

Pimpri Chinchwad Education Trust's

# Pimpri Chinchwad University

Sathe, Pune - 412106



PCET's  
Pimpri  
Chinchwad  
University

Learn | Grow | Achieve

## Curriculum Structure

**Executive M. Tech CSE (Artificial Intelligence)**

**(Batch: 2024-2026)**

**School of Engineering and Technology**



Effective from Academic Year 2024-25

## Program Structure

### **Preamble:**

The curriculum of B. Tech Computer Science and Engineering program offered by the Department of Computer Science Engineering under Academic Regulation of NEP 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Maharashtra State Council of Higher Education, National Higher Education Qualifications Framework (NHEQF) and National Credit Framework (NCrF). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like AICTE, ACM and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders. The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments.

After due deliberations, the scheme and syllabus have been formulated. Salient features of this model curriculum are enumerated as under:

1. Reduced number of credits.
2. Well defined learning objectives & outcomes for each course.
3. Inclusion of courses on socially relevant topics.
4. Built-in flexibility to the students in terms of professional elective and open elective courses and minor course.
5. Mandatory internship to equip the students with practical knowledge and provide them exposure to real time industrial environments.
6. Mapping of Courses to its equivalent NPTEL/SWAYAM Course.

### **Vision and Mission of Program:**

#### **Vision:**

To develop engineers well versed with Critical Theory and Practical's (problem solving ability and sensitive to National and Global challenges from Inter-disciplinary perspective. To create Industry ready; socially and ethically strong professionals.

#### **Mission:**

Our mission is

- To develop the Computer Professionals by imparting computer engineering knowledge with professional ethics.
- To provide the service to the communities to which we belong at local and national levels, combined with a deep awareness of our ethical responsibilities to our profession and to society.

### Program Educational Objectives:

Program Educational Objectives (PEOs) for a BTECH in Computer Science and Engineering program are as follows:

- **PEO 1:**To provide students with knowledge and skills to become leading experts in the field of computer science engineering.
- **PEO2:**To provide an innovative and comprehensive curriculum that integrates theoretical knowledge with practical experience, research opportunities, and professional development
- **PEO 3:**To groom the student's overall personality for professional growth.
- **PEO 4:**To inculcate values and ethics among the students and making them aware about their social commitments.

### Program Outcome

Program Outcomes (POs) At the end of program, students should be able to

<b>PO 1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Object

Program Specific Outcomes (PSOs) At the end of program, students should be able to

<b>PSO1</b>	Use knowledge to write programs and integrate them with the hardware/software products in the domains of artificial Intelligent systems, data Science, networking and web technology.
<b>PSO2</b>	Participate in planning and implement solutions to cater to business specific requirements, displaying team dynamics and professional ethics.

## **Executive M. Tech CSE (Artificial Intelligence)**

### **Hybrid Mode (Online /In Campus)**

Programme Features AI is set to transform business like never before, creating new opportunities for entrepreneurs, business leaders and workers in every industry. PCU Executive M. Tech in Artificial Intelligence programme has been designed for professionals across industries, looking to gain hands-on knowledge of AI implementation while building the next generation business models. Who is this Programme for? Early to Mid Level Professionals seeking career growth This programme is aimed to provide hands-on knowledge of AI implementation especially in the areas of Speech Technologies, Computer Vision and Natural Language Processing to early-career enthusiasts such as: Data Analysts, Business Analysts, Data Scientists, ML Engineers, Computer Programmers, Developers, Software Engineers.

### **Programme Highlights**

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1. M.Tech. Artificial Intelligence and Machine Learning is a PCU (PimpriChinchwad University) in Work Integrated Learning Programme (WILP). PCU Work Integrated Learning Programmes are UGC approved.
2. This programme is of 4 semesters and can be pursued only by working professionals. You can pursue the programme without any career break.
3. The programme will also enable working professionals to attend contact classes from anywhere over a technology-enabled platform. The contact classes will be conducted mostly on weekends or after business hours.
4. Meant for IT professionals and Software developers aiming to become expert Machine Learning Engineers & AI Scientists.
5. The programme uses a Continuous Evaluation System that assesses the learners over convenient and regular intervals. Such a system provides timely and frequent feedback and helps busy working professionals stay on course with the programme.
6. The education delivery methodology is a blend of classroom and experiential learning. Experiential learning consists of Virtual lab exercises, assignments, case studies and work-integrated activities.
7. Participants who successfully complete the programme will become members of an elite & global community of PCU (PimpriChinchwad University) Alumni

## INDEX

Sr. No.	Content	Pg. No.
1.	Curriculum Framework	
2.	Tentative list of Electives. Open Electives, Life Skill Courses, Proficiency Foundation Courses, HSMC Courses, Minor courses	
3.	Course Code Nomenclature	

Sr. No.	Type of course	Abbreviations
1	Basic Science Course (BSC)	<b>BSC</b>
2	Engineering Science Course(ESC)	<b>ESC</b>
3	Programme Core Course (PCC)	<b>PCC</b>
4	Programme Elective Course (PEC)	<b>PEC</b>
5	Multidisciplinary Minor (MD M)	<b>MIN</b>
6	Open Elective (OE) Other than a particular program	<b>OE</b>
7	"Vocational and Skill Enhancement Course (VSEC)"	<b>VSEC</b>
8	Ability Enhancement Course (AEC -01, AEC-02)	<b>AEC</b>
9	Entrepreneurship/Economics/ Management Courses	<b>MGMT</b>
10	Indian Knowledge System (IKS)	<b>IKS</b>
11	Value Education Course (VEC)	<b>VEC</b>
12	Research Methodology	<b>RM</b>
13	Comm. Engg. Project (CEP)/Field Project (FP)	<b>CEP/FP</b>
14	Project	<b>PROJ</b>
15	Internship/ OJT	<b>OJT</b>
16	Co-curricular Courses (CC)	<b>CC</b>
17	Massive Open Online Courses (MOOC)	<b>MOOC</b>

## SEMESTER - I

Course Code	Course Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	CREDITS	HRS	CIA	ESA	PR/OR	Total
PMTAI501	PCC	Research Methodology and IPR	3	-	-	3	3	40	60	-	100
PMTAI502	PCC	Artificial Intelligence and Knowledge Representation	3	-	-	3	3	40	60	-	100
PMTAI503	PCC	Artificial Intelligence and Knowledge Representation Lab	-	1	-	1	2	25	-	25	50
PMTAI504	PCC	Machine Learning Techniques	3	-	-	3	3	40	60	-	100
PMTAI505	PCC	Machine Learning Techniques Lab	-	1	-	1	2	25	-	25	50
PMTAI601	PCC	MOOC 1	2		1	3	3	40	60	-	100
PMTAI507	PCC	Seminar and Research Paper Writing I		4	-	4	4	50		50	100
		<b>Total</b>	<b>11</b>	<b>6</b>	<b>1</b>	<b>18</b>	<b>20</b>	<b>260</b>	<b>240</b>	<b>100</b>	<b>600</b>

## SEMESTER - II

Course Code	Course Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	CREDITS	HRS.	CIA	ESA	PR/OR	Total
PMTAI509	PCC	Deep Learning Techniques	3	-	-	3	3	40	60	-	100
PMTAI510	PCC	Deep Learning Techniques Laboratory	-	1	-	1	2	25	-	25	50
PMTAI511	PCC	Natural Language Processing	3	-	-	3	3	40	60	-	100
PMTAI512	PCC	Natural Language Processing Lab	-	1	-	1	2	25	-	25	50
PMTAI513	PCC	Applied Statistical Techniques	4	-	-	4	4	40	60	-	100
PMTAI516	PCC	Seminar and Research Paper II		4	-	4	4	50	-	50	100
PMTAI603	PROJ	Project Phase I		10	-	5	20	100	-	100	200
		<b>Total</b>	<b>10</b>	<b>16</b>	<b>0</b>	<b>21</b>	<b>38</b>	<b>320</b>	<b>180</b>	<b>200</b>	<b>700</b>

### SEMESTER - III

Course Code	Course Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	CREDITS	HRS.	CIA	ESA	PR/OR	Total
PMTAI506	PCC	Advanced Software Engineering and Project Management	3	-	-	3	3	40	60	-	100
PMTAI602	PCC	MOOC 2	2		1	3	3	40	60		100
PMTAI603	PROJ	Project Phase II		<b>20</b>	-	10	20	200	-	200	400
PMTAI516	PCC	Seminar and Research Paper III		4	-	4	4	50	-	50	100
		<b>Total</b>	<b>5</b>	<b>24</b>	<b>1</b>	<b>20</b>	<b>30</b>	<b>290</b>	<b>120</b>	<b>250</b>	<b>700</b>

### SEMESTER - IV

Course Code	Course Type	Course Name	TEACHING SCHEME					ASSESSMENT SCHEME			
			THY	PR	TU	CREDITS	HRS.	CIA	ESA	PR/OR	Total
PMTAI515	VSEC	Data Visualization Techniques	-	2	-	2	4	25	-	25	50
PMTAI607	PCC	MOOC 3	2		1	3	3	40	60		100
PMTAI605	PROJ	Project Phase III	-	24	-	12	24	300	-	300	600
PMTAI606	PROJ	Seminar and Research Paper IV		8	-	4	8	50	-	50	100
		<b>Total</b>	<b>2</b>	<b>34</b>	<b>1</b>	<b>21</b>	<b>39</b>	<b>415</b>	<b>60</b>	<b>400</b>	<b>850</b>

## COURSE CURRICULUM

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>			<b>Semester: I</b>	<b>Level: PG</b>	
<b>Course Name</b>		<b>Research Methodology and IPR</b>			<b>Course Code/ Course Type</b>	<b>PMTAI501</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>	<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
3	0	0	3	3	40	60	-
<b>Pre-Requisite:</b>							
<ol style="list-style-type: none"> <li>Basic Understanding of Computer Science Concepts</li> <li>Critical Thinking and Analytical Skills</li> </ol>							
<b>Course Objectives (CO):</b>					<b>The objectives of RM&amp;IPR are to:</b>		
					<ol style="list-style-type: none"> <li>Learn research fundamentals to develop solid understanding of research ethics.</li> <li>Learn various research designs and methodologies, including experimental, survey, and case study designs.</li> <li>Enhance written and oral communication skills for presenting research proposals, findings, and conclusions.</li> <li>Develop a comprehensive understanding of intellectual property rights, including patents, copyrights, trademarks, and trade secrets.</li> <li>Gain knowledge of national and international laws and regulations governing intellectual property rights.</li> </ol>		
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>		
					<ol style="list-style-type: none"> <li>Demonstrate research problems and gain research ethics.</li> <li>Use various research designs.</li> <li>Explore the presentation skills in research proposals and writings.</li> <li>Use the tools filing the patents and IPR.</li> <li>Apply the different laws and regulations for IP rights.</li> </ol>		

## Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
<b>UNIT I</b>		
<p><b>Introduction to Research Methodology</b> -Understanding research, types of research, and the scientific method. Research ethics and integrity.</p> <p><b>Problem Formulation and Literature Review:</b> Identifying research problems. Reviewing existing literature and formulating research questions.</p>	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>		
<p><b>Research Design:</b> Experimental design. Survey design. Case study design. Qualitative and quantitative research methods.</p> <p><b>Data Collection and Analysis:</b> Methods of data collection (surveys, interviews, experiments, etc.). Data analysis techniques (qualitative and quantitative).</p>	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
<p><b>Writing and Presenting Research:</b> Research proposal writing. Academic writing style and citation. Presenting research findings: oral presentations and posters.</p> <p><b>Research Project Management:</b> Time management. Resource allocation. Risk assessment and mitigation.</p>	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
<p><b>Introduction to Intellectual Property:</b> Overview of intellectual property rights (patents, copyrights, trademarks, trade secrets). Importance of IPR in the context of technology and innovation.</p> <p><b>Patents:</b> Basics of patent law and patentability criteria. Patent filing procedure. Patent searching and analysis.</p>	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
<p><b>IPR Issues in Research and Development:</b> IP management strategies for research institutions and companies. IP licensing and technology transfer.</p> <p><b>International IPR Laws and Treaties:</b> Overview of international treaties like TRIPS Agreement. Comparison of IPR laws across different jurisdictions.</p> <p><b>IPR Enforcement and Litigation:</b> Legal remedies for IPR infringement. Case studies of notable IPR disputes.</p> <p><b>Emerging Issues in IPR:</b> IPR challenges in emerging technologies (AI, blockchain, etc.). Ethical considerations in IPR.</p>	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>		<b>45</b>

## **Learning resources**

### **Textbooks:**

1. Research Methodology: Methods and Techniques by C.R. Kothari
2. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar
3. Intellectual Property Rights: Text and Cases" by V.K. Ahuja

### **Reference Books:**

1. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell
2. Intellectual Property: Patents, Trademarks, and Copyrights by Richard Stim
3. Intellectual Property Law: Text, Cases, and Materials by Tanya Aplin and Jennifer Davis

### **Online Resources/E-learning Resources:**

1. <https://www.coursera.org/search?query=research%20methodology>
2. <https://www.edx.org/search?q=research+methodology>

<b>Name of the Program:</b>		<b>M.TECH CSE(AI)</b>		<b>Semester : I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Artificial Intelligence and Knowledge Representation</b>		<b>Course Code/Course Type</b>		<b>PMTAI502</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment )</b>	<b>Practical/ Oral</b>
3	NA	NA	3	3	40	60	NA
<b>Pre-Requisite:</b> Knowledge of Data Structures							
<b>Course Objectives (CO):</b>				<b>The objectives of AI &amp;KR are to:</b>			
				<ol style="list-style-type: none"> <li>1. Learn the informed and uninformed problem types and apply search strategies to solve them.</li> <li>2. Apply difficult real life problems in a state space representation so as to solve those using AI techniques like searching and game playing.</li> <li>3. Design and evaluate intelligent expert models for perception and prediction from intelligent environment.</li> <li>4. Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.</li> <li>5. Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>				<b>Students would be able to:</b>			
				<ol style="list-style-type: none"> <li>1. Identify problems that are amenable to solution by specific AI methods</li> <li>2. Represent knowledge in Prolog and write code for drawing inferences.</li> <li>3. Identify appropriate AI technique for the problem at hand</li> <li>4. Compare strengths and weaknesses of different artificial Intelligence techniques.</li> <li>5. Sensitive towards development of responsible Artificial Intelligence.</li> </ol>			

## Course Contents

Descriptors/Topics	CLO	Hours
<b>UNIT I</b>		
Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>		
Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
Knowledge Representation: Using Predicate logic, representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification.  Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
Reasoning with Uncertain Knowledge: Uncertainty, non-monotonic reasoning, truth maintenance systems, default reasoning and closed world assumption, Introduction to probabilistic reasoning, Bayesian probabilistic inference, introduction to fuzzy sets and fuzzy logic, reasoning using fuzzy logic. .	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells, Support for explanation examples, Knowledge acquisition-examples.	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>		<b>45</b>

## Learning resources

### Text Books:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.

2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition, 2008
3. Artificial Neural Networks B. Yagna Narayana, PHI.
4. Artificial Intelligence, 2nd Edition, E. Rich and K. Knight (TMH).

**Reference Books:**

1. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
2. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.
3. Neural Networks Simon Haykin PHI.
4. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

**Online Resources/ E-learning Resources:**

1. <https://cyber.harvard.edu/topics/ethics-and-governance-ai>
2. <https://royalsocietypublishing.org/doi/full/10.1098/rsta.2018.0085>
3. <https://arxiv.org/abs/1812.02953>

<b>Name of the Program:</b>		<b>M.TECH CSE(AI)</b>		<b>Semester : I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Artificial Intelligence and Knowledge Representation lab</b>		<b>Course Code/Course Type</b>		<b>PMTAI503</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment )</b>	<b>Practical/ Oral</b>
NA	1	NA	1	2	25	NA	25
<b>Pre-Requisite:</b> Knowledge of Data Structures							
Course Objectives (CO):				<b>The objectives of AI &amp;KR Lab are to:</b> <ol style="list-style-type: none"> <li>1. Comprehend the informed and uninformed problem types and apply search strategies to solve them.</li> <li>2. Apply difficult real life problems in a state space representation so as to solve those using AI techniques like searching and game playing.</li> <li>3. Design and evaluate intelligent expert models for perception and prediction from intelligent environment.</li> <li>4. Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.</li> <li>5. Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.</li> </ol>			
Course Learning Outcomes (CLO):				<b>Students would be able to:</b> <ol style="list-style-type: none"> <li>1. Identify problems that are amenable to solution by specific AI methods</li> <li>2. Represent knowledge in Prolog and write code for drawing inferences.</li> <li>3. Identify appropriate AI technique for the problem at hand</li> <li>4. Compare strengths and weaknesses of different artificial Intelligence techniques.</li> <li>5. Sensitive towards development of responsible Artificial Intelligence</li> </ol>			

## Practical Plan

Assignment/ Practical/ Activity Number	Assignment / Practical/ Activity Title	Week Number/ Turn	Details	CLO	Hours
1	Practical 1:	Week 1	Create a SWI Prolog program to represent the family tree	CLO1	2
2	Practical 2:	Week 2	FACTORIAL, FIBONACCI SERIES AND PRIME NUMBER CHECKING Q1. Find whether a number N is prime or not Q2. Find factorial of a number N. Q3. Find Nth term of Fibonacci series	CLO1	2
3	Practical 3:	Week 3	Lists are important in Prolog. You will often need to pattern match against lists. Create a prolog file named Lab3_List_exercise.pl and create the following knowledge base.	CLO2	2
4	Practical 4:	Week 4/ Week 5	Eight queens problem is a constraint satisfaction problem (CSP). The task is to place eight queens in the 64 available squares in such a way that no queen attacks each other. So the problem can be formulated with variables x1, x2, x3, x4, x5, x6, x7, x8 and y1, y2, y3, y4, y5, y6, y7, y8.	CLO 2	4
5	Practical 5:	Week 6	The Tower of Hanoi puzzle in prolog	CLO3	2
6	Practical 6:	Week 7	WAP to Solve Travel salesman problem in prolog	CLO3	2
7	Practical 7:	Week 8	WAP to solve Water Jug in prolog	CLO4	2
8	Practical 8:	Week 9	WAP to solve Monkey Bannana Problem in prolog	CLO4	2
9	Practical 9:	Week 10	Write a program in PROLOG to implement factorial (N, F) where F represents the factorial of a number N.	CLO5	2
10	Practical 10:	Week 11/ Week 12	A prolog program will represent this expert knowledge in terms of rules in its knowledge base for Expert systems are computer applications which embody some non-algorithmic expertise for solving certain types of problems.	CLO5	4
11	Mini Project /Task	Week 13/14/15	Mini Project	CLO1/ 2/3/4/5	6
<b>Total Hours</b>					<b>30</b>

## **Learning resources**

### **Text Books:**

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition, 2008
3. Artificial Neural Networks B. Yagna Narayana, PHI.
4. Artificial Intelligence, 2nd Edition, E. Rich and K. Knight (TMH).

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2. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.
3. Neural Networks Simon Haykin PHI.
4. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

### **Online Resources/ E learning Resource:**

1. <https://cyber.harvard.edu/topics/ethics-and-governance-ai>
2. <https://royalsocietypublishing.org/doi/full/10.1098/rsta.2018.0085>
3. <https://arxiv.org/abs/1812.02953>

<b>Name of the Program:</b>		<b>M.TECH CSE(AI)</b>			<b>Semester : I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Machine Learning Techniques</b>			<b>Course Code/Course Type</b>		<b>PMTAI504</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>	
3	NA	NA	3	3	40	60	NA	
<b>Pre-Requisite:</b> Knowledge of Analytics								
<b>Course Objectives (CO):</b>					<b>The objectives of ML are to:</b>			
					<ol style="list-style-type: none"> <li>1. Comprehend the informed and uninformed problem types and apply search strategies to solve them.</li> <li>2. Apply difficult real-life problems in a state space representation to solve those using ML techniques like searching and game playing.</li> <li>3. Design and evaluate intelligent expert models for perception and prediction from an intelligent environment.</li> <li>4. Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision-making techniques.</li> <li>5. Demonstrate and enrich knowledge to select and apply ML tools to synthesize information and develop models within constraints of the application area.</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>			
					<ol style="list-style-type: none"> <li>1. Identify problems that are amenable to solution by specific ML methods</li> <li>2. Represent knowledge in Prolog and write code for drawing inferences.</li> <li>3. Identify appropriate ML technique for the problem at hand</li> <li>4. Compare strengths and weaknesses of different artificial Intelligence techniques.</li> <li>5. Sensitive towards development of responsible Machine Learning</li> </ol>			

## Course Contents

Descriptors/Topics	CLO	Hours
<b>UNIT I</b>		
Introduction: Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance. Linear Regression: Introduction, Linear regression, Simple and Multiple Linear regression, Polynomial regression, evaluating regression fit.	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>		
Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, Python exercise on Decision Tree. Instance based Learning: K nearest neighbors, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis) , Python exercise on kNN and PCA. Recommender System: Content based system; Collaborative filtering based.	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes, Logistic Regression. Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem.	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks, and the back propagation algorithm  Ensembles: Introduction, Bagging and boosting, Random Forest, Discussion on some research papers. Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering.	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells, Support for explanation examples, Knowledge acquisition-examples.	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>		<b>45</b>

## **Learning resources**

### **Text Books:**

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020. Artificial Neural Networks B. Yagna Narayana, PHI.
3. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).

### **Reference Books:**

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007. Neural Networks Simon Haykin PHI.
3. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

### **Online Resources/ E learning Resource**

1. [https://onlinecourses.nptel.ac.in/noc23\\_cs18/preview](https://onlinecourses.nptel.ac.in/noc23_cs18/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs24/preview](https://onlinecourses.nptel.ac.in/noc22_cs24/preview)
3. <https://sgfin.github.io/learning-resources/>

<b>Name of the Program:</b>		<b>M.TECH CSE(AI)</b>			<b>Semester: I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Machine Learning Techniques Lab</b>			<b>Course Code/Course Type</b>		<b>PMTAI505</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>	
NA	1	NA	1	2	25	-	25	
<b>Pre-Requisite:</b> Knowledge of AI								
<b>Course Objectives (CO):</b>					<b>The objectives of ML Lab are to:</b>			
					<ol style="list-style-type: none"> <li>1. Understand the informed and uninformed problem types and apply search strategies to solve them.</li> <li>2. Apply difficult real-life problems in a state space representation to solve those using ML techniques like searching and game playing.</li> <li>3. Design and evaluate intelligent expert models for perception and prediction from an intelligent environment.</li> <li>4. Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.</li> <li>5. Demonstrate and enrich knowledge to select and apply ML tools to synthesize information and develop models within constraints of the application area.</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>			
					<ol style="list-style-type: none"> <li>1. Identify problems that are amenable to solution by specific ML methods</li> <li>2. Represent knowledge in Prolog and write code for drawing inferences.</li> <li>3. Identify appropriate ML technique for the problem at hand</li> <li>4. Compare strengths and weaknesses of different artificial Intelligence techniques.</li> <li>5. Sensitive towards development of responsible Machine Learning</li> </ol>			

## Practical Plan

Assignment/ Practical/ Activity Number	Assignment / Practical/ Activity Title	Week Number/ Turn	Details	CLO	Hours
1	Practical 1:	Week 1	Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib.	CLO1	2
2	Practical 2:	Week 2	Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix.	CLO1	2
3	Practical 3:	Week 3	Given a set of sample points in N dimensional feature space. Write a program to fit the points with a hyper plane using Linear Regression. Calculate sum of residual error.	CLO2	2
4	Practical 4:	Week 4/ Week 5	Write a program that provides option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points.	CLO 2	4
5	Practical 5:	Week 6	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CLO3	2
6	Practical 6:	Week 7	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.	CLO3	2
7	Practical 7:	Week 8	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few	CLO4	2

			test data sets.		
8	Practical 8:	Week 9	Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate its test performance.	CLO4	2
9	Practical 9:	Week 10	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	CLO5	2
10	Practical 10:	Week 11/ Week 12	Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K.	CLO5	4
11	Mini Project /Task	Week 13/14/15	Mini Project	CLO1/ 2/3/4/5	6
<b>Total Hours</b>					<b>30</b>

## Learning resources

### **Text Books:**

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020. Artificial Neural Networks B. Yagna Narayana, PHI.
3. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).

### **Reference Books:**

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007. Neural Networks Simon Haykin PHI.
3. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

### **Online Resources/ E Learning Resource**

1. [https://onlinecourses.nptel.ac.in/noc23\\_cs18/preview](https://onlinecourses.nptel.ac.in/noc23_cs18/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs24/preview](https://onlinecourses.nptel.ac.in/noc22_cs24/preview)
3. <https://sgfin.github.io/learning-resources/>

## List of MOOC-I

Course Code	Subject Name	Course Type	Link
PMTAI 601	Software testing	PCC	<a href="https://classroom.udacity.com/courses/cs258/lessons/48449993/concepts/487233190923">https://classroom.udacity.com/courses/cs258/lessons/48449993/concepts/487233190923</a>
	Software Architect (Open Space)		<a href="http://https://www.udacity.com/course/software-architecture-design--ud821">http://https://www.udacity.com/course/software-architecture-design--ud821</a>
	DevOps		<a href="https://www.edx.org/course/accelerate-software-delivery-using-microsoft-dev217x#!">https://www.edx.org/course/accelerate-software-delivery-using-microsoft-dev217x#!</a>
	Agile Development		<a href="https://www.coursera.org/specializations/agile-development">https://www.coursera.org/specializations/agile-development</a>
	IOT		<a href="https://www.coursera.org/learn/iot-software-architecture">https://www.coursera.org/learn/iot-software-architecture</a>
	AdelaideX: Computational Thinking and Big Data		<a href="https://www.edx.org/learn/data-science/university-of-adelaide-computational-thinking-and-big-data?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/data-science/university-of-adelaide-computational-thinking-and-big-data?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	AWS: Introduction to Designing Data Lakes on AWS		<a href="https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-introduction-to-designing-data-lakes-on-aws?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-introduction-to-designing-data-lakes-on-aws?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	AWS: AWS Cloud Practitioner Essentials		<a href="https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-cloud-practitioner-essentials?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-cloud-practitioner-essentials?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	AWS: AWS Developer: Building on AWS		<a href="https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-developer-building-on-aws?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-developer-building-on-aws?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	AWS: AWS IoT: Developing and Deploying an Internet of Things		<a href="https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-iot-developing-and-deploying-an-internet-of-things?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-iot-developing-and-deploying-an-internet-of-things?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
AWS: AWS: Getting Started with Cloud Security	<a href="https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-getting-started-with-cloud-security?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-getting-started-with-cloud-security?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>		

## COURSE CURRICULUM

**Course Contents/Syllabus: (All the units carry equal weightage in Summative Assessment and equal engagement)**

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Seminar and Research Paper Writing I</b>		<b>Course Code/ Course Type</b>		<b>PMTAI507</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
-	4	-	4	4	50	-	50
<b>Pre-Requisite:</b>							
<b>Guidelines:</b>							
<ol style="list-style-type: none"> <li>Individual student needs to study recent research topics in the field of Computer Engineering under the guidance of allocated guide.</li> <li>Students can choose topic related to Computer Engineering considering recent trends and its societal importance and at least 5 latest research papers to be studied in seminar.</li> <li>The extensive Literature Survey, Mathematical Modeling of particular method and valuable conclusion is expected from seminar study.</li> <li>Seminar Report should be submitted as a compliance of term work associated with subject.</li> <li>At least 1 review paper publication is expected as research outcome of seminar.</li> <li>Total Duration: 24 Contact Hours and 24 Hours should be spent by students on completion of related activities and requirements.</li> </ol>							
<b>Seminar Activities</b>							

<b>Sr. No.</b>	<b>Activity</b>	<b>Hours</b>
<b>1.</b>	Week 1, 2, 3: Guide allotment, finalization of topic, Planning of the work. Review-1 conduction	12
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, of detail topic.	12
<b>3.</b>	Week 6, 7, 8 : Detail Topic Mathematical model, methodology and findings Review-2 conduction	12
<b>4.</b>	Week 9, 10 : Comparison of detail topic with other existing methods	12
<b>5.</b>	Week 11, 12: Seminar Report writing and publication or copyright planning Final Review conduction.	12
	<b>Total</b>	<b>60</b>

# **COURSE SYLLABUS**

## **MTECH CSE (AI)**

### **SEMESTER-II**

## COURSE CURRICULUM

### Course Contents/Syllabus:

<b>Name of the Program:</b>		<b>MTECH CSE(AI)</b>		<b>Semester : II</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Deep Learning Techniques</b>		<b>Course Code/ Course Type</b>		<b>PMTAI509</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>				<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
3	-	-	3	3	40	60	-
<b>Pre-Requisite:</b> <ol style="list-style-type: none"> <li>1. Basics of Machine Learning</li> <li>2. Python Programming Language</li> <li>3. Basics of Probability</li> </ol>							
<b>Course Objectives (CO):</b>		<b>The objectives of Deep Learning Techniques are:</b> <ol style="list-style-type: none"> <li>1. To learn the concept of Deep Learning and its application</li> <li>2. To introduce the idea of Convolutional neural networks and their architecture</li> <li>3. To introduce techniques used for training artificial neural networks</li> <li>4. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.</li> <li>5. To enable design and deployment of deep learning models for machine learning problems</li> </ol>					
<b>Course Learning Outcomes (CLO):</b>		<b>Students would be able to:</b> <ol style="list-style-type: none"> <li>1. Comprehend the mathematics behind functioning of artificial neural networks and CNN.</li> <li>2. Analyze the given dataset for designing a neural network-based solution</li> <li>3. Design and implementation of deep learning models for signal/image processing applications</li> <li>4. Design and deploy simple TensorFlow-based deep learning solutions to classification problems</li> <li>5. Implement deep learning algorithms and solve real-world problems.</li> </ol>					

Descriptors/Topics	CLO	Hours
<b>UNIT I Understanding Deep Learning and its application:</b>		
<p><b>Understanding Deep Learning and its application:</b> Introduction to Deep Learning (DL), DL Applications in various domains, Supervised and unsupervised learning, Model training, overfitting, model deployment, inferencing.</p> <p><b>Convolutional Neural Networks (CNN):</b> Introduction to Deep Supervised Learning, Convolution &amp; Pooling, Dropout, LeNet, AlexNet, ZFNet, VGGNet, GoogleNet, ResNet, DenseNet and other State-of-the-art CNNs.</p>	<b>CLO 1</b>	<b>9</b>
<b>UNIT II Text representations and embeddings:</b>		
<p><b>Text representations and embeddings:</b> Transfer Learning: Transfer Learning Scenarios, Applications of Transfer Learning, Transfer Learning Methods, Fine Tuning and Data Augmentation, Related Research Areas.</p> <p><b>CNN for Computer Vision:</b> Image Classification and Localization, Object Detection, Semantic Segmentation, Instance Segmentation</p>	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
<p><b>Applications of Recurrent and Recursive Neural Networks:</b> Understanding Recurrent and Recursive Neural Networks, Word Embedding, Language Models, Text Classification, Named Entity Recognition, Machine Translation, Parsing, Sentiment Analysis, Speech Recognition, Encoder Decoder architectures, Attention Model, Transformer, BERT, ChatGPT</p>	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
<p><b>Reinforcement Learning:</b> Introduction, Markovian Decision Process, Q Learning, Deep Q Learning</p>	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
<p><b>Generative Network:</b> Understanding Generative Adversarial Networks, Image Inpainting, Image Super Resolution, Colorization of Black and White Images, Human Face Generation, Text2Image</p>	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>		<b>45</b>

## Learning resources

### Textbooks:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press

2. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly Media, Inc.

3. Francois Chollet, Deep Learning with Python, Manning Publications

### **Reference Books:**

1. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, <http://www.deeplearningbook.org>. MIT Press, 2016.
2. Bengio, Yoshua. Learning deep architectures for AI (Foundations and trends in Machine Learning)

### **Online Resources/E-learning Resources:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs11/preview](https://onlinecourses.nptel.ac.in/noc20_cs11/preview) Deep Learning By Prof. Prabir Kumar Biswas | IIT Kharagpur
2. [https://onlinecourses.nptel.ac.in/noc24\\_cs59/preview](https://onlinecourses.nptel.ac.in/noc24_cs59/preview) By Prof. Sudarshan Iyengar, Prof. Padmavati | IIT Ropar, Punjab Engineering College (Deemed to be University)

## COURSE CURRICULUM

### Course Contents/Syllabus:

<b>Name of the Program:</b>		<b>MTECH CSE (AI)</b>		<b>Semester : 2</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Deep Learning Techniques Lab.</b>		<b>Course Code/ Course Type</b>		<b>PMTAI510</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>				<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
-	1	-	1	2	25	-	25
<b>Pre-Requisite:</b>							
<ol style="list-style-type: none"> <li>1. Basics of Machine Learning</li> <li>2. Python Programming Language</li> <li>3. Basics of Probability</li> </ol>							
<b>Course Objectives (CO):</b>		<b>The objectives of Deep Learning Techniques are:</b>					
		<ol style="list-style-type: none"> <li>1. To learn the concept of Deep Learning and its application</li> <li>2. To introduce the idea of Convolutional neural networks and their architecture</li> <li>3. To introduce techniques used for training artificial neural networks</li> <li>4. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.</li> <li>5. To enable design and deployment of deep learning models for machine learning problems</li> </ol>					
<b>Course Learning Outcomes (CLO):</b>		<b>Students would be able to:</b>					
		<ol style="list-style-type: none"> <li>1. Comprehend the mathematics behind functioning of artificial neural networks and CNN.</li> <li>2. Analyze the given dataset for designing a neural network-based solution</li> <li>3. Design and implementation of deep learning models for signal/image processing applications</li> <li>4. Design and deploy simple TensorFlow-based deep learning solutions to classification problems</li> <li>5. Implement deep learning algorithms and solve real-world problems.</li> </ol>					

## Practical Plan

Assignment/Practical/Activity Number	Assignment/Practical/Activity Title	Week Number/ Turn	Details	CLO	Hours
1.	Practical 1:	Week 1,	Write a program to convert text into speech.	CLO1	2
2.	Practical 2:	Week2,	Write a program to convert video into frames.	CLO2	2
3.	Practical 3:	Week3	Write a program for character recognition using CNN.	CLO1, CLO3	2
4.	Practical 4:	Week 4,	Build a feed forward neural network for prediction of logic gates.	CLO3	2
5.	Practical 5:	Week5,	Write a program to predict a caption for a sample image using CNN.	CLO1, CLO3	2
6.	Practical 6	Week6	Write a program for object detection using image labeling tools.	CLO4 CLO5	2
7.	Practical 7	Week 7,	Write a program for Time-Series Forecasting with the LSTM Model.	CLO4	2
8.	Practical 8	Week 8,	Write a program to implement deep learning Techniques for image segmentation.	CLO4	2
9.	Practical 9	Week 9	Write a program to detect Dog image using YOLO Algorithm.	CLO4	2
10.	Practical 10	Week 10,	Write a program to develop Autoencoders using MNIST Handwritten Digits.	CLO5	2
11.	Practical 11	Week 11, Week 12	Write a program to develop a GAN for Generating MNIST Handwritten Digits.	CLO5	2
12.	Mini Project	Week13	Mini Project	CLO5	2
13.	Mini Project	Week 14	Mini Project	CLO5	3
14.	Mini Project	Week15	Mini Project	CLO5	3
<b>Total</b>					<b>30</b>

## Learning resources

### Textbooks:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press
2. Adam Gibson, Josh Patterson, Deep Learning, O'Reilly Media, Inc.
3. Francois Chollet, Deep Learning with Python, Manning Publications

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2. [https://onlinecourses.nptel.ac.in/noc24\\_cs59/preview](https://onlinecourses.nptel.ac.in/noc24_cs59/preview) By Prof. Sudarshan Iyengar, Prof. Padmavati | IIT Ropar, Punjab Engineering College (Deemed to be University)

## COURSE CURRICULUM

<b>Name of the Program:</b>		MTECH CSE (AI)			Semester : 2	Level: PG	
<b>Course Name</b>		Natural Language Processing			<b>Course Code/ Course Type</b>	PMTAI511	
<b>Course Pattern</b>		2024			<b>Version</b>	1.0	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
3	NA	NA	3	3	40	60	NA
<b>Pre-Requisite:</b> <ol style="list-style-type: none"> <li>Basics of Machine Learning</li> <li>Python Programming Language</li> <li>Basics of Probability</li> </ol>							
<b>Course Objectives (CO):</b>					<b>The objectives of NLP are to:</b> <ol style="list-style-type: none"> <li>Comprehend leading trends and systems in natural language processing.</li> <li>Describe concepts of morphology, syntax, semantics, and pragmatics of the language.</li> <li>Comprehend Language Models and their evaluation.</li> <li>Writing programs in Python to carry out natural language processing.</li> <li>Implement deep learning algorithms in Python and learn how to train deep networks for NLP applications.</li> </ol>		
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b> <ol style="list-style-type: none"> <li>Explain processes and representations used in syntax, semantics, and other components of natural language processing.</li> <li>Use machine learning and deep learning algorithms for Natural Language Processing applications.</li> <li>Explore the models used for word/sentence representations for various NLP applications.</li> <li>Use the tools for performing text analytics in a variety of contexts.</li> <li>Apply the different Feature Extraction and Embedding's processes</li> </ol>		

## Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
<b>UNIT I</b>		
<b>Introduction</b> - terminologies -basic techniques in natural language processing, including tokenization, part-of-speech tagging, chunking, syntax parsing, Dependency parsing, named entity recognition, Co-reference Resolution Word-sense Disambiguation.	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>		
<b>Text representations and embeddings:</b> One-hot encoding, Bag-of-Words (BoW) Dictionary: Term Frequency – Inverse Document Frequency (TF IDF), N-gram. Introduction to various nlp toolkits such as nltk, Spacy etc.	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
<b>Neural Networks Basics:-</b> Feed forward Neural Network, Recurrent Neural Networks, LSTM, An Introduction to Transformers and Sequence-to-Sequence Learning. Neural Networks for NLP – Vector Representation of words – Contextual Understanding of text – Co-occurrence of matrix – N-grams – Dense Word Vector.	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
<b>Feature Extraction and Embeddings</b> Word2Vec – CBOW and Skip-gram Models – One-word learning architecture Forward pass for Word2Vec – Reduction of complexity – sub-sampling and negative sampling. Continuous Skip-Gram Model, GloVe, BERT, XLNet.	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
<b>NLP Challenges</b> Word sense Disambiguation NER. Named Entity Recognition, Sentiment 7 M. Tech. Artificial Intelligence and Data Science, PCCoE Pune 26 analysis, Text categorization: Basic supervised text categorization algorithms, including Naive Bayes, k Nearest Neighbour (kNN) and Logistic Regression.	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>		<b>45</b>

### Learning resources

#### Textbooks:

1. C.D. Manning et al, “Foundations of Statistical Natural Language Processing,” MIT Press. MIT Press, 1999. isbn: 9780262133609.
2. James Allen, “Natural Language Processing with Python”, O’Reilly Media, July 2009.

#### Reference Books:

1. Daniel Jurafsky and James H. Martin "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition," 1st. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2000. isbn: 0130950696.
2. Jacob Perkins, "Python 3 text processing with NLTK 3 cookbook," Packet Publishing Ltd, 2014.
3. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, <http://www.deeplearningbook.org>. MIT Press, 2016.

**Online Resources/E-learning Resources:**

1. Natural Language Toolkit [nltk.org](http://nltk.org)

## COURSE CURRICULUM

<b>Name of the Program:</b>		<b>MTECH CSE (AI)</b>			<b>Semester : 2</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Natural Language Processing Lab</b>			<b>Course Code/ Course Type</b>		<b>PMTAI512</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>	
-	1	-	1	2	25	-	25	
<b>Pre-Requisite:</b>								
<ol style="list-style-type: none"> <li>1. Data Structures</li> <li>2. Python / R Programming</li> </ol>								
<b>Course Objectives (CO):</b>					<b>The objectives of NLP Lab are:</b>			
					<ol style="list-style-type: none"> <li>1. To provide practical knowledge of language processing that involves various operations that can be performed on text data.</li> <li>2. To familiarize with fundamental topics in language processing that include tokenization, stemming, tagging, classification, and information extraction using Python programs.</li> <li>3. To facilitate understanding of regular expressions, formal grammar that describe the structure of an unlimited set of sentences.</li> <li>4. To create classifiers and choose the best classifier.</li> <li>5. To perform NLP operations on existing corpora and build simple AI Applications.</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>			
					<ol style="list-style-type: none"> <li>1. Apply the concept of natural language processing (NLP) using Natural Language Toolkit (NLTK).</li> <li>2. Build text corpora with tokenization, Stemming, Lemmatization,</li> <li>3. Apply visualization techniques.</li> <li>4. Evaluate the classifiers and choose the best classifier.</li> <li>5. Use different libraries for NLP Applications</li> </ol>			

## Course Contents/Syllabus:

### Practical Plan

Assignment/Practical/Activity Number	Assignment/Practical/Activity Title	Week Number/Turn	Details	CLO	Hours
1	Practical 1:	Week 1, Week2, Week3	Perform Automatic, N-gram and Transformation based Tagging for text data.	CLO 1	6
2	Practical 2:	Week 4, Week5, Week6	Write a program to demonstrate Mapping Words to Properties Using Python Dictionaries	CLO 2	6
3	Practical 3:	Week 7, Week8, Week9	Implement Chabot.	CLO 3	6
4	Practical 4:	Week 10, Week 11, Week12	Perform Tokenization, Stemming, and Lemmatization to carry out the analysis with text corpora.	CLO 4	6
5	Practical 5:	Week 13, Week14, Week15	Perform Classification of product reviews on ecommerce websites	CLO 5	6
<b>Total</b>					<b>30</b>

### Learning resources

#### Textbooks:

1. Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2012.
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Python", O'Reilly, 2nd Edition, 2018.

#### Reference Books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, Pearson Education, 2009.
2. NitinIndurkha and Fred J. Damerau, —Handbook of Natural Language Processing, 2ndEdition, Chapman and Hall/CRC Press, 2010.
3. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. NitinHardaniya, Jacob Perkins, —Natural Language Processing: Python and NLTKII, Packt Publishers, 2016.

#### Online Resources/E-learning Resources:

1. <https://nltk.org>
2. <https://nlp-iiith.vlabs.ac.in/>

## COURSE CURRICULUM

### Course Contents/Syllabus:

<b>Name of the Program:</b>		<b>M.Tech CSE (AI)</b>		<b>Semester : II</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Advanced Statistical Techniques</b>		<b>Course Code/ Course Type</b>		<b>PMTAI513</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment )</b>	<b>Practical/ Oral</b>
3	0	0	3	3	40	60	-
<b>Prerequisite:</b> Basicstatistical concepts.							
<b>Course Objectives (CO):</b>					<b>The objectives of (Advanced Statistical Techniques) are:</b>		
					<ol style="list-style-type: none"> <li>1. To familiarize the students with advanced techniques in Statistics</li> <li>2. To acquire knowledge of techniques of advanced level of sampling &amp; estimation</li> <li>3. To apply tests of hypothetical techniques and its applications that would enhance analytical thinking power.</li> <li>4. Tocomprehendthe where and how to apply parametric &amp; non parametric tests with applications.</li> <li>5. Tocomprehend various hypothesis tests.</li> </ol>		
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>		
					<ol style="list-style-type: none"> <li>1. Students will be able to identify the advanced terms in statistics.</li> <li>2. Explain the estimation &amp; its techniques.</li> <li>3. Apply knowledge of hypothesis techniques to test large and small samples.</li> <li>4. Learn&amp; apply non parametric tests on practical situations.</li> <li>5. Apply various hypothesis test in real time environment.</li> </ol>		
<b>Descriptors/Topics</b>						<b>CLO</b>	<b>Hours</b>

<b>UNIT I</b>	<b>Basic Statistical Concepts</b>		
	Introduction Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Multiple Correlation, Linear and Multiple regression, Reliability of Regression Estimates.	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>	<b>Sampling Techniques</b>		
	Random sampling, Sampling from finite and infinite populations, with and without replacement, central limit theorem, Standard error of sampling, Sampling distribution of sample mean and proportion, stratified random sampling.	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>	<b>Estimation</b>		
	Introduction, Types of estimation, Interval estimation, Point estimation: Maximum likelihood function, Method of moments, Criteria for good estimates: Unbiasedness, Consistency, Sufficiency by Neyman factorization theorem and Efficiency, their applications in estimation.	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>	<b>Test of Hypothesis-I</b>		
	Introduction, Hypothesis, Simple and composite hypothesis, Type I and Type II errors, Level of significance, Critical region, Student's-t test, Z-test	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>	<b>Test of Hypothesis-II</b>		
	Test of hypothesis for small & large sample by Chi-Square distribution, Student's-t distributions, F-distributions. Degree of freedom, Analysis of variance (ANOVA): one-way, two-way (without interactions), P-Value.	<b>CLO 5</b>	<b>9</b>
<b>Total Hours</b>			<b>45</b>

### Learning resources

#### Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2014.
2. Hugh Neill, Trigonometry: A complete Introduction, John Murray Learning, 2018.
3. George B. Thomas, Jr and Ross L. Finney, Calculus and Analytic Geometry, 9th Edition, 1998

#### Reference Book(s):

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2010.
2. Ron Larson, Trigonometry, Brooks/Cole, 9th Edition, 2013.
3. Robert E. Moyer, Trigonometry, Mc. Graw Hill, Addison-Wesely, 4th Edition, 2009.

## COURSE CURRICULUM

Sr. No.		Activity				Hours	
<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: II</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Seminar and Research Paper Writing II</b>		<b>Course Code/ Course Type</b>		<b>PMTAI516</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
-	4	-	4	4	50	-	50
<b>Pre-Requisite:</b>							
Guidelines:							
<ol style="list-style-type: none"> <li>Individual student needs to study recent research topics in the field of Computer Engineering under the guidance of allocated guide.</li> <li>Students can choose topic related to Computer Engineering considering recent trends and its societal importance and at least 5 latest research papers to be studied in seminar.</li> <li>The extensive Literature Survey, Mathematical Modeling of particular method and valuable conclusion is expected from seminar study.</li> <li>Seminar Report should be submitted as a compliance of term work associated with subject.</li> <li>At least 1 review paper publication is expected as research outcome of seminar.</li> <li>Total Duration: 24 Contact Hours and 24 Hours should be spend by students on completion of related activities and requirements.</li> </ol>							
<b>Detailed Syllabus:</b>							
<b>Seminar Activities</b>							
<b>1.</b>	Week 1, 2, 3: Guide allotment, finalization of topic, Planning of the work. Review-1 conduction					12	
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, of detail topic.					12	
<b>3.</b>	Week 6, 7, 8 : Detail Topic Mathematical model, methodology and findings Review-2 conduction					12	
<b>4.</b>	Week 9, 10 : Comparison of detail topic with other existing methods					12	
<b>5.</b>	Week 11, 12: Seminar Report writing and publication or copyright planning Final Review conduction.					12	
	<b>Total</b>					<b>60</b>	

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: III</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Project Phase I</b>		<b>Course Code/ Course Type</b>		<b>PMTAI603</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/Oral</b>
-	20	-	10	20	200	-	200
<b>Pre-Requisite:</b> 1. Basics of Software Engineering and Computer Programming Concepts 2. Basics of Programming Language such as C, MATLAB, Python.							
<b>Course Objectives (CO):</b>				<b>The objective of Project Phase I is to:</b>			
				<ol style="list-style-type: none"> <li>To comprehend the —Product Development Process.</li> <li>To plan for various activities of the major project and channelize the work towards product development.</li> <li>To build, design and implement real time application using available platforms.</li> <li>To inculcate research culture in students for their technical growth</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>				<b>Students would be able to:</b>			
				<ol style="list-style-type: none"> <li>Comprehend, plan and execute the major Project with appreciable research outcomes.</li> <li>Design real time application considering immerging areas in technology</li> <li>Prepare good quality technical report based on the project.</li> <li>Demonstrate technical ideas and its relevance in recent technology</li> <li>Publish good quality paper in reputed journal and present their work in reputed conferences.</li> </ol>			
<b>Guidelines:</b>							
<ol style="list-style-type: none"> <li>Individual student need to design and demonstrate project under the guidance of allocated guide.</li> <li>Sponsored Project or Project Internship is acceptable considering postgraduate scope.</li> <li>Students can choose project domain and problem statement as per latest research areas, recent technology trends and societal importance.</li> <li>Project Report-1 should be submitted as a compliance of term work associated with subject.</li> <li>At least 2 Paper publications are expected as research outcome of Project Stage-I (Scopus</li> </ol>							

indexed Conference or Journal) and 40% of planned project work should be completed for submission of Dissertation Phase-I

6. Total Duration: 120 hours are contact hours with guides and for reviews, 120 hours are expected to be spend by students to satisfy all project requirements and implementations.

**Detailed Syllabus:**

**Project Phase – I [Company/ In-house project]**

<b>Sr. No.</b>	<b>Activity</b>	<b>Hours</b>
<b>1.</b>	Week 1, 2, 3: Guide allotment, applying for sponsorship and project internship, finalization of topic and platform, Planning of the work.	18
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, Review 1 for finalization of topic and specification.	18
<b>3.</b>	Week 6, 7, 8 : understanding platform implementation and related software flow and execute block level design , Review 2 to understand the progress of the project	18
<b>4.</b>	Week 9, 10 : Simulation of proposed methodology on appropriate software tools and finalization of hardware platform	18
<b>5.</b>	Week 11, 12: Project Report writing and publication or copyright planning and execution. Demonstration of Project work and Final Review for submission and term work compliances	18
	<b>Total</b>	<b>90</b>

# COURSE SYLLABUS

## MTECH CSE (AI)

### SEMESTER-III

## COURSE CURRICULUM

<b>Name of the Program:</b>		<b>M. TECH CSE(AI)</b>			<b>Semester: I</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Advanced Software Engineering and Project Management</b>			<b>Course Code/ Course Type</b>		<b>PMTAI506</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Theory</b>	<b>CIA(Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/Oral</b>	
3	0	0	3	3	40	60	-	
<b>Pre-Requisite:</b> 1. <b>Basic Understanding of Software Engineering</b> 2. <b>Basic knowledge of Software Development Methodologies</b>								
<b>Course Objectives (CO):</b>					<b>The objectives of ASEPM are to:</b>			
					1. Comprehend advanced software development processes 2. Acquire expertise in software architecture design principles and practices. 3. Gain proficiency in using software metrics to measure and improve software quality, productivity, and performance. 4. Develop strategic project planning and estimation skills for accurately estimating project scope, time, and resources. 5. Develop skills in monitoring project progress and performance.			
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>			
					1. Explain advanced software development processes 2. Apply various software architecture design principles and practices. 3. Use software metrics to measure and improve software quality 4. Estimate project scope, time, and resources. 5. Apply the skills in monitoring project progress and performance.			

## Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
<b>UNIT I</b>		
<p><b>Software Development Lifecycle (SDLC) Models:</b> Review of traditional SDLC models (Waterfall, V-Model) and their limitations. Introduction to iterative and incremental development models (Agile, Scrum, Kanban). Comparison of different SDLC models and their suitability for various project contexts.</p> <p><b>Software Architecture and Design Patterns:</b> Principles of software architecture design. Study of architectural patterns (MVC, MVVM, Microservices) and their application in software development. Design patterns for object-oriented software design (Singleton, Factory, Observer, etc.).</p>	<b>CLO 1</b>	<b>9</b>
<b>UNIT II</b>		
<p><b>Software Quality Assurance and Testing:</b> Techniques for software quality assurance (QA) and testing. Test-driven development (TDD) and behavior-driven development (BDD). Automated testing frameworks and tools (JUnit, Selenium, etc.). Continuous integration and continuous deployment (CI/CD) pipelines.</p>	<b>CLO 2</b>	<b>9</b>
<b>UNIT III</b>		
<p><b>Software Metrics and Measurement:</b> Importance of software metrics in project management and quality assurance. Common software metrics (LOC, cyclomatic complexity, defect density, etc.). Use of metrics for project estimation, tracking, and improvement.</p>	<b>CLO 3</b>	<b>9</b>
<b>UNIT IV</b>		
<p><b>Project Planning and Estimation:</b> Techniques for project planning, scheduling, and resource allocation. Estimation techniques (bottom-up, top-down, parametric estimation). Risk management and mitigation strategies.</p> <p><b>Agile Project Management:</b> Principles of Agile project management. Scrum framework: roles, ceremonies, and artifacts. Kanban methodology: principles and practices.</p>	<b>CLO 4</b>	<b>9</b>
<b>UNIT V</b>		
<p><b>Project Tracking and Control:</b> Monitoring project progress and performance. Earned value management (EVM) for project cost and schedule tracking. Agile project tracking techniques (burndown charts,</p>	<b>CLO 5</b>	<b>9</b>

velocity, cumulative flow diagrams).		
<b>Stakeholder Management and Communication:</b> Importance of stakeholder identification and engagement.		
Effective communication strategies for project stakeholders.		
Conflict resolution and negotiation techniques.		
<b>Project Closure and Lessons Learned:</b> Project closure activities and deliverables. Conducting project post-mortems and capturing lessons learned. Continuous improvement in project management processes.		
<b>Total Hours</b>		<b>45</b>

### **Learning Resources:**

#### **Textbooks:**

1. Software Engineering: A Practitioner's Approach" by Roger S. Pressman
2. Clean Architecture: A Craftsman's Guide to Software Structure and Design" by Robert C. Martin:
3. Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner

#### **Reference Books:**

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley
2. The Mythical Man-Month: Essays on Software Engineering" by Frederick P. Brooks Jr.:
3. Lean Software Development: An Agile Toolkit" by Mary Poppendieck and Tom Poppendieck

#### **Online Resources/E-learning Resources:**

1. <https://www.coursera.org/search?query=advanced%20software%20engineering>
2. <https://www.projectmanagement.com/>
3. <https://www.scrum.org/>

## List of MOOC-II

Course Code	Subject Name	Course Type	Link
PMT AI602	ChalmersX: Decision-Making for Autonomous Systems	PCC	<a href="https://www.edx.org/learn/decision-making/chalmers-university-of-technology-decision-making-for-autonomous-systems?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/decision-making/chalmers-university-of-technology-decision-making-for-autonomous-systems?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	ACCA: Robotic process and intelligent automation for finance		<a href="https://www.edx.org/learn/finance/acca-robotic-process-and-intelligent-automation-for-finance?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/finance/acca-robotic-process-and-intelligent-automation-for-finance?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	BerkeleyX: Bitcoin and Cryptocurrencies		<a href="https://www.edx.org/learn/bitcoin/university-of-california-berkeley-bitcoin-and-cryptocurrencies?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list">https://www.edx.org/learn/bitcoin/university-of-california-berkeley-bitcoin-and-cryptocurrencies?hs_analytics_source=referrals&amp;utm_source=mooc.org&amp;utm_medium=referral&amp;utm_campaign=mooc.org-course-list</a>
	Prompt Engineering and Advanced ChatGPT		<a href="https://www.my-mooc.com/en/mooc/prompt-engineering-and-advanced-chatgpt">https://www.my-mooc.com/en/mooc/prompt-engineering-and-advanced-chatgpt</a>
	Autonomous Mobile Robots		<a href="https://www.my-mooc.com/en/mooc/autonomous-mobile-robots-ethx-amrx-1">https://www.my-mooc.com/en/mooc/autonomous-mobile-robots-ethx-amrx-1</a>
	Practical Machine Learning		<a href="https://www.my-mooc.com/en/mooc/practical-machine-learning">https://www.my-mooc.com/en/mooc/practical-machine-learning</a>
	Reinforcement Learning		<a href="https://www.my-mooc.com/en/mooc/reinforcement-learning--ud600">https://www.my-mooc.com/en/mooc/reinforcement-learning--ud600</a>
	Introduction to Computer Vision		<a href="https://www.my-mooc.com/en/mooc/introduction-to-computer-vision--ud810">https://www.my-mooc.com/en/mooc/introduction-to-computer-vision--ud810</a>
	Knowledge-Based AI: Cognitive Systems		<a href="https://www.my-mooc.com/en/mooc/knowledge-based-ai-cognitive-systems--ud409">https://www.my-mooc.com/en/mooc/knowledge-based-ai-cognitive-systems--ud409</a>

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: III</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Project Phase I</b>		<b>Course Code/ Course Type</b>		<b>PMTAI603</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/Oral</b>
-	20	-	10	20	200	-	200
<b>Pre-Requisite:</b> 1. Basics of Software Engineering and Computer Programming Concepts 2. Basics of Programming Language such as C, MATLAB, Python.							
<b>Course Objectives (CO):</b>				<b>The objective of Project Phase I is to:</b>			
				<ol style="list-style-type: none"> <li>5. To comprehend the —Product Development Process.</li> <li>6. To plan for various activities of the major project and channelize the work towards product development.</li> <li>7. To build, design and implement real time application using available platforms.</li> <li>8. To inculcate research culture in students for their technical growth</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>				<b>Students would be able to:</b>			
				<ol style="list-style-type: none"> <li>6. Comprehend, plan and execute the major Project with appreciable research outcomes.</li> <li>7. Design real time application considering immerging areas in technology</li> <li>8. Prepare good quality technical report based on the project.</li> <li>9. Demonstrate technical ideas and its relevance in recent technology</li> <li>10. Publish good quality paper in reputed journal and present their work in reputed conferences.</li> </ol>			
<b>Guidelines:</b>							
<ol style="list-style-type: none"> <li>7. Individual student need to design and demonstrate project under the guidance of allocated guide.</li> <li>8. Sponsored Project or Project Internship is acceptable considering postgraduate scope.</li> <li>9. Students can choose project domain and problem statement as per latest research areas, recent technology trends and societal importance.</li> <li>10. Project Report-1 should be submitted as a compliance of term work associated with subject.</li> <li>11. At least 2 Paper publications are expected as research outcome of Project Stage-I (Scopus indexed Conference or Journal) and 40% of planned project work should be completed for submission of Dissertation Phase-I</li> <li>12. Total Duration: 120 hours are contact hours with guides and for reviews, 120 hours are</li> </ol>							

expected to be spend by students to satisfy all project requirements and implementations.

**Detailed Syllabus:**

**Project Phase – I [Company/ In-house project]**

<b>Sr. No.</b>	<b>Activity</b>	<b>Hours</b>
<b>1.</b>	Week 1, 2, 3: Guide allotment, applying for sponsorship and project internship, finalization of topic and platform, Planning of the work.	18
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, Review 1 for finalization of topic and specification.	18
<b>3.</b>	Week 6, 7, 8 : understanding platform implementation and related software flow and execute block level design , Review 2 to understand the progress of the project	18
<b>4.</b>	Week 9, 10 : Simulation of proposed methodology on appropriate software tools and finalization of hardware platform	18
<b>5.</b>	Week 11, 12: Project Report writing and publication or copyright planning and execution. Demonstration of Project work and Final Review for submission and term work compliances	18
	<b>Total</b>	<b>90</b>

## COURSE CURRICULUM

Sr. No.		Activity				Hours	
<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: II</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Seminar and Research Paper Writing II</b>		<b>Course Code/ Course Type</b>		<b>PMTAI516</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/ Oral</b>
-	4	-	4	4	50	-	50
<b>Pre-Requisite:</b>							
Guidelines:							
<ol style="list-style-type: none"> <li>Individual student needs to study recent research topics in the field of Computer Engineering under the guidance of allocated guide.</li> <li>Students can choose topic related to Computer Engineering considering recent trends and its societal importance and at least 5 latest research papers to be studied in seminar.</li> <li>The extensive Literature Survey, Mathematical Modeling of particular method and valuable conclusion is expected from seminar study.</li> <li>Seminar Report should be submitted as a compliance of term work associated with subject.</li> <li>At least 1 review paper publication is expected as research outcome of seminar.</li> <li>Total Duration: 24 Contact Hours and 24 Hours should be spend by students on completion of related activities and requirements.</li> </ol>							
<b>Detailed Syllabus:</b>							
<b>Seminar Activities</b>							
<b>1.</b>	Week 1, 2, 3: Guide allotment, finalization of topic, Planning of the work. Review-1 conduction					12	
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, of detail topic.					12	
<b>3.</b>	Week 6, 7, 8 : Detail Topic Mathematical model, methodology and findings Review-2 conduction					12	
<b>4.</b>	Week 9, 10 : Comparison of detail topic with other existing methods					12	
<b>5.</b>	Week 11, 12: Seminar Report writing and publication or copyright planning Final Review conduction.					12	
	<b>Total</b>					<b>60</b>	

# **COURSE SYLLABUS**

## **MTECH CSE (AI)**

### **SEMESTER-IV**

## COURSE CURRICULUM

<b>Name of the Program:</b>		<b>M.TECH CSE-AI</b>			<b>Semester: II</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Data Visualization Techniques</b>			<b>Course Code/Course Type</b>		<b>PMTAI515</b>	
<b>Course Pattern</b>		<b>2024</b>			<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>			
<b>Theory</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/Oral</b>	
NA	2	NA	2	4	25	NA	25	
<b>Pre-Requisite:</b>								
<ol style="list-style-type: none"> <li>1. Basic knowledge of machine learning algorithms and techniques.</li> <li>2. Familiarity with Python programming language and relevant libraries (e.g., NumPy, pandas).</li> </ol>								
<b>Course Objectives (CO):</b>					<b>The objective of Data Visualization Techniques AI:</b>			
					<ol style="list-style-type: none"> <li>1. Understand the importance of Data Visualization.</li> <li>2. Explore different techniques and methods for Data Visualization.</li> <li>3. Analyze the time series data.</li> <li>4. Examine the multivariate data using various methods.</li> <li>5. Apply data visualization to develop a dashboard.</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>					<b>Students would be able to:</b>			
					<ol style="list-style-type: none"> <li>1. Understanding data visualization Concepts</li> <li>2. Knowledge of data visualization Techniques</li> <li>3. Ability to Apply data visualization Methods</li> <li>4. Critical Evaluation of data visualization.</li> <li>5. Application development using data visualization.</li> </ol>			

### Course Contents/Syllabus:

#### Practical Plan

Assignment/Practical/Activity Number	Assignment/Practical/Activity Title	Week Number/Turn	Details	CLO	Hours
1	Practical 1:	Week 1, Week2	Introduction to Data Visualization <ul style="list-style-type: none"> <li>• Overview of data visualization principles</li> <li>• Importance of visualization in data analysis</li> <li>• Types of data and appropriate visualizations</li> </ul>	CLO1	8

2	Practical 2:	Week3	<b>Data Visualization Tools</b> <ul style="list-style-type: none"> <li>• Introduction to tools like:</li> <li>• Python: matplotlib, seaborn</li> <li>• R: ggplot2, plotly</li> <li>• Tableau: Basics of creating visualizations</li> </ul>	C L O 1	4
3	Practical 3:	Week 4	<b>Design Principles</b> <ul style="list-style-type: none"> <li>• Gestalt principles of visual perception</li> <li>• Color theory and its application in visualizations</li> <li>• Layout and composition in data visualization</li> </ul>	C L O 1	4
4	Practical 4:	Week 5	<b>Exploratory Data Analysis (EDA)</b> <ul style="list-style-type: none"> <li>• Using visualizations for EDA</li> <li>• Handling missing data and outliers visually</li> <li>• Interactive visualizations for EDA</li> </ul>	C L O 1	4
5	Practical 5:	Week 6	<b>Static Visualizations</b> <ul style="list-style-type: none"> <li>• Creating bar charts, histograms, scatter plots</li> <li>• Box plots and violin plots</li> <li>• Advanced techniques: heatmaps, mosaic plots</li> </ul>	C L O 5	4
6	Practical 6:	Week 7	<b>Dynamic and Interactive Visualizations</b> <ul style="list-style-type: none"> <li>• Introduction to interactive plotting libraries</li> <li>• Creating interactive dashboards</li> <li>• Adding interactivity to visualizations</li> </ul>	C L O 5	4
7	Practical 7:	Week 8,9	<b>Geographic and Temporal Data Visualization</b> <ul style="list-style-type: none"> <li>• Mapping techniques and tools (e.g., Leaflet, GeoPandas)</li> <li>• Visualizing temporal data (time series, timelines)</li> </ul>	C L O 2	8
8	Practical 8:	Week 10	<b>Special Topics in Data Visualization</b> <ul style="list-style-type: none"> <li>• Network visualization</li> <li>• Text and sentiment visualization</li> <li>• Advanced chart types (e.g., Sankey diagrams, radar charts)</li> </ul>	C L O 3	4
9	Practical 9:	Week 11	<b>Ethics and Storytelling through Data Visualization</b> <ul style="list-style-type: none"> <li>• Ethical considerations in visualization</li> <li>• Telling compelling stories with data</li> <li>• Communicating uncertainty and avoiding</li> </ul>	C L O 4	4
10	Practical 10:	Week 12	<b>Mini Project</b> <ul style="list-style-type: none"> <li>• Students choose a dataset and design a comprehensive visualization project</li> <li>• Includes a written report explaining</li> </ul>	C L O 4	4

design choices and insights gained					
11	Practical 11:	Week 13,14	Mini Project	C L O 3	8
12	Practical 12:	Week 15	Mini Project	C L O 4	4
<b>Total</b>					<b>60</b>

### Learning resources

#### **Text Books:**

1. Tamara Munzer, Visualization Analysis and Design, 1st edition, CRC Press, United States, 2015.
2. Michael Fry, Jeffrey Ohlmann, Jeffrey Camm, James Cochran, Data Visualization: Exploring and Explaining with Data, South-Western College Publishing, 2021

#### **Reference Books:**

1. Dr. Chun-hauh Chen, W. K. Hardle, A. Unwin, Handbook of Data Visualization, 1st edition, Springer publication, Germany, 2008.
2. Ben Fry, Visualizing Data, 1st edition, O'Reilly Media, United States, 2008.
3. Avril Coghlan, A little book of R for multivariate analysis, 1st edition, Welcome Trust Sanger Institute, United Kingdom, 2013.

#### **Online Resources/ E learning Resource**

1. [https://onlinecourses.nptel.ac.in/noc23\\_cs18/preview](https://onlinecourses.nptel.ac.in/noc23_cs18/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs24/preview](https://onlinecourses.nptel.ac.in/noc22_cs24/preview)
3. <https://sgfin.github.io/learning-resources/>

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: IV</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Project Phase II</b>		<b>Course Code/ Course Type</b>		<b>PMTAI605</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theory</b>	<b>Practical</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practical/Oral</b>
-	32	-	16	32	300	-	300
<b>Pre-Requisite:</b>							
<ol style="list-style-type: none"> <li>1. Basics of Software Engineering and Computer Programming Concepts</li> <li>2. Basics of Programming Language such as C, MATLAB, Python.</li> </ol>							
<b>Course Objectives (CO):</b>				<b>The objective of Project Phase II is to:</b>			
				<ol style="list-style-type: none"> <li>1. To comprehend the —Product Development Process.</li> <li>2. To plan for various activities of the major project and channelize the work towards product development.</li> <li>3. To build, design and implement real time application using available platforms.</li> <li>4. To inculcate research culture in students for their technical growth</li> </ol>			
<b>Course Learning Outcomes (CLO):</b>				<b>Students would be able to:</b>			
				<ol style="list-style-type: none"> <li>1. Comprehend, plan and execute the major Project with appreciable research outcomes.</li> <li>2. Design real time application considering immerging areas in technology</li> <li>3. Prepare good quality technical report based on the project.</li> <li>4. Demonstrate technical ideas and its relevance in recent technology</li> <li>5. Publish good quality paper in reputed journal and present their work in reputed conferences.</li> </ol>			
<b>Project Phase – I [Company/ In-house project]</b>							

<b>Sr. No.</b>	<b>Activity</b>	<b>Hours</b>
<b>1.</b>	Week 1, 2, 3: Guide allotment, applying for sponsorship and project internship, finalization of topic and platform, Planning of the work.	18
<b>2.</b>	Week 4, 5: Literature review, Specification and Methodology Finalization, Review 1 for finalization of topic and specification.	18
<b>3.</b>	Week 6, 7, 8 : understanding platform implementation and related software flow and execute block level design , Review 2 to understand the progress of the project	18
<b>4.</b>	Week 9, 10 : Simulation of proposed methodology on appropriate software tools and finalization of hardware platform	18
<b>5.</b>	Week 11, 12: Project Report writing and publication or copyright planning and execution. Demonstration of Project work and Final Review for submission and term work compliances	18
	<b>Total</b>	<b>90</b>

## COURSE CURRICULUM

### Course Contents/Syllabus:

(All the units carry equal weightage in Summative Assessment and equal engagement)

<b>Name of the Program:</b>		<b>M. TECH CSE (AI)</b>		<b>Semester: IV</b>		<b>Level: PG</b>	
<b>Course Name</b>		<b>Seminar</b>		<b>Course Code/ Course Type</b>		<b>PMTAI606</b>	
<b>Course Pattern</b>		<b>2024</b>		<b>Version</b>		<b>1.0</b>	
<b>Teaching Scheme</b>					<b>Assessment Scheme</b>		
<b>Theor y</b>	<b>Practic al</b>	<b>Self-Work</b>	<b>Total Credits</b>	<b>Hours</b>	<b>CIA (Continuous Internal Assessment)</b>	<b>ESA (End Semester Assessment)</b>	<b>Practica l/Oral</b>
	4	-	4	4	50	-	50
<b>Pre-Requisite:</b>							
Guidelines:							
<ol style="list-style-type: none"> <li>Individual student needs to study recent research topics in the field of Computer Engineering under the guidance of allocated guide.</li> <li>Students can choose topic related to Computer Engineering considering recent trends and its societal importance and at least 5 latest research papers to be studied in seminar.</li> <li>The extensive Literature Survey, Mathematical Modeling of particular method and valuable conclusion is expected from seminar study.</li> <li>Seminar Report should be submitted as a compliance of term work associated with subject.</li> <li>At least 1 review paper publication is expected as research outcome of seminar.</li> <li>Total Duration: 24 Contact Hours and 24 Hours should be spend by students on completion of related activities and requirements.</li> </ol>							
<b>Detailed Syllabus:</b>							
<b>Seminar Activities</b>							
<b>Sr. No.</b>	<b>Activity</b>						<b>Hours</b>
1.	Week 1, 2, 3: Guide allotment, finalization of topic, Planning of the work. Review-1 conduction						12
2.	Week 4, 5: Literature review, Specification and Methodology Finalization, of detail topic.						12
3.	Week 6, 7, 8 : Detail Topic Mathematical model, methodology and findings Review-2 conduction						12
4.	Week 9, 10 : Comparison of detail topic with other existing methods						12
5.	Week 11, 12: Seminar Report writing and publication or copyright planning Final Review conduction.						12
	<b>Total</b>						<b>60</b>

## **List of MOOC-III( Content NA)**