VIVEKANAND EDUCATION SOCIETY

INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Hashu Advani Memorial Complex, Collector's Colony, Chembur,
Mumbai, 400074, Maharashtra, India www.vesit.ac.in

Syllabus Approved By:

Academic Council of V.E.S. Institute of Technology

Preamble

Engineering education forms the cornerstone of technological innovation, industrial advancement, and societal transformation. As the world navigates an era of rapid change driven by automation, artificial intelligence, sustainable technologies, and global connectivity, VESIT positions itself as a catalyst for cultivating a dynamic learning ecosystem.

At VESIT, we strive to foster critical thinking, technical expertise, academic excellence, and holistic development among aspiring engineers. We are committed to shaping professionals who are adaptable, collaborative and are also deeply conscious of their social and environmental responsibilities.

Leveraging its autonomous status and affiliation with the University of Mumbai, VESIT designs a forward-thinking, outcome-based curriculum that emphasizes industry relevance and experiential learning.

The syllabus at VESIT has been structured in alignment with the principles of the National Education Policy (NEP) 2020, focusing on flexibility and multidisciplinary learning. The key thrust areas of education at VESIT include:-

Student-Centric Approach:

The programme is designed to offer students greater autonomy in shaping their academic journey. The syllabus comprises of **Core (Major) and Minor courses** from Diverse Disciplines as well as a wide range of **Open Electives**. Students can tailor their learning paths based on their interests and career aspirations. The curriculum also integrates mentored field projects and on the job training, providing valuable hands- on experience. Additionally, students with a research inclination can also explore **research-based projects** or pursue **Honours by Research.**

Multidisciplinary Approach:

VESIT's curriculum reflects a strong interdisciplinary focus, incorporating emerging fields and cutting- edge technologies. Courses are designed to bridge various domains with offerings such as **Machine learning, Artificial Intelligence & Data Science, Cyber Security, Geographic Information Systems (GIS), Internet of Things (IoT), Register transfer level VLSI, Robotics, Quantum Technologies, Mobile application development, Industrial Automation, Edge Computing and Embedded Intelligence and Information Security.**

This approach encourages broader thinking and prepares students for diverse career paths.

Emphasis on Conceptual Clarity:

The curriculum lays stress also on a strong theoretical foundation, ensuring that students gain deep conceptual understanding, which is essential for mastering advanced topics and solving real-world problems.

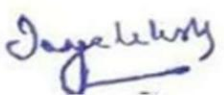
Fostering Creativity and Critical Thinking:

Courses are designed to nurture a critical and creative mindset, promoting analytical reasoning, problem-solving, and innovation. Students are encouraged to question, explore, and think beyond conventional solutions.

Comprehensive Evaluation and Assessment:

Student performance is assessed through a number of assessment tools that includes the Mid-term Tests, Continuous Assessments, End-Semester Examinations. These evaluation tools are designed to measure the knowledge retention of students as well as their ability to apply concepts effectively in practical situations.

Guided by a vision of excellence and inclusivity, and supported by a passionate faculty, VESIT aspires to be a hub where ideas flourish, startups emerge, and industry-academia partnerships thrive. Our goal is to transform students into innovators, entrepreneurs, researchers and responsible leaders poised to drive sustainable growth and meaningful change in society.



Dr. J M Nair
Principal, VESIT

Dr. M Vijayalakshmi
Vice Principal, VESIT

Dr. Mrs. Gresha S Bhatia
Academic Coordinator, VESIT

Preamble

Department of Artificial Intelligence and Data Science

The **Department of Artificial Intelligence and Data Science (AI&DS)** at **Vivekanand Education Society's Institute of Technology (VESIT)** is dedicated to preparing students for the rapidly evolving landscape of intelligent systems and data-driven technologies. In alignment with the **National Education Policy (NEP) 2020**, the department fosters academic excellence, innovation, and holistic development through a dynamic and student-centric curriculum.

The syllabus offers a progressive blend of foundational knowledge and emerging technologies across core areas such as **Data Structures, Probability and Graph Theory, Database Management Systems, Foundations of Data Science, Artificial Intelligence, Analysis of Algorithms, Machine Learning, Data Mining, Deep Learning, Generative AI, Blockchain, Cloud Computing, and Full Stack Development**. Through a combination of theory, practical labs, industry-relevant electives, and value-added courses, students develop strong analytical, programming, and problem-solving skills.

The curriculum integrates **project-based learning, internships, continuous assessments, open electives, and experiential learning opportunities**, thereby promoting interdisciplinary exploration, critical thinking, and real-world readiness. With strong emphasis on **ethics, innovation, entrepreneurship, and sustainability**, the department nurtures future technologists who can responsibly design, build, and deploy intelligent systems for societal advancement.

Through an ecosystem enriched with qualified faculty, industry exposure, hands-on tools, and collaborative research, the AI&DS department aspires to produce graduates who are **technologically proficient, ethically grounded, and globally competitive**, capable of addressing complex challenges in academia, industry, and innovation-driven enterprises.

Dr. M Vijayalakshmi
H.O.D -AIDS

Anjali Yeole

Dr. Anjali Yeole
Dy.H.O.D-AIDS

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Artificial Intelligence and Data Science

Department of Artificial Intelligence and Data science

Syllabus (NEP Scheme)

Sem-III and Sem-IV

w.e.f. A.Y. 2024-25

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pract.	Tut	Theory	Pract/ tut	Total
NADPC31	Probability and Graph Theory	2	-		2		2
NADPC32	Data Structure	3	2		3	1	4
NADPC33	Database Management System	3	2		3	1	4
NADPC34	Foundation of Data Science	1	2		1	1	2
NADMM31	Cryptography and System Security	3	2		3	1	4
AE31	Professional Communication and Ethics II	2			2		2
EM31	Finance Management	2	-		2	-	2
Total		**16**	**08**		**16**	**04**	**20**

Examination Scheme

Course Code	Course Name	Theory				Term Work	Pract	Total
		Internal Assessment		End Sem Exam	Exam Duration (hrs.)			
		MT	CA					
NADPC31	Probability and Graph Theory	20	20	60	2	-	--	100
NADPC32	Data Structures	20	20	60	2	25	25	150
NADPC33	Database Management System	20	20	60	2	25	25	150
NADPC34	Foundation of Data Science	--	--	--	--	25	50	75
NADMM31	Cryptography and System Security	20	20	60	2	25	25	150
AE31	Professional Communication and Ethics II	--	--	--	--	50	--	50
EM31	Finance Management	20	--	30	--		--	50
Total		**100**	**80**	**270**	**--**	**150**	**125**	**725**

COURSE NAME: Probability and Graph Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC31	Probability and Graph Theory (Theory)	02	---	---	02	---	---	02

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC31	Probability and Graph Theory (Theory)	02	---	---	02	---	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC31	Probability and Graph Theory (Theory)	20	20	60	---	---	100

Prerequisite:	
Course Objectives:	
1	To identify a random variable that describes randomness or an uncertainty in certain realistic situations.
2	To learn important probability distributions like Discrete and Normal Distributions.
3	To study Continuous Probability Distributions, random variables and Central Limit Theorem.
4	To explain basic concepts in graph theory
5	Discuss the concept of graph, tree, Euler graph and cut set.
6	See the applications of graphs in science, business and industry.
Course Outcomes: After successful completion of the course student will	
1	be able to evaluate randomness in certain realistic situations which can be either discrete or continuous type and compute statistical constants of these random variables.
2	gain knowledge to identify probability distributions from the discrete population of data to provide actionable insight.
3	Gain knowledge to identify probability distributions from the continuous population of data to provide actionable insight.
4	be able to understand the fundamental concept of graph and its representation for real life problems
5	Be able to apply concepts of graph theory in modelling and solving non-trivial problems in different fields of study.
6	Be able to compare, understand and analyze different applications of graphs.

Probability and Graph Theory (Theory)

Module		Content	Hrs
1.0		**Introduction to Probability**	**04**
	1.1 **1.2**	Elements of Probability, Random Variable, Probability Density Function, Variance, Continuous and Discrete Random Variables, Two Random Variables Joint and Marginal Probability Distribution, Conditional Distribution, Bayes Theorem, Conditional Independence.	
2.0		**Discrete Probability Distributions**	**05**
	2.1	Discrete Random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution.	
3.0		**Continuous Probability Distributions**	**07**
	3.1	Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, Exponential and Normal distributions.	
	3.2	Joint Distribution function, Independent random variable, sum of independent random variable. Conditional distribution : discrete case ,continuous case, joint probability distribution of functions of random variable	
4.0		**Introduction to Graph Theory**	**02**
	4.1	Basic Terminology, Representation of Graphs, Walks, Paths, Circuits, Connectedness, Handshaking Lemma, Isomorphism, Subgraphs, Reach ability, Union and Intersection of Graphs.	
	4.2	Euler Graph, Hamiltonian Graph, Bipartite graphs and Applications	
5.0		**Directed Graph**	**05**
	5.1 **5.2**	Fundamental circuits, cut sets and cut vertices. Directed Graphs and connectedness, Network flows, MaxFlow-MinCut Theorem, Matrix representation of a graph. Planar graphs: Kuratowski's Graphs, Detection of Planarity, Thickness and Crossing, Depth First Search (DFS) and Breadth First Search (BFS) topological sort.	
6.0		**Applications of Graphs**	
		Introductions of Airline scheduling (flow problem), Directions in a map (Shortest path), Solving Sudoku's puzzles (Graph colouring), Search Engine Algorithms (PageRank algorithm). Social Media Marketing (Community detection)	**03**
Total			**26**

Textbooks:	
1	A first Course in Probability – Sheldon Ross – Pearson Publication
1	Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition- 2007. ISBN 978-81-7758-424-0.
2	Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8 th edition, Cengage, 2012
3	N. Deo, Graph Theory with Applications to Engineering and Computer Science, PHI publication, 3rd edition, 2009
References:	
1	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata- McGraw Hill, Sixth edition, Sixth reprint 2008, ISBN-(13): 978-0-07-064824-1 .
2	Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://neo4j.com/case-studies/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc.	10 marks

*For sr. no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

COURSE NAME: DATA STRUCTURES

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC32	Data Structures (Theory)	03	---	---	03	---	---	03
NADPC32	Data Structures (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC32	Data Structures (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC32	Data Structures (Theory)	20	20	60	---	---	100

Prerequisite: C Programming	
Course Objectives: The course aims:	
1	To understand the need and significance of Data structures as a computer Professional.
2	To teach concept and implementation of linear and Nonlinear data structures.
3	To analyze various data structures and select the appropriate one to solve a specific real-world problem.
4	To introduce various techniques for representation of the data in the real world.
5	To teach various searching techniques.
Course Outcomes: Students will be	
1	Able to understand the fundamentals of Linear data structures and operations on them.
2	Be able to identify scenarios for usage of different data structures and implement them.
3	Able to understand the fundamentals of Non-Linear data (tree) structure and implement them.
4	Able to understand various types of tree and its application.
5	Be able to analyze and implement appropriate searching and sorting techniques for a given problem.
6	Able to demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADPC32	Data Structures (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC32	Data Structures (Lab)	---	---	---	25	25	50

Prerequisite: C Programming Language.	
Lab Objectives:	
1	To implement basic data structures such as arrays, linked lists, stacks and queues
2	Solve problem involving different types of trees
3	To develop application using data structure algorithms
Lab Outcomes:	
1	Students will be able to implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them.
2	Students will be able to implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them
3	Students will be able to choose appropriate data structure and apply it in various problems
4	Students will be able to select appropriate searching techniques for given problems.

Data Structures (Theory)

Module		Detailed Content	Hours
1		**Introduction**	**2**
	1.1	Introduction to Data Structures, Concept of ADT, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures.	
2		**Stack and Queues**	**8**
	2.1	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion.	
	2.2	Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.	
3		**Linked List**	**10**
	3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.	
4		**Trees**	**6**
	4.1	Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding.	
5		**Types of Tree**	**7**
	5.1	Search Trees-AVL Tree, Red Black Tree, B Tree, B+ Tree and n-ary tree	
	5.2	Introduction to Heaps, Heap representation using array, heap creation and deletion, Heap operations	
6		**Sorting and searching Techniques**	**6**
	6.1	Linear Search, Binary Search, Tries, Hashing, Collision resolution Technique	
	6.2	Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Bucket Sort	
			39

Textbooks:	
1	Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
2	Reema Thareja, "Data Structures using C", Oxford Press.
3	Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach With C", 2nd Edition, CENGAGE Learning.

4	Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education
5	Data Structures Using C, ISRD Group, 2nd Edition, Tata McGraw-Hill.

References:

1	Prof. P. S. Deshpande, Prof. O. G. Kakde, "C and Data Structures", DreamTech press.
2	E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.
3	Rajesh K Shukla, "Data Structures using C and C++", Wiley-India
4	GAV PAI, "Data Structures", Schaum's Outlines.
5	Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition

Access to software and virtual labs:

1	https://cse01-iiith.vlabs.ac.in/List%20of%20experiments.html
2	https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
3	https://nptel.ac.in/courses/106/102/106102064/ 2 https://www.coursera.org/specializations/data-structures-algorithms 3 https://www.edx.org/course/data-structures-fundamentals
4	https://cse01-iiith.vlabs.ac.in/List%20of%20experiments.html

Industry articles and case studies :

1	https://www.gyata.ai/data-structure/articles/
2	https://www.geeksforgeeks.org/real-time-application-of-data-structures/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks

4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc.	10 marks

*For sr. no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Data Structures (Lab)

Suggested Experiments Students are required to complete at least 10 experiments.

Sr. No.	Name of the Experiment
1	Implement Stack and its operations with real life applications
2	Convert an Infix expression to Postfix expression using stack ADT.
3	Evaluate Postfix Expression using Stack ADT.
4	Implement Linear Queue using array.
5	Implement Circular Queue using array.
6	Implement Priority Queue ADT using array.
7	Implement Singly Linked List.
8	Implement Circular Linked List.
9	Implement Doubly Linked List.
10	Implement Stack / Linear Queue using Linked List.
11	Implement Binary Search Tree
12	Searching Techniques : Binary Search, Tries, Hashing
13	Sorting Techniques: Merge Sort, Quick Sort, Heap Sort, Bucket Sort

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.

2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)
Evaluation Exam	
1	Practical Exam based on the entire syllabus

Every student is accepted to implement real life application from 3 module.

COURSE NAME: Database Management System

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC33	Database Management System (Theory)	03	---	---	03	---	---	03
NADPC33	Database Management System (Lab)	---	02	---	---	01	---	01

Database Management System (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC33	Database Management System (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC33	Database Management System (Theory)	20	20	60	---	---	100

Prerequisite:	
Course Objectives: The course aims:	
1	Develop entity relationship data model and its mapping to relational model
2	Learn relational algebra and Formulate SQL queries
3	Apply normalization techniques to normalize the database
4	Understand the concept of transaction, concurrency control and recovery techniques.
Course Outcomes:	
1	Recognize the need of database management system
2	Design ER and EER diagrams for real life applications.

3	Construct relational models and write relational algebra queries.
4	Formulate SQL queries

5	Apply the concept of normalization to relational database design.
6	Describe the concept of transaction, concurrency and recovery.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	
NADPC33	Database Management System (Lab)	---	02	---	---	01	---	

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
PADPC33	Database Management System (Lab)	---	---	---	25	25	50

Prerequisite:	
Lab Objectives:	
1	To identify and define problem statements for real life applications
2	To Build Relational Model from ER/EER and demonstrate usage of relational algebra.
3	To Apply SQL to store and retrieve data efficiently
4	To understand the concepts of transaction processing- concurrency control & recovery procedures.
Lab Outcomes: On successful completion, of course, learner/student will be able to:	
1	Define problem statement and Construct the conceptual model for real life application.
2	Create and populate a RDBMS using SQL.
3	Formulate and write SQL queries for efficient information retrieval
4	Apply view, triggers and procedures to demonstrate specific event handling.
5	Demonstrate database connectivity using JDBC.
6	Demonstrate the concept of concurrent transactions.

Database Management System (Theory)

Module		Detailed Content	Hrs
1		**Database System Concepts**	**03**
	1.1	**An Introduction to database** - Data, database, DBMS, Disadvantages of file processing system, advantages of DBMS over file processing system Characteristics of databases, Application of database.	
	1.2	**Data abstraction**, Database languages, Instance and schema, Data independence - Logical and Physical Independence.	
	1.3	**Introduction to client server architecture**- Two/Three tier Architecture. Components of DBMS and overall Structure of DBMS. Database Users, functions of Database Administrator.	
2		**Entity–Relationship Data Model**	06
	2.1	**The Entity-Relationship (ER) Model**: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys **Relationship constraints:** Cardinality and Participation, Extended	
	2.2	**Entity-Relationship (EER) Model:** Generalization, Specialization and Aggregation	
3		**Relational Model and Relational Algebra**	08
	3.1	**Introduction to the Relational Model**: relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model	
	3.2	**Relational Algebra:** Relational Algebra-operators, Relational Algebra Queries.	
4		**Relational-Database Design**	06
	4.1	**Pitfalls in Relational-Database designs** **Normalization:** Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.	
		Structured Query Language (SQL)	06
	5.1	**Overview of SQL**: Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check constraints,	

5	5.2	**Commands:** Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins **Nested and complex queries,** Triggers	
		Transactions Management and Concurrency and Recovery	10
6	6.1	**Transaction concept**, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View,	
	6.2	**Concurrency Control:** Lock-based, Timestamp-based protocols,	
	6.3	**Recovery System:** Log based recovery, Deadlock handling	
		Total	39

Textbooks:	
1	Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
References:	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5thEdition.
2	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3	G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Access to software and virtual labs:	
1	https://livesql.oracle.com/apex/f?p=590:1000
2	https://www.programiz.com/sql/online-compiler/
Industry articles and case studies :	
1	How is AI Transforming Data Management? https://www.datacamp.com/blog/how-is-ai-transforming-data-management
2	Amazon, PayPal, Netflix, Stock Trading Platforms, Google Maps, Slack, Salesforce
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	Microsoft SQL Server with Intelligent Query Processing

2	Oracle Autonomous Database
3	Google Cloud AI

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment test/Tutorials etc.	10 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Database Management System (LAB)

Suggested Experiments: (minimum number of experiments to be completed can be specified)	
Sr. No.	**Name of the Experiment**
1	Identify real world problems and develop the problem statement. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create a database using DDL and apply integrity constraints.
4	Perform data manipulations operations on populated databases.
5	Perform Authorization using Grant and Revoke.
6	Implement Basic and complex SQL queries.
7	Implementation of Views and Triggers.
8	Demonstrate database connectivity using JDBC.
9	Implementation and demonstration of Transaction and Concurrency control Techniques using locks.

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

COURSE NAME: Foundation of Data Science

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC34	Foundation of Data Science (Theory)	01	---	---	--	---	---	--
NADPC34	Foundation of Data Science (Lab)	---	02	---	---	02	---	02

Foundation of Data Science

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC34	Foundation of Data Science (Theory)	01	---	---	01	--	--	--

Prerequisite: Basic Python	
Course Objectives: The course aims:	
1	To learn fundamentals of data science and important python packages
2	To Understand python library Pandas for process data from various data source.
3	To Understand python library Numpy for data manipulation.
4	To learn python library seaborn and matplotlib.
5	To Understand python data science workflow.
Course Outcomes: At the end of the course, students will be able to	
1	Understand core terminology of data science and data analytics
2	Identify different source of data ,retrieve and load and pre-process different dataset format
3	Analyze popular Python libraries such as pandas, NumPy, seaborn and mathplotlib.
4	Explore data wrangling, reshaping, summarizing, analyzing and ultimately reporting their results through data visualization tools.
5	To create an entire data science application.

Foundation of Data Science (LAB)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADPC34	Foundation of Data Science (Lab)	---	02	---	---	02	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC34	Foundation of Data Science (Lab)	---	---	---	25	50	75

Lab Prerequisite:	
Lab Objectives:	
1	To learn fundamentals of data science and important python packages
2	To Understand python library Pandas for process data from various data source.
3	To Understand python library Numpy for data manipulation.
4	To learn python library seaborn and matplotlib.
5	To Understand python data science workflow.
Lab Outcomes: After successful completion of the course students will be able to:	
1	Understand core terminology of data science and data analytics
2	Identify different source of data ,retrieve and load and pre-process different dataset format
3	Analyze popular Python libraries such as pandas, NumPy, seaborn and mathplotlib.
4	Explore data wrangling, reshaping, summarizing, analyzing and ultimately reporting their results through data visualization tools.
5	To create an entire data science application.

Foundation of Data Science (Theory)

Module		Content	Hrs
1.0		**Fundamentals Data Science and data analytics**	**02**
	1.1	Introduction to Data science, Basic terminologies of DS: Data Science, Data scientist, Data Modelling, Data visualization, Data Wrangling.	
	1.2	Types of Data Analytics: Predictive, Descriptive, Diagnostic and prescriptive. Python packages for data science.	
2.0		**Pandas:**	**04**
	2.1	**Data Analysis library:** Data Structure in Pandas: Series, data frame, Panel. **Series Creation:** Using Dict , narraylist,list **Accessing Series**: Slicing, indexing and ranging, iloc and loc method. **Viewing Data frame**: using describe, iloc, head, tail, index, column name. **Working with pandas :** Handling Mixing values: Dropna,Fillna **Functions**: groupby, sort, merge, min, max, std etc. **Data Processing: Processing** CSV data, Processing JSON data, Processing XLS data, Date and time in data, Reading html contents.	
3.0		**Numpy: Types of arrays : ID,2D,3D**	**04**
	3.1	**Attributes of ndarray** : Using. ndim ,Using .shape , Using .size ,Using .dtype **Creating functions for arrays** : Using arrange() ,Using linspace(), Using ones(), Using zeros() , Using diag() , Using random.rand() , Using random.randn() , Using random.seed() **Basic operation**s :(+, -, *, /, %, //, &, |, ~, <=, >, >=, ==, !=) Accessing array elements using axis values , Indexing with Boolean array **Shape manipulation** : Using flatten , Using reshape , Using resize , Using split , Using stack **Broadcasting** : Using tile(), Using ones() , Using newaxis()	
4.0		**Visualizations Using Seaborn and Matplotlib:**	**03**
	4.1	**Chart properties:** Creating a chart, Labelling the axes, Formatting line style and colour, Saving the chart in a file. **Styling the chart :** Adding annotations , Adding legends , Presentation style Types of presentation styles **Visualization techniques :** Histogram, Histogram with grid,Distplot Pairplot Scatterplot, Lmplot , box plot	
Total			**13**

Textbooks:	
1	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, Wes McKinney,
2	M. T. Savaliya , R. K. Maurya, "Programming through Python", StarEdu solutions
3	E Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Publication.

4	Yashavant Kanetkar, "Let Us Python", BPB Pub
5	Dr. R. Nageswara Rao," Core Python Programming", Dreamtech Press, Wiley Publication

References:	
1	Zed A. Shaw, "Learn Python 3 the Hard Way", Zed Shaw's Hard Way Series.
2	Martin C. Brown," Python: The Complete Reference", McGraw-Hill Publication.
3	Paul Barry," Head First Python", 2nd Edition, O'Reilly Media, Inc.

Access to software and virtual labs:	
1	https://www.programiz.com/python-programming/online-compiler/
2	https://www.onlinegdb.com/online_python_compiler
Industry articles and case studies :	
1	Top 10 Real-World Data Science Case Studies https://www.turing.com/resources/data-science-case-studies
2	https://www.kaggle.com/discussions/getting-started/357731
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	Google colab
2	Jupyter Notebook

Foundation of Data Science (LAB)

COMPUTING PLATFORM All students should install the Anaconda Distribution of Python latest stable version available at https://www.anaconda.com/distribution/. This includes installing Python and creating a first Jupyter notebook.	
• Python Bootcamp I: Jupyter notebooks and GitHub • Maintaining a code repository is a good way of organizing, revising and sharing code. Maintain code in a GitHub repository.	
1.	**Data Loading and Access across various format** • Accessing data in various formats CSV, JSON, xls, etc. • Import and export data • Data retrieval from web-based sources using API's

2.	**Programming assessment on Pandas:** Data science pipeline is wrangling the data, which includes, cleaning, merging, reshaping and summarizing/aggregating them. ● Pandas Dataframe, Joining and merging data frame ● Pandas String ● Grouping and aggregations ● Handling missing values ● Date time ● Plotting
3.	**Programing assessment on Numpy** ● Matrix Operations ● Arrays creation and operations on array ● Sorting and Searching ● Date Time ● Strings ● Statistics (Computer Parameters for Given Data Distributions)
4.	**Data visualization using Seaborn and Matplotlib** Load sample dataset and perform exploratory data analysis and plot the graph for ● Scatter plots ● Line plots ● Bar ● Histogram ● Density plot
5.	**Mini Project**
Students need to perform a total of 15 to 20 experiments covering all the above content.	

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Assessment:
The Subject will carry a term work of 25 marks for all the experiment performed.
The Final Evaluation will be based on Practical Exam and Mini Project which will carry 50 marks.

COURSE NAME: Cryptography & System Security

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADMM31	Cryptography & System Security (Theory)	03	---	---	03	---	---	03
NADMM31	Cryptography & System Security (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADMM31	Cryptography & System Security (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADMM 3 1	Cryptography & System Security (Theory)	20	20	60	---	---	100

Prerequisite:	
Course Objectives:	
1.	To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
2.	To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3.	To explore the design issues and working principles of various authentication protocols, PKI standards and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
4.	To develop the ability to use existing cryptographic utilities to build programs for secure communication.

Course Outcomes: At the end of the course student should be	
1.	Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2.	Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3.	Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes
4.	Apply different digital signature algorithms to achieve authentication and design secure applications
5.	Understand network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6.	Analyze and apply system security concept to recognize malicious code.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADMM31	Cryptography & System Security (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADMM 3 1	Cryptography & System Security (Lab)	---	---	---	25	25	50

Prerequisite: The Lab experiments aims:	
Lab Objectives:	
1	To be able to apply the knowledge of symmetric cryptography to implement simple ciphers
2	To be able to analyze and implement public key algorithms like RSA and El Gamal
3	To analyze and evaluate performance of hashing algorithms
4	To explore the different network reconnaissance tools to gather information about networks.
Lab Outcomes:	
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers.
2	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal.
3	Implementation of Diffie Hellman Key exchange algorithm
4	For varying message sizes, test the integrity of the message using MD-5, SHA-1, and analyze the performance of the two protocols. Use crypt APIs.
5	Exploring wireless security tools like Kismet, Nets tumbler etc

Cryptography & System Security (Theory)

Module No	Unit No	Detailed Content	Hrs
1	**Introduction & Number Theory**		**10**
	1.1	Security Goals, Services, Mechanisms and attacks, Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography.	
	1.2	Modular Arithmetic and Number Theory: - Euclid's algorithm–Prime numbers-Fermat's and Euler's theorem- Testing for primality -The Chinese remainder theorem, Discrete logarithms.	
2	**Symmetric and Asymmetric key Cryptography and key Management**		**12**
	2.1	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC5 algorithm.	
	2.2	Public key cryptography: Principles of public key cryptosystems-The RSA algorithm,	
	2.3	Key management techniques: using symmetric and asymmetric algorithms and trusted third party. Diffie Hellman Key exchange algorithm.	
3	**Hashes, Message Digests and Digital Certificates**		**06**
	3.1	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, and CMAC.	
	3.2	Digital Certificate: X.509, PKI	
4	**Authentication Protocols & Digital signature schemes**		**08**
	4.1	User Authentication and Entity Authentication, One-way and mutual authentication schemes, Needham Schroeder Authentication protocol, Kerberos Authentication protocol.	
	4.2	Digital Signature Schemes – RSA,	
5	**Network Security and Applications**		**10**
	5.1	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing.	

	5.2	Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service	
	System Security		**06**
6	**6.1**	Software Vulnerabilities: Buffer Overflow, Format string, cross-site scripting, SQL injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	
Total			**52**

Textbooks:	
1	William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
2	Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
3	Bernard Menezes, "Cryptography & Network Security", Cengage Learning.
4	Network Security Bible, Eric Cole, Second Edition, Wiley.
Reference Books:	
1	Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2	Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.
3	
Access to software and virtual labs:	
	https://cse29-iiith.vlabs.ac.in/
Industry articles and case studies :	
	https://www.kroll.com/en/insights/publications/cyber/case-studies
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://www.kaggle.com/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks

3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc	10 marks

*For sr. no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Cryptography & System Security (Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.

Star (*) marked experiments are compulsory.

Sr/No	Name of the Experiment
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers.
2	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal.
3	Implementation of Diffie Hellman Key exchange algorithm
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyze the performance of the two protocols. Use crypt APIs.
5	Exploring wireless security tools like Kismet, NetStumbler etc.
6	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
7	Study of packet sniffer tools Wireshark, :- 1. Observer performance in promiscuous as well as non-promiscuous mode. 2. Show the packets can be traced based on different filters.
8	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc. .

9	Detect ARP spoofing using nmap and/or open source tool ARPWATCH and Wireshark
10	Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

COURSE NAME: Professional Communication &Ethics-II

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
AE31	Professional Communication & Ethics-II	02	---	---	02	---	---	02

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
AE31	Professional Communication & Ethics-II	02	---	---	02	--	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
AE3 1	Professional Communication & Ethics-II	---	---	---	50	--	50

Prerequisite: Professional Communication and Ethics-I	
Course Objectives:	
1	To discern and develop an effective style of writing important technical/business documents.
2	To investigate possible resources and plan a successful job campaign.
3	To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4	To develop creative and impactful presentation skills.
5	To analyze personal traits, interests, values, aptitudes and skills.
6	To understand the importance of integrity and develop a personal code of Ethics.
Course Outcomes:	
1	Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.

2	Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3	Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4	Deliver persuasive and professional presentations.
5	Develop creative thinking and interpersonal skills required for effective professional communication.
6	Apply codes of ethical conduct, personal integrity and norms of organizational behavior.

Module		**Topics**	**Hours**
1	**ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)**		**6**
	1.1	**Definition, Purpose & Types of Proposals** ● Solicited & Unsolicited Proposals ● Types (Short and Long proposals)	
	1.2	**Parts of a Proposal** ● Elements ● Scope and Limitations ● Conclusion	
	1.3	**Objectives of Report Writing** ● Information ● Decision Making ● Analysis ● Recommendations	
	1.4	**Parts of a Long Formal Report:** ● Prefatory Parts (Front Matter) ● Report Proper (Main Body) ● Appended Parts (Back Matter)	
	1.5	**Language and Style of Reports** ● Tense, Person & Voice of Reports ● Numbering Style of Chapters, Sections, Figures, Tables ● Referencing Styles in APA & MLA Format ● Proofreading through Plagiarism Checkers	

	1.6	**Technical Paper Writing:** ● Parts of a Technical Paper ● Language and Formatting ● Writing an abstract ● Referencing in IEEE Format	

	1.7	**Presenting data-figures, diagrams and labeling** ● Graphic Organizers for Summaries ● Radial Diagrams like Mind Maps ● Flow Charts ● Cyclic Diagrams ● Linear Diagrams like Timelines ● Pyramids ● Venn Diagrams	
2	**EMPLOYMENT SKILLS**		
	2.1	**Cover Letter & Resume** ● Parts and Content of a Cover Letter ● Difference between Bio-data, Resume & CV ● Essential Parts of a Resume ● Types of Resume (Chronological, Functional & Combination)	**6**
	2.2	**Statement of Purpose** ● Importance of SOP ● Tips for Writing an Effective SOP	
	2.3	**Group Discussions** ● Purpose of a GD ● Parameters of Evaluating a GD ● Types of GDs (Normal, Case-based & Role Plays) ● GD Etiquettes	
	2.4	**Personal Interviews** ● Planning and Preparation ● Types of Questions ● Types of Interviews (Structured, Stress, Behavioral, Problem ● Solving & Case-based) ● Modes of Interviews: Face-to-face (One-to one and Panel) ● Telephonic, Virtual	
3	**BUSINESS MEETINGS**		**2**

	3.1	• **Documentation** • Notice • Agenda • Minutes	
	3.2	• **Conducting Business Meetings:** • Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette	
4	**TECHNICAL/ BUSINESS PRESENTATIONS**		**2**
	4.1	• **Effective Presentation Strategies** • Defining Purpose • Analyzing Audience, Location and Event • Gathering, Selecting And Arranging Material • Structuring a Presentation • Making Effective Slides • Types of Presentations Aids • Closing a Presentation • Platform skills	
	4.2	**Group Presentations** • Sharing Responsibility in a Team • Building contents and visuals together • Transition Phases	
5	**INTERPERSONAL SKILLS**		**5**
	5.1	**Interpersonal Skills** • Emotional Intelligence • Leadership & Motivation • Conflict Management & Negotiation • Time Management • Assertiveness • Decision Making	
6.	**CORPORATE ETHICS**		
	6.1	**6.1 Intellectual Property Rights** • Copyrights • Trademarks • Patents • Industrial Designs	**2**

	6.2	**Case Studies** ● Cases related to Business/ Corporate Ethics	
7	**PROFESSIONAL WRITING SKILLS**		
	7.1	**Developing Professional Writing Skills** ● Effective introduction with emphasis on general statement, opposing statement and thesis statement ● Critical response to a text with special reference to purpose, evaluation of the content, theme and style of a text ● Organization of ideas, sentence construction and word choice, grammar and usage ● Explanation and support of ideas (special reference to writing paragraphs opening statement, body, closing statement, linkers)	**3**
	7.2	**Creative Writing** ● Narrative essays ● Content writing ● Blog	
		Total	**26**

Reference Books:

1	Lesiker and Petit (1997), "Report Writing for Business", McGraw-Hill Education 10^{th} edition
2	Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
3	Bovée, C. L., & Thill, J. V. (2017). *Business communication today*, 14^{th} Edition, NJ: Pearson.
4	Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational Behaviour*. Harlow, England: Pearson.
5	Fred Luthans. (2010). *Organizational Behavior* , McGraw Hill Education, 12^{th} edition
6	B N Ghosh(2017), *Managing Soft Skills for Personality Development*, Tata McGraw Hill Education.

7	R. C. Sharma, Krishna Mohan, Virendra Singh Nirban (2020). *Business Correspondence and Report Writing* , 6th Edition, McGraw Hill
8.	Julie-Ann Amos (2004). *Handling Tough Job Interviews* Jaico Publishing House
References: Web Links	

	http://networketiquette.net/ https://public.wsu.edu/~brians/errors/ http://users3.ev1.net/~pamthompson/body_language. h tm http://www.albion.com/netiquette/corerules.html http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/1535_questionanswer/pa ge15.shtml http://www.colostate.edu/Depts/Speech/rccs/theory44.html http://www.dailywritingtips.com

Term Work: Term Work will be of 50 marks as given below

Sr No	Headings	Marks
A	Assignments	10 Marks
B	Mini Project with Presentation	10 Marks
C	Media Studies	10 Marks
D	Book Report and Presentation	10 Marks
E	Group Discussion	10 Marks
	Total	50 Marks

A) Assignments: List of assignments are as given below. The assignments have to be discussed in the group and approved by the faculty. All assignments will be submitted by students individually. (10 Marks):-

Sr No	List of Assignments
1.	Resume, Cover Letter and SOP
2.	Summarizing data figures into paragraphs (Module 1.7)
3.	Notice, Agenda and Minutes of Meeting
4.	Two case studies on Business Ethics
5.	Assignment on (Teamwork, Leadership, Decision Making and Problem Solving)

B) Report on Final presentation: A detail typed report to be prepared with a minimum of 25 pages and maximum 30 pages. The format of the report to be discussed and approved by faculty

C) It is mandatory for all students to participate in the Final Group Discussion.

COURSE NAME: Finance Management

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
EM31	Finance Management	02	---	---	02	---	---	02

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
EM31	Finance Management	02	--	---	---	--	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
EM3 1	Finance Management	20	---	30	---	--	50

Course Objectives:	
1	To know about the Indian financial system, instruments and market.
2	To understand the relationship between risk, return and time value of Money.
3	To understand the financial statements and ratio analysis.
4	To understand personal taxation.
Course Outcomes: Student will be able	
1	To explain Indian financial system, instrument and market.
2	To determine risk, return and time value of Money with respect to financial decisions.
3	To decide investment decisions for projects with the help of financial ratios.
4	To determine components involved in taxation

Finance Management (Theory)

Module	Chapter	Content	Hrs.
1		**Indian Financial System**	8
	1.1	Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds- Debentures, Certificates of Deposit, Treasury Bills, Trade credit.	
	1.2	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	
	1.3	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions: Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2		**Financial Risk and Returns**	6
	2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio	

	2.2	Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	
	2.3	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3		**Corporate Finance**	6
	3.1	Overview of Financial Statements: Balance Sheet, Profit and Loss Account, and Cash Flow Statement.	
	3.2	Financial Ratio Analysis: Purpose of Financial Ratio Analysis. Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4		**Introduction to Taxation**	6
	4.1	Introduction and Objectives, Assessment Year, Previous Year, Person	
	4.2	Assessee, Assessment, Income	
	4.3	Gross Total Income, Total Income, Scheme of charging income tax	
		Total	**26**

Reference Books:	
1	Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2	Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3	Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4	Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Semester IV

Course Code	Course Name	Teaching Staff (Contact Hours)			Credit Assigned		
		Theory	Pract	tut	Theory	Pract.	Total.
NADPC41	Computer Network and Operating Systems	2	-		2	-	2
NADPC42	Analysis of Algorithms	3	2		3	1	4
NADPC43	Artificial Intelligence	3	2		3	1	4
NADMM 4 1	Ethical Hacking and Digital Forensic	3	2		3	1	4
NOE4XX	Open elective I	3	1		3	1	4
NADVS41	Mobile App Development		2			2	2
NADFP41	CEP Mobile App		2			2	2
NADEM41	Innovation and Entrepreneurship		2			2	2
Total		14	13		14	10	24

Examination Scheme								
Course Code	Course Name	Theory				Ter m Work	Pract	Total
		Internal Assessment		End Sem Exam	Exam Duration (hrs.)			
		MT	CA					
NADPC41	Computer Network and Operating Systems	20	20	60	2	-	--	100
NADPC42	Analysis of Algorithms	20	20	60	2	25	25	150
NADPC43	Artificial Intelligence	20	20	60	2	25	25	150
NADMM41	Ethical Hacking and Digital Forensic	20	20	60	2	25	25	150
NOE4XX	Open elective I	20	20	60	2	25		125
NADVS41	Mobile App Development	--	--	--	--	25		25
NADFP41	CEP Mobile App	--	--	--	--	25		25
NADEM41	Innovation and Entrepreneurship					25		25
Total		**100**	**100**	**300**	**--**	**175**	**75**	**750**

Open Elective -I		
Sr.No.	**Course Code**	**Course Name**
1	**NOE406**	**Green Technologies and Practices**
2	**NOE407**	**Futuristic Power systems**
3	**NOE408**	**Sensors and actuators**
4	**NOE409**	**Fundamentals of Additive manufacturing technologies**
5	**NOE410**	**Reliability Engineering**
6	**NOE411**	**Disaster Management**

Semester IV

COURSE NAME: Computer Networks and Operating Systems

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC41	Computer Networks and Operating Systems (Theory)	03	---	---	03	---	---	03

Computer Networks and Operating Systems (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC41	Computer Networks and Operating Systems (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC41	Computer Networks and Operating Systems (Theory)	20	20	60	---	---	100

Course Objectives:	
1	To introduce basic concepts and functions of operating systems.
2	To understand the concept of process, thread and resource management.
3	To understand the concepts of process synchronization and deadlock.
4	To understand various Memory management techniques.
5	To introduce concepts of computer networks and working of various layers of OSI.
6	To understand various transport layer and application layer protocols
Course Outcome:	
1	Understand the objectives, functions and structure of OS
2	Analyze the concept of process management and evaluate performance of process scheduling algorithms.
3	Understand and apply the concepts of synchronization and deadlocks
4	Evaluate performance of Memory allocation

5	Explain related concepts and functions of Physical, Data Link Layer and Network Layer.
6	Explain related concepts and functions of Transport Layer and Application Layer.

Module		Detailed Content	Hours
1	**Operating system Overview**		2
	1.1	Introduction, Objectives, Functions and Evolution of Operating System	
	1.2	Operating system structures: Layered, Monolithic and Microkernel	
	1.3	Linux Kernel, Shell and System Calls	
2	**Process and Process Scheduling**		5
	2.1	Concept of a Process, Process States, Process Description, Process Control Block.	
	2.2	Uniprocessor Scheduling-Types: Preemptive and Non-preemptive scheduling algorithms (FCFS, SJF, Priority, RR)	
	2.3	Threads: Definition and Types, Concept of Multithreading	
3	**Process Synchronization and Deadlocks**		5
	3.1	Principles of Concurrency, Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem.	
	3.2	Principles of Deadlock: Conditions and Resource, Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery, Dining Philosophers Problem.	
4	**Memory Management**		4
	4.1	Memory Management Requirements, Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Basics of Paging and Segmentation.	
5	**Introduction Network Architecture**		5
	5.1	Introduction of Networks, Reference models: Layer details of OSI, TCP/IP models. Difference between OSI and TCP/IP.	
	5.2	Data Link Layer: Medium Access Control Sublayer Channel Allocation problem, Multiple access Protocol (CSMA/CD)	
	5.3	Network Layer: IPv4 Addressing (classful and classless), Subnetting, IPv4 Protocol, Network Address Translation (NAT), IPv6 addressing, IPv4 vs IPv6 addressing	
6		**Interface To Networks**	5
	6.1	Transport Layer: Service primitives, Sockets, Connection management (Handshake), UDP, TCP, TCP state transition.	

	6.1	Application Layer: HTTP, SMTP, DHCP, DNS.	
Total			**26**

Textbooks:	
1	A.S. Tanenbaum, Computer Networks, Pearson Education
2	B.A. Forouzan, Data Communications and Networking, McGraw Hill Education
3	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
4	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0
References:	
1	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rdEdition
2	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rdEdition.
3	Maurice J. Bach, "Design of UNIX Operating System", PHI
4	Sumitabha Das, "UNIX: Concepts and Applications", McGraw Hill, 4thEdition
5	James F. Kurose, Keith W. Ross, Computer Networking : A Top-Down Approach Featuring the Internet, Pearson Education
6	Behrouz A. Forouzan, Firouz Mosharraf, Computer Networks : A Top down Approach, McGraw Hill Education

Access to software and virtual labs:	
1	Ubuntu / Kali Linux.
2	NS2/NS3 Simulator / CISCO
3	http://vlabs.iitkgp.ac.in/ant/1/ https://hansalshah007.github.io/osvirtuallab/diskscheduling_index.html http://ebootathon.com/labs/beta/csit/OS/exp2/procedure.html
Industry articles and case studies :	
1	A Case Study on Computer Networking and Its Network Configuration (https://www.wjrr.org/download_data/WJRR1206011.pdf)
2	Operating System Case Study Linux (http://www.eie.polyu.edu.hk/~em/it0506pdf/2%20Linux.pdf)
3	A Comparative Study of Operating Systems: Case of Windows, UNIX, Linux, Mac, Android and iOS (https://www.ijcaonline.org/archives/volume176/number39/adekotujo-2020-ijca- 920494.pdf)
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	CISCO (Artificial Intelligence in Networking) https://www.cisco.com/c/en/us/solutions/artificial-intelligence/artificial-intelligence-machine-learning-in- networking.html

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.
Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc.	10 marks

*For sr. no. 1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

COURSE NAME: Analysis of Algorithms

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC42	Analysis of Algorithms (Theory)	03	---	---	03	---	---	03
NADPC42	Analysis of Algorithms (Lab)	---	02	---	---	01	---	01

Analysis of Algorithms (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC42	Analysis of Algorithms (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC42	Analysis of Algorithms (Theory)	20	20	60	---	---	100

Prerequisite: Data structure concepts, Discrete structures	
Course Objectives:	
1	To provide mathematical approaches for Analysis of Algorithms
2	To understand and solve problems using various algorithmic approaches
3	To analyze algorithms using various methods
Course Outcomes: At the end of the course learner will be able to	
1	Analyze the running time and space complexity of algorithms.
2	Describe, apply and analyze the complexity of divide and conquer strategy.
3	Describe, apply and analyze the complexity of greedy strategy.
4	Describe, apply and analyze the complexity of dynamic programming strategy.
5	Explain and apply backtracking, branch and bound.
6	Explain and apply string matching techniques.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADPC42	Analysis of Algorithms (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC42	Analysis of Algorithms (Lab)	---	---	---	25	25	50

Prerequisite: Basic knowledge of programming and data structure	
Lab Objectives:	
1	To introduce the methods of designing and analyzing algorithms
2	Design and implement efficient algorithms for a specified application
3	Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
4	Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.
Lab Outcomes: At the end of the course, the students will be able to	
1	Implement the algorithms using different approaches.
2	Analyze the complexities of various algorithms.
3	Compare the complexity of the algorithms for specific problem.

Analysis of Algorithms (Theory)

Module		Detailed Contents	Hours
1		**Introduction**	7
	1.1	Performance analysis, space and time complexity, Growth of function, Amortized Complexity, Asymptotic Notation. Efficiency of algorithm, best case and worst case analysis.	
	1.2	Recurrences: Homogeneous, Non-Homogeneous, Logarithmic, The substitution method, Recursion tree method, Masters' Method	
	1.3	Class of P and NP, NP Complete and NP hard problem, NP-Completeness Example of NP / Hard complete problem introduction : Travelling Salesman, CLIQUE, Knapsack Problem and Hamiltonian Cycle	
2		**Analysis of sorting and searching algorithms**	5
	2.1	Analysis of sorting algorithms: Insertion ,Selection and Bubble sort divide and conquer algorithm : Analysis of merge and quick sort and binary search Analysis of hash search.	
	2.2	General method, Finding minimum and maximum, Strassen's Matrix Multiplication,	
3		**Greedy Method Approach**	6
	3.1	General Method, Single source shortest path: Dijkstra Algorithm Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms.	
4		**Dynamic Programming Approach**	8
	4.1	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm, All pair shortest path: Floyd Warshall Algorithm, Approximate solution for : 0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence, Optimal Binary Search Tree using dynamic programming.	
5		**Backtracking and Branch and Bound**	6
	5.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph colouring, Hamiltonian Cycle	
	5.2	Branch and Bound: Travelling Salesperson Problem, N Puzzle problem	
6		**Advance Algorithms for Data Science**	7
	6.1		
	6.2	Counting knapsack Problem, Blooms Filter, constraint stratification problem: Sudoku/ crypt arithmetic's.	
	6.3	Applications: Plagiarism detection and spam filter.	
Total			**39**

Textbooks:	
1	T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.

2	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.

References:	
1	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.
2	S. K. Basu, "Design Methods and Analysis of Algorithm", PHI

Access to software and virtual labs:

1	https://nptel.ac.in/courses/106106131

Industry articles and case studies :

1	https://www.geeksforgeeks.org/0-1-knapsack-problem-dp-10/

Internal Assessment: Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.
Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:*For sr. no. 1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc	10 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Analysis of Algorithms Lab

Description		
Implementation can be in any language.		
Suggested Practical List:		
Sr No		**Suggested Experiment List**
1		Introduction
	1.1	Selection sort, Insertion sort
2		Divide and Conquer Approach
	2.1	Finding Minimum and Maximum, Merge sort, Quick sort, Binary search
3		Greedy Method Approach
	3.1	Single source shortest path- Dijkstra Fractional Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and Prim's algorithm
4		Dynamic Programming Approach
	4.1	Single source shortest path- Bellman Ford All pair shortest path- Floyd Warshall 0/1 knapsack Travelling salesperson problem Longest common subsequence
5		Backtracking and Branch and bound
	5.1	N-queen problem Sum of subsets Graph colouring 15 Puzzle Problem
6		Advance data science algorithm
	1.2	Bloom filter, Sudoku/ Crypt arithmetic's and Distance Measure : Euclidean distance, Jaccard distance

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Evaluation Exam: Practical Exam based on the entire syllabus

COURSE NAME: Artificial Intelligence

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC43	Artificial Intelligence (Theory)	03	---	---	03	---	---	03
NADPC43	Artificial Intelligence (Lab)	---	02	---	---	01	---	01

Artificial Intelligence Theory

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADPC43	Artificial Intelligence (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC43	Artificial Intelligence (Theory)	20	20	60	---	---	100

Course Prerequisite:	
Course Objectives:	
1	To gain perspective of AI and its foundations.
2	To study different agent architectures and properties of the environment
3	To understand the basic principles of AI towards problem solving, inference, perception, Knowledge representation, and learning.
4	To investigate probabilistic reasoning under uncertain and incomplete information.
5	To explore the current scope, potential, limitations, and implications of intelligent systems
Course Outcomes: After successful completion of the course students will be able to:	
1	Identify the characteristics of the environment and differentiate between various agent architectures.
2	Apply the most suitable search strategy to design problem solving agents.
3	Represent a natural language description of statements in logic and apply the inference rules to design Knowledge Based agents.
4	Apply a probabilistic model for reasoning under uncertainty.
5	Comprehend various learning techniques.
6	Describe the various building blocks of an expert system for a given real word problem.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADPC43	Artificial Intelligence (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADPC43	Artificial Intelligence (Lab)	---	---	---	25	25	50

Lab Prerequisite:	
Lab Objectives:	
1	To design suitable Agent Architecture for a given real world AI problem
2	To implement knowledge representation and reasoning in AI language
3	To design a Problem-Solving Agent
4	To incorporate reasoning under uncertainty for an AI agent
Lab Outcomes: After successful completion of the course students will be able to:	
1	Identify suitable Agent Architecture for a given real world AI problem
2	Implement simple programs using Prolog
3	Implement various search techniques for a Problem-Solving Agent
4	Represent natural language description as statements in Logic and apply inference rules to it
5	Construct a Bayesian Belief Network for a given problem and draw probabilistic inferences from it

Artificial Intelligence (Theory)

Module		Detailed Content	Hours
1		**Introduction to Artificial Intelligence**	3
	1.1	AI, The Foundations of Artificial Intelligence ,The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI	
	1.2	Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents	
2		**Problem-solving**	4
	2.1	Solving Problems by Searching : Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.	
	2.2	Search in Complex Environments: Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with Nondeterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments .	
	2.3	Adversarial Search and Games: Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms.	
3		**Knowledge, reasoning, and planning**	12
	3.1	Logical Agents: Knowledge-Based Agents, Overview of Propositional Logic.	
	3.2	First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Forward Reasoning, Backward Reasoning, Resolution in First Order Logic.	
	3.3	Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Objects and Model Logic, Reasoning Systems for Categories, Reasoning with Default Information.	
	3.4	Automated Planning: Definition of Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning.	
4		**Uncertain knowledge and reasoning**	
	4.1	Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, Naive Bayes Models.	
	4.2	Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Exact Inference in Bayesian Networks.	
	4.3	Probabilistic Reasoning over Time: Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models.	
5		**Natural Language Processing**	
	5.1	Introduction: Origin & History of NLP, The need of NLP, Generic NLP System, Levels of NLP, Knowledge in Language Processing,	

		Ambiguity in Natural Language, Challenges of NLP, Applications of NLP.	
	5.2	Applications of NLP, Overview of Machine Learning and Deep Learning	
6		**Modern AI Applications**	
	6.1	Generative AI: What is Generative AI?, Generative AI vs. Traditional AI, How Does Generative AI Work?, Types of Generative AI, Real-world Uses for Generative AI.	
	6.2	Reinforcement Learning: Introduction, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Early History of Reinforcement Learning .	
	6.3	Ethics in AI : What are Ethics?, Types of Ethics, Ethical issues in Artificial Intelligence.	

Textbooks:	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach —Second Edition" Pearson Education.
2	Elaine Rich and Kevin Knight —Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3	George F Luger —Artificial Intelligence‖ Low Price Edition, Pearson Education., Fourth edition.
References:	
1	Ivan Bratko —PROLOG Programming for Artificial Intelligence‖, Pearson Education, Third Edition.
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3	Saroj Kaushik —Artificial Intelligence‖, Cengage Learning.
4	Davis E. Goldberg, —Genetic Algorithms: Search, Optimization and Machine Learning‖, Addison Wesley, N.Y., 1989.
5	Patrick Henry Winston, —Artificial Intelligence‖, Addison-Wesley, Third Edition.
6	N. P. Padhy, —Artificial Intelligence and Intelligent Systems‖, Oxford University Press.

Access to software and virtual labs:	
	https://www.swi-prolog.org/download/stable
Industry articles and case studies :	
	https://www.digitaleurope.org/news/case-studies-on-artificial-intelligence/
	https://www.linkedin.com/pulse/rise-artificial-intelligence-comprehensive-case-f1ytc/
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	https://www.kaggle.com/

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc	10 marks

*For sr. no. 1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
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3	All questions have equal weightage and carry 20 marks each
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Internal Assessment:
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Sr. No.	Rubrics	Marks
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4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc	10 marks

*For sr. no. 1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

Artificial Intelligence (Lab)

Suggested Experiments:	
Sr. No.	**Name of the Experiment**
1	Provide the PEAS description and TASK Environment for a given AI problem , Identify suitable Agent Architecture for the problem
2	Formulate the Problem Statement for the AI System
3	Implement any one Uninformed Search (DFS/BFS) for 4 queen/8 queen/8 puzzle or any state space
4	Implement any one of the Informed search techniques E.g. A-Star algorithm for 8 puzzle problem/ TSP
5	Implement any one of the Local Search techniques. E.g. Hill Climbing, Simulated Annealing, Genetic algorithm for 4 queen
6	Prove the goal sentence from the following set of statements in FOPL by applying forward, backward and resolution inference algorithms. wampus/ resolution graph
7	Prove the goal sentence from the following set of statements in FOPL by applying forward, backward and resolution inference algorithms. wampus/ resolution graph
8	Case study of any existing successful AI system

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.

2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Evaluation Exam	
1	Practical Exam based on the entire syllabus

COURSE NAME: Ethical Hacking and Digital Forensic

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADMM41	Ethical Hacking and Digital Forensic (Theory)	03	---	---	03	---	---	03
NADMM41	Ethical Hacking and Digital Forensic (Lab)	---	02	---	---	01	---	01

Ethical Hacking and Digital Forensic (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADMM41	Ethical Hacking and Digital Forensic (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADMM41	Ethical Hacking and Digital Forensic (Theory)	20	20	60	---	---	100

Course Prerequisite:

Course Objectives:

1	Understand the steps and tools of ethical hacking.
2	Learn web security threats and defences.
3	Explore hardware security techniques.
4	Grasp the principles and lifecycle of digital forensics.
5	Master forensic tools and report writing techniques.

Course Outcomes:

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

1	Conduct ethical hacking and mitigate security vulnerabilities.
2	Identify and defend against web attacks.
3	Implement and manage hardware security measures.
4	Perform digital forensic investigations.
5	Use forensic tools for analysis and create structured reports.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADMM 4 1	Ethical Hacking and Digital Forensic (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADMM 4 1	Ethical Hacking and Digital Forensic (Lab)	---	---	---	25	25	50

Prerequisite:	
Lab Objectives:	
1.	Learn ethics and methodologies in ethical hacking.
2.	Identify and secure various network devices.
3.	Explore attack types and develop defence strategies.
4.	Understand computer forensics and forensic tools.
5.	Extract and analyze data from RAM.
6.	Acquire and verify digital images using forensic tools.

Lab Outcomes: After completing this lab, students will learn

1.	The Ethical Aspect of Ethical Hacking and e Ethical Hacking Methodology.
2.	The network security issues in different types of network devices.
3.	Various attack scenarios and their remedies.
4.	Computer Forensics and different tools used for forensic investigation.
5.	Extract critical information from volatile memory using forensic tools.
6.	Image acquisition techniques using different tools.

Ethical Hacking and Digital Forensic (Theory)

Module	Detailed Content	Hours
1	**Introduction to Ethical Hacking**	**6**
	Steps of ethical hacking, Demonstration of Routing Protocols using Cisco Packet Tracer. Information gathering, reconnaissance, scanning, vulnerability assessment, Open VAS, Nessus, System hacking: Password cracking, penetration testing, Social engineering attacks, Malware threats, hacking wireless networks (WEP, WPA, WPA- 2),	
2	**Introduction to web security and Attacks**	**6**
	OWASP, Web Security Considerations, User Authentication, Cookies, SSL, HTTPS, Privacy on Web, Account Harvesting, Web Bugs, Sniffing, ARP poisoning, Denial of service attacks, Hacking Web Applications, Clickjacking, Cross-Site scripting and Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, SSO, Vulnerability assessments, SQL injection, Web Service Security, OAuth 2.0, Demonstration of hacking tools on Kali Linux such as SQLMap, HTTrack, hping, burp suite,Wireshark etc.	
3	**Elements of Hardware Security**	**6**
	Side channel attacks, physical unclonable functions, Firewalls, Backdoors and trapdoors, Demonstration of Side Channel Attacks on RSA, IDS and Honeypots. Various attack scenarios and their remedies. Demonstration of attacks using DVWA.	
4	**Introduction to Digital Forensics and lifecycle**	
	Principles of Digital Forensic. Introduction to Digital Evidences: Challenging Aspects of Digital Evidence, Scientific Evidence, Presenting Digital Evidence. Digital Investigation Process Models: Physical Model, Staircase Model, Evidence Flow Model.	**6**
5	**Computer Forensics**	
	OS File Systems Review: Windows Systems- FAT32 and NTFS, UNIX File Systems, MAC File Systems Windows OS Artifacts: Registry, Event Logs Memory Forensics : RAM Forensic Analysis, Creating a RAM Memory Image, Volatility framework, Extracting Information Computer Forensic Tools: Need of Computer Forensic Tools, Types of Computer Forensic Tools, Tasks performed by Computer Forensic Tools	**6**
6	**Forensic Tools and Report Writing**	
	Forensic Image Acquisition in Linux : Acquire an Image with dd Tools, Acquire an Image with Forensic Formats, Preserve Digital Evidence with Cryptography, Image Acquisition over a Network, Acquire Removable Media, Forensic Investigation Report Writing: Reporting Standards, Report Style and Formatting, Report Content and Organization.	**6**
Total		**36**

Textbooks:	
1	1. Computer Security Principles and Practice --William Stallings, Seventh Edition, Pearson Education, 2017
2	2. Security in Computing -- Charles P. Pfleeger, Fifth Edition, Pearson Education, 2015
3	3. Network Security and Cryptography -- Bernard Menezes, Cengage Learning, 2014
4	4. Network Security Bible -- Eric Cole, Second Edition, Wiley, 2011
5	5. Mark Stamp's Information Security: Principles and Practice --Deven Shah, Wiley, 2009
Reference Books:	
1	1. UNIX Network Programming –Richard Steven,Addison Wesley, 2003
2	2. Cryptography and Network Security -- Atul Kahate, 3rd edition, Tata Mc Graw Hill, 2013
3	3. TCP/IP Protocol Suite -- B. A. Forouzan, 4th Edition, Tata Mc Graw Hill, 2017
	4. Applied Cryptography, Protocols Algorithms and Source Code in C Bruce Schneier, 2nd Edition / 20th Anniversary Edition, Wiley, 2015
Access to software and virtual labs:	
	https://www.pearsonitcertification.com/articles/article.aspx?p=462199&seqNum=2
	https://flylib.com/books/en/3.394.1.51/1/
	https://www.sleuthkit.org/autopsy/
Industry articles and case studies :	
	https://www.amazon.in/Art-Memory-Forensics-Detecting-Malware/dp/1118825098
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
	http://md5deep.sourceforge.net/md5deep.html
	https://tools.kali.org/
	https://kalilinuxtutorials.com/
	https://kalilinuxtutorials.com/
	https://accessdata.com/product-download/ftk-imager-version-4-3-0

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approximately 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered based on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No.	Rubrics	Marks
1	*Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Content beyond syllabus presentation	10 marks
3	Creating Proof of concept	10 marks
4	Mini Project / Extra Experiments/ Virtual Lab / Competitive programming-based event / Group Discussion	10 marks
5	Multiple Choice Questions (Quiz)	5 marks
6	GATE Based Assignment/Tutorials etc	10 marks

*For sr. no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Ethical Hacking and Digital Forensic (Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	Study of computer forensics and different tools used for forensic investigation.
2	Live Forensics case investigation Autopsy.
3	Recover deleted files using forensics tools.
4	Find the last connected USB on your system (USB forensics).
5	View the last activity on your PC.
6	Extracting browser artifacts.

7	Collect Email evidence on the victim PC.
8	Study the steps for hiding and extract any text file behind an image file/audio file using command prompt.
9	Extract Exchangeable image file format(EXIF) Data from image files using Exifreader software.
10	Comparison of two files for forensics investigation by Compare IT Software.
11	Study various tools to collect information passively. for example, WHOIS, Social Media, Shodan, Google Hacking, DNS Querying, The Harvester Recon-ng, Maltego
12	Explore tools that can be used in active reconnaissance(Nmap)
13	Use the Nikto tool to scan a Web application and find vulnerabilities.
14	Explore tools for session hijacking and password cracking.
15.	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome).

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think different.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Evaluation Exam	
1	Practical Exam based on the entire syllabus

COURSE NAME: Mobile App Development

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADVS41	Mobile App Development	--	02	---	--	02	---	02

Mobile App Development

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NADVS41	Mobile App Development	---	02	---	---	02	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADVS 4 1	Mobile App Development	---	---	---	25	--	25

Course Objectives:	
1	Learn the basics of Dart Programming Language.
2	Learn the basics of the Flutter framework.
3	Develop the App UI by incorporating widgets, layouts, gestures and animation
4	Learn the advanced concepts of the Flutter framework.
5	Develop the App UI by incorporating widgets, layouts, gestures and animation
6	Create a production ready Flutter App by including files and firebase backend service.
Course Outcomes: **At the end of the course, students will be able to —-**	
1	Use Dart Programming Language for mobile application development.
2	Understand cross platform mobile application development using Flutter framework
3	Design and Develop interactive Flutter App by using widgets, layouts, gestures and animation
4	Understand cross platform mobile application development using Flutter framework
5	Design and Develop interactive Flutter App by using widgets, layouts, gestures and animation
6	Analyze and Build production ready Flutter App by incorporating backend services and deploying on Android / iOS

Module	Detailed Content	
1	Basics of Dart Programming	
	1.1	Types and Casting in Dart, Null-aware Operators in Dart, Dart Programming - Loops, Collections in Dart, Dart Sets, Calsses and object, Classes and enums, Dart Exception Handling With Examples, Dart Future, async and await,
2	Basics of Flutter Programming	
	2.1	Introduction of Flutter, Understanding Widget, Lifecycle Events, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App.
3	Developing Flutter UI: Widgets, Layouts, Gestures	
	3.1	USING COMMON WIDGETS: SafeArea, Appbar, Column, Row, Container, Buttons, Text, Richtext, Form, Images and Icon.
	3.2	BUILDING LAYOUTS: high level view of layouts, Creating the layout, Types of layout widgets
	3.3	APPLYING GESTURES: Setting Up GestureDetector, Implementing the Draggable and Drop Target Widgets, Using the GestureDetector for Moving and Scaling
4	Animation and Navigation	
	4.1	ADDING ANIMATION TO AN APP: Using Animated Container, Using Animated CrossFade, Using Animated Opacity, Using Animation Controller, Using Staggered Animation
	4.2	CREATING AN APP'S NAVIGATION: Using the Navigator, Using the Named Navigator Route, Using the Bottom NavigationBar, Using the TabBar and TabBarView
5	Working with files and Firebase	
	5.1	Including libraries in Flutter app, including a file with the app, Reading/Writing to files, Using JSON.
	5.2	Adding the Firebase and Firestore Backend, Configuring the Firebase Project, Adding a Cloud Firestore
6	Creating Production Ready Apps	
	6.1	Testing and Deploying of Flutter Application: Widget testing, Deploying Flutter Apps on Android / iOS
Textbooks:		
1	Beginning App Development with Flutter, Rap Payne. Apress	
2	Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020.	
3	Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019.	
References:		
1	Flutter in Action by Eric Windmill, MANING, 2019	
2	Google Flutter Mobile Development Quick Start Guide. Packt, 2019	

Suggested Experiments:
Student in group of 4 (max), will perform 5 Assignment / Activity / Experiment based on the above syllabus

COURSE NAME:

CEP: App Development

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADFP41	CEP App Development	—	---	02	--	--	02	02

CEP: App Development

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADFP41	CEP App Development	—	---	02	—	--	02	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADFP 4 1	CEP App Development	--	—	--	25	---	25

Course Prerequisite:	
Course Objectives:	
1	To engage students in field visits, with an objective of identifying and formulating problem statements based on observations during visits in industry, Government/ Non- governmental organizations as well as the broader societal context. **(with reference to Scheme A).** Students engage in experiential learning through developing industry or organizational case studies, analysing real-world processes, and proposing innovative enhancements based on critical observations and analysis **(with reference to Scheme B).** These approach bridges academic theory with practical application, fostering deeper understanding and actionable insights for students.
2	To apply theoretical knowledge and foster creativity & innovation in addressing practical real-world problems.
3	To enhance student's analytical, design & problem-solving skills, increase student's Critical thinking ability to engage them in lifelong learning.
4	To develop teamwork skills to achieve project goals and deadlines.
Course Outcomes:	

At the end of the course the student will gain the capability to:	
1	To identify and resolve the issues with industry & society at large, to provide practical solutions for real-world challenges.
2	To implement novel and efficient solutions fostering interdisciplinary collaboration in addressing challenges
3	To apply appropriate techniques, resources and modern engineering tools, to improve the analytical, design, and problem-solving skills to abreast with the booming technologies.
4	Cultivation of effective teamwork abilities, facilitating collaboration and synergy among individuals to achieve common goals.

Schemes: In field project, students are expected perform any one the following activities:

A) To identify and address real-world challenges encountered in industry or society, bridging theory with practical application. By immersing students in real life scenarios, the course facilitates a comprehensive understanding of operations in industry and manufacturing processes. In addition to this, it fosters hands- on experiences, allowing students to apply classroom knowledge and refine essential professional skills. The course also provides networking opportunities with industry experts. Through engaging projects, students synthesize concepts from their academic coursework, empowering them to explore, design, implement, and present solutions to engineering problems.

B) Students will engage in experiential learning to connect academic knowledge with real- world contexts through the development of case studies focused on various sectors such as industry, government, or non- governmental organizations. These case studies involve observing and analysing processes, operations, or systems during visits or surveys. Through critical thinking, students can propose potential enhancements or innovations to improve existing processes, operations, or systems.

Module		Content	Hrs
1		**Project Planning and Proposal Development:** Defining project objectives and scope, conducting literature review and background research, developing project proposal and timeline, Identifying required resources and constraints.	6
2		**Design and Implementation:** Selecting appropriate methodologies and Simulation tools, designing system architecture and components, Prototyping and testing system functionalities, iterative development and troubleshooting.	6
3		**Documentation and Reporting:** Maintaining detailed project documentation, Recording progress, challenges and solutions, Writing technical reports and documentation, Creating presentations for project updates and final presentation.	6
4		**Project Presentation and Evaluation:** Delivering oral presentations of project progress, Demonstrating project outcomes and achievements, responding to questions and feedback from peers and instructors, reflecting on lessons learned and areas for improvement.	6
		Total	**24**

Term Work:

Guideline to maintain quality of field project are as follows :

Students can achieve this by making proper selection of projects based on field visit/ study of archives from the library. Encourage the use of open source softwares for simulation, design and documentation of the projects.

Project Topic selection and approval :-

1. The group may be of maximum **FOUR (04)** students.
2. The students are required to visit industry/community/library to identify the problem statement and be able to provide the proof of interaction.
3. Topic selection and approval by **2 Expert** faculty from department at the start of semester.
4. **Log Book** to be prepared for each group to record the work per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signatures in it per week. The log book can be managed **online** with proper authentication method using google sheets/forms or open source project management software.
5. **Suggested steps for project selection and implementation as per**

scheme A.

a. After identification of a problem statement during field visit, it is mandatory to design (analog+digital) sensor/IC based circuit on PCB in the project. Pure software projects will not be allowed.
b. Application is made using PCB + Arduino (IDE)/ ESP32/Basic Raspberry-pi board. (Hardware + software co-design). (Project should be completely hardware based with minimal software use).
c. Identification and testing of different components, instruments, simulation software for projects.
d. Topic selected should be application based. The chosen topic should not belong to existing experiment list with medium/high difficulty level of implementation.
e. Designing and analysing circuits by students using standard material and software.
f. Initial project demonstration and testing is expected to be done by soldering on general purpose PCB. Discourage use of breadboards.
g. Study of PCB, Simulation on software and making of final PCB layout for given circuit.
h. Implementing the final circuits on PCB by mounting required components with application using Arduino.

6. Suggested list of components : Transistors, diodes, regulators, gates, counters, FF, Latches, Decoder, Mux, comparator, Adder, Subtractor, ALU, CPLDs, DC motors, resistor, capacitor, inductor, Op-amp etc.(Students may add more components as per the requirement of project)

2	**Project Report Format:** 1. Project **report** should include the objectives, circuit diagram, operation, application, waveforms (if applicable), simulation results and final prepared PCB image, conclusion and references etc. 2. Report should not exceed **20 pages** and spiral binding not required.
3	**The final certification and acceptance of term work ensures satisfactory performance of project work and minimum passing marks in term work.**

4	**Term Work evaluation and marking as per Scheme A:** **1. At the end of semester the above 2 expert faculty who have approved the topic will internally evaluate the performance.** **2. Students have to give a presentation and demonstration on the Field Project.** **3. In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the project completed. Based upon it the marks will be awarded to students.** **4. Distribution of 50 Marks for Term Work:** **● Initial Stage : Field study report and Project Proposal = 10 Marks** **● Circuit simulation/ Zero PCB (GPP) implementation + Arduino Interfacing** **= 05 Marks** **o (Project review: Stage 1 and 2 will be evaluated in 3rd or 4th week of the semester).** **● Project report: Circuit Design + Explanation + Analysis Results + Conclusion** **+ References = 10 Marks** **● Prototype Demonstration and Testing: PCB (simulation + Layout) + Final result with Arduino interfacing / ESP32/Basic Raspberry-pi board.+ Working Demo = 15 Marks** **● Final Presentation and Report: PPT (upto 12 slides) + Answers given to Questions = 10 Marks**
	Project selection, implementation and report writing with reference to Course Description B. **The student will mention the objectives of the field visit, description including field visit data collection, processes/ operations, analysis and suggestions for the improvement and innovations if any.** **Distribution of 50 Marks for Term Work in scheme B is as follows:** **1. Assessment of case study report with analysis prepared by student groups: 25 marks** **2. Presentation by student groups and Q&A: 15 marks** **3. Suggestions given for improvement in the present Processes/ Systems / Operations, innovation identification: 10 marks.**

COURSE NAME:

Introduction to Innovation and Entrepreneurship for Engineers

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADEM41	Introduction to Innovation and Entrepreneurship for Engineers	—	---	02	--	--	02	02

Introduction to Innovation and Entrepreneurship for Engineers

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NADEM41	Introduction to Innovation and Entrepreneurship for Engineers	—	---	02	—	--	02	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NADEM41	Introduction to Innovation and Entrepreneurship for Engineers	--	—	--	25	---	25

Course Prerequisite:	
Course Objectives:	
1	Understand the concepts and theories of innovation and entrepreneurship within engineering disciplines.
2	Develop critical thinking and problem-solving skills necessary for identifying and evaluating entrepreneurial opportunities.
3	Gain practical experience in ideation, prototyping, and validation of innovative solutions to engineering challenges.
4	Explore the role of engineering in addressing societal and environmental challenges through innovation and entrepreneurship.
5	Cultivate teamwork, communication, and leadership skills essential for entrepreneurial success in interdisciplinary contexts.
Course Outcomes: At the end of the course the student will gain the capability to:	
1	Understand principles of innovation and entrepreneurship.

2	Identify and evaluate entrepreneurial opportunities.
3	Understand and Apply design thinking and innovation methodologies.
4	Develop and validate viable business models and innovative solutions.
5	Understand and demonstrate ethical practices in innovation and entrepreneurship
6	Demonstrate entrepreneurial mind set and skills.

Introduction to Innovation and Entrepreneurship for Engineers

Module	Contents	Hrs
1	**Introduction to Innovation and Design Thinking**	06
1.1	Overview of innovation concepts and importance in engineering.	
1.2	Types of innovation and innovation processes.	
1.3	Introduction to design thinking methodology.	
1.4	Applying design thinking principles to engineering challenges.	
1.5	Empathy mapping and user journey analysis.	
1.6	Iterative design process and user testing.	
2	**Opportunity Identification, Ideation**	04
2.1	Techniques for identifying customer needs and pain points.	
2.2	Idea generation exercises and brainstorming sessions.	
2.3	Problem-solving through human-centered design.	
3	**Prototyping and MVP Development**	04
3.1	Introduction to prototyping techniques and tools.	
3.2	Minimum viable product (MVP) development and validation.	
3.3	Rapid iteration and feedback gathering.	
4	**Introduction to Entrepreneurship**	04
4.1	Overview of entrepreneurship concepts and mindset.	
4.2	Role of entrepreneurs in driving economic and social change.	

4.3	Characteristics of successful entrepreneurs. - Case Studies	
5	**Business Model Innovation and Validation**	04
5.1	Introduction to business model canvas and value proposition design.	
5.2	Revenue models, pricing strategies, and cost structure analysis.	
5.3	Techniques for market research and customer validation.	
5.4	Identifying target markets and understanding customer needs.	
6	**Legal and Ethical Considerations**	04
6.1	Intellectual property rights and patents in engineering innovation.	
6.2	Ethical considerations in entrepreneurship and engineering practice.	
6.3	Social responsibility and sustainability in innovation and entrepreneurship.	
	Total	**26**

Textbooks:	
1	"Entrepreneurship Development and Small Business Enterprises" by Poornima M. Charantimath
2	"Innovation and Entrepreneurship: Practice and Principles" by Peter F. Drucker
3	"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" by Alexander Osterwalder and Yves Pigneur
4	"Innovative India: Science and Technology Entrepreneurship" by K. Vijayaraghavan and Rajan Srikanth
5	"Startup Nation: Making India a Startup Ecosystem" by Dr. H.K. Mittal
6	"Entrepreneurship: Theory, Process, and Practice" by Kuratko, Hornsby, and Covin:
7	"Zero to One: Notes on Startups, or How to Build the Future" by Peter Thiel and Blake Masters
Websites :	
1	Startup India (startupindia.gov.in): • Provides resources, guidelines, and support for startups and entrepreneurs in India, including information on funding, policies, and events.
2	National Entrepreneurship Network (NEN) (wadhwanifoundation.org/national- entrepreneurship-network):

	• Offers resources, workshops, and programs for entrepreneurship education and ecosystem development in India.
3	MIT OpenCourseWare (ocw.mit.edu): • Offers free online courses on entrepreneurship and innovation, including lecture notes, assignments, and case studies from MIT's entrepreneurship curriculum.
4	Stanford eCorner (ecorner.stanford.edu) • Features a rich collection of videos, podcasts, and articles on entrepreneurship and innovation from Stanford University, including talks by successful entrepreneurs and industry experts.
5	Coursera (coursera.org) • Provides online courses on entrepreneurship and innovation from top universities and institutions, allowing students to learn at their own pace and earn certificates.
6	TiE (The Indus Entrepreneurs) (tie.org) • A global nonprofit organization dedicated to fostering entrepreneurship through mentoring, networking, and education, with many chapters in India offering local support and events.
Additional Resources:	
1	Entrepreneurship Development Institute of India (EDII) (ediindia.org) • Provides entrepreneurship education, training, and research programs, as well as workshops and seminars on various aspects of entrepreneurship.
2	Harvard Business Review (hbr.org) • Offers articles, case studies, and insights on innovation, entrepreneurship, and business strategy from industry experts and thought leaders.
3	Khan Academy (khanacademy.org) • Offers free educational resources, including lessons on entrepreneurship, economics, and business fundamentals.

Term Work :	
The Assessment will be based on a set of 5 activities of 5 marks each. The suggested list of activities:	
1	Individual and group assignments (e.g., business model canvas, market research report).
2	Presentations and pitches for venture ideas.
3	Participation in discussions and workshops.
4	Reflection papers or journals documenting personal learning and growth.
5	Presentation of innovation projects by students.
6	Feedback and peer evaluation of prototypes.
7	Reflection on the innovation process and lessons learned.