, and outlier detection. Merging/Appending datasets (e.g., merging sensor data from multiple sources). Engineering Application: Cleaning manufacturing defect logs. Learning Objectives: Transform raw datasets into analysis-ready formats. Assessment: *Assignment*: Clean and merge vibration sensor data from a wind turbine.	
Unit- 3	**Advanced Formulas & PivotTables**	**(5 Hours)**
	Topics: Advanced functions: XLOOKUP, INDEX-MATCH, SUMIFS. PivotTables: Grouping, calculated fields, and slicers. Engineering KPIs: Mean Time Between Failures (MTBF), defect rates. Case Study: Analyzing production line efficiency. Learning Objectives: Calculate engineering metrics and summarize large datasets. Assessment: *Project*: Build a PivotTable dashboard to track factory downtime.	
Unit- 4	**Statistical Analysis & Forecasting**	**(5 Hours)**
	Descriptive statistics (AVERAGEIF, STDEV.P). Hypothesis testing (t-tests, ANOVA) using Data Analysis ToolPak. Time-series forecasting: Exponential smoothing, moving averages. Engineering Application: Predicting equipment failure rates. Learning Objectives: Validate hypotheses and forecast engineering trends. Assessment: *Case Study*: Use regression to predict energy consumption in a HVAC system	
Unit- 5	**Automation with Macros & VBA**	**(5 Hours)**

	Topics: Recording macros for repetitive tasks (e.g., monthly reports). Basic VBA scripting: Loops, conditional statements. Automating data imports and visualization updates. Engineering Application: Automating quality control checks. Learning Objectives: Develop automated workflows to improve efficiency. Assessment: *Project*: Create a macro to generate daily production reports	
Unit 6	**Advanced Dashboards & Power BI Integration**	**(5 Hours)**
	Building interactive dashboards with slicers and timelines. Power Pivot: Data modelling and DAX formulas. Exporting Excel data to Power BI for advanced visualization. Engineering Application: Real-time monitoring of structural health data. Learning Objectives: Design dashboards for real-time decision-making. Assessment: *Capstone Project*: Build a Power BI dashboard for predictive maintenance of industrial machinery.	

Reference Book
1. *Advanced Excel Essentials" by Jordan Goldmeier* (for Power Query/DAX).
2. *"Excel Power Pivot & Power Query For Dummies" by Michael Alexander*.
3. "Excel Data Analysis For Dummies" – Paul McFedries Covers basic to intermediate data analysis tools in Excel.
4. "Data Analysis with Microsoft Excel" – Kenneth N. Berk & Patrick Carey ,A structured guide to statistical and analytical functions in Excel.
5. "Microsoft Excel 365 Bible" – Michael Alexander & Dick Kusleika, Comprehensive coverage of Excel features, including PivotTables and Power Query.
6. "Power Pivot and Power BI" – Michael Alexander & Matt Allington. Focuses on Power Pivot, DAX, and business intelligence in Excel.
7. "M is for (Data) Monkey" – Ken Puls & Miguel Escobar, Best for mastering Power Query (data transformation & cleaning).
8. "The Definitive Guide to DAX" – Marco Russo & Alberto Ferrari, Deep dive into DAX (Data Analysis Expressions) for Power Pivot
9. "Advanced Excel Essentials" – Jordan Goldmeier, Covers advanced functions, array formulas, and dashboard techniques.
10. "Excel Dashboards & Reports For Dummies" – Michael Alexander, Step-by-step guide to building interactive dashboards.

Indira College of Engineering and Management (An autonomous Institute**)**						
Third Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective –II Data Security & Privacy			Code	24UAIL405 A	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Basic Programming Skills, Basic Statistics, Data Structures and Algorithms
Course Objective:

1	Understand the fundamental concepts of data security and privacy.
2	Learn various cryptographic techniques for data protection.
3	Explore privacy-enhancing technologies and regulatory frameworks.
4	Analyze security threats and mitigation strategies in data-driven environments.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1	Explain key principles of data security and privacy.	Level 2 :Understand
CO2	Apply cryptographic methods to secure data.	Level 3: Apply
CO3	Assess privacy risks and compliance with legal frameworks.	Level 4: Analyze
CO4	Implement security measures for real-world applications.	Level 5: Evaluate

Unit 1	**Fundamentals of Data Security**	**(6 Hours)**
	Concepts of Data Security and Privacy: Confidentiality, Integrity, Availability (CIA triad),Data privacy, Importance of data security in modern enterprises and IT systems, Data Security Vulnerabilities and Threats: Common vulnerabilities: software bugs, weak passwords, misconfigurations, Threat types: Insider threats, external attacks, accidental data leaks, Risk assessment and threat modeling basics, Security Policies and Access Control Models: Security policy components, Types of access control: Discretionary Access Control (DAC),Mandatory	CO1, CO2

	Access Control (MAC), Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC)	
Unit-2	**Cryptographic Techniques**	**(6 Hours)**
	Symmetric and Asymmetric Cryptography: Symmetric key encryption, Asymmetric key encryption, Use cases and comparison: speed, complexity, key distribution, Key exchange protocols (Diffie-Hellman), Hash Functions and Digital Signatures, Key Management and Authentication Protocols	CO2, CO3
Unit-3	**Privacy and Data Protection Regulations**	**(6 Hours)**
	Privacy Principles and Data Protection Laws: Fair Information Practice Principles (FIPPs), Overview of major global laws:GDPR (EU), HIPAA (US - healthcare), CCPA (California), Indian PDP Bill (if applicable),Legal obligations for data controllers and processors, Anonymization and Pseudonymization Techniques, Privacy Risk Assessment and Mitigation:Data inventory and flow mapping, Identifying personal/sensitive data,Conducting Privacy Impact Assessments (PIA),Mitigation strategies: encryption, data minimization, retention policies	CO3, CO4
Unit- 4	**Security Threats and Countermeasures**	**(6 Hours)**
	Malware, Phishing, and Social Engineering Attacks: Types of malware: viruses, worms, Trojans, ransomware, Phishing techniques: spear phishing, whaling, clone phishing, Social engineering tactics: baiting, pretexting, tailgating, Real-world examples and prevention techniques, Intrusion Detection and Prevention Systems (IDS/IPS), Security Best Practices in Cloud and IoT Environments, Cloud security principles: shared responsibility, encryption, identity management, Cloud service models (IaaS, PaaS, SaaS) and their security implications,IoT security challenges: resource limitations, unsecured endpoints.	CO1, CO3
Unit- 5	**Emerging Trends in Data Security**	**(6 Hours)**
	Blockchain for Data Security: Overview of blockchain principles: decentralization, immutability, consensus, Use cases: data integrity, identity verification, secure logging, Smart contracts and privacy concerns, AI-Driven Security Solutions: AI/ML in threat detection and response, Challenges: false positives, adversarial attacks, Case Studies on Data Breaches and Their Impact	CO2, CO4

Reference Book
1."Network Security Essentials" by William Stallings
2. "Applied Cryptography" by Bruce Schneier

3. "Privacy Engineering" by Ian Oliver
Text Book
1. "Principles of Information Security" by Michael E. Whitman and Herbert J. Mattord
2. "Computer Security: Principles and Practice" by William Stallings and Lawrie Brown
3. Mark Stamp, Information Security: Principles and Practice, Wiley, 2nd Edition, 2011.
4. Boris Lubarsky, Privacy, Data Protection and Cybersecurity in Europe, Palgrave Macmillan, 2017.
E Book
1. Big Data Analytics Privacy Law Considerations
2. Data Policies, Laws, and Regulations- https://openknowledge.worldbank.org/server/api/core/bitstreams/42ad2959-f7bd-559c-9fc1-b9c1be448fa1/content
3. William Stallings – *Cryptography and Network Security: Principles and Practice* (7th Edition)- https://dl.hiva-network.com/Library/security/Cryptography-and-network-security-principles-and-practice.pdf
E-Links
1. Hands-On Virtual Labs and Demos- https://intellectualpoint.com/resources/hands-on-virtual-labs-and-demos/
2. Virtual Hacking Labs- https://www.virtualhackinglabs.com/
3. Data, Security, and Privacy- https://www.coursera.org/learn/data-security-privacy

Indira College of Engineering and Management (An autonomous Institute)						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective –II Design Thinking			Code	24UAIL405 B	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Basics of Communication and Soft Skills, Basics of Problem-Solving and Critical Thinking

Course Objective:

1	Understand the fundamental principles and importance of Design Thinking.
2	Learn the five-stage Design Thinking process to solve complex problems.
3	Develop innovative solutions using empathy, ideation, and prototyping techniques.
4	Apply Design Thinking methodologies to real-world challenges across industries.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1	Explain the fundamental concepts and need for Design Thinking.	Level 2 :Understand
CO2	Utilize Design Thinking frameworks to understand user needs and ideate solutions.	Level 3: Apply
CO3	Develop and prototype innovative solutions based on Design Thinking methodologies.	Level 4: Analyze
CO4	Apply Design Thinking principles to real-world industry problems.	Level 5: Evaluate

Unit 1	**Introduction to Design Thinking**	**(6 Hours)**
	Definition and Importance of Design Thinking, Phases of Design Thinking, Characteristics of a Design Thinker, Difference Between Traditional Problem-Solving and Design Thinking, Real-World Applications of Design Thinking, Hands-on Activity: Design Thinking Exercise.	CO1, CO2
Unit- 2	**Empathy and Problem Definition**	**(6 Hours)**
	Understanding user needs through observation and interviews, Empathy mapping and user personas, Problem framing and	CO2, CO3

	redefining the problem statement, Techniques for identifying user pain points	
Unit- 3	**Ideation Techniques**	**(6 Hours)**
	Brainstorming and Mind Mapping Techniques:Generating diverse ideas through free association,Organizing thoughts using mind maps for clarity, Lateral Thinking and SCAMPER Methodology :Applying Edward de Bono's lateral thinking approach, Using SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse) for idea enhancement Storyboarding and Role-Playing for Ideation: Visualizing user journeys and scenarios through storyboarding, Exploring different perspectives using role-playing techniques, Selecting and Prioritizing Ideas: Criteria-based evaluation of ideas Feasibility, desirability, and viability analysis Decision matrix and voting techniques for idea selection	CO3, CO4
Unit- 4	**Prototyping and Testing**	**(6 Hours)**
	Low-fidelity vs. high-fidelity prototypes, Rapid prototyping tools and techniques, Usability testing and feedback collection, Iterative improvements based on user feedback	CO1, CO3
Unit- 5	**Applications and Case Studies**	**(6 Hours)**
	Blockchain for Data Security and Smart Contracts, AI-Driven Security Solutions and Threat Intelligence, Case Studies on Major Data Breaches (Equifax, Facebook-Cambridge Analytica), Future of Cybersecurity: Quantum Cryptography, Homomorphic Encryption	CO2, CO4

Reference Book
1. "The Design of Business" by Roger L. Martin
2. "This is Service Design Thinking" by Marc Stickdorn and Jakob Schneider
3. "Creative Confidence" by Tom Kelley and David Kelley
Text Book
1. "Design Thinking for Strategic Innovation" by Idris Mootee
2. "The Art of Innovation" by Tom Kelley
3. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School Idris Mootee Wiley 1st Edition, 2013
4. Change by Design: How Design Thinking Creates New Alternatives for Business and

Society Tim Brown Harvard Business Review Press 1st Edition, 2009
E Book
1. An Introduction to Design Thinking Process Guide- https://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf
2. Design Thinking for Strategic Innovation - http://aitskadapa.ac.in/e-books/CSE/DESIGN%20THINKING/Design%20Thinking%20for%20Strategic%20Innovation_%20What%20They%20Can_t%20Teach%20You%20at%20Business%20or%20Design%20School%20%28%20PDFDrive%20%29.pdf
3. Design Thinking for Educators Toolkit- https://f.hubspotusercontent30.net/hubfs/6474038/Design%20for%20Learning/IDEO_DTEdu_v2_toolkit%2Bworkbook.pdf
E-Links
1. Creative Design, Prototyping & Experiential Lab – IIT Guwahati- https://cpe-iitg.vlabs.ac.in/?utm_source=chatgpt.com
2. "What Is Design Thinking & Why Is It Important?" – Harvard Business School Online- https://online.hbs.edu/blog/post/what-is-design-thinking
3. Design Thinking Courses – Coursera- https://www.coursera.org/courses?query=design%20thinking

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Open Elective –II Social Network Analysis			Code	24UAIL405 C	
Credits	2	**Pr/week**		**Evaluation Scheme**	Theory **TAE/CAE/ESE**	Practical INT/EXT
		Th/week	2		10/15/25	

Prerequisite: Basic Knowledge of probability, and statistics, Data Structures and Algorithms, Basic Python programming skills

Course Objective:

1	Understand the theoretical foundations of social network structures and properties.
2	Explore various models, metrics, and algorithms used for social network analysis.
3	Apply software tools for visualizing and analyzing real-world network data.
4	Interpret network-based insights for applications in diverse domains.

Course Outcomes:

	Upon successful completion of this course, students will be able to:	
CO1:	Explain core concepts and terminologies of social network theory.	Level 2 :Understand
CO2:	Apply graph metrics and mathematical models for network analysis.	Level 3: Apply
CO3:	Use SNA tools to analyze and visualize network data.	Level 4: Analyze
CO4	Evaluate and derive insights from real-world social networks.	Level 5: Evaluate

Unit 1	**Introduction to Social Networks**	**(6 Hours)**
	Definition and scope of Social Network Analysis, Types of networks: social, communication, information, biological, Structure vs. dynamics of networks, Importance of SNA in interdisciplinary research, Examples of social networks: Facebook, Twitter, citation networks	CO1
Unit-2	**Mathematical Foundations and Metrics**	**(6 Hours)**
	Graph theory fundamentals: graphs, subgraphs, degrees, paths,	CO1, CO2

	cliques, Adjacency matrix, incidence matrix, Laplacian matrix, Network properties: density, average path length, clustering coefficient, Centrality Measures:Degree centrality, Betweenness centrality, Closeness centrality, Eigenvector centrality, Structural holes and brokerage	
Unit- 3	**Network Models and Community Detection**	**(6 Hours)**
	Random Network Model , Small-world Model , Scale-free Networks , Community detection: Girvan–Newman algorithm, Modularity and Louvain algorithm, Link prediction and influence maximization.	CO2
Unit- 4	**Tools, Visualization, and Implementation**	**(6 Hours)**
	Introduction to tools: **Gephi**, **NetworkX**, **Pajek**, **NodeXL,** Data collection: APIs (Twitter, Facebook), web scraping, Data cleaning and preprocessing, Network visualization: layout algorithms (Force Atlas, Fruchterman-Reingold), Python-based analysis with NetworkX (basic code snippets)	CO3
Unit- 5	**Applications and Case Studies**	**(6 Hours)**
	Social media analytics (retweet, mention networks), Information diffusion and virality, Epidemic modeling and contact tracing networks, Collaboration networks in research and education, SNA in marketing, recommendation, and political networks, Ethical issues in social network data handling	CO4

Reference Book
1. Easley, D., & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press.
2. Tsvetovat, M., & Kouznetsov, A. (2011). Social Network Analysis for Startups, O'Reilly Media.
3. Hansen, D., Shneiderman, B., & Smith, M. A. (2010). Analyzing Social Media Networks with NodeXL, Elsevier.
Text Book
1. Wasserman, S., & Faust, K. (1994). Social Network Analysis: Methods and Applications, Cambridge University Press.
2. Scott, J. (2017). Social Network Analysis (4th ed.), SAGE Publications.
3. Social Network Analysis: Methods and Examples Authors: Song Yang, Franziska B. Keller, and Lu Zheng Publisher: SAGE Publications, 2017
4. Social Network Analysis: Theory and Applications Authors: B. Abhishek and Sumit Hirve

Publisher: Wiley
E Book
1. https://library.oapen.org/bitstream/handle/20.500.12657/58730/1/9781849668200.pdf
2. https://www.asecib.ase.ro/mps/Social%20Network%20Analysis%20%5B1994%5D.pdf
3. https://library.uc.edu.kh/userfiles/pdf/18.Models%20and%20Methods%20in%20Social%20Network%20Analysis.pdf
E-Links
1. https://www.coursera.org/learn/social-network-analysis
2. https://iitb.vlabs.co.in/
3. https://networkx.org/documentation/stable/tutorial.html

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	SEC-III Continuous Integration/ Deployment Framework			**Code**	24UAIP404 A	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25/-

Prerequisite: Basic knowledge of software development and version control systems (Git)

Course Objective:

1	Understand CI/CD concepts and modern DevOps lifecycle.
2	Gain hands-on experience with popular CI/CD tools.
3	Build and manage deployment pipelines for real-world applications.
4	Integrate automated testing, code quality, and monitoring in CI/CD

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	Explain core concepts of CI/CD and its role in DevOps lifecycle	Remember(L1), Understand(L2)
CO2	Set up a CI/CD pipeline using open-source tools	Apply(L3)
CO3	Automate testing, building, and deployment using scripts and workflows	Apply(L3), Analyze(L4)
CO4	Evaluate the effectiveness of CI/CD integration with quality and monitoring	Analyze(L4), Evaluate(L3)

Lab No.	Lab Assignment Description	CO Mapping
1	Setup Git and GitHub repository; demonstrate cloning, branching, and pull requests	CO1
2	Create a basic build script using Maven/Gradle/npm for a sample project	CO2
3	Install Jenkins and configure a freestyle project to build a JavaScript/Java project	CO2
4	Create a GitHub Actions workflow for automated testing and build	CO2, CO3
5	Write a Dockerfile and build/run a Docker container locally	CO3

6	Integrate Docker with CI (build Docker image in Jenkins or GitHub Actions)	CO3
7	Deploy a sample web app to Heroku or Netlify using a CI/CD pipeline	CO3
8	Integrate SonarQube for code quality analysis in the pipeline	CO3, CO4
9	Use a basic monitoring tool (like Prometheus or StatusCake) for health checks	CO4
10	Schedule nightly builds with Jenkins or GitHub Actions cron trigger	CO2, CO3
11	Use GitHub Secrets to manage API tokens or passwords securely in work-flows	CO3
12	**Capstone:** Implement full CI/CD for a sample project (code → build → test → deploy)	CO2, CO3, CO4

Text Books

1. Humble, Jez, and David Farley. *Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation*. Addison-Wesley, 2010.
2. Kim, Gene, Jez Humble, Patrick Debois, and John Willis. *The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security*. IT Revolution Press, 2016.

Reference Books

1. Pathania, Nikhil. *Learning Continuous Integration with Jenkins*. Packt Publishing, 2017.
2. Poulton, Nigel. *Docker Deep Dive*. Leanpub, 2020.

E Books

1. Google SRE Team. *Site Reliability Engineering*. O'Reilly Media, 2016. Available at sre.google/books
2. Jenkins Community. *Jenkins User Handbook*. Jenkins.io, n.d. https://www.jenkins.io/doc/book/

E-links

1. GitHub. *GitHub Actions Documentation*. GitHub Docs, n.d. https://docs.github.com/en/actions
2. FreeCodeCamp. *CI/CD Blog Tutorials & Guides*. FreeCodeCamp, n.d. https://www.freecodecamp.org/news/tag/cicd/

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	SEC-III GitLab Continuous Integration/ Deployment Framework			**Code**	24UAIP404 B	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: Familiarity with GitLab, Git commands, YAML syntax, and basic scripting

Course Objective:

1	To provide in-depth knowledge of GitLab's CI/CD pipelines.
2	To Automate build, test, and deployment phases within GitLab.
3	To Configure advanced CI/CD features like runners, cache, triggers, etc.
4	To provide in-depth knowledge of GitLab's CI/CD pipelines.

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	Describe GitLab architecture and pipeline features	Remember (L1), Understand (L2)
CO2	Build and customize GitLab CI/CD pipelines using .gitlab-ci.yml	Apply (L3)
CO3	Manage GitLab Runners and pipeline environments	Apply (L3), Analyze (L4)
CO4	Troubleshoot pipeline failures and optimize for performance	Analyze (L4), Evaluate (L5)

Lab No.	Lab Assignment Description
1	Create a GitLab project and commit sample code
2	Install and register a GitLab Runner (shared or shell-based)
3	Write a simple `.gitlab-ci.yml` file with `build` and `test` stages
4	Add environment variables and secrets to GitLab and use them in pipelines

5	Set up caching and artifacts in GitLab pipeline
6	Integrate Docker build and push to Docker Hub using GitLab CI
7	Configure manual jobs and conditional job execution (e.g., only on `main` branch)
8	Implement a GitLab CI/CD pipeline that runs tests and deploys to Heroku
9	Debug a failed pipeline and fix the issue (e.g., script error, permission denied, etc.)
10	Use GitLab's built-in code quality and security scanning features
11	Setup GitLab Pages to deploy a static website using CI/CD
12	**Capstone:** Design a multi-stage GitLab CI/CD pipeline with complete build → test → deploy → notify

Text Books
1. ***Rike, Christopher*** *(2019). GitLab CI: The Beginner's Guide to Continuous Integration and Delivery using GitLab. Self-published.*
2. ***Martin, Jonathan Lee*** *(2013). GitLab Repository Management. Packt Publishing.*
Reference Books
1. van Baarsen, Jeroen *(2014). GitLab Cookbook. Packt Publishing*
E Books
1. The official *GitLab CI/CD Documentation* is available at docs.gitlab.com, providing comprehensive information on writing `.gitlab-ci.yml` files, runners, environments, and more.
2. *GitLab Learning Portal* offers free learning paths and certifications at learn.gitlab.com.
E Links
1. *Dev.to*'s GitLab tag (at dev.to/t/gitlab) features community-generated tutorials, from beginner to advanced levels.
2. *Medium.com* hosts a wide collection of blog articles and tutorials on GitLab CI/CD written by DevOps practitioners.

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	SEC-III Azure DevOps			**Code**	24UAIP404 C	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: Prior experience with Git, Azure fundamentals & application development concept

Course Objective:

1	To learn how to use Azure DevOps for end-to-end software delivery.
2	To Create and manage pipelines, boards, repos, and artifacts.
3	To Deploy the applications using Azure Pipelines and integrations.
4	To Monitor and manage deployments on Azure Cloud.

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	Understand core components of Azure DevOps	Understand (L2)
CO2	Create and manage build and release pipelines using Azure Pipelines	Apply (L3)
CO3	Integrate Boards, Repos, Artifacts, and Test Plans	Apply (L3), Analyze (L4)
CO4	Deploy applications to Azure and evaluate pipeline metrics	Apply (L3), Evaluate (L5)

Lab No.	Lab Assignment Description
1	Create an Azure DevOps organization and project
2	Setup Azure Repos and push a sample codebase
3	Create a basic build pipeline using YAML
4	Integrate unit testing (e.g., NUnit, Mocha) into build pipeline

5	Create a release pipeline to deploy an app to Azure App Service
6	Use Azure Boards to create and manage work items/tasks
7	Publish and consume packages using Azure Artifacts
8	Set up pipeline to deploy Docker container to Azure Container Registry
9	Enable logging and monitoring with Azure Monitor and Application Insights
10	Integrate Azure Test Plans for manual and automated test management
11	Add deployment approval gates and conditions in Azure release pipelines
12	**Capstone:** Create full CI/CD pipeline for a sample web app using Azure DevOps tools

Reference Books

1. Zaal, Sjoukje. *Azure DevOps Explained: Get Started with Azure DevOps and Develop Your DevOps Practices*. Packt Publishing, 2020.
2. Soni, Mitesh. *Implementing DevOps with Microsoft Azure*. Packt Publishing, 2017.

Text Books

1. Chandrasekara, Chaminda, and Pushpa Herath. *Professional Azure DevOps*. Apress, 2020.

E Books

1. Microsoft. *Azure DevOps Learning Path*. Microsoft Learn, n.d. https://learn.microsoft.com/en-us/training/paths/devops-fundamentals/
2. Microsoft. *Azure DevOps Documentation*. Microsoft Docs, n.d. https://learn.microsoft.com/en-us/azure/devops/

E Links

1. Hanselman, Scott. *Azure Friday (Video Series)*. Microsoft/Azure YouTube Channel, n.d.
2. Packt Publishing. *Packt Free Learning Library*. Packt Publishing, n.d. https://www.packtpub.com/free-learning

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Modern Office (Life Skill) Management			**Code**	24UBSP407	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: A basic understanding of workplace behavior and communication. - Openness to learning professional skills for effective functioning in a modern work environment.

Course Objective:

1	To equip students with essential communication and interpersonal skills for professional environments.
2	To develop practical understanding of professional etiquette and ethical behavior.
3	To build competencies in teamwork, time management, and conflict resolution.
4	To foster skills for personal growth, adaptability, and workplace resilience.
5	To prepare the students for effective functioning and career progression in modern office settings

Course Outcomes:

CO	**CO Statement**	**Bloom's Level**
CO1	Demonstrate effective verbal, non-verbal, and digital communication in workplace scenarios.	Apply (L3)
CO2	Practice professional behavior, ethical responsibility, and etiquette in office environments.	Apply (L3), Understand (L2)
CO3	Collaborate in team settings and apply conflict resolution strategies.	Apply (L3), Analyze (L4)
CO4	Organize tasks, manage time, and maintain workplace productivity and safety.	Apply (L3)
CO5	Develop a personal growth plan using career skills like goal setting, networking, and adaptability.	Create (L6), Evaluate (L5)

Sr. No	List of Practical Assignments (Any 10)
1	Design a modern office layout using digital or physical tools.
2	Draft a formal business letter and email for a professional context.
3	Prepare an agenda and minutes of a simulated office meeting.
4	Create a document filing and indexing system for office records.
5	Format a professional report using word processing software.
6	Use spreadsheets to perform basic data entry, calculations, and charting.
7	Develop a short presentation on a business topic with visuals and transitions.
8	Maintain a weekly time log and analyze productivity patterns.
9	Participate in a group task to simulate teamwork and task delegation.
10	Role-play common professional interactions to demonstrate workplace etiquette.
11	Develop a basic cybersecurity and data protection checklist for office use.
12	Create an office manual with communication protocols and digital tool guidelines.
13	Simulate a virtual meeting using tools like Zoom or Google Meet and demonstrate meeting protocols.
14	Create a personal development plan using SWOT analysis for career planning.
15	Prepare a visual flowchart or process diagram of office workflows (e.g., document approval, meeting scheduling).

Reference Books

1. Aulet, Bill. *Disciplined Entrepreneurship: 24 Steps to a Successful Startup*. Wiley, 2013.
2. Bhatia, R.C. *Modern Office Management*. Atlantic Publishers, 2008.
3. Chopra, R.K. *Office Management: Developing Skills for Smooth Functioning*. Himalaya Publishing House, 2010.
4. Andrews, Sudhir. *Effective Office Management*. Tata McGraw-Hill, 2009.
5. Harvard Business Review. *HBR's 10 Must Reads on Entrepreneurship and Startups*. Harvard Business Review Press, 2020.
6. Arora, S.P. *Office Organization and Management*. Vikas Publishing, 2011.
7. Ghosh, P.K. *Office Management*. Sultan Chand & Sons, 2012.

Text Books

1. Jain, S.C. *Office Management and Commercial Correspondence*. Kalyani Publishers, 2015.
2. Pillai, R.S.N., and Bagavathi. *Modern Office Practice and Management*. S. Chand Publishing, 2016.
3. Sinha, P.K. *Office Management*. Swastik Publications, 2014.

E Books

1. Wilson, Kevin. *Microsoft Office 365 Essentials: Get up and Running with Microsoft Office 365*. Apress, 2018.
2. Meeuwisse, Raef. *Cybersecurity for Beginners*. Cyber Simplicity, 2017.
3. Thiel, Peter. *Zero to One: Notes on Startups, or How to Build the Future*. Crown Business, 2014.

4. Blank, Steve, and Bob Dorf. *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*. K&S Ranch, 2012.
5. Drucker, Peter F. *The Effective Executive: The Definitive Guide to Getting the Right Things Done*. HarperBusiness, 2006.

E- Links

1. GCF Learn Free – Microsoft Office Tutorials: https://edu.gcfglobal.org/en/
2. Canva - Create presentations and office manuals: https://www.canva.com/
3. Trello - Online task and workflow management: https://trello.com/
4. Coursera – Work Smarter, Not Harder (Productivity Course): https://www.coursera.org/learn/work-smarter-not-harder
5. SlideCarnival – Free PowerPoint & Google Slide Templates: https://www.slidescarnival.com/
6. Zoom Help Center – Virtual Meeting Guidelines: https://support.zoom.us/hc/en-us
7. Google Workspace Learning Center: https://support.google.com/a/users

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Entrepreneurship Essentials II			**Code**	24UESP408	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week				25

Prerequisite: A basic understanding of workplace behavior and communication. - Openness to learning professional skills for effective functioning in a modern work environment.

Course Objective:

1	To deepen students' understanding of startup growth, innovation, and funding mechanisms.
2	To enable students to design scalable business strategies and navigate competitive landscapes.
3	To provide knowledge of global entrepreneurship, digital transformation, and advanced financial tools.
4	To introduce students to incubators, accelerators, and pitching competitions.
5	To promote strategic thinking in team building, stakeholder engagement, and sustainable entrepreneurship.

Course Outcomes:

CO	CO Statement	Bloom's Level
CO1	Understand global and digital trends in entrepreneurship	Understand(L2)
CO2	Analyze advanced startup strategies including scaling and funding	Analyze(L4)
CO3	Design investor-ready startup pitches and strategic roadmaps	Create(L6)
CO4	Evaluate the role of incubators, accelerators, and government support schemes	Evaluate(L3)
CO5	Apply sustainable, ethical, and inclusive practices in business growth	Apply(L3), Evaluate (L5)

Sr. No.	Title of Practical	COs Mapped
1	Analyze an innovative startup's design thinking approach (case-based assignment)	CO1
2	Conduct a design sprint: From problem statement to prototype	CO1, CO2
3	Develop and compare scaling strategies for two different business models	CO2
4	Prepare a competitive positioning map for a selected startup idea	CO2
5	Draft a financial plan with valuation and cap table for a startup	CO3
6	Create and present a pitch deck targeting angel investors or venture capitalists	CO3, CO4
7	Compare funding schemes from Startup India and global incubators	CO4
8	Prepare a report on government schemes (e.g., AIM, SIDBI) and how startups can leverage them	CO4
9	Identify and plan for sustainable practices within a business model (e.g., ESG inclusion)	CO5
10	Develop a strategy for inclusive hiring and ethical scaling for a startup	CO5
11	Create a plan to enter an international market: legal, cultural, and strategic considerations	CO1, CO4
12	Evaluate a real pitch from Shark Tank or similar programs and critique using investment criteria	CO3, CO4
13	Participate in or simulate an incubator/accelerator pitch bootcamp	CO2, CO3, CO4

Reference Books

1. Aulet, Bill. *Disciplined Entrepreneurship: 24 Steps to a Successful Startup*. Wiley, 2013.
2. Kim, W. Chan, and Renée Mauborgne. *Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant*. Harvard Business Review Press, 2015.
3. Christensen, Clayton M. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Review Press, 2016.
4. Bornstein, David, and Susan Davis. *Social Entrepreneurship: What Everyone Needs to Know*. Oxford University Press, 2010.
5. Harvard Business Review. *HBR's 10 Must Reads on Entrepreneurship and Startups*. Harvard Business Review Press, 2020.

Text Books

1. **Bill Aulet**, *Disciplined Entrepreneurship: 24 Steps to a Successful Startup*, Wiley, 2013.
2. **Eric Ries**, *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*, Crown Business, 2011

3. **Peter F. Drucker**, *Innovation and Entrepreneurship*, Harper Business, Revised Edition, 2006

E Books

1. Blank, Steve, and Bob Dorf. *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*. K & S Ranch, 2012.
2. Thiel, Peter, with Blake Masters. *Zero to One: Notes on Startups, or How to Build the Future*. Crown Business, 2014.
3. Government of India. *Startup India Learning Program*. Available online at startupindia.gov.in
4. **Steve Blank** and **Bob Dorf**, *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*, K&S Ranch, 2012. – Available on Internet Archive
5. **Peter Thiel** with **Blake Masters**, *Zero to One: Notes on Startups, or How to Build the Future*, Crown Business, 2014. – Amazon eBook
6. **Poornima M. Charantimath**, *Entrepreneurship Development and Small Business Enterprises*, Pearson Education, 2018. – Available on academic e-libraries like Pearson eLibrary or Google Books

E Links

1. **Startup India Learning Program** – https://www.startupindia.gov.in
2. **Atal Innovation Mission (AIM)** – https://aim.gov.in
3. **Harvard Online: Entrepreneurial Strategy** – https://online.hbs.edu/courses/entrepreneurial-strategy/
4. **Coursera – Digital Transformation in Business** https://www.coursera.org

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	VEC II (Environmental Awareness)			**Code**	24UVEP409 A	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week			10/15/	25

Prerequisite: Basic understanding of Indian history and political science.

Course Objective:

1	To introduce the multidisciplinary nature and scope of environmental studies.
2	To understand ecosystem structures, biodiversity, and ecological balance through hands-on observation and documentation.
3	To examine the use and impact of natural resources on environmental sustainability.
4	To explore biodiversity conservation practices and develop eco-sensitive thinking through field-based inquiry.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Illustrate the interdependence of ecosystems through activity-based exploration	Understand (L2)
CO2	Analyze the role of natural resources in sustainable development using real-world data.	Analyze (L4)
CO3	Investigate biodiversity threats and conservation strategies through surveys and projects	Analyze(L4)
CO4	Create awareness tools or reports promoting sustainability based on their findings.	Create (L6)

List of Assignments:

Week	Topic to be covered
1	**Introduction Workshop**: Group discussion and poster making on "Why Environmental Studies Matter for Technologists"
2	**Eco Mapping**: Identify and document elements of an ecosystem within the college campus
3	**Model the Food Web**: Create food chains and food webs using flowcharts (digital tools like Canva / Lucidchart)
4	**Case Study Review**: Present real-world examples of forest, grassland, and aquatic ecosystems
5	**Soil and Water Testing Activity**: Test soil pH, water quality (use school-level kits), and interpret results
6	**Field Visit / Virtual Tour**: Document deforestation or mining impact in a chosen region; students prepare a comparative report
7	**Water Audit Exercise**: Estimate water usage at home/hostel and identify areas of overuse; propose conservation measures
8	**Renewable Energy Models**: Create a simple model or PPT on any renewable energy source (e.g., solar cooker, wind energy demo)
9	**Biodiversity Documentation**: Survey nearby areas for plant/animal species; identify any endemic/endangered species
10	**Conservation Proposal Pitch**: In groups, students prepare a mini proposal for biodiversity conservation at local level
11	**Group Project Work**: Work on mini project report/documentation on any ecosystem/natural resource topic
12	**Presentation & Viva**: Final presentation and oral examination based on project work and learning portfolio

Reference Book
1. Odum, Eugene P. “Fundamentals of Ecology”
2. R.Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford
Text Book
1. Erach Bharucha, “Textbook of Environmental Studies”, UGC
2. Anubha Kaushik and C.P. Kaushik, “Environmental Studies”, New Age International
E-Links
1. https://www.unep.org
2. https://nptel.ac.in/courses/
3. https://www.environment.gov.in

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Philosophy and Wisdom Traditions			**Code**	24UVEP409 B	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week			10/15/	25

Prerequisite: Basic understanding of personal values, general awareness of Indian culture and society, and foundational communication skills.

Course Objective:

1	To cultivate ethical awareness and moral reasoning in both personal and professional life.
2	To introduce Indian philosophical thought and its relevance to modern-day challenges.
3	To explore the ethical implications of science, technology, and innovation.
4	To nurture leadership, teamwork, and value-based entrepreneurship.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Demonstrate an understanding of ethical principles and Indian ethos.	Understand (L2)
CO2	Apply the teachings of Indian thinkers to evaluate modern-day ethical dilemmas.	Apply (L3)
CO3	Analyze the societal impact of technology and sustainable development.	Analyze (L4),
CO4	Develop value-based leadership, teamwork, and innovation strategies.	Create (L6)

List of Assignments:

Week	Topic to be covered	Activity
1	Introduction to Value Education	Group discussion on "What are values?" & storytelling around personal value dilemmas.
2	Indian Ethos	Role play: Practicing truth, dharma, and karma in simulated situations.
3	Thinkers: Kanad & Kapila	Create a visual timeline or mind map reflecting scientific inquiry and systems thinking.
4	Critical Thinking & Curiosity	Debate on "Knowledge vs Information." Case analysis from Indian scriptures.
5	Self-Discipline & Integrity	Personal Journaling Activity
6	Thinkers: Adi Shankaracharya & Basaveshwara	Podcast creation (group) on social . equality or logic and reasoning.
7	Science and Ethics	Case study: AI ethics, social media algorithms, and privacy.
8	Sustainable Development	Simulation: Build a mini-project plan with ethical and green principles.
9	Thinkers: Aryabhata & Nagarjuna	Poster making or video project on scientific innovation with responsibility.
10	Nationhood & Social Reform	Skit or street play: Unity in diversity and equality in India.
11	Social Justice and Engineering	Panel discussion: Role of AI in inclusive development.
12	Thinkers: M. Visvesvaraya & Homi Bhabha	Timeline creation and presentation on India's engineering milestones.
13	Leadership and Teamwork	Leadership challenge activity or peer-led workshops.
14	Innovation & Entrepreneurship	Design a startup pitch with ethical impact at its core.
15	Reflective Assignment + Viva	Final reflections, report submission, viva on learning outcomes

Reference Book
1. Kapila Vatsyayan – The Indian Mind: Essentials of Indian Philosophy and Culture.
2. M.K. Gandhi – My Experiments with Truth.
Text Book
3. R.R. Gaur, R. Sangal, G.P. Bagaria – A Foundation Course in Human Values and Professional Ethics, Excel Books.
4. Swami Vivekananda – Selections from the Complete Works.
5. Dr. Kalam, A.P.J. – Ignited Minds.
E-Links
1. https://nptel.ac.in/courses/109104115 – NPTEL Course on Human Values
2. https://epgp.inflibnet.ac.in/ – E-PG Pathshala
3. SWAYAM – Political Science Courses

Indira College of Engineering and Management (An autonomous Institute**)**						
Second Year of Artificial Intelligence and Data Science Engineering (2024 Course)						
Course	Foundations of Ethical Living			**Code**	24UVEP409 C	
Credits	2	**Pr/week**	4	**Evaluation Scheme**	Theory TAE/CAE/ESE	Practical **INT**/EXT
		Th/week			10/15/	25

Prerequisite:

1. Basic understanding of Indian history and philosophy
2. Willingness to reflect on personal and professional values

Course Objective:

1	To introduce core ethical values and Indian philosophical thought.
2	To enable critical thinking about the role of ethics in technology and leadership.
3	To develop empathy, integrity, and social responsibility through experiential learning.
4	To inspire students to apply ethical principles in personal and professional decision-making.

Course Outcomes:

CO	**CO statement**	**Bloom's Level**
CO1	Describe key ethical values and Indian philosophical teachings relevant to professional life.	Remember (L1)
CO2	Analyze the role of ethics in science, technology, and society through historical and modern lenses.	Analyze (L4)
CO3	Apply ethical reasoning to case studies and real-life professional scenarios.	Apply(L3)
CO4	Develop personal and team-based projects reflecting ethical leadership and social responsibility.	Create (L6)

List of Assignments:

Week	Topic to be covered	Activity
1	Introduction to Value Education	Self-awareness journaling, group discussion on personal values
2	The Indian Ethos: Truth, Non-Violence, Dharma, Karma	Poster-making and storytelling activity around Indian thinkers
3	Scientific Inquiry (Maharshi Kanad, Kapila)	Debate: "Are scientific values ethical values?"
4	Knowledge, Self-Discipline, and Integrity	Reflection essays: "My Role Model of Integrity"
5	Social Equality and Inclusivity (Basaveshwara)	Simulation activity: Privilege walk or role-play
6	Ethics in Technology and Engineering	Case Study: Facial recognition, AI Bias, Surveillance
7	Environmental Responsibility and Sustainable Thinking	Field visit or online docu-screening + reflective write-up
8	Nationhood, Engineering for Inclusion (Visvesvaraya, Bhabha)	Group project planning: "Engineering for Social Good"
9	Leadership and Teamwork (Ratan Tata, A.P.J. Abdul Kalam)	Team-based leadership challenge (Role-play, Time-bound tasks)
10	Innovation and Entrepreneurship with Ethics	Innovation Pitch: Students present ethical startups or AI projects
11	Project Work	Compilation of all assignments and project execution
12	Presentation + Viva	Team presentations, peer feedback, and oral assessment

Reference Book
1. “The Story of My Experiments with Truth” by Mahatma Gandhi
2. “Ignited Minds” by A.P.J. Abdul Kalam
3. “The Ethical Engineer” by Robert McGinn
Text Book
1. "Ethics in Engineering" by Mike Martin & Roland Schinzinger.
2. "Value Education and Professional Ethics" by R.R. Gaur, R. Sangal, and G.P. Bagaria
E-Links
1. Stanford Encyclopedia of Philosophy
2. AI Ethics Case Studies – Harvard