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

Effective from: 2023-24

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	Dr. M Vijayalakshmi	Dr. Mrs. Gresha S Bhatia
Principal, VESIT	Vice Principal, VESIT	Academic Coordinator, VESIT

Preamble Department of Computer Engineering

The programme under the Department of Computer Engineering is committed to nurturing innovation-driven, technically competent, and industry-ready professionals. The schema and syllabus is designed in sync with the mission of the department and adhering programme objectives(POs) and structured through course objectives(COs). The core curriculum emphasizes computational thinking, algorithmic precision, and software-hardware integration through foundational courses such as Data Structures, Operating Systems, Design and Analysis of Algorithms, and Computer Networks. To stay ahead in a competitive technological environment, the department integrates **Multidisciplinary Minor Courses (MDM)** in Artificial Intelligence, Machine Learning, and Deep Learning, enabling students to master data-driven decision-making and intelligent system design. This solid groundwork is complemented by advanced topics in Cryptography, Blockchain Development, and Software Engineering to cultivate system-level understanding and problem-solving acumen. The emphasis on **industry readiness** is exemplified through **Vocational and Skill Development** tracks in Full Stack Web Development, Cloud and Distributed Computing, and Mobile App Development, which prepare students for real-world software development environments and DevOps culture. Furthermore, **Program Electives** in NLP, Embedded Systems, Data Engineering, and GeoInformatics allow learners to tailor their expertise to specific industry domains. The department also champions sustainability and ethical innovation through **Open Electives** in Green Technologies, Cyber Laws & Digital Forensics, and Smart Systems, encouraging responsible technological advancement. Emerging areas such as Quantum Technologies, Edge Computing, Robotics, and VLSI are woven into the **Minor in Emerging Areas (MEA)** to ensure forward compatibility and academic agility. Through a strategic blend of theory, practice, and emerging tech, the Department empowers students to lead in next-generation computing and intelligent systems with clarity, competence, and conscience.

Dr. Nupur Giri — HOD, CMPN, VESIT

Dr. Mrs. Gresha S Bhatia — DHOD, CMPN, VESIT

Department of Computer Engineering

Revised Syllabus (NEP Scheme)

Sem-III

w.e.f. A.Y. 2025-26

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Semester III Teaching Scheme

Course Type	Course Code	Course name	Teaching scheme (Contact Hours)			Credits assigned			Total
			Th	Pr	Tut	Th	Pr	Tut	
PCC	NCMPC31	Discrete Structures and Graph Theory	3	-	1	3	-	1	4
PCC	NCMPC32// NCMPCL32	Data Structures	3	2	-	3	1	-	4
PCC	NCMPC34/ NCMPCL34	Database Management Systems	3	2	-	3	1	-	4
MDM	NCMMM31	Course 1 Mathematics for AIML	3	-	1	3	-	1	4
AEC	NCMAE31	Professional Communication and Ethics II	1	1		1	1		2
EM	NCMEM31	Financial Management for Engineers	2	-	-	2	-	-	2
			15	**5**	**2**	**15**	**3**	**2**	**20**
Total Hours			**22**			**Total Credits**			**20**

Semester III Examination Scheme

Course Type	Course Code	Course Name	Theory				Term Work	Pract & oral	Total
			Internal Assessment		End Sem Exam	Exam Duration (in Hrs)			
			Mid Test	CA					
PCC	NCMPC31	Discrete Structures and Graph Theory	20	20	60	2	25	-	**125**
PCC	NCMPC32/ NCMPCL32	Data Structures	20	20	60	2	25	25	**150**
PCC	NCMPC34/ NCMPCL34	Database Management Systems	20	20	60	2	25	25	**150**
MDM	NCMMM31	Course 1 Mathematics for AIML	20	20	60	2	25	-	**125**
AEC	NCMAE31	Professional Communication and Ethics II	-	-	-	-	50	-	**50**
EM	NCMEM31	Financial Management for Engineers	20	-	30	-	-	-	**50**
								TOTAL MARKS	**650**

Semester IV Teaching Scheme

Course Type	Course Code	Course name	Teaching scheme (Contact Hours)			Credits assigned			Total
			Th	Pr	Tu	Th	Pr	Tut	
PCC	NCMPC41/ NCMPCL41	Design & Analysis of Algorithms	3	2	-	2	1	-	3
PCC	NCMPC42	Computer Networks	3	-	-	3	-	-	3
PCC	NCMPC43	Operating System	3	-	-	3	-	-	3
OE	NOE40X	Open Elective 1	3	-	1	4	-	-	4
VSEC	NCMVS41	Full Stack Web Development	1	2	-	-	2	-	2
MDM	NCMMM41/ NCMMML41	Course 2 Artificial Intelligence	3	2	-	3	1	-	4
EM	NCMEM41	Innovation and Entrepreneurship	-	-	2	-	-	2	2
ELC	NCMFP41	Field Project	-	2	-	-	2	-	2
PCC	NCMPCL41	Open Source Lab	-	2	-	-	1	-	1
			16	**10**	**3**	**15**	**7**	2	**24**
		Total Hours	**29**			**Total Credits**			**24**

Semester IV Examination Scheme

Course Type	Course Code	Course Name	Theory				Term Work	Pract & oral	Total
			Internal Assessment		End Sem Exam	Exam Duration (in Hrs)			
			Mid Test	CA					
PCC	NCMPC41/ NCMPCL41	Design & Analysis of Algorithms	20	20	60	2	25	25	**150**
PCC	NCMPC42	Computer Networks	20	20	60	2	-	-	**100**
PCC	NCMPC43	Operating System	20	20	60	2	-	-	**100**
OE	NOE40X	Open Elective 1	20	20	60	2	-	-	**100**
VSEC	NCMVS41	Full Stack Web Development	-	-	-	-	50	-	**50**
MDM	NCMMM41/ NCMMML41	Course 2 Artificial Intelligence	20	20	60	2	25	25	**150**

EM	NCMEM41	Innovation and Entrepreneurship	-	-	-	-	25	-	**25**
ELC	NCMFP41	Field Project	-	-	-	-	25	-	**25**
PCC	NCMPCL41	Open Source Lab	-	-	-	-	25	25	**50**
								TOTAL MARKS	**750**

Open Elective 1		
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

SEM III SYLLABUS

Department of Computer Engineering

COURSE NAME: DISCRETE STRUCTURES AND GRAPH THEORY

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC31	Discrete Structures and Graph Theory (Theory)	3	-	1	3	-	1	4

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid- Term Test	Continuous Assessment					
NCMPC31	Discrete Structures and Graph Theory (Theory)	20	20	60	2	25	-	125

Prerequisite: Basic Mathematics	
Course Objectives	
1	Cultivate clear thinking and creative problem-solving.
2	Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3	To apply graph theory in solving practical problems.
4	Thoroughly prepare for the mathematical aspects of other Computer Engineering courses
Course Outcomes: On successful completion, of course, learner/student will be able to	
1	Apply propositional and predicate logic to construct valid arguments and proofs.
2	Analyze relations and functions using set theory concepts and representations.

3	Illustrate and classify posets and lattices using diagrams and structural properties.
4	Solve combinatorial problems using counting principles and techniques.
5	Apply algebraic structures in group theory and coding for error detection and correction.
6	Analyze and interpret graph structures and their properties in various applications.

Module	Detailed Contents		CO	Hours
1	**Logic**		CO1	6
	1.1	Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.		
2	**Relations and Functions**		CO2	6
	2.1	Basic Concepts of Set Theory		
	2.2	**Relations:** Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes		
	2.3	**Function**s: Definition, Types of functions, Composition of functions, Identity and Inverse function		
3	**Posets and Lattice**		CO3	5
	3.1	Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice		
4	**Counting**		CO4	4
	4.1	Basic Counting Principle-Sum Rule, Product Rule, Inclusion-Exclusion Principle, Pigeonhole Principle		
5	**Algebraic Structures and Coding Theory**		CO5	10
	5.1	Algebraic structures with one binary operation: Semigroup, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism		
	5.2	Algebraic structures with two binary operations: Ring		
	5.3	Coding Theory: Coding, binary information, error detection, decoding and error correction, Maximum likelihood		

6	**Graphs Theory**			
	6.1	Graphs Types of graphs, Graph Representation, Subgraphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex.	CO6	8
			Total	**39**

Textbooks	
1	Bernard Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.
2	C. L. Liu "Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company. Reprinted 2000.
3	K. H. Rosen, "Discrete Mathematics and applications", fifth edition 2003, Tata McGraw Hill Publishing Company
References	
1	Y N Singh, "Discrete Mathematical Structures", Wiley-India.
2	J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India.
3	J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publishing Company
4	Seymour Lipschutz, Marc Lars Lipson, "Discrete Mathematics" Schaum"s Outline, McGraw Hill Education.
5	Narsing Deo, "Graph Theory with applications to engineering and computer science", PHI Publications.
6	P. K. Bisht, H. S. Dhami, "Discrete Mathematics", Oxford press.
7	Rajesh Maurya,Ganesh M Magar,Swati R Maurya "Discrete Structures",Wiley Publication
Useful Links	
	Resources
1	https://www.edx.org/learn/discrete-mathematicS

2	https://www.coursera.org/specializations/discrete-mathematics
3	https://nptel.ac.in/courses/106/106/106106094/
4	https://swayam.gov.in/nd1_noc19_cs67/preview
	AI Tool
	https://www.yeschat.ai/gpts-2OToSmyfat-Discrete-Mathematics
	https://studymonkey.ai/subjects/discrete-math
	https://www.compscilib.com/search/discrete-math
	Case Studies
	https://shorturl.at/Vwk1t
	https://www.mathily.org/dm-rw.html
	https://www.lifescied.org/doi/10.1187/cbe.18-11-0222

Continuous Assessment

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered upon approval by the subject teachers. It should be a minimum of 2 or a maximum of 4 from the following table

No.	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/workshop/talk/competition followed by a small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project-based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks	10 Marks
8	Content beyond syllabus presentation	10 Marks

9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	GATE Based Assignment tests/Tutorials etc	10 Marks
12	Peer Review and participation	5/10 Marks
*For sr.no.7, 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.		
Termwork		
Minimum 10 Tutorials need to be completed for termwork of 25 Marks of 1 credit		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	

Direct Assessment	
End Semester Theory Examination: 60 Marks	
1	The question paper will consist of 5 questions, each carrying 20 marks.
2	The students need to solve a total of 3 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	The remaining questions (Q.2 to Q.5) will be selected from all the modules.
Internal Assessment: 40 Marks	
The assessment consists of one Mid-team Test of 20 Marks and a Continuous Assessment of 20 Marks. The Mid Term Test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.	

COURSE NAME: DATA STRUCTURES

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC32	Data Structures (Theory)	03	---	---	03	---	---	03
	Data Structures (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC32	Data Structures (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPC32	Data Structures (Theory)	20	20	60	02	-	-	100

Prerequisite: C Programming	
Course Objectives	
1	To understand the significance of Data structures as a Computer Professional.
2	To appreciate the concept of Linear data structures - Stack & Queue along with its Applications.
3	To recognize the different types of Linked Lists and identify the appropriate one to solve a specific real-world problem.
4	To introduce various types of Trees and their applications in a practical scenario
5	To instigate the concept of Graphs and their traversals along with applications.
6	To understand various searching techniques and appreciate the role of Collision resolution Techniques in Hashing
Course Outcomes	
1	Appreciate the role of Data Structures in day-to-day lives.

2	Perform various operations like searching, insertion, deletion, and traversals on Linear data structures - Stack & Queue.
3	Explain the different types of Linked Lists and select a suitable one for the given scenario.
4	Illustrate the various types of Trees and identify an appropriate Tree data structure to solve a real-life situation.
5	Analyze and implement Graph traversals on a given problem.
6	Perform various searching techniques and collision resolution techniques in Hashing.

Module		Content	CO	Hours
1	**Introduction to Data Structures**		CO1	04
	1.1	Introduction to Pointers and Structures in C; Single and Multidimensional arrays: Memory representation, Operations on Arrays.		
	1.2	Introduction to Data Structures - Concept of ADT; Types of Data Structures - Primitive and Non-Primitive Data structures; Linear and Non-Linear Data structures; Operations on Data Structures.		
2	**Stack and Queues**		CO2	07
	2.1	Introduction to Stack, Operations on Stack; Array Implementation of Stack; Applications of Stack: Well formed-ness of Parenthesis, Infix to Postfix Conversion, Postfix Evaluation, Recursion		
	2.2	Introduction to Queue, Operations on Queue; Array Implementation of Queue; Types of Queue - Circular Queue, Priority Queue, Double Ended Queue; Applications of Queue		
3	**Linked list**		CO3	08
	3.1	Introduction to Linked List, 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; Implementation of Stack and Queue using Singly Linked List; Singly Linked List Applications - Polynomial Representation and Addition, Multiplication		
4	**Trees**		CO4	08
	4.1	Introduction to Trees - Terminologies, Representation, Properties, Types; Operations on Binary Tree; Applications of Binary Tree - Expression Tree, Huffman Encoding. Binary Search Tree - Operations on BST; Search Trees - AVL Tree, Rotations in AVL Tree, Operations on AVL Tree; Introduction of B Tree, B+ Tree.		
5	**Graphs**		CO5	06

	5.1	Introduction to Graph - Graph Terminologies; Representation of Graph; Graph Traversals - Depth First Search(DFS), Breadth First Search (BFS); Graph Application - Topological Sorting, Graph Coloring.		
6	**Searching Techniques**		CO6	06
	6.1	Searching - Linear Search, Binary Search Introduction to Hashing, Hash Functions, Collision Resolution Techniques		
			Total	**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.
6	Classic Data Structures, D. Samanta, Prentice Hall India Pvt., Limited, 2004
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.
Useful Links	
Resources	
1	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://swayam.gov.in/nd1_noc19_cs67/preview
Algorithm Simulation Tools	
1.	https://visualgo.net/en

	https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
Virtual Lab	
1	https://cse01-iiith.vlabs.ac.in/List%20of%20experiments.html
Industry articles	
1	https://ln.run/1X-Ed
2	https://ln.run/zu5ue
Case Studies	
1	http://surl.li/uhmku

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10Marks

12	GATE Based Assignment tests/Tutorials etc	10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPCL32	Data Structures (Lab)	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPCL32	Data Structures (Lab)	-	-	-	-	25	25	50

Prerequisite: C Programming	
Lab Objectives	
1	To implement basic data structures such as arrays, linked lists, stacks, and queues
2	Solve problems involving graphs, and trees
3	To develop applications using data structure algorithms
4	Compute the complexity of various 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 to various problems
4	Students will be able to select appropriate searching techniques for given problems.

Suggested Experiments

- Students are required to complete at least 10 experiments.
- Make sure that **2 experiments** from each module are based on the Data Structures Course.

No.	Name of the Experiment	LO
1	Implement Stack ADT using an array	LO1

2	Convert an Infix expression to a Postfix expression using stack ADT.	LO1
3	Evaluate Postfix Expression using Stack ADT.	LO1
4	Applications of Stack ADT.	LO1
5	Implement Linear Queue ADT using an array.	LO1
6	Implement Circular Queue ADT using an array.	LO2
7	Implement Priority Queue ADT using an array.	LO2
8	Implement Singly Linked List ADT.	LO1/LO2
9	Implement Circular Singly Linked List ADT.	LO2
10	Implement Doubly Linked List ADT.	LO2
11	Implement Stack / Linear Queue ADT using Linked List.	LO1
12	Implement Operations on a Binary Search Tree.	LO2
13	Implement Huffman Encoding	LO3
14	Implement Graph Traversal techniques: a) Depth First Search b) Breadth-First Search	LO3
15	Applications of Binary Search Technique	LO4
16	Implementation of Topological sort	LO4
17	Implementation of hashing functions with different collision resolution techniques	LO4
18	Implement Binary Search	LO4
Useful Links		
1	www.leetcode.com	
2	www.hackerrank.com	
3	www.cs.usfca.edu/~galles/visualization/Algorithms.html	
4	www.codechef.com	
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)	
Practical & Oral Exam		
1	Based on the subject and related lab of Data Structures Theory and Lab, Total 25 Marks	

COURSE NAME: DATABASE MANAGEMENT SYSTEMS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC34	Database Management Systems (Theory)	03	---	---	03	---	---	03
	Database Management Systems ((Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC34	Database Management Systems (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPC34	Database Management Systems (Theory)	20	20	60	02	-	-	100

Prerequisite: Data Structures	
Course Objectives	
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 diagram 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.

Module		Content	CO	Hours
1		**Introduction Database Concepts**	CO1	02
	1.1	Introduction, Characteristics of databases,Data abstraction and data Independence, DBMS system architecture		
2		**Entity–Relationship Data Model**	CO2	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 Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation		
3		**Relational Model and relational Algebra**	CO2, CO3	08
	3.1	**Relational Model**: Relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model **Relational Algebra**: Unary and Binary operators, Relational Algebra Queries.		
4		**Structured Query Language (SQL)**	CO4	10
	4.1	**Overview of SQL**: Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity , check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries		
5		**Relational-Database Design**	CO5	07
	5.1	**Relational-Database Design:** Pitfalls in Relational-Database designs, Concept of normalization Function Dependencies: Attribute Closure and applications, Decomposition: Lossy and Lossless Decomposition, Normal Forms: First Normal Form, 2NF, 3NF, BCNF.		
6		**Transactions Management and Concurrency control**		06
	6.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concepts behind Concurrency Control	CO6	
			Total	**39**

Textbooks	
1	Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, 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, 5th Edition.
2	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
4	G. K. Gupta, Database Management Systems, McGraw Hill, 2012
Useful Links	
Resources	
1	https://nptel.ac.in/courses/106/105/106105175/
2	https://swayam.gov.in/nd1_noc19_cs46/preview
3	https://www.classcentral.com/course/swayam-database-management-system-9914
4	https://www.mooc-list.com/tags/dbms
AI Tools	
1	Draw.io: A free, web-based tool for creating ER and EER diagrams.
2	https://dbschema.com/ :An interactive database design and management tool
3	SQLFiddle: An online tool to write and test SQL queries against different databases.
4	SQLBot: An AI tool that helps generate SQL queries from natural language inputs.
Industry articles	
1	https://shorturl.at/NFsay:The Google File System
2	Bigtable: A Distributed Storage System for Structured Data: Google
Case Studies	
1	https://8weeksqlchallenge.com/
2	https://docs.oracle.com/cd/E16338_01/gateways.112/e12069/ch4.htm#GMSWN300

Continuous Assessment		
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered upon approval by the subject teachers. It should be a minimum of 2 or a maximum of 4 from the following table		
No.	**Rubrics**	**Marks**
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/workshop/talk/competition followed by a small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case Study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project-based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	GATE Based on Assignment tests/Tutorials etc	10 Marks
12	Peer Review and participation	5/10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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.	

DATABASE MANAGEMENT SYSTEM LAB

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPCL34	Database Management Systems(Lab)	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPCL34	Database Management Systems (Lab)	-	-	-	-	25	25	50

Prerequisite: Discrete Structures	
Lab Objectives:	
1	To explore design and develop of relational model
2	To present SQL and procedural interfaces to SQL comprehensively
3	To introduce the concepts of transactions and transaction processing
Lab Outcomes: At the end of the course, the students will be able to	
1	Design ER /EER diagram and convert to relational model for the real world application.
2	Apply DDL, DML, DCL and TCL commands
3	Write simple and complex queries
4	Use PL / SQL Constructs.
5	Demonstrate the concept of concurrent transactions execution and frontend-backend connectivity.

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

Star (*) marked experiments are compulsory.

Sr. No.	Title of Experiment	LO
1*	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System.	LO1
2*	Apply DML Commands for the specified system.	LO2

3*	Perform Simple queries, string manipulation operations and aggregate functions.	LO3
4*	Implement various Join operations and Views.	LO3
5*	Perform Nested and Complex queries.	LO3
6*	Perform DCL and TCL commands.	LO2
7	Implementation and demonstration of Transaction and Concurrency control techniques using locks.	LO5
8*	Implement procedure and functions(PL/SQL).	LO4
9*	Implementation of Triggers.	LO4
10	Implementation of Explicit Cursor .	LO3
11	Demonstrate Database connectivity.	LO5

Useful Links	
1	https://nptel.ac.in/courses/106/105/106105175/
2	https://swayam.gov.in/nd1_noc19_cs46/preview
3	https://www.classcentral.com/course/swayam-database-management-system-9914
4	https://www.mooc-list.com/tags/dbms
5	https://nptel.ac.in/courses/106/105/106105175/
Virtual Lab	
1	http://vlabs.iitkgp.ac.in/se/4/simulation/
2	https://vsit.edu.in/vlab/DBMS/Views_Simulator.html
AI Tools	
1	Draw.io: A free, web-based tool for creating ER and EER diagrams.
2	https://dbschema.com/ :An interactive database design and management tool
3	SQLFiddle: An online tool to write and test SQL queries against different databases.
4	SQLBot: An AI tool that helps generate SQL queries from natural language inputs.

Term Work	
1	Term work should consist of 10 case study based experiments. Sample Case Studies :Company Database System,University Database System, Railway Reservation System,Banking System, Hotel Management System, Library Management System, E-Commerce Management System, Hospital Management System, Airline Reservation System, Insurance Database System (Case Study Manual)

2	Journal must include at least 2 assignments on content of theory and practical of "Database Management System"
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)
Practical & Oral Exam	
Based on the entire Syllabus of PCC Database management system and Database management system lab, Total 25 Marks	

COURSE NAME: MATHEMATICS FOR AIML

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM31	Mathematics for AIML	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMM31	Mathematics for AIML	20	20	60	02	25	-	125

Prerequisite: Set Theory and Calculus, Counting Principles, Permutation and combination.	
Course Objectives	
1	To equip the students with a working knowledge of probability, statistics, and modeling in the presence of uncertainties.
2	To understand the concept of hypothesis and significance tests.
3	To help the students to develop interest in random phenomena and to introduce both theoretical issues and applications that may be useful in practical life.
Course Outcomes	
1	Build the foundations for Probability via practical notions.
2	Understand random variable theory of discrete and continuous probability distributions.
3	Compute probability using probability distribution of discrete and continuous Random variable, Binomial, Poisson and Normal distribution etc.
4	Apply Testing of Hypothesis for different sample sizes
5	Apply and visualize various Statistical Techniques applied to datasets
6	Understand and apply basics of Linear Algebra for datasets and algorithms

Module		Content	CO	Hours
1		**Introduction to Probability**	CO1	03
	1.1	Definition and basics of Random experiment, Sample space, Events, Mutually exclusive and exhaustive events, Probability, Addition rule.		

	1.2	Conditional probability, Multiplication rule, Independent events, Total probability theorem, Bayes theorem.		
2	**Random Variables and its distributions**		CO2	10
	2.1	Discrete random variable, probability mass function, continuous random variable, probability density function, cumulative distribution function.		
	2.2	Joint probability distributions of two random variables: discrete and continuous, marginal and conditional distribution, independence of random variables.		
	2.3	Probability distribution of functions of one and two random variables.		
	2.4	Expectation, Variance, Covariance, Raw and Central Moments, Moment generating function.		
3	**Special Probability Distributions**		CO3	05
	3.1	Discrete Distributions: Binomial distribution, Poisson distribution.		
	3.2	Continuous Distribution: Normal distribution, Central limit theorem.		
4	**Test of Hypotheses**		CO4	08
	4.1	Hypothesis, Type-I, Type-II Errors, Level of Significance, Critical region, One-tailed and Two-tailed test.		
	4.2	Student's t-distribution (Small Samples test): i) Testing the Significance of the Difference between mean of sample and mean of Population ii) Testing the Significance of the Difference between mean of two samples (samples are independent) iii) Testing the Significance of the Difference between mean of two samples (samples are dependent)		
	4.3	z-test (Large Samples Test): Testing the Significance of the Difference between mean of sample and mean of Population, Testing the Significance of the Difference between mean of two samples (samples are independent), Chi-squared distribution		
	4.4	F-Test, ANOVA		
5	**Statistical Techniques**		CO5	06
	5.1	**Descriptive Statistics:** Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Measures of Kurtosis.		
	5.2	Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution.		

6	**Linear Algebra**		CO6	07
	6.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof)		
	6.2	Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		
	6.3	Similarity of matrices, diagonalizable and non-diagonalizable matrices		
			Total	**39**

Textbooks	
1.	Devore, J. L.: Probability & Statistics for Engineering and the Sciences, 8th edition, Cengage Learning, 2012.
2.	Gupta and Kapoor, Fundamental of Mathematical Statistics, S Chand
3.	David C. Lay, **Linear Algebra and Its Applications**, 5th Edition, Pearson.
4.	Palaniammal S, Probability and Random Processes, Prentice Hall India Learning Private Limited
Reference Books	
1.	Milton, J. S. and Arnold J. C.: Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th edition, Tata McGraw-Hill, 2007.
2.	Meyer, P. L.: Introductory Probability and Statistical Applications, 2nd edition, Addison-Wesley, 1970.
3.	Johnson, R. A., Miller: Freund's Probability and Statistics for Engineers, 8th edition, PHI, 2010.
4.	Ross, S. M.: Introduction to Probability Models, 11th edition, Academic Press, 2014.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2	https://www.coursera.org/learn/machine-learning-probability-and-statistics
AI tools and case studies	
1	https://medium.com/enjoy-algorithm/detailed-maths-topics-in-machine-learning-ca55cd537709
2	https://deepnote.com/
3	https://www.manim.community/
4	https://shorturl.at/FNieG
5	https://distill.pub/2019/visual-exploration-gaussian-processes/
6	https://shorturl.at/fSD1a

7	https://www.scilab.org/
8	https://octave.org/

Internal Assessment		
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.		
Continuous Assessment		
Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.		
Sr.No	**Rubrics**	**Marks**
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10 Marks
12	GATE Based Assignment tests/Tutorials etc	10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	

2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
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.

Term Work	
1	**Term work should consist of at least 6 tutorials covering the entire syllabus**
2	The final certification and acceptance of term work ensures satisfactory performance of tutorials and minimum passing marks in term work.
3	**Total 25 Marks** **(Tutorials: 20-marks, Term work Assessment: 05-marks)**

COURSE NAME:PROFESSIONAL COMMUNICATION AND ETHICS II

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Pract.	Tutorial	Theory	TW/PR	Tut	Total
NCMAE31	Professional Communication and Ethics II	01	1*	–	01	01	-	02

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		MT Test	CA					
NCMAE31	Professional Communication and Ethics II	-	-	-	-	50	-	50

*Students to be divided into batches of 2 Hours duration	
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		CO	Hours
1	**ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)**		CO1	06
	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**		CO2	

06

	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)		
	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**	CO3	02
	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**	CO4	02

	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**		
	5.1	**Interpersonal Skills** ● Emotional Intelligence ● Leadership & Motivation ● Conflict Management & Negotiation ● Time Management ● Assertiveness ● Decision Making	CO5	05
6		**CORPORATE ETHICS**	CO6	02
	6.1	**6.1Intellectual Property Rights** ● Copyrights ● Trademarks ● Patents ● Industrial Designs		
	6.2	**Case Studies** • Cases related to Business/ Corporate Ethics		
7	**PROFESSIONAL WRITING SKILLS**		CO5	03
	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)		
	7.2	**Creative Writing** • Narrative essays • Content writing • Blog		
		Total	**26**	

Reference Books	
1	Lesiker and Petit (1997), "Report Writing for Business", McGraw-Hill Education10th 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, 14th 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, 12th 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
Web Links	
1	http://networketiquette.net/
2	https://public.wsu.edu/~brians/errors/
3	http://users3.ev1.net/~pamthompson/body_language.htm
4	http://www.albion.com/netiquette/corerules.html
5	http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/1535_questionanswer/page15.shtml
6	http://www.colostate.edu/Depts/Speech/rccs/theory44.html
7	http://www.dailywritingtips.com

Term Work

Term Work will be for 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 faculty. Each student in the group will have to write the assignments individually (10 Marks):-

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 presentation: A detail typed report has to be prepared of minimum 25 pages and maximum 30 pages. The format of the report has to be discussed and approved by faculty

C) A final Group Discussion Round will be conducted and every student must participate in the group discussion

COURSE NAME: FINANCE MANAGEMENT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMEM 31	Finance Management (Theory)	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	CA*					
NCMEM 31	Finance Management (Theory)	20		30	01	-	-	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 the 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

Module	Content		CO	Hours
1	**Indian Financial System**		CO1	08
	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**		CO2	06
	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**		CO3	06
	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**		CO4	06
	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.

Internal Assessment:

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

End Semester Theory Examination	
1	Question paper will be of 30 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 10 marks each
4	Any three questions out of five need to be solved.

SEM IV SYLLABUS

Department of Computer Engineering

Semester IV Teaching Scheme									
Course Type	**Course Code**	**Course name**	**Teaching scheme (Contact Hours)**			**Credits assigned**			**Total**
			Th	**Pr**	**Tu**	**Th**	**Pr**	**Tut**	
PCC	NCMPC41	Design & Analysis of Algorithms	3	2	-	2	1	-	3
PCC	NCMPC42	Computer Networks	3	-	-	3	-	-	3
PCC	NCMPC43	Operating System	3	-	-	3	-	-	3
OE	NOE40X	Open Elective 1	3	-	1	4	-	-	4
VSEC	NCMVS41	Full Stack Web Development	1	2	-	-	2	-	2
MDM	NCMMM41/ NCMMML41	Artificial Intelligence	3	2	-	3	1	-	4
EM	NCMEM41	Innovation and Entrepreneurship	-	-	2	-	-	2	2
ELC	NCMFP41	Field Project	-	2	-	-	2	-	2
PCC	NCMPCL41	Open Source Lab	-	2	-	-	1	-	1
			16	**10**	**3**	**15**	**7**	2	**24**
		Total Hours	**29**			**Total Credits**			**24**

Semester IV Examination Scheme									
Course Type	**Course Code**	**Course Name**	**Theory**				**Term Work**	**Pract & oral**	**Total**
			Internal Assessment		**End Sem Exam**	**Exam Duration (in Hrs)**			
			Mid Test	**CA**					
PCC	NCMPC41	Design & Analysis of Algorithms	20	20	60	2	25	25	**150**
PCC	NCMPC42	Computer Networks	20	20	60	2	-	-	**100**
PCC	NCMPC43	Operating System	20	20	60	2	-	-	**100**
OE	NOE40X	Open Elective 1	20	20	60	2	-	-	**100**
VSEC	NCMVS41	Full Stack Web Development	-	-	-	-	50	-	**50**
MDM	NCMMM41/ NCMMML41	Artificial Intelligence	20	20	60	2	25	25	**150**
EM	NCMEM41	Innovation and Entrepreneurship	-	-	-	-	25	-	**25**

ELC	NCMFP41	Field Project	-	-	-	-	25	-	**25**
PCC	NCMPCL41	Open Source Lab	-	-	-	-	25	25	**50**
								TOTAL MARKS	**750**

Open Elective 1		
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

COURSE NAME: DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC41	Design and Analysis of Algorithms (Theory)	03	---	---	02	---	---	02
	Design and Analysis of Algorithms (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC41	Design and Analysis of Algorithms (Theory)	03	-	-	02	-	-	02

Course Name	Examination Scheme						
	Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
	Internal Assessment		End Sem Exam				
	Mid-Term Test	Continuous Assessment					
Design and Analysis of Algorithms (Theory)	20	20	60	2	-	-	100

Course Prerequisite: Data Structures, Discrete Structures & Graph Theory	
Course Objectives	
1	To provide mathematical approaches for the Analysis of Algorithms
2	To understand and solve problems using various algorithmic approaches
3	To analyze algorithms using various methods
4	To understand and solve string-matching algorithm
Course Outcomes	
1	Analyze the running time and space complexity of algorithms and describe P and NP Algorithms.

2	Describe, apply, and analyze the complexity of the Divide and Conquer strategy.
3	Describe, apply, and analyze the complexity of the Greedy strategy.
4	Describe, apply, and analyze the complexity of the Dynamic Programming strategy.
5	Explain and apply Backtracking, Branch and Bound.
6	Explain and apply string-matching techniques.

Module	Detailed Contents		CO	Hours
1	**Introduction to Design and Analysis of Algorithms**		CO1	10
	1.1	Performance analysis, space, and time complexity Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis; Analysis of selection sort, insertion sort.		
	1.2	Recurrences: The substitution method, Recursion tree method, Master method		
	1.3	Complexity Classes: Definition of P, NP, NP-Hard, NP-Complete		
2	**Divide and Conquer Strategy**		CO2	06
	2.1	General method, Min-Max Algorithm, Merge sort, Quick sort, Analysis of Binary search, Strassen's Matrix Multiplication.		
3	**Greedy Method Approach**		CO3	06
	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**		CO4	09
	4.1	General Method, Multistage graphs, Matrix Chain Multiplication, Longest common subsequence, Optimal Binary Search Trees, 0/1 knapsack Problem.		
5	**Backtracking and Branch and bound**		CO5	05
	5.1	Backtracking: N-queen problem, Sum of subsets		
	5.2	Branch and Bound: 15 Puzzle problem, Traveling Salesperson problem.		

6	**String Matching Algorithms**		CO6	03
	6.1	Naïve string-matching algorithm, Rabin Karp algorithm, Knuth-Morris-Pratt algorithm		
			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.
3	J. Kleinberg and E. Tardos, Algorithm Design, Pearson International Edition, 2005.
Useful Links	
Resources	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms
AI Tools	
5	Algorithmia: https://algorithmia.com/
6	TensorFlow: https://www.tensorflow.org/
7	VisuAlgo: https://visualgo.net/
8	Algorithm Visualizer: https://algorithm-visualizer.org/
9	Pathfinding Visualizer: https://bengavrilov.github.io/Path-Finding-Visualizer/
Industry articles	
10	Artificial intelligence (AI) algorithms: a complete overview : https://www.tableau.com/data-insights/ai/algorithms
11	What Is an Algorithm? http://bit.ly/3RndUg6

12	Algorithmic bias detection and mitigation: Best practices and policies to reduce consumer harms https://bit.ly/4b1Rw31
13	Code-Dependent: Pros and Cons of the Algorithm Age : https://pewrsr.ch/3Ro3P2H
Case Studies	
14	A Case Study in Algorithm Analysis https://ics.uci.edu/~goodrich/teach/cs161/notes/MaxSubarray.pdf
15	An Introduction to the Analysis of Algorithms https://sedgewick.io/books/analysis-of-algorithms/
16	Parallel MCMC Algorithms: Theoretical Foundations, Algorithm Design, Case Studies https://ar5iv.org/abs/2209.04750

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks

10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10 Marks
12	GATE Based Assignment tests/Tutorials etc	10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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.	

DESIGN AND ANALYSIS OF ALGORITHMS(LAB)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPCL41	Design and Analysis of Algorithms (Lab)	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPCL41	Design and Analysis of Algorithms (Lab)	-	-	-	-	25	25	50

Lab 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 a suitable algorithm for the given real-world problem.
4	Analyze the worst-case running time of algorithms and understand fundamental algorithmic problems.
Lab Outcomes	
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 a suitable algorithm for the given real-world problem.
4	Analyze the worst-case running time of algorithms and understand fundamental algorithmic problems.

Suggested Experiments:
- Students are required to complete **at least 10 experiments.**
- Implementation can be in any programming language.

Sr. No.	Name of the Experiment	LO
1	**Introduction to Design and Analysis of Algorithms** ● Implement Selection Sort and compare the sorting time based on step count. ● Implement Insertion Sort and compare the sorting time based on step count.	LO1
2	**Introduction to Design and Analysis of Algorithms** ● Write a case study on Complexity Classes: P, NP, NP-Hard, NP-Complete	LO1
3	**Divide and Conquer Approach:** ● Implement and analyze Merge sort ● Implement and analyze Quick sort	LO2
4	**Divide and Conquer Approach:** ● Implement and analyze Binary search	LO2
5	**Greedy Method** ● Single source shortest path- Dijkstra	LO2
6	**Greedy Method** ● Implement and analyze Fractional Knapsack problem	LO2
7	**Greedy Method** ● Implement and analyze Job sequencing with deadlines	LO2
8	**Greedy Method** ● Implement and analyze Minimum cost spanning tree using Kruskal algorithm ● Implement and analyze Minimum cost spanning tree using Prim's algorithm	LO2
9	**Dynamic Programming Approach (any one)** ● Implement and analyze 0/1 knapsack ● Implement and analyze Matrix Chain Multiplication ● Implement and analyze Longest common subsequence ● Implement and analyze Optimal Binary Search Tree	LO3
10	**Backtracking and Branch and bound (any one)** ● Implement and analyze N-queen problem using Backtracking design strategy ● Implement and analyze Sum of subsets using Backtracking design strategy ● Implement and analyze 15 Puzzle Problems using Branch and Bound design strategy.	LO3
11	**String Matching Algorithms (any one)** ● Implement Naïve string-matching Algorithms	LO4

	• Implement Rabin Karp algorithm • Implement Knuth-Morris-Pratt algorithm	

Useful Links	
1	https://cse01-iiith.vlabs.ac.in/exp/sorting/
2	https://nptel.ac.in/courses/106/106/106106131/
3	https://swayam.gov.in/nd1_noc19_cs47/preview
4	https://www.coursera.org/specializations/algorithms
Tools and Articles	
5	Algorithm Visualizer: https://algorithm-visualizer.org/
6	Pathfinding Visualizer: https://bengavrilov.github.io/Path-Finding-Visualizer/
7	Design and Analysis of Algorithms by Stanford University: https://online.stanford.edu/courses/cs161-design-and-analysis-algorithms
8	MIT OpenCourseWare - Design and Analysis of Algorithms: https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/

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

COURSE NAME: COMPUTER NETWORKS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC 42	Computer Networks (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPC 42	Computer Networks (Theory)	20	20	60	02	-	-	100

Course Objectives	
1	To introduce concepts of data communication and computer networks.
2	To explore the working of various layers of OSI.
3	To explore the issues and challenges of protocols design for TCP/IP protocol suite.
4	To Study and Analyze various routing algorithms.
5	To understand various transport layer and application layer protocols.
Course Outcomes: On successful completion of course, learner will be able to	
1	Understand fundamentals of computer networks along with concepts of data communication
2	Explore different design issues of data link layer and medium access sub layer
3	Understand Network Layer , Network Addressing Schemes.
4	To understand Transport Layer and Congestion control algorithms.
5	Explore protocols of application layer
6	Understand advanced concepts of Computer Networks such as Network Designing and Security aspects.

Module	Contents		CO	Hours
1	**Introduction to Networking**		CO1	06
	1.1	Introduction to computer network, Network application, Evolution of Computer Network , Interconnection networking devices, Client and server and Peer to Peer Networks.		
	1.2	Transmission media: Electromagnetic Spectrum, Ranges of Transmission media, Physical Layer: Introduction, Network topology, Wired and Wireless Communication, Principles of Cellular Communication, Introduction to 2G, 3G, 4G and 5G technologies		
	1.3	Communication Service Primitives, Design issues for Layers Reference models: ISO-OSI Layered Architecture, TCP/IP Reference Models, Packet and Circuit Switching.		
2	**Data Link Layer**		CO2	08
	2.1	Data Link Layer: Elementary Data Link protocols Design Issues: Framing, Error Control: Error Detection and Correction (Hamming Code, CRC, Checksum), Flow Control: Stop and Wait, Sliding Window (Go Back N, Selective Repeat)		
	2.2	Medium Access Control Sublayer: Channel Allocation problem, Multiple Access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CA, CSMA/CD),1-persistent , n-persistent, p-persistent CSMA, Wired LANS: Ethernet, Ethernet Standards, Introduction to Wireless LAN, Bluetooth & ZigBee		
3	**Network layer**		CO3	08
	3.1	Internet Protocol, IP header format, Network Addressing: IPV4 Addressing, Special Addresses, Various Classes of Network Addresses, Physical address, Mapping of Physical Address to Network Addresses, Classless Addressing: Subnet, Supernet, NAT		
	3.2	Network Layer design issues, Communication Primitives, Unicast, Multicast, Broadcast. Routing algorithms: Static V/s Dynamic Routing. Static Routing: Optimality Principle , Shortest Path Routing, Dynamic Routing: Distance Vector Routing, Link state routing, Introduction to RIP, OSPF, BGP, Introduction to Mobile IP		
4	**Network Layer Protocols**		CO3, CO4	05
	4.1	ARP, RARP, ICMP, Introduction to IGMP		
5	**Transport Layer**		CO5	08

	5.1	Introduction, Services Provided by Transport layer to adjacent layers., TCP and UDP header format, TCP state transition, TCP timers		
	5.2	**Congestion control algorithms:** Open loop congestion control, Closed loop congestion control, QoS parameters, Traffic Shaping, Token & Leaky bucket algorithms **The Transport Service**: Transport service primitives, Socket Programming, Berkeley Sockets		
6	**Application Layer**		CO6	04
	6.1	Application Layer Resource Record and Types of Name Server. HTTP, SMTP, FTP, DHCP, POP3 MIME		
		Total		**39**

Textbooks	
1	A.S. Tanenbaum, Computer Networks,4th edition Pearson Education
2	B.A. Forouzan, Data Communications and Networking, 5th edition, TMH
3	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet,6th edition, Addison Wesley
4	J. Richard Burke, Network Management: Concepts and Practice: A Hands-on Approach, Prentice Hall, 2004
References	
1	S.Keshav,An Engineering Approach To Computer Networking, Pearson
2	Natalia Olifer & Victor Olifer,Computer Networks: Principles, Technologies & Protocols for Network Design, Wiley India, 2011.
3	Larry L.Peterson, Bruce S.Davie, Computer Networks: A Systems Approach, Second Edition ,The Morgan Kaufmann Series in Networking
Useful Links	
Resources	
1	https://archive.nptel.ac.in/courses/106/105/106105183/
2	https://nptel.ac.in/courses/106106091
3	https://www.netacad.com/courses/networking/networking-essentials
4	https://www.coursera.org/learn/computer-networking
5	https://nptel.ac.in/courses/106/105/106105081
6	https://www.edx.org/course/introduction-to-networking
7	https://www.coursera.org/learn/sdn

Virtual Lab	
8	http://vlabs.iitkgp.ernet.in/ant/1/simulation/
9	http://www.nitttrkol.ac.in/vlab-cse-nl-exp-1.php#top OSPF
10	https://shorturl.at/cje7o
AI in Networking	
11	https://shorturl.at/R9EYJ
12	https://www.juniper.net/us/en/products/mist-ai.html
13	https://shorturl.at/1kFx5
White papers	
14	• https://shorturl.at/k3ebk : CISCO • https://rb.gy/prv0fm : CISCO • https://shorturl.at/gEZhb :CISCO • https://shorturl.at/ZSZA2 : SIEMENS • https://shorturl.at/PUnWZ : amdocs
Case Studies	
15	https://shorturl.at/458FO
16	https://shorturl.at/KGvv6

Continuous Assessment

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered upon approval by the subject teachers. It should be a minimum of 2 or a maximum of 4 from the following table

Sr.No.	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/workshop/talk/competition followed by a small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project-based Learning and evaluation/Extra assignment/Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks

10	Mini Project / Extra Experiments / Virtual Lab	10 Marks
11	GATE Based Assignment tests / Tutorials etc	10 Marks
12	Peer Review and participation	5/10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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: OPERATING SYSTEM

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPC 43	Operating System (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPC 43	Operating System (Theory)	20	20	60	02	-	-	100

Course Prerequisite: Data structures and Computer architecture	
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, I/O and File management techniques.
5	To study the need and fundamentals of special-purpose operating systems with the advent of new emerging technologies.
Course Outcomes: After successful completion of the course students will be able to	
1	Understand the objectives and functions of the OS.
2	Analyze the concept of Process Management and evaluate performance of process scheduling
3	Understand and apply concepts of Synchronization and deadlock
4	Evaluate Performance of Memory allocation and replacement policies
5	Understand the concepts of file Management and I/O management and analyze techniques of disk scheduling
6	Compare the functions of various special-purpose Operating Systems.

Module	Detailed Content		CO	Hours
1	**Operating system Overview**		CO1	04
	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**		CO2	08
	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, SRTN, Priority,RR)		
	2.3	Threads: Definition and Types, Concept of Multithreading		
3	**Process Synchronization and Deadlocks**		CO3	08
	3.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization.		
	3.2	Mutual Exclusion: Requirements, Hardware Support (TSL), Operating System Support (Semaphores), Producer and Consumer problem, Dining Philosophers Problem,		
	3.3	Principles of Deadlock: Conditions and Resource, Resource Allocation Graph, Multi - Instance Resource Allocation Graph, Deadlock Prevention,Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and Recovery.		
4	**Memory Management**		CO4	09
	4.1	Memory Management Requirements,Memory Partitioning: Fixed, Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation, TLB		
	4.2	Virtual Memory: Demand Paging, Page Replacement Strategies: FIFO, Optimal, LRU, Thrashing, Belady's Anomaly		
5	**File Management and I/O management**		CO5	06
	5.1	Overview, File Attributes and File Organization and Access, File Directories structures, File Allocation methods, Sharing, Real Time OS, Mobile OS		
	5.2	I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling:FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK		
6	**Special Purpose Operating System**			04

	6.1	Open-source and Proprietary Operating System, Fundamentals and case study of various operating systems. Distributed Operating System, Network Operating System,Embedded Operating Systems,Cloud and IoT Operating Systems, Real-Time Operating System, Mobile Operating System.	CO6	
		Total		**39**

Textbooks	
1	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8thEdition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 9thEdition, 2016, ISBN 978-81-265-5427-0
3	A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.
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
Useful Links	
Resources	
1	https://swayam.gov.in/nd1_noc19_cs50/preview
2	https://nptel.ac.in/courses/117/106/117106113/
3	https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559
AI Tools	
4	https://www.tensorflow.org/
Industry articles	
5	https://shorturl.at/qLeSI
6	https://shorturl.at/baOSd

Case Studies	
7	https://shorturl.at/DWYAX
8	https://shorturl.at/ZM2va
Virtual Lab	
9	https://naim30.github.io/OS-virtual-lab/

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	GATE Based on Assignment tests/Tutorials etc	10 Marks
12	Peer Review and participation	5/10 Marks

*For sr.no.7, 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.

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Tutorials
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: FULL STACK WEB DEVELOPMENT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMVS41	Full Stack Web Development	1	2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMVS41	Full Stack Web Development	-	-	-	-	50	-	50

Prerequisite: Introduction and basics of HTML, CSS	
Course Objectives	
1	To orient students to Web Programming fundamentals.
2	To expose students to JavaScript to develop interactive web page development.
3	To orient students to Basics of REACT along with installation
4	To expose students to Advanced concepts in REACT
5	To gain proficiency in querying documents using MongoDB (NoSQL) and PostgreSQL
6	To expose students to node.js applications using express framework.
Course Outcomes	
1	Understand web design using HTML, CSS and client-side scripting using JavaScript programs.
2	Build User Interface and create simple React applications.
3	Understand server-side development using Node.js and Express.js.
4	Create a basic RESTful API using Node.js and Express.
5	To understand competence in database management using MongoDB (NoSQL) and PostgreSQL (SQL).
6	Students will demonstrate the ability to design and develop a complete full-stack web application.

Module	Content		CO	Hours
1	**Web programming fundamentals**		CO1	01
	1.1	Working of web browser, HTTP protocol, Version Control/Git: Git for source code management and collaboration.		
2	**Java script**		CO1	02
	2.1	Variables, Condition, Loops, Functions, Events, Arrow functions, Setting CSS Styles using JavaScript, DOM manipulation, Fetching data.		
3	**React fundamentals**		CO2	03
	3.1	Installation, Installing libraries, Folder and file structure, Components, Component lifecycle, State and Props, React Router and Single page applications, UI design, Forms, Events, Animations, Best practices.		
4	**Advanced React**		CO2	02
	4.1	Functional components- Refs, Use effects, Hooks, Flow architecture, Model-View Controller framework, Flux, Bundling the application. Web pack, Basics of React Native.		
5	**Node.js, MongoDB and PostgreSQL**		CO3, CO5	03
	5.1	Environment setup, First app, Asynchronous programming, Callback concept, Event loops, REPL, Event emitter, Web module design with Node.js and MongoDB. Data Modeling in PostgreSQL, Querying PostgreSQL, Data Modeling in MongoDB, Querying MongoDB, MongoDB Atlas or compass and Deployment.		
6	**Express**		CO4, CO6	02
	6.1	Introduction, Express router, REST API, Generator, Authentication, sessions, Integrating with React.		
		Total		**13**

FULL STACK WEB DEVELOPMENT(LAB)

Sr. No.	Lab Objectives:
1	To orient students to Web Programming fundamentals.
2	To expose students to JavaScript to develop interactive web page development.
3	To orient students to Basics of REACT along with installation
4	To expose students to Advanced concepts in REACT
5	To orient students to Fundamentals of node.js
6	To expose students to node.js applications using express framework.

Sr. No.	Lab Outcomes:
1	Select protocols or technologies required for various web applications.
2	Apply JavaScript to add functionality to web pages.
3	Design front end applications using basic React.
4	Design front end applications using functional components of React.
5	Design back-end applications using Node.js.
6	Construct web based Node.js applications using Express.

Sr. No	List of experiments	LOs
1	Apply fundamental design principles to create a visually appealing and user-friendly frontend interface using HTML and CSS.	LO1
2	Write simple JavaScript programs to perform arithmetic operations, manipulate strings, and use conditional statements and loops.	LO2
3	Create a simple React application with components, props, and state. Implement basic interactivity such as handling user input. Exercises: ● Setting up a React project. ● Components and Props. ● State and Lifecycle. ● Handling events.	LO3
4	Building a Todo List App with React using REACT components exercise:	LO4

	• Create components for adding, deleting, and marking tasks as completed. Utilize state management to update the UI dynamically.	
5	Set up a basic Node.js server and create simple HTTP endpoints to handle requests and responses. Exercises: • Setting up a Node.js project. • Creating routes with Express. • Handling HTTP requests and responses. • Middleware and error handling.	LO5
6	Building a RESTful API with Express Experiment: Create routes for CRUD operations (Create, Read, Update, Delete) on a mock dataset. Use Express middleware for request handling and validation.	LO6
7	Connect a Node.js application to a MongoDB database. Implement CRUD operations to interact with the database using the MongoDB Node.js driver.	LO5, LO6
8	Set up a PostgreSQL database and create tables to store relational data. Perform basic CRUD operations using SQL queries.	LO5, LO6
9	Develop a migration script to transfer data from MongoDB collections to corresponding tables in PostgreSQL. Handle data transformation and ensure data integrity during the migration process.	LO5, LO6
10	Develop a complete web application that incorporates frontend components built with React, a backend API created with Express and Node.js, and data storage using either MongoDB or PostgreSQL. Implement features such as user authentication, data validation, and CRUD operations.	LO4, LO5, LO6

Textbooks:	
1	Subramaniam, Venkat. Rediscovering JavaScript: Master ES6, ES7, and ES8. United States, Pragmatic Bookshelf, 2018.
2	Banks, Alex, and Porcello, Eve. Learning React: Functional Web Development with React and Redux. United States, O'Reilly Media, 2017.
3	Bugl, Daniel. Learning Redux. United Kingdom, Packt Publishing, 2017.
4	Mead, Andrew. Learning Node.js Development: Learn the Fundamentals of Node.js, and Deploy and Test Node.js Applications on the Web. United Kingdom, Packt Publishing, 2018.
5	Bojinov, Valentin. RESTful Web API Design with Node.js 10, Third Edition: Learn to Create Robust RESTful Web Services with Node.js, MongoDB, and Express.js, 3rd Edition. United Kingdom, Packt Publishing, 2018.

References:	
1	Brown, Ethan. Web Development with Node and Express: Leveraging the JavaScript Stack. United States, O'Reilly Media, 2014.

Useful Links	
1	https://reactjs.org/tutorial/tutorial.html
2	https://react-redux.js.org/introduction/quick-start
3	https://webpack.js.org/
4	https://www.youtube.com/watch?v=-27HAh8c0YU
5	MDN Web Docs - JavaScript
6	React Documentation
7	Node.js Documentation
8	Express.js Documentation
9	MongoDB Documentation
10	PostgreSQL Documentation
AI Tools	
1	Code Generation and Assistance: GitHub Copilot, TabNine
2	Testing and Debugging: DeepCode, Snyk
3	Automated Code Review: Codacy, SonarQube
4	Performance Optimization: LightStep, Datadog APM
5	Front-End Development: Figma with AI Plugins, Adobe XD with AI Features
6	Back-End Development: AWS CodeGuru, Kite
7	Database Management: DataRobot, OtterTune
8	DevOps and Deployment: Ansible with AI, Harness.io
9	Project Management and Collaboration: Asana with AITrello with AI Plugins
10	Documentation: Jasper (formerly Jarvis), Scribe

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
Term Work	
1	Term work should consist of 8 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 50 Marks** Experiments: 15-marks, Assignment : Figma Prototype (5 marks) + Mini Project Report (5 Marks), Mini Project Demo & Presentation: (25 Marks)

COURSE NAME: ARTIFICIAL INTELLIGENCE

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM41	Artificial Intelligence (Theory)	03	---	---	03	---	---	03
NCMMML41	Artificial Intelligence (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM41	Artificial Intelligence (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMM41	Artificial Intelligence (Theory)	20	20	60	2	-	-	100

Prerequisite: None	
Course Objectives	
1	To introduce the fundamental concepts of Artificial Intelligence (AI), intelligent agents, and the historical evolution and ethical considerations of AI.
2	To understand and implement various problem-solving and search techniques including uninformed and informed search strategies.
3	To learn and apply optimization techniques such as local search and genetic algorithms for solving AI problems.
4	To understand different methods of knowledge representation and reasoning including propositional and predicate logic.
5	To explore reasoning under uncertainty using probabilistic methods and belief networks.
6	To study planning approaches and machine learning paradigms such as supervised, unsupervised, and

	reinforcement learning.
Course Outcomes:	
1	Understand the basics of Artificial Intelligence, identify different types of intelligent agents and environments, and discuss ethical implications of AI.
2	Formulate problems as search problems and apply both uninformed and informed search algorithms, including game-playing strategies.
3	Apply optimization techniques such as hill climbing, simulated annealing, and genetic algorithms to solve real-world AI problems.
4	Represent knowledge using propositional and predicate logic, and apply inference mechanisms such as forward/backward chaining and resolution.
5	Model and reason under uncertainty using Bayesian networks and understand how to interpret probabilistic data structures.
6	Demonstrate knowledge of AI planning strategies and various types of learning including supervised, unsupervised, and reinforcement learning.

Module		Content	CO	Hours
1		**Introduction to Artificial Intelligence and Intelligent Agents**	CO1	06
	1.1	Introduction Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally, Intelligent Systems: Categorization of Intelligent Systems, Components of AI, Artificial Intelligence (AI), Responsible AI		
	1.2	Intelligent Agents: Introduction of agents, Structure and Characteristics of Intelligent Agent, Types of Agents: Simple Reflex, Model Based, Goal Based, Utility Based Agents, The concept of rationality, Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent, Learning Agents		
	1.3	History of AI, Applications of AI, The present state of AI, Ethics in AI		
2		**Problem Solving and Searching Techniques**	CO1 CO2	09
	2.1	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems		
	2.2	Solving Problems by Searching,Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality		

	2.3	Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Uniform Cost Search, Depth Limited Search, Depth First Iterative Deepening (DFID)		
	2.4	Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search		
	2.5	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning		
3		**Optimization and Adversarial Search**	CO3	05
	3.1	Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Local beam search, Genetic algorithms		
4		**Knowledge and Reasoning**	CO4	09
	4.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems.		
	4.2	Propositional Logic(PL), Predicate Logic:FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL		
	4.3	Forward Chaining, Backward Chaining and Resolution in FOPL, Ontological Engineering Categories and Objects, Events, Reasoning Systems for Categories.		
5		**Reasoning Under Uncertainty**	CO5	04
	5.1	Handling Uncertain Knowledge, Bayesian Belief Networks, Directed Acyclic Graphs, Reasoning in Belief Networks		
6		**Planning and Learning**	CO6	**06**
	6.1	The planning problem, Partial order planning, total order planning.		
	6.2	Types of Learning, Concepts of Supervised, Unsupervised, Semi -Supervised Learning, Reinforcement Learning, Ensemble Learning		
			Total	**39**

Textbooks	
1	Stuart J. Russell and Peter Norvig, "Artificial IntelligenceAModernApproach —SecondEdition" Pearson Education

2	Elaine Richand Kevin Knight—Artificial Intelligence‖ Third Edition,TataMcGraw-HillEducation Pvt. Ltd., 2008.
3	GeorgeF 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	DavisE. Goldberg,—Genetic Algorithms:Search, Optimization and MachineLearning‖,AddisonWesley,N.Y.,1989.
Useful Links	
	Resources
1	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2	https://nptel.ac.in/courses/106105077
	AI Tools
3	https://altair.com/altair-rapidminer
4	https://shorturl.at/jM33J
5	https://www.dataiku.com/
	Industry articles
6	**https://shorturl.at/MZgOv** **https://shorturl.at/K8VIr** **https://shorturl.at/21koY** **https://rb.gy/b19n5r**
	Case Studies
7	**https://shorturl.at/i53iD** **https://shorturl.at/uSJdT** **https://rb.gy/t4u82y** **https://rb.gy/ugzibx**

Internal Assessment:		
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.		
Continuous Assessment:		
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.		
Sr. No	**Rubrics**	**Marks**
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10 Marks
*For sr.no.7, the date of certification exam should be within the term and in case a student is unable to complete th certification, the grading has to be done accordingly.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
End Semester Theory Examination:		
1	Question Paper will comprise a total of six questions	

2	All Question carries equal Marks
3	Questions will be mixed in nature(For Ex.-Suppose question 2 has part (a) from module 3 then part (b) will be from any other module other than module 3
4	Only Four Questions need to be solved
5	In the question paper, the weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

ARTIFICIAL INTELLIGENCE (LAB)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMML41	Artificial Intelligence (Lab)	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMML41	Artificial Intelligence (Lab)	-	-	-	-	25	25	50

Lab Prerequisite: Mathematics for AI ML	
Lab Objectives	
1	To realize the basic techniques to build expert systems
2	To apply appropriate search techniques used in problem solving
3	To create knowledge base and apply reasoning for real world problems
4	To distinguish between various planning and learning techniques
Lab Outcomes	
1	Identify languages and technologies for Artificial Intelligence
2	Understand and implement uninformed, informed and local searching techniques for real world problems.
3	Create a knowledge base and apply reasoning using any AI language
4	Identify and analyze the appropriate planning and learning techniques.
5	Design and implement expert systems for real world problems.

Suggested Experiments: Students are required to complete at least 8 experiments.		
Star (*) marked experiments are compulsory.		
Sr. No.	**Name of the Experiment**	**LO**
1*	Identify and formulate an appropriate real world problem statement relevant to AI and define its PEAS descriptor and various properties of the environment.	LO1
2*	Implement Family Tree / Tower of Hanoi / Water Jug Problem in PROLOG	LO1
3*	Implement any one of the uninformed Searching algorithms (BFS / DFS / DLS / IDDFS) by identifying and analyzing the given problem to reach the goal state.	LO2
4*	Implement A* search algorithm by identifying and analyzing the given problem to reach the goal state.	LO2
5*	Implement Adversarial search for Game playing algorithms.	LO2
6*	Implement Local Search algorithm for optimization : Hill climbing search / Genetic Algorithm	LO2
7*	To create a knowledge base for a Rule based Expert System in a real world scenario using FOL in PROLOG.	LO3
8	Identify, analyze, implement a planning problem using PDDL	LO4
9	Implement passive or active reinforcement learning.	LO5
10	Implement AI trends using any one of the AI tools - Dreamstudio, Looka, Lumen5, Deep Nostalgia.	LO5

Useful Links	
1	https://www.analyticsvidhya.com/blog/2023/05/emerging-trends-in-ai-and-machine-learning
2	https://influencermarketinghub.com/ai-trends
3	https://www.forbes.com/sites/bernardmarr/2023/02/28/beyond-chatgpt-14-mind-blowing-ai-tools-everyone-should-be-trying-out-now/
Tools and Articles	
4	https://shorturl.at/AUzJQ
5	https://rb.gy/b19n5r

6	https://rb.gy/9z3p1z
7	https://microsoft.github.io/AI-For-Beginners/

Term Work	
1	Term work should consist of 8 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: INNOVATION AND ENTREPRENEURSHIP

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tut	Theory	TW/PR	Tut	Total
NCMEM41	Innovation and Entrepreneurship	--	---	02	--	--	02	02

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMEM41	Innovation and Entrepreneurship	—	—	—	–	25	—	25

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	
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 mindset and skills.

Module	Contents		Hours
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/tutorials 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.

COURSE NAME: FIELD PROJECT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
NCMFP41	**Field Project**	-	02	-	-	02	-	02

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in 2Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMFP41	**Field Project**	-	-	-	-	25	-	25

Prerequisite: Project Management, Communication Skills, Report writing	
Course Objectives	
1	To engage students in field visits, to identify and formulate problem statements based on observations during visits in industry, Government/Non- governmental organizations as well as the broader societal context.
2	To apply theoretical knowledge and foster creativity & innovation in addressing real-world problems.
3	To enhance student's analytical, design, problem-solving, and critical thinking skills to engage them in lifelong learning.
4	To develop teamwork skills to achieve project goals and deadlines.
5	To build Vocational or Skill Enhancement Course (VSEC) applications.
Course Outcomes	
1	Apply concepts learned in classrooms to real-world socioeconomic conditions enhancing their understanding and skills.
2	To apply appropriate techniques, resources, and modern engineering tools, to address the challenges faced to improve the analytical, design, and problem-solving skills by using emerging technologies.
3	Show insights into the challenges, opportunities and culture of socioeconomic diversity, preparing them for future roles as responsible citizens.
4	To cultivate effective teamwork abilities, and facilitate collaborations.
5	To provide technology solutions to real world problem.

6	To inculcate ethics, team building, and lifelong learning.

No.	Guidelines for field project
1	● Projects must address innovation, self-learning and societal problems and are conducted within the semester by a maximum of 4 students in a group. ● Apply open-source software for simulation, design, and documentation of the projects. **Project Topic Selection and Approval:** 1. The students are required to visit the industry/community/NGO to identify the problem and be able to provide proof of interaction work for 52-60 hours for 2 credits. 2. During the field visit, a questionnaire should be developed to survey the assigned problem statement. 3. A research proposal may be prepared based on the constraints identified from the data analyzed during the survey. 4. Topic selection and approval by the guide. **Suggested steps for project Implementation:** **a.** Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide **b.** The best solution must be integrated into a working model using various components of their domain areas for the Major course. **c.** A conceptual design of the proposed solution, including a detailed description of the selected algorithms and processes, needs to be documented. **d.** The final integrated best solution (prototype) is tested as per the stakeholders requirements. **e.** Gather feedback and plan for future improvements based on the insights received. **f.** A logbook be prepared by each group, wherein the group can record weekly work progress, and the guide can verify and record notes/comments. The logbook can be managed online with proper authentication methods using Google Sheets / Forms or open-source project management software. **g.** The solution is to be validated with proper justification and a report to be compiled in the standard format of the college.

2	The project report should include the problem statement, its objectives, survey, data collected, methodology applied, simulation results, conclusion, references etc. ● Follow the standard institutional format for documentation. ● Include justification of the solution, stakeholder feedback, and proposed improvements. **The final certification and acceptance of term work ensures satisfactory performance of project work and minimum passing marks in term work.**
3	Term work will be based on an assessment of Implementation and a Logbook which is filled by students weekly as per their weekly progress 1. Students have to give a presentation and demonstration on the Field Project. 2. During evaluation each student should be assessed for his/her contribution, understanding, and knowledge gained about the project completed.
4	Term Work evaluation will be based on reviews. 1. Assessment of case study report with analysis prepared by student groups: **15 marks** 2. Presentation by student groups and Q&A: **5 marks** 3. Attendance marked by guide in the logbook : **5 marks**
5	**Useful links:** **1. Sample Github Repository** **2. Template for Endorsement** **3. Report Template**

COURSE NAME: OPEN SOURCE LAB

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMPCL 41	Open Source Lab	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMPCL 41	Open Source Lab	-	-	-	-	25	25	50

Prerequisite: Data structures, Computer Architecture, Programming	
Lab Objectives	
1	Understand the basic concepts of operating systems and Computer Networks.
2	Gain knowledge of process management, File management, and Memory management.
3	To understand the operations performed by OSI layers
4	To understand the principles, protocols, and mechanisms of the data link, Network and transport layer for reliable and efficient end-to-end data transfer in the network.
Lab Outcomes	
1	Understand the basic concepts of Operating Systems and Computer Networks.
2	Demonstrate efficient scheduling and resource allocation strategies, optimizing CPU utilization and enhancing system performance.
3	Optimized memory allocation strategies significantly reduce system overhead and improve overall performance.
4	Demonstrate proficiency in configuring and troubleshooting data link layer protocols in simulated network environments for Media Access Control and collision detection.
5	Demonstrate the ability to design, analyze, and evaluate the impact of network layer protocols on overall network performance
6	Demonstrate proficiency in implementing and analyzing transport layer mechanisms like Congestion Control.

Suggested Experiments: Students are required to complete at least 8 experiments.Star (*) marked experiments are compulsory.	
List of Experiments	
1*	Introduction to Basic Commands
	1. Install a Linux distribution (e.g., Ubuntu) on a virtual machine using tools like VirtualBox or VMware.(Tools: VMware) 2. Exploring the user basic commands of Unix/Linux (creating groups, chown, chmod , directory name, tty, diff, umask etc.) 3. Understand and apply networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig,route)
2*	File System Management
	4. Creating, modifying, and deleting files and directories: ● Create a directory structure, add files, modify their content, and delete them. Implementation of System calls like printing a file, displaying file using Unix/Linux internals 5. Understanding file permissions and ownership: ● Set permissions for different users, change ownership of files, and explore the impact on access. 6. Implement Disk Scheduling: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK
3*	Process Management
	Implement Basic Process management algorithms (Any from FCFS , SJF , SRTN, RR ,multilevel Queue scheduling)Monitoring and controlling processes: Use tools like top or htop to monitor processes, and kill or suspend processes.
4*	Memory Management
	1. Simulation of paging or segmentation 2. To implement basic memory management algorithms(e.g., first fit, best fit)
5	Process Deadlocks: Implement two or more deadlock prevention or avoidance algorithms. (Banker's algorithm, Wait-Die, Wound-Wait, or Resource Allocation Graph algorithm)
6*	Apply network simulator tools (viz NS2 /Netsim) to understand the functioning of ALOHA, Carrier Sense Multiple Access / Collision Detection (CSMA/CD)
7*	Network Topology: To build a simple network topology and configure it for static routing protocol using GNS3. 1. Perform packet filtering by enabling IP forwarding using IPtables in GNS3. 2. Implement the above using routers and switches.
8*	To compare the Performance Analysis of Dynamic Routing Protocols (OSPF, RIP) using NS2/ Cisco packet tracer
9*	Simulation of ARP/RARP using Cisco Packet Tracer
10	To implement TCP Congestion Control using NS2

Useful Links	
1	https://swayam.gov.in/nd1_noc19_cs50/preview
2	https://nptel.ac.in/courses/117/106/117106113/
3	https://www.classcentral.com/course/swayam-introduction-to-operating-systems-6559
4	https://tutorials.ptnetacad.net/
5	https://www.nsnam.org/docs/tutorial/html/introduction.html
6	https://www.slideshare.net/DrPraveenJain1/netsim-user-manual
7	https://networklessons.com/cisco/ccna-200-301 https://www.cisco.com/c/en/us/support/docs/ip/open-shortest-path-first-ospf/7039-1.html
AI Tools	
1	Juniper Networks AI-Driven Enterprise: https://www.juniper.net/content/dam/www/assets/solution-briefs/us/en/enabling-the-ai-driven-enterprise.pdf
2	Zeek https://zeek.org
3	Moloch (Arkime) https://arkime.com/
4	OpenNMS https://www.opennms.com/
5	ntopng https://www.ntop.org/products/traffic-analysis/ntop/
Industry articles	
1	https://shorturl.at/qLeSI
2	https://shorturl.at/baOSd
3	https://www.elastic.co/blog/elastic-stack-generative-ai-telecommunication
Case Studies	
1	https://shorturl.at/DWYAX
2	https://shorturl.at/ZM2va
Virtual Lab	
1	https://naim30.github.io/OS-virtual-lab/

Term Work	
1	Term work should consist of at least 8 experiments.
2	The journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks(Experiments: 15-marks, Term work Assessment: 10-marks)
Practical & Oral Exam	
1	Based on the subjects PCC / Computer Networks and PCC / Operating System

MDM 1 SYLLABUS

Department of Computer Engineering

MDM 1 Teaching Scheme									
Course Type	Course Code	Course name	Teaching scheme (Contact Hours)			Credits assigned			Total
			Th	Pr	Tut	Th	Pr	Tut	
MDM	NCMMM31	Mathematics for AIML	3	-	1	3	-	1	4
MDM	NCMMM41/ NCMMML41	Artificial Intelligence	3	2	-	3	1	-	4

MDM1 Examination Scheme									
Course Type	Course Code	Course Name	Theory				Term Work	Pract & oral	Total
			Internal Assessment		End Sem Exam	Exam Duration (in Hrs)			
			Mid Test	CA					
MDM	NCMMM31	Mathematics for AIML	20	20	60	2	25	-	**125**
MDM	NCMMM41/ NCMMML41	Artificial Intelligence	20	20	60	2	25	25	**150**

COURSE NAME: MATHEMATICS FOR AIML

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM31	Mathematics for AIML	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMM31	Mathematics for AIML	20	20	60	02	25	-	125

Prerequisite: Set Theory and Calculus, Counting Principles, Permutation and combination.	
Course Objectives	
1	To equip the students with a working knowledge of probability, statistics, and modeling in the presence of uncertainties.
2	To understand the concept of hypothesis and significance tests.
3	To help the students to develop interest in random phenomena and to introduce both theoretical issues and applications that may be useful in practical life.
Course Outcomes	
1	Build the foundations for Probability via practical notions.
2	Understand random variable theory of discrete and continuous probability distributions.
3	Compute probability using probability distribution of discrete and continuous Random variable, Binomial, Poisson and Normal distribution etc.
4	Apply Testing of Hypothesis for different sample sizes
5	Apply and visualize various Statistical Techniques applied to datasets
6	Understand and apply basics of Linear Algebra for datasets and algorithms

Module		Content	CO	Hours
1		**Introduction to Probability**	CO1	03
	1.1	Definition and basics of Random experiment, Sample space, Events, Mutually exclusive and exhaustive events, Probability, Addition rule.		

	1.2	Conditional probability, Multiplication rule, Independent events, Total probability theorem, Bayes theorem.		
2	**Random Variables and its distributions**		CO2	10
	2.1	Discrete random variable, probability mass function, continuous random variable, probability density function, cumulative distribution function.		
	2.2	Joint probability distributions of two random variables: discrete and continuous, marginal and conditional distribution, independence of random variables.		
	2.3	Probability distribution of functions of one and two random variables.		
	2.4	Expectation, Variance, Covariance, Raw and Central Moments, Moment generating function.		
3	**Special Probability Distributions**		CO3	05
	3.1	Discrete Distributions: Binomial distribution, Poisson distribution.		
	3.2	Continuous Distribution: Normal distribution, Central limit theorem.		
4	**Test of Hypotheses**		CO4	08
	4.1	Hypothesis, Type-I, Type-II Errors, Level of Significance, Critical region, One-tailed and Two-tailed test.		
	4.2	Student's t-distribution (Small Samples test): i) Testing the Significance of the Difference between mean of sample and mean of Population ii) Testing the Significance of the Difference between mean of two samples (samples are independent) iii) Testing the Significance of the Difference between mean of two samples (samples are dependent)		
	4.3	z-test (Large Samples Test): Testing the Significance of the Difference between mean of sample and mean of Population, Testing the Significance of the Difference between mean of two samples (samples are independent), Chi-squared distribution		
	4.4	F-Test, ANOVA		
5	**Statistical Techniques**		CO5	06
	5.1	**Descriptive Statistics:** Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Measures of Kurtosis.		
	5.2	Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution.		
6	**Linear Algebra**		CO6	07

	6.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof)		
	6.2	Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		
	6.3	Similarity of matrices, diagonalizable and non-diagonalizable matrices		
			Total	**39**

Textbooks	
1.	Devore, J. L.: Probability & Statistics for Engineering and the Sciences, 8th edition, Cengage Learning, 2012.
2.	Gupta and Kapoor, Fundamental of Mathematical Statistics, S Chand
3.	David C. Lay, **Linear Algebra and Its Applications**, 5th Edition, Pearson.
4.	Palaniammal S, Probability and Random Processes, Prentice Hall India Learning Private Limited
Reference Books	
1.	Milton, J. S. and Arnold J. C.: Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th edition, Tata McGraw-Hill, 2007.
2.	Meyer, P. L.: Introductory Probability and Statistical Applications, 2nd edition, Addison-Wesley, 1970.
3.	Johnson, R. A., Miller: Freund's Probability and Statistics for Engineers, 8th edition, PHI, 2010.
4.	Ross, S. M.: Introduction to Probability Models, 11th edition, Academic Press, 2014.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2	https://www.coursera.org/learn/machine-learning-probability-and-statistics
AI tools and case studies	
1	https://medium.com/enjoy-algorithm/detailed-maths-topics-in-machine-learning-ca55cd537709
2	https://deepnote.com/
3	https://www.manim.community/
4	https://shorturl.at/FNieG
5	https://distill.pub/2019/visual-exploration-gaussian-processes/
6	https://shorturl.at/fSD1a
7	https://www.scilab.org/
8	https://octave.org/

Internal Assessment		
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.		
Continuous Assessment		
Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.		
Sr.No	**Rubrics**	**Marks**
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10 Marks
12	GATE Based Assignment tests/Tutorials etc	10 Marks
*For sr.no.7, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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.

Term Work	
1	**Term work should consist of at least 6 tutorials covering the entire syllabus**
2	The final certification and acceptance of term work ensures satisfactory performance of tutorials and minimum passing marks in term work.
3	**Total 25 Marks** **(Tutorials: 20-marks, Term work Assessment: 05-marks)**

COURSE NAME: ARTIFICIAL INTELLIGENCE

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM41	Artificial Intelligence (Theory)	03	---	---	03	---	---	03
NCMMML41	Artificial Intelligence (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMM41	Artificial Intelligence (Theory)	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMM41	Artificial Intelligence (Theory)	20	20	60	2	-	-	100

Prerequisite: None

Course Objectives

1	To introduce the fundamental concepts of Artificial Intelligence (AI), intelligent agents, and the historical evolution and ethical considerations of AI.
2	To understand and implement various problem-solving and search techniques including uninformed and informed search strategies.
3	To learn and apply optimization techniques such as local search and genetic algorithms for solving AI problems.
4	To understand different methods of knowledge representation and reasoning including propositional and predicate logic.
5	To explore reasoning under uncertainty using probabilistic methods and belief networks.
6	To study planning approaches and machine learning paradigms such as supervised, unsupervised, and reinforcement learning.

Course Outcomes:

1	Understand the basics of Artificial Intelligence, identify different types of intelligent agents and environments, and discuss ethical implications of AI.
2	Formulate problems as search problems and apply both uninformed and informed search algorithms, including game-playing strategies.
3	Apply optimization techniques such as hill climbing, simulated annealing, and genetic algorithms to solve real-world AI problems.
4	Represent knowledge using propositional and predicate logic, and apply inference mechanisms such as forward/backward chaining and resolution.
5	Model and reason under uncertainty using Bayesian networks and understand how to interpret probabilistic data structures.
6	Demonstrate knowledge of AI planning strategies and various types of learning including supervised, unsupervised, and reinforcement learning.

Module		Content	CO	Hours
1		**Introduction to Artificial Intelligence and Intelligent Agents**	CO1	06
	1.1	Introduction Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally, Intelligent Systems: Categorization of Intelligent Systems, Components of AI, Artificial Intelligence (AI), Responsible AI		
	1.2	Intelligent Agents: Introduction of agents, Structure and Characteristics of Intelligent Agent, Types of Agents: Simple Reflex, Model Based, Goal Based, Utility Based Agents, The concept of rationality, Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent, Learning Agents		
	1.3	History of AI, Applications of AI, The present state of AI, Ethics in AI		
2		**Problem Solving and Searching Techniques**	CO1, CO2	09
	2.1	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems		
	2.2	Solving Problems by Searching,Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality		
	2.3	Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Uniform Cost Search, Depth Limited Search,		

		Depth First Iterative Deepening (DFID)		
	2.4	Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search		
	2.5	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning		
3		**Optimization and Adversarial Search**	CO3	05
	3.1	Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Local beam search, Genetic algorithms		
4		**Knowledge and Reasoning**	CO4	09
	4.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems.		
	4.2	Propositional Logic(PL), Predicate Logic:FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL		
	4.3	Forward Chaining, Backward Chaining and Resolution in FOPL, Ontological Engineering Categories and Objects, Events, Reasoning Systems for Categories.		
5		**Reasoning Under Uncertainty**	CO5	04
	5.1	Handling Uncertain Knowledge, Bayesian Belief Networks, Directed Acyclic Graphs, Reasoning in Belief Networks		
6		**Planning and Learning**	CO6	**06**
	6.1	The planning problem, Partial order planning, total order planning.		
	6.2	Types of Learning, Concepts of Supervised, Unsupervised, Semi -Supervised Learning, Reinforcement Learning, Ensemble Learning		
			Total	**39**

Textbooks	
1	Stuart J. Russell and Peter Norvig, "Artificial IntelligenceAModernApproach —SecondEdition" Pearson Education

2	Elaine Richand Kevin Knight—Artificial Intelligence‖ Third Edition,TataMcGraw-HillEducation Pvt. Ltd., 2008.
3	GeorgeF 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	DavisE. Goldberg,—Genetic Algorithms:Search, Optimization and MachineLearning‖,AddisonWesley,N.Y.,1989.
Useful Links	
	Resources
1	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2	https://nptel.ac.in/courses/106105077
	AI Tools
3	https://altair.com/altair-rapidminer
4	https://shorturl.at/jM33J
5	https://www.dataiku.com/
	Industry articles
6	**https://shorturl.at/MZgOv** **https://shorturl.at/K8VIr** **https://shorturl.at/21koY** **https://rb.gy/b19n5r**
	Case Studies
7	**https://shorturl.at/i53iD** **https://shorturl.at/uSJdT** **https://rb.gy/t4u82y** **https://rb.gy/ugzibx**

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment:

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5 Marks
2	Literature review of papers/journals	5 Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5 Marks
4	Wins in the event/competition/hackathon pertaining to the course	10 Marks
5	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10 Marks
6	Project based Learning and evaluation / Extra assignment / Question paper solution	10 Marks
7	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10 Marks
8	Content beyond syllabus presentation	10 Marks
9	Creating Proof of Concept	10 Marks
10	Mini Project / Extra Experiments/ Virtual Lab	10 Marks
11	Peer Review and participation	5/10 Marks

*For sr.no.7, 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.

Indirect Assessment

1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture

End Semester Theory Examination:

1	Question Paper will comprise a total of six questions
2	All Question carries equal Marks
3	Questions will be mixed in nature(For Ex.-Suppose question 2 has part (a) from module 3 then part (b) will be from any other module other than module 3

4	Only Four Questions need to be solved
5	In the question paper, the weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

ARTIFICIAL INTELLIGENCE (LAB)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NCMMML42	Artificial Intelligence (Lab)	-	02	-	-	01	-	01

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NCMMML42	Artificial Intelligence (Lab)	-	-	-	-	25	25	50

Lab Prerequisite: Mathematics for AI ML	
Lab Objectives	
1	To realize the basic techniques to build expert systems
2	To apply appropriate search techniques used in problem solving
3	To create knowledge base and apply reasoning for real world problems
4	To distinguish between various planning and learning techniques
Lab Outcomes	
1	Identify languages and technologies for Artificial Intelligence
2	Understand and implement uninformed, informed and local searching techniques for real world problems.
3	Create a knowledge base and apply reasoning using any AI language
4	Identify and analyze the appropriate planning and learning techniques.
5	Design and implement expert systems for real world problems.

Suggested Experiments: Students are required to complete at least 8 experiments.

Star (*) marked experiments are compulsory.

Sr. No.	Name of the Experiment	LO
1*	Identify and formulate an appropriate real world problem statement relevant to AI and define its PEAS descriptor and various properties of the environment.	LO1

2*	Implement Family Tree / Tower of Hanoi / Water Jug Problem in PROLOG	LO1
3*	Implement any one of the uninformed Searching algorithms (BFS / DFS / DLS / IDDFS) by identifying and analyzing the given problem to reach the goal state.	LO2
4*	Implement A* search algorithm by identifying and analyzing the given problem to reach the goal state.	LO2
5*	Implement Adversarial search for Game playing algorithms.	LO2
6*	Implement Local Search algorithm for optimization : Hill climbing search / Genetic Algorithm	LO2
7*	To create a knowledge base for a Rule based Expert System in a real world scenario using FOL in PROLOG.	LO3
8	Identify, analyze, implement a planning problem using PDDL	LO4
9	Implement passive or active reinforcement learning.	LO5
10	Implement AI trends using any one of the AI tools - Dreamstudio, Looka, Lumen5, Deep Nostalgia.	LO5

Useful Links	
1	https://www.analyticsvidhya.com/blog/2023/05/emerging-trends-in-ai-and-machine-learning
2	https://influencermarketinghub.com/ai-trends
3	https://www.forbes.com/sites/bernardmarr/2023/02/28/beyond-chatgpt-14-mind-blowing-ai-tools-everyone-should-be-trying-out-now/
Tools and Articles	
4	https://shorturl.at/AUzJQ
5	https://rb.gy/b19n5r
6	https://rb.gy/9z3p1z
7	https://microsoft.github.io/AI-For-Beginners/

Term Work	
1	Term work should consist of 8 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)

SE OPEN ELECTIVE 1

List of Open Elective 1

Open Elective 1		
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

Course Code	Teaching Scheme (Teaching Hours)			Credits Assigned			
	Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE406	03	-	01	03	-	01	04

Course Code	Examination Scheme						
	Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
	Internal Assessment		End Sem Exam				
	Mid-Term Test	Continuous Assessment					
NOE406	20	20	60	02	-	-	100

COURSE NAME: GREEN TECHNOLOGIES & PRACTICES

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE406	Green Technologies and Practices (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE406	Green Technologies and Practices (Theory)	20	20	60	02	-	-	100

Rationale: Technology is application of knowledge to practical requirements. Green technologies encompass various aspects of technology which help us reduce the human impact on the environment and create ways of sustainable development. Social equitability, economic feasibility and sustainability are the key parameters for green technology. Today, the environment is racing towards the tipping point at which we would have done permanent irreversible damages to the planet earth. Our current actions are pulling the world towards an ecological landslide which if happens would make destruction simply inevitable. Green technologies are an approach towards saving the earth and are necessary. Green technologies are our way out of destruction.

Course Objectives	
1	To acquire knowledge on the concept of green technologies
2	To understand the principles of Green Chemistry in the Energy efficient technologies.
3	To analyze the methods of reducing CO2 levels in atmosphere for Cleaner Production Project Development and Implementation
4	To evaluate the methods of Pollution Prevention and Cleaner Production Awareness Plan.
5	To analyze the application of Energy Efficacy.
6	To apply the knowledge of Green Fuels during implementation.
Course Outcomes	
1	Enlist different concepts of green technologies in a project.

2	Describe the principles of Green Chemistry in the Energy efficient technologies.
3	Select the best method for the carbon credits of various activities for Cleaner Production Project Development and Implementation.
4	Evaluate the importance of life cycle assessment for Pollution Prevention and Cleaner Production Awareness Plan.
5	To apply the problems related to Pollution Prevention and Cleaner Production Awareness Plan.
6	To choose the green fuels based on their benefits for sustainable development.

Module	Contents		Honors
1	**Introduction to Green Technology**		07
	1.1	Definition- Importance – Historical evolution – advantages and Disadvantages of green technologies.	
	1.2	Factors affecting green technologies.	
	1.3	Role of Industry, Government and Institutions-Industrial Ecology.	
	1.4	Role of industrial ecology in green technology.	
2	**Green Chemistry**		08
	2.1	Principles of Green Chemistry, Green chemistry metrics-atom economy.	
	2.2	E factor, reaction mass efficiency.	
	2.3	Waste: Sources of waste, different types of waste.	
	2.4	Chemical, physical and biochemical methods of waste minimization.	
	2.5	Clean development mechanism: reuse, recovery & recycle.	
	2.6	Raw material substitution: Wealth from waste, case studies.	
3	**Cleaner Production Project Development and Implementation**		09
	3.1	Overview of CP Assessment Steps and Skills, Process Flow Diagram.	
	3.2	Material Balance, CP Option Generation: Technical and Environmental Feasibility analysis.	
	3.3	Economic valuation of alternatives: Total Cost Analysis – CP Financing.	
	3.4	Preparing a Program Plan: Measuring Progress-ISO 14000.	
4	**Pollution Prevention and Cleaner Production Awareness Plan**		10
	4.1	Waste audit: Environmental Statement.	
	4.2	Carbon credit, Carbon trading, Carbon footprint.	

	4.3	Carbon sequestration.	
	4.4	Life Cycle Assessment- Elements of LCA.	
	4.5	Life Cycle Costing.	
	4.6	Eco Labelling.	
5	**Energy Efficacy**		08
	5.1	Availability and need of conventional energy resources: major environmental problems related to the conventional energy resources.	
	5.2	Future possibilities of energy need and availability.	
	5.3	Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices.	
	5.4	Solar Energy: principles, working and application.	
6	**Green Fuels**		10
	6.1	Definition-benefits and challenges: comparison of green fuels with Conventional fossil fuels with reference to environmental, economic and social impacts- public policies and market driven initiatives.	
	6.2	Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes.	
	6.3	Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context.	
	6.4	Tidal and geothermal energy.	
		Total	**52**

Textbooks	
1	Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
2	Pollution Prevention and Abatement Handbook –Towards Cleaner Production by World bank Group (1998), World Bank and UNEP, Washington D.C.
3	Cleaner Production Audit by Prasad Modak, C. Visvanathan and Mandar Parasnis (1995), Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok
4	Handbook of Organic Waste Conversion by Bewik M.W.M.
5	Solar Energy by Sukhatme S.P.
Reference Books	
1	Energy, The Solar Hydrogen Alternative by Bokris J.O.

2	Non-conventional Energy Sources by Rai G.D.
3	Waste Energy Utilization Technology by Kiang Y. H.
4	Wind, Tidal, Geothermal, Biomass and Non–conventional energy Green fuel by G.D.Rai.

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5
2	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5
3	Wins in the event/competition/hackathon pertaining to the course	10
4	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10
5	Content beyond syllabus presentation	10
6	Creating Proof of Concept	10
7	Mini Project / Extra Experiments/ Virtual Lab	10
8	Peer Review and participation	5/10
9	GATE Based Assignment tests/Tutorials etc	10

*For sr.no.4, 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.

Indirect Assessment

1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture

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: FUTURISTIC POWER SYSTEMS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE407	Futuristic Power systems (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE407	Futuristic Power systems (Theory)	20	20	60	02	-	-	100

Course Objectives: Students will be learning,	
1	To explore the state of the art and future trends in power systems.
2	To understand the technical, economic and social challenges in power system evolution.
3	To realize the role and importance of Microgrids if futuristic power systems.
Course Outcomes: Students should be able to,	
1	To solicit the importance of large scale renewable energy integration with existing grid infrastructure.
2	To understand the importance and utility of Energy storage systems in futuristic power systems.
3	To explore large scale microgrid deployment with RES and ESS integration.
4	To understand the role of communication and IT Infrastructure in the power system and related challenges.
5	To explore the potential of Microgrids and its importance in the Indian context.

Module	Contents	Hours
1	**Introduction:** Present status of worldwide scenario of electricity generation, transmission and distribution; Energy infrastructure-Resilience and Security; Social, Technical and economic challenges; Major trends driving power system evolution; State of the art technologies in power system.	06

2	**Renewable Energy Integration:** Review of renewable energy (RE) resources and systems: Solar- PV, Solar Thermal, Wind, Biomass, Micro-hydro and Fuel Cell, comparison of various RE resources; Renewable Energy Policies and present status of integration with existing grid; Large scale integration of renewable energy Technical challenges, enabling technologies, International requirements; Renewable energy forecasting	12
3	**Energy Storage Systems (ESS):** Review of energy storage components: Battery, VRB, Ultra-capacitor, Fuel Cells, Pumped Hydro-Storage and flywheels, comparison of ESS technologies; Importance of ESS in futuristic power systems; Aggregated ESS, Distributed ESS; Applications of ESS: Energy Management (Load Leveling and Peak Shifting), Fluctuation Suppression (Intermittency Mitigation), Uninterruptible Power System Low-Voltage Ride Through; Placement of the ESS to Improve Power Quality, Voltage Regulation Using ESS, ESS as Spinning Reserve.	12
4	**Micro-grid and Smart-grid:** Micro-grid evolution: Micro-grid concept, importance in futuristic power system, basic architectures and control, objectives and state of the art technologies; Microgrid as a building block of Smart-grid; Smart-grid concept, Smart Grid versus conventional electrical networks, Smart-grid infrastructure, Smart Grid communication system and its cyber security, International standard IEC 61850 and its application to Smart-grid; Microgrids /smart grid and Electric Vehicles integration. Technical, Economic, Environmental and Social Benefits of Microgrid Operation.	12
5	**Communication and IT infrastructure:** Requirements of Communication and IT infrastructure in futuristic power systems: various communication protocols, comparison of performance; IEEE standard: IEEE 802.11 Mesh Networking, IEEE 802.15.4-Wireless Sensor Networks; Communications Technologies for Smart metering; Cyber security issues and mitigation techniques.	06
6	**Microgrids in India:** Microgrids for Rural Electrification, Review of Microgrid Best Practices through Case Studies: Strategic Planning, Operations: Commercial and Financial Considerations; Technical and Social Context.	06
	Total	52

Textbooks	
1	Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
2	Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015

3	Introduction to the Smart Grid- Concepts, Technologies and Evolution by Salman K. Salman, IET, 2017
4	Energy Storage Systems and Components by Alfred Rufer, CRC Press, 2018
Reference Books	
1	Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2nd Edition-2016, CRC
2	Clean Energy Microgrids, Edited by Shin'ya Obara and Jorge Morel IET, 2017
3	Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elsevier WoodHead Publishing, 2018
4	Smart Microgrids: Lessons from Campus Microgrid Design and Implementation edited by Hassan Farhangi, CRC Press 2017
Website Reference / Video Courses:	
1	NPTEL Web Course on: DC Microgrid And Control System Prof. Avik Bhattacharya, IIT Roorkee
2	NPTEL Web Course on Electronics and Distributed Generation Dr. Vinod John Department of Electrical Engineering IISc Bangalore
3	NPTEL Web Course on Introduction to Smart Grid, PROF. N.P. PADHY Department of Electrical Engineering IIT Roorkee PROF. PREMALATA JENA Department of Electrical Engineering
4	NPTEL Web Course on Electric vehicles and Renewable energy, Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5
2	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5
3	Wins in the event/competition/hackathon pertaining to the course	10
4	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10
5	Content beyond syllabus presentation	10
6	Creating Proof of Concept	10

7	Mini Project / Extra Experiments/ Virtual Lab	10
8	Peer Review and participation	5/10
9	GATE Based Assignment tests/Tutorials etc	10
*For sr.no.4, 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.		
Indirect Assessment		
1	Mock Viva/Practical	
2	Skill Enhancement Lecture	
3	Extra Assignments/lab/lecture	
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: SENSORS AND ACTUATORS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE408	Sensors and Actuators (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE408	Sensors and Actuators (Theory)	20	20	60	02	-	-	100

Course Objectives	
1	To explain the measurement systems, errors of measurement.
2	To provide an understanding of the operation of sensors and transducers.
3	To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used in Industry for Temperature, Pressure , Level & Flow measurement
4	To provide an understanding of the various types of actuation systems
Course Outcomes	
1	Explain the measurement systems, errors of measurement. List and compare various standards used for selection of transducers/sensors.
2	Describe the operation of sensors employed in Industrial applications.
3	Describe the working principles of Temperature transducers and Pressure sensors and their applications
4	Explain the working of different transducers for Flow and Level measurement
5	Explain different actuating systems like Pneumatic and Hydraulic
6	Describe the working principle of various electrical actuators and compare Pneumatic, Hydraulic and electric actuators.

Module	Content	Hrs

1	**Introduction to Measurement Systems**		06
	1.1	Introduction, Block diagram, Functional elements of measurement system, Static and Dynamic characteristics of transducers. Errors, Remedies for Errors.	
	1.2	Definition of Sensor & Transducer, classification, selection criteria, Need for sensors and Transducers.	
		Tutorial: 2	02
2	**Industrial Sensors**		06
	2.1	Principle,Construction and working of - resistive sensors, inductive sensors, capacitive sensors, piezoelectric sensors, encoders, tachometers and strain gauge	
	2.2	Panel and Industrial switches**:** Toggle, Push button, proximity, tactile, Temperature, Flow, Level and, Pressure Switch, Vibration switch	
		Tutorial : 2	02
3	**Temperature and Pressure Measurement**		07
	3.1	Definition and different Temperature scales.	
	3.2	Resistance Temperature Detector (RTD): Principle, types, configuration, construction ,working and characteristics of RTD	
	3.3	Thermocouple: Principle, thermo electric effect, See-beck effect, Peltier effect, Laws of thermocouple, types of thermocouples with characteristic curve, Thermocouple specifications, cold junction compensation method	
	3.4	Thermistor, NTC & PTC Types, application,Characteristics	
	3.5	**Pressure**- Pressure scales, units and relations, classification, elastic elements like bourdon tube, diaphragm, bellows, properties and selection	
		Tutorial : 3	03
4	**Flow and Level Measurement**		07
	4.1	Introduction to fluid flow: types of fluid, continuity equation. Bernoulli's equation, hydrostatic law, Pascal's law	
	4.2	Orifice, Venturi, nozzle, characteristics of Head type flow meters, Rotameter, Magnetic flow meter, Mass flow meter, Vortex flow meter, ultrasonic	
	4.3	**Level Measurement:** Need for level measurement, classification of Level Measurement Techniques.Construction and working of Tubular level gauge, DP cell, ultrasonic, Capacitance and Radar.	
		Tutorial : 2	02
5	**Pneumatic and Hydraulic System**		07
	5.1	**Pneumatic components**: ISA symbols, Instrument Air and Plant Air. Air compressor system and its accessories.	

	5.2	Linear actuators- Single-acting, Double-acting	
	5.3	Directional control valves , Flow control valves, Sequence valves, Pneumatic logic gates, Pneumatic Circuits-Standard Symbols used for developing pneumatic circuits,	
	5.4	**Hydraulic components**: Hydraulic pumps, Pressure regulation method, Loading valves, Hydraulic valves.	
		Tutorial : 2	02
6	6.1	**Electric Actuators** Definition, types and selection of Actuators. Electrical actuating systems: Electric Motors- Principle of operation and its application: D.C motors - AC motors,- Stepper motors.and servo motor	06
	6.2	**VFD:** introduction and Need, working of AC & DC drives. Selection and comparison of pneumatic, hydraulic and electric systems	
		Tutorial : 2	02
		Total	**52**

Textbooks	
1	B.C Nakra, K.K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003 - Electronic instruments.
2	Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003).
3	A. K. Sawhney, Puneet Sawhney,A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996.
4	Andrew Parr, Hydraulic &pneumatics; A Technicians & Engineers Guide, Second Edition.
Reference Books	
1	Andrew Williams, "Applied instrumentation in the process industries", 2 nd Edition, Vol. 1 & 3, Gulf publishing company. Doeblin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.
2	Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3	Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
4	Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005. S.P.
5	Sukhatme, Heat Transfer, 3rd edition, University Press.
6	B.E. Jones, Instrument Technology.
7	Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.

8	Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition.
9	Sawhney A.K., ―Mechanical Measurement‖, Dhanpatrai And Co.
10	Bansal R.K., ―Fluid Mechanics and Hydraulic Machines‖, Laxmi publications.
11	David W. Spitzer, ―Industrial Flow Measurement‖, ISA Publication.

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Multiple Choice Questions (Quiz)	5
2	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	5
3	Wins in the event/competition/hackathon pertaining to the course	10
4	NPTEL/ Coursera/ Udemy/any MOOC Certificate course for 4 weeks or more	10
5	Content beyond syllabus presentation	10
6	Creating Proof of Concept	10
7	Mini Project / Extra Experiments/ Virtual Lab	10
8	Peer Review and participation	5/10
9	GATE Based Assignment tests/Tutorials etc	10

*For sr.no.4, 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.

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture

3	Extra Assignments/lab/lecture
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: FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE409	Fundamentals of Additive Manufacturing Technologies (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE409	Fundamentals of Additive Manufacturing Technologies (Theory)	20	20	60	02	-	-	100

Course Objectives	
1	Understanding of different additive manufacturing technologies for realizing metallic and non-metallic objects.
2	Link computer interface with the digital manufacturing process and their demonstration using commercially available software
3	Develop a fundamental understanding of different perspectives and recent development in this Additive Manufacturing field
4	Oriented to cover from basic understanding to practical applications of this technology to develop the products
Course Outcomes	
1	Interpet an STL CAM file for manipulation
2	Design 3D files using Open Source 3D CAD modeler
3	Describe Liquid Additive Manufacturing Process
4	Describe The Additive Manufacturing Process
5	Describe Wire based Additive Manufacturing Process
6	Describe Powder Feed-based Additive Manufacturing Process

Module	Content	Hours
1	Introduction to Additive Manufacturing(AM), Solid Modeling CAM Modelling For AM, STL File Structure and Configurations Orientation of STL File, Support Structure, Optimal Part Orientation, Classification of Slicing Method, Uniform Slicing of STL files, Adaptive Slicing of STL files, ToolPath Plannings.	08
2	Introduction to code-based 3D modeling software OPENSCAD, OPENSCAD Software 3D shapes, Transformations, Boolean operations, Data types & variables Flow control, Modules and functions, List comprehension,2D primitives, Extruding 2D primitives into 3D shapes.	06
3	Liquid AM classification, Photo Polymerization and classification, StereoLithography process (SLA) Fundamentals, SubSystems, Apparatus, Perfactory 3D printing methods, PolyJet 3D printing, AutoStrade's Edart, Solid Ground Curing, Microstereolithography, Robotic SLA	07
4	Sheet AM Cubic Technologies AM, Kira Paper Lamination Technology, Solidimentation Plastic Sheet Lamination, CAM-LEM, Ennex Corporations Offset Fabbers.	06
5	Classification of Wire AM, Fused Deposition Modelling, Metal Wire AM, Shape Deposition Manufacturing, Electron Beam based Wire beam AM, Laser Metal Wire AM.	06
6	Powder Feed AM, Process Modelling of Powder Feed AM, Laser Beam Based Powder Feed AM, Electron Beam Based Powder Feed AM, Binder Based Powder Feed AM.	06
	Total	39

List of Suggested Tutorials (13 Hours)

Sr. No	Demonstration/Practical
1	Installation with OpenSCAD
2	Making and manipulating a Cube using OpenSCAD
3	Making cylinder and rotating objects
4	Scaling your Model
5	The sphere primitive and resizing objects
6	Defining and using modules
7	Creating and utilizing modules as separate scripts
8	OpenSCAD variables
9	Creating repeating patterns of parts/models - For loops
10	Rotationally extruding 3D objects from 2D objects

11	Doing math calculations in OpenSCAD
12	Slicing your Model using 3D printer software
13	Configuring a 3d Printer

Note: Suggested List of Tutorials is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging tutorials, (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

Textbooks:	
1	Introduction To Additive Manufacturing (Paperback, Dr. Sridhar S, Natesh C P).
2	Rapid Prototyping to Direct Digital Manufacturing Gibson l D. W. Rosen l B. Stucker

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/anyMOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
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: - RELIABILITY ENGINEERING

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE410	Reliability Engineering (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE410	Reliability Engineering (Theory)	20	20	60	02	-	-	100

Course Objectives:	
1	To impart various aspects of probability theory.
2	To impart various aspects of system reliability.
3	To understand Maintainability and Availability.
4	To understand Failure Mode, Effects and Criticality Analysis procedure.
Course Outcomes	
1	Understand, apply, and analyze the concept of Probability to engineering problems.
2	Demonstrate various reliability concepts to calculate different reliability parameters.
3	Understand the design for Maintainability and Availability.
4	Compute Failure Mode Effects and Criticality Analysis.

Module		Contents	Hours
1		**Probability theory**	08
	1.1	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.	
	1.2	Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	

		Tutorial on Module 1	02
2	**Reliability Concepts**		08
	2.1	Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time to Failure (MTTF), MTBF, Reliability Functions.	
	2.2	Reliability Hazard Models: Constant Failure Rate, linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	
	Tutorial on Module 2		02
3	**System Reliability**		04
	3.1	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	
	Tutorial on Module 3		02
4		**Reliability Improvement**	07
	4.1	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success, Path method, Decomposition method.	
	Tutorial on Module 4		02
5	**Maintainability and Availability**		07
	5.1	System downtime, Design for Maintainability: Maintenance requirements.	
	5.2	Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
	Tutorial on Module 5		02
6	**Failure Mode, Effects and Criticality Analysis**		05
	6.1	Failure mode effects analysis: severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis.	
	Tutorial on Module 6		03
		Total	52

Textbooks:	
1	L.S. Srinath, Reliability Engineering, "Affiliated EastWast Press (P) Ltd, 3rd Edition
2	Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw Hill, 4th Edition.
3	B. S. Dhillion C. Singh, Engineering Reliability, John Wiley & Sons,5th edition
Reference books:	
1	P.D.T. Conor, Practical Reliability Engg. John Wiley & Sons,3rd Edition.

2	K.C. Kapur, L.R. Lamber son, Reliability in Engineering Design, John Wiley & Sons,3rdEdition.
3	Murray R. Spiegel, Probability and Statistics, Tata McGraw-Hill Publishing Co. Ltd.,5th edition.

Internal Assessment

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.

Continuous Assessment

Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. It should be minimum 2 or maximum 4 from the following table.

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
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: DISASTER MANAGEMENT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE411	Disaster Management (Theory)	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme						
		Theory			Exam Duration (in Hrs)	Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam				
		Mid-Term Test	Continuous Assessment					
NOE411	Disaster Management (Theory))	20	20	60	02	-	-	100

Course Objectives	
1	To understand causes of different types of natural and man-made disasters, global warming, climate change and their effects.
2	To understand causes of different types of mitigation /rehabilitation measures.
3	To understand existing government policies and agencies.
4	To understand financing relief, preventive and mitigation measures.
Course Outcomes	
1	Analyze the impact of global warming, climate change and control their effects on the living and non- living things.
2	Compare and contrast with / from natural disasters and manmade disasters.
3	Make policies and design systems and structures to mitigate the effects of natural and manmade disasters.
4	Prepare the system for increasing public awareness regarding preparation and execution of emergency management programs and the role of various national institutes for disaster management.
5	Implement the resources of financial relief measures.
6	Analyze and implement preventive and mitigation measures in case of disasters.

Module	Contents		Hours
1	**Introduction**		04
	1.1	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters.	
	1.2	Introduction to global warming and climate change.	
		Tutorial on Module 1	02
2	**Natural Disaster and Manmade disasters**		07
	2.1	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion.	
	2.2	Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	
		Tutorial on Module 2	02
3	**Disaster Management, Policy and Administration**		07
	3.1	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management Policy and administration:	
	3.2	Importance and principles of disaster management policies, command and coordination of disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
		Tutorial on Module 3	02
4		**Institutional Framework for Disaster Management in India**	07
	4.1	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.	
	4.2	Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and software's for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard	
		Tutorial on Module 4	02
5		**Financing Relief Measures**	07
	5.1	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well	

		as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters.	
	5.2	Ways to approach these teams. International relief aid agencies and their role in extreme events.	
		Tutorial on Module 5	**02**
6		**Preventive and Mitigation Measures**	07
	6.1	Pre-disaster, during disaster and post-disaster measures in some events in general. Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication.	
	6.2	Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	
		Tutorial on Module 6	03
		Total	52

Textbooks:	
1	Harsh K.Gupta ,Disaster Management, Universities PressPublications,1st edition,2003
2	O.S.Dagur,Disaster Management: An Appraisal of Institutional Mechanisms in India,Centre for land warfare studies,1st edition,2011.
3	Rajdeep Dasgupta,Disaster management & rehabilitation, Mittal Publications,1st edition,2019.
Reference books:	
1	Jack Pinkowski,Disaster Management Handbook, CRC Press Taylor and Francis group, 1st edition,2008.
2	R B Singh,Natural Hazards and Disaster Management, Vulnerability and Mitigation,Rawat Publications, 1st edition,2006.
3	C.P. Lo Albert, K.W. Yonng,Concepts and Techniques of GIS,Prentice Hall (India) Publications.,2nd edition,2016
Industry articles and case studies:	
1	https://www.britannica.com/event/Chernobyl-disaster
2	https://en.wikipedia.org/wiki/Maharashtra_floods_of_2005

Internal Assessment
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. The Mid Term test is to be conducted when approximately 50% syllabus is completed and its duration will be one hour.
Continuous Assessment
Continuous Assessment is of **20 marks.** The rubrics for assessment will be considered on approval by the

subject teachers. It should be minimum 2 or maximum 4 from the following table.		
Sr. No	**Rubrics**	**Marks**
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

Indirect Assessment	
1	Mock Viva/Practical
2	Skill Enhancement Lecture
3	Extra Assignments/lab/lecture
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.