Artificial Intelligence Technology Institute

B.Tech. Artificial Intelligence Technology Institute

Curriculum and Syllabus

(Applicable to the students admitted from AY: 2026 onwards)

SRM University *AP*, Andhra Pradesh

Department Vision

To be a globally recognized leader in the field of Artificial Intelligence Technology Institute, by fostering innovation through cutting-edge collaborative research to inform interdisciplinary education.

Department Mission

1. Create inclusive and highly motivated individuals and leaders who promote diversity, innovation, creativity, and a high sense of responsibility towards societal progress.
2. Strive for excellence by promoting interdisciplinary education and research through global collaborations.
3. Deliver state-of-the-art research-based education that equips students with the skills to address contemporary challenges and contribute to the field's advancement.
4. Foster a culture of innovation and entrepreneurship, by working closely with leading industry partners to translate ideas into real-life solutions.
5. Aim to be a global knowledge hub by collaborating with leading institutions and industries.

Program Educational Objectives (PEO)

1. Enable the undergraduate students to learn the fundamentals Artificial Intelligence Technology Institute deeply and lay a strong foundation for their professional careers or higher studies.
2. Impart the skills to design and develop solutions for complex engineering problems in a multi-disciplinary environment.
3. Work in guided multi-disciplinary Artificial Intelligence Technology Institute -related field research groups using technical know- how, common tools and environments to achieve project objectives.
4. Facilitate the development of effective communication skills, lifelong learning, leadership qualities and ethical professional conduct across their higher education and career paths.

Mission of the Department to Program Educational Objectives (PEO) Mapping

	PEO 1	PEO 2	PEO 3	PEO 4
Mission Statement 1	3	3	2	3
Mission Statement 2	3	3	3	1
Mission Statement 3	3	3	3	2
Mission Statement 4	1	3	3	3
Mission Statement 5	3	3	3	3

Program Specific Outcomes (PSO)

1. Architect modern communication systems to meet stated requirements.
2. Design, build and test electronic systems for given specifications.
3. Analyse, plan and apply the acquired knowledge in basic sciences, mathematics to solve complex problems with technical, economic, environmental, and social contexts.

Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)															
	POs												PSOs		
PEOs	nEngineeri dgeKnowle	Problem Analysis	Design andDevelo pment	Analysis, Design anResearch	Modern Tool and I CT Usage	Society, Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Iannddi Tveidaumal sworkSkill	Communication Skills	Project Management andFinance	Self-Directed andLifel ongLear ning	PSO 1	PSO 2	PSO 3
PEO 1	3	2	1	1	2	-	-	1	2	1	-	2	1	1	1
PEO 2	2	3	3	3	3	-	2	2	2	2	2	3	3	3	3
PEO 3	3	3	3	3	3	1	2	3	3	3	3	2	3	2	2
PEO 4	2	2	2	2	-	2	2	3	3	3	1	3	1	1	3

Category Wise Credit Distribution

Course Sub-Category	Sub-Category Credits	Category Credits	Learning Hours
Ability Enhancement Courses (AEC)		8	
University AEC	4		240
School AEC	4		
Value Added Courses (VAC)		6	
University VAC	6		180
School VAC	-		
Skill Enhancement Courses (SEC)		22	
School SEC	18		
Department SEC	4		660
SEC Elective			
Foundation/ Interdisciplinary courses (FIC)		17	
School FIC	17		510
Department FIC	-		
Core + Core Elective including Specialization (CC)		85	
Core	78		2550
Core Elective (Inc Specialization)	7		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		14	
Internship / Design Project / Startup / NGO	4		420
Internship / Research / Thesis	10		
	Total	**167**	**5010**

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	2	2	2	2	-	-	-	-	8	**5**
Value Added Courses - VAC	2	2	2*	2*	2*	2	-	-	6	**3**
Skill Enhancement Courses - SEC	2	2	2	4	6	6	-	-	22	**13**
Foundation / Interdisciplinary Courses - FIC	8	6	3	-	-	-	-	-	17	**10**
CC/SE/CE/TE/DE/HSS	6	10	16	11	15	16	7	4	85	**53**
Minor / Open Elective - OE	-	-	3	3	3	3	3	-	15	**9**
(Research / Design / Industrial Practice / Project / Thesis / Internship) - RDIP	-	-	-	-	-	-	4	10	14	**7**
Grand Total	**20**	**22**	**26**	**20**	**24**	**27**	**14**	**14**	**167**	**100**

Note: L-T/D-P/Pr and the class allocation is as follows.

- Learning Hours : 30 learning hours are equal to 1 credit.
- Lecture/Tutorial : 15 contact hours (60 minutes each) per semester are equal to 1 credit.
- Discussion : 30 contact hours (60 minutes each) per semester are equal to 1 credit.
- Practical : 30 contact hours (60 minutes each) per semester are equal to 1 credit.
- Project : 30 project hours (60 minutes each) per semester are equal to 1 credit.

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Neerukonda, Mangalagiri Mandal,
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SEMESTER - I								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	AEC		Art of Listening, Speaking and Reading Skills	1	0	1	2
2	VAC	U VAC		AI Foundation Lab (Prompt Engineering)	0	0	2	2
3	FIC	FIC		Engineering Physics	2	0	1	3
4	FIC	FIC		Calculus for Engineers	3	0	0	3
5	FIC	FIC		Principles of Economics and Management	0	0	2	2
6	SEC	SEC		Analytical Reasoning and Aptitude Skills - 1	1	0	1	2
7	Core	CC		Fundamentals of Computing and Programming in C	3	0	1	4
8	Core	CC		AI Foundation lab (Python)	0	0	2	2
				Semester Total	**10**	**0**	**10**	**20**

SEMESTER - II								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	AEC		Effective Writing and Presentation Skills	1	0	1	2
2	VAC	U VAC		Universal Human Value Ethics (which will be offered under MOOC - SWAYAM)	2	0	0	2
3	FIC	FIC		Discrete Mathematics	3	0	0	3
4	FIC	FIC		Matrices and Linear Transformations	3	0	0	3
5	SEC	SEC		Foreign Languages	2	0	0	2
6	Core	CC		Database Management System	3	0	1	4
7	Core	CC		Data Structures	3	0	1	4
8	Core	CC		AI Engineering lab (Advanced Python)	0	0	2	2
				Semester Total	**17**	**0**	**5**	**22**

SEMESTER - III								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	AEC		Problem Solving Skills	1	0	1	2
2	VAC	U VAC		Co-Curricular Activities	0	0	2*	2*
3	SEC	SEC		Analytical Reasoning and Aptitude Skills -II	1	0	1	2
4	FIC	FIC		Probability and Random Variables	3	0	0	3
5	Core	CC		Digital Logic with Computer Organization & Architecture	3	0	1	4
6	Core	CC		Operating Systems	3	0	1	4
7	Core	CC		Artificial Intelligence and Machine Learning-I (AI: Representation and Problem Solving)	3	0	1	4
8	Core	CC		Design and Analysis of Algorithm	3	0	1	4
9	Open Elective	**OE**		Open Elective/Minor - I	**3**	**0**	**0**	**3**
				Semester Total	**20**	**0**	**8**	**26**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	AEC		Creativity and Critical Thinking Skills	0	0	2	2
2	**VAC**	**U VAC**		**Co-Curricular Activities**	**0**	**0**	**2**	**2***
3	SEC	SEC		Industry Standard Employability skills I	2	0	0	2
4	SEC	SEC		Industry Standard Coding for Employability skills - I	1	0	1	2
5	Core	CC		Computer Networks	3	0	1	4
6	Core	CC		Theory of Computations and Compiler Design	3	0	0	3
7	Core	CC		Artificial Intelligence and Machine Learning II (Introduction to Machine Learning)	3	0	1	4
8	Open Elective	**OE**		Open Elective/Minor - II	**3**	**0**	**0**	**3**
				Semester Total	**15**	**0**	**7**	**20**

SEMESTER - V								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC		Co-Curricular Activities	0	0	2	2*
2	SEC	SEC		Industry Standard Employability skills II	1	0	1	2
3	SEC	SEC		Career Skills - I (GenAI with AgenticAI)	1	0	1	2
4	SEC	SEC		Industry Standard Coding for Employability skills - II	1	0	1	2
5	Core	CC		Natural Language Processing	3	0	1	4
6	Core	CC		Digital Image Processing	0	0	2	3
7	Core	CC		Artificial Intelligence and Machine Learning III (Introduction to Deep Learning)	3	0	1	4
8	Stream Elective	SE		Elective - I: (Agriculture, Cyber Security, Energy, Finance, Robotics, Healthcare)	3	0	1	4
9	Open Elective	**OE**		Open Elective/Minor - III	**3**	**0**	**0**	**3**
				Semester Total	**13**	**0**	**10**	**24**

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Guntur District, Mangalagiri, Andhra Pradesh - 522240.

SEMESTER - VI								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC		Co-Curricular Activities	0	0	2	2
2	SEC	SEC		Industry Standard Employability skills III	1	0	1	2
3	SEC	SEC		Career Skills - II	1	0	1	2
4	SEC	SEC		Industry Standard Coding for Employability skills - III	1	0	1	2
5	Core	CC		Graph Representation System	3	0	1	4
6	Core	CC		AI Augmented Software Engineering and Project Management	3	0	1	4
7	Core Elective	CE		Core Elective - I 1. Big Data Analytics 2. VR/AR 3. Computer Graphics 4. Cloud/Fog/Edge Computing 5. LLM Engineering 6. MLOps 7. Optimization Techniques 8. Intelligent Systems 9. Decision Making under Uncertainty 10. Federated Learning 11. Soft Computing	3	0	1	4
8	Stream Elective	SE		Elective - II: (Agriculture, Cyber Security, Energy, Finance, Robotics, Healthcare)	3	0	1	4
9	Open Elective	**OE**		Open Elective/Minor - IV	**3**	**0**	**0**	**3**
				Semester Total	**18**	**0**	**9**	**27**

SEMESTER – VII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SIRP	SIRP		Summer Internship (Industry / Research Project) - II	0	0	4	4
2	Core Elective	CE		Core Elective - II 1. Big Data Analytics 2. VR/AR 3. Computer Graphics 4. Cloud/Fog/Edge Computing 5. LLM Engineering 6. MLOps 7. Optimization Techniques 8. Intelligent Systems 9. Decision Making under Uncertainty 10. Federated Learning 11. Soft Computing	3	0	0	3

3	Open Elective	OE		Open Elective/Minor - V	**3**	**0**	**0**	**3**
4	Stream Elective	SE		Elective - III: (Agriculture, Cyber Security, Energy, Finance, Robotics, Healthcare)	3	0	1	4
				Semester Total	**9**	**0**	**5**	**14**

SEMESTER – VIII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	IRP	IRP		Capstone Project	0	0	12	10
2	Stream Elective	SE		Elective - IV: (Agriculture, Cyber Security, Energy, Finance, Robotics, Healthcare)	3	0	1	4
				Semester Total	**3**	**0**	**13**	**14**

SEMESTER I

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AI Foundation Lab (Prompt Engineering)

Course Code		Course Category	U VAC	Credit	L	T	D	P	Pr	TW + SL	Total
					0	0	0	2	0	0	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	0	0	0	16	0	0	32
Course Offering by	AITI	Progressive Course(s)		Professional / Licensing Standards							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. To understand how large language models generate text, why they produce fluent but unreliable output, and what this mechanism implies for professional use.
2. To enable students to construct precise, structured instructions for AI systems using a five-component specification framework (Objective, Role, Context, Constraints, Format).
3. To apply iterative refinement, multi-step prompt workflows, and verification protocols to produce reliable, responsible, and professionally accountable AI-assisted work across problem domains.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate the five-component specification framework to convert vague requests into precise, testable instructions for AI systems.	3	70%	65%
Outcome 2	Apply a working mental model of text generation (prediction vs. truth) to anticipate hallucination, overconfidence, and other structural failure modes.	3	70%	65%
Outcome 3	Examine failing prompts and repair them through systematic diagnosis, single-variable iteration, and documented improvement logs.	4	70%	65%
Outcome 4	Analyze complex tasks into multi-step prompt workflows (reasoning scaffolds, prompt chains) with explicit human verification checkpoints.	4	65%	65%
Outcome 5	Devise and test a domain-specific prompt system integrating context blocks, constraints, verification protocol, and responsible-use safeguards.	4	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

CLOs	Program Learning Outcomes (PLO)														
	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO1	PSO2	PSO3
Outcome 1		2	2		3					3		2			
Outcome 2	2	3		2	3			2				3			

Outcome 3		3	2	2	3					2		3			
Outcome 4		3	3	2	3				2	2	2	2			
Outcome 5		2	3	2	3	2		3	2	3	2	3			
Average	**2.0**	**2.6**	**2.5**	**2.0**	**3.0**	**2.0**		**2.5**	**2.0**	**2.5**	**2.0**	**2.6**			

Correlation : **3** = High, **2 =** Medium, **1** = Low

SRM University *AP*, Andhra Pradesh

Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Course Unitization Plan Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	From Questions to Specifications: what prompt engineering actually is	1	CO1	1
2	The Generative Mechanism: prediction vs. truth, confidence vs. correctness	2	CO2	1, 2
3	Hallucination Lab: hunting fabrication under high-risk conditions	2	CO2	2, 3
4	Context Control: the relevance test and prompt surgery	2	CO1	1, 3
5	The Five-Component Anatomy: Objective, Role, Context, Constraints, Format	2	CO1	1, 3
6	Instruction Clarity: the two-interpretations test	2	CO1	1, 3
7	Role Prompting: lenses, not upgrades	2	CO1, CO2	3
8	Constraints: encoding what must not happen	2	CO1	3
9	Output Control: format shapes reasoning	2	CO1	3
10	Systematic Debugging: five anti-patterns, five-step diagnosis	2	CO3	1, 3
11	Iteration Discipline: one variable at a time, documented	2	CO3	3
12	Reasoning Scaffolds: structuring complex thinking step-by-step	2	CO4	3, 4
13	Prompt Chaining: outputs become inputs, humans hold checkpoints	2	CO4	3, 4
14	Self-Critique & Verification Protocols: catching errors before they ship	2	CO3, CO4	2, 3
15	Limits, Bias & Responsibility: disclosure, accountability, human-in-the-loop	2	CO5	1, 2, 5
16	Capstone: a domain-specific prompt system, built, tested, defended	3	CO5	1, 2, 3, 4, 5
Total Contact Hours		**32**		
Total Learning Hours		**32**		

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Assignment (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed											
1) Remember					20%		10%	10%		10%	
2) Understand					30%		20%	20%		20%	
3) Apply					30%		40%	30%		35%	
4) Analyze					20%		30%	40%		35%	
5) Evaluate											
6) Create											
Total					**100%**		**100%**	**100%**		**100%**	

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Assignment	Project	Theory	Practical	Project
COs Addressed											
Conducting Marks					10		20	20		50	
Converting Marks					10		20	20		50	
Total Converting Marks					30			20	50		
Total Marks	100										

Recommended Resources

1. Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux, 2019.
3. Prompt Engineering Guide, DAIR.AI (promptingguide.ai) — open educational resource, platform-neutral.
4. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach (introductory topics), Pearson.
5. Prompting documentation from multiple AI providers, read comparatively to preserve platform neutrality.

Course Designers

1. Bloom AI University — Curriculum Design Team

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Fundamentals of Computing and Programming in C

Course Code		**Course Category**	CC	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. Gain basic knowledge in C programming language

2. Acquire knowledge on Decision making and functions in C

3. Learn arrays, strings and pointers concept in C

4. Understand the basics concepts of Structures, Union and File handling techniques using C Programming

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Describe C structures, enumerators, keywords, header files and operators	**2**	**75%**	**70%**
Outcome 2	Illustrate Decision-Making statements and Functions.	**3**	**70%**	**65%**
Outcome 3	Interpret arrays, strings, and pointers programming in C	**3**	**70%**	**65%**

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Outcome 4	Apply Structures, unions, File handling operations on different scenarios	**3**	**70%**	**65%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO1	PSO2	PSO3
Outcome 1	3	3	2	1									2	2	3
Outcome 2	3	3	2	1									3	2	3
Outcome 3	3	3	2	2									3	2	3
Outcome 4	3	3	2	2									3	2	3
Average	3	3	2	2								2	3	2	2

Correlation : 3 = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	**Unit Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
1	**INTRODUCTION TO COMPUTER SCIENCE**	**9**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer: ALU, input-output units, memory,	2	1	1,2

	program counter - variables and addresses - instructions: store, arithmetic, input and output			
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	1	1	1,2
	Computer languages: Machine, symbolic and high-level language Level languages	1	1	1,2
	Creating and Running Programs: Writing, editing (any editor), compiling (gcc)	1	1	1,2
	linking, and executing in Linux environment	2	1	1,2
2	**C PROGRAMMING BASICS**	**9**		
	Structure of a C program, identifiers Basic data types and sizes. Constants, Variables	2	1	1,2
	Arithmetic, relational and logical operators, increment and decrement operator's	2	1	1,2
	Conditional operator, assignment operator, expressions Type conversi Type	1	1	1,2
	Conditional Expressions Precedence and order of evaluation, Sample Programs.	1	1	1,2
	SELECTION & DECISION MAKING: if-else, null else, nested if, examples, multi-way selection: switch, else-if, examples.	1	1	1,2
	ITERATION: Loops - while, do-while and for, break, continue,	1	1	1,2
	initialization and updating, event and counter controlled loops and examples.	1	1,2	1,2
3	**FUNCTIONS AND ARRAYS**	**9**		
	User defined functions, standard library functions	1	2,3	1,2
	Passing 1-D arrays, 2-D arrays to functions.	1	2,3	1,2
	Recursive functions - Recursive solutions for Fibonacci series, towers of Hanoi.	1	2,3	1,2
	C Pre-processor and header files	1	2,3	1,2

	Concepts, declaration, definition, storing and accessing elements	2	2,3	1,2
	one dimensional, two dimensional and multidimensional arrays	2	2,3	1,2
	array operations and examples, Character arrays and string manipulations	1	2,3	1,2
4	**POINTERS**	**9**		
	Concepts, initialization of pointer variables	1	3,4	1,2
	pointers as function arguments, passing by address, dangling memory, address arithmetic	2	3,4	1,2
	character pointers and functions, pointers to pointers	1	3,4	1,2
	pointers and multi-dimensional arrays, dynamic memory management functions	3	3,4	1,2
	command line arguments	2	3,4	1,2
5	**ENUMERATED, STRUCTURE AND UNION TYPES**	**9**		
	Structures - Declaration, definition, and initialization of structures, accessing structures	1	5	2, 3, 4
	nested structures, arrays of structures, structures and functions, pointers to structures,	2	5	2, 3, 4
	self-referential structures. Unions, typedef, bit-fields, program applications	2	5	2, 3, 4
	Bit-wise operators: logical, shift, rotation, masks.	1	5	2, 3, 4
	FILE HANDLING: Concept of a file, text files and binary files, formatted I/O, file I/O operations and example programs.	3	5	2, 3, 4
	Total Contact Hours	45		
	Total Learning Hours			

Course Unitization Plan Lab

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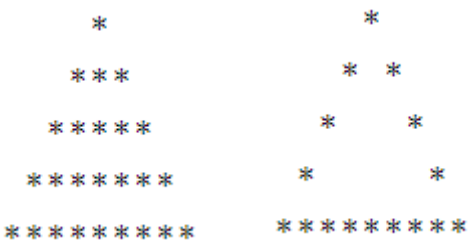
Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
2	a. Calculation of the area of the triangle. a. Swap two numbers without using a temporary variable. Find the roots of a quadratic equation	2	1	1,2
3	a. Find the sum of individual digits of a positive integer and find the reverse of the given number. a. Generate the first n terms of Fibonacci sequence. Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	1	1, 2	1,2
4	a. Print the multiplication table of a given number n up to a given value, where n is entered by the user. a. Decimal number to binary conversion. Check whether a given number is the Armstrong number or not.	2	1, 2	1,2
5	Triangle star patterns  I II	2	1, 2	1,2

6	**a)** (n Cr) an d (n Pr) of th e g iv en n u m b er s $1+x+x^2\backslash 2+x^3\backslash 3!+x^4\backslash 4!+\ldots\ldots\ldots X^n\backslash n!$	1	2,3	1,2
7	Interchange the largest and smallest numbers in the array. Searching an element in an array Sorting array elements.	1	2,3	1,2
8	Transpose of a matrix. Addition and multiplication of 2 matrices.	1	2,3	1,2
9	Function to find both the largest and smallest number of an array of integers. Liner search. Replace a character of string either from beginning or ending or at a specified location.	1	2,3	1,2
10	Pre-processor directives . If Def . Undef Pragma	1	2,3	1,2
11	Illustrate call by value and call by reference. Reverse a string using pointers Compare two arrays using pointers	2	3, 4	1,2,3
12	Array of Int and Char Pointers. Array with Malloc(), calloc() and realloc().	2	3, 4	1,2,3
13	To find the factorial of a given integer. To find the GCD (greatest common divisor) of two given integers. Towers of Hanoi	2	3, 4	1,2,3
14	Reading a complex number Writing a complex number. Addition of two complex numbers Multiplication of two complex numbers	2	5	2, 3, 4
15	File copy Word, line and character count in a file.	2	5	2, 3, 4

Total Contact Hours	**30**
Total Learning Hours	60

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
1) Remember	–	–	–	–	–	–	–	–	–	–	–
2) Understand	CO1	CO1	–	–	CO1	CO1	CO1	–	CO1	CO1	CO1
3) Apply	CO2	CO2	CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2, CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2
4) Analyze	–	–	–	–	–	–	–	–	–	–	–
5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
6) Create	–	–	–	–	–	–	–	–	–	–	–
Total	**5**	**15**	**5**	**5**	**10**	**-**	**-**	**10**	**30**	**20**	**-**

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Kernighan, B. W., & Ritchie, D. M. (2002). The C programming language
2. Dey, P., & Ghosh, M. (2011). Programming in C
3. Hanly, J. R., & Koffman, E. B. (2007). Problem solving and program design in C. Pearson Education India
4. Bichkar, R. S. Programming with C. (2012) Universities Press

Other Resources

1. Gottfried B. (2016) Programming with C. Mcgraw hill Education, Fourteenth reprint

Course Designers

1. Dr. Ashok Kumar Pradhan, Associate Professor, Dept of CSE, SRM University – AP.

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

AI Foundation Lab (Python)

Course Code		**Course Category**	**CC**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					0	0	0	0	2	0	2
Pre-Requisite Course(s)	Fundamentals of Programming, Problem Solving and Computational Thinking	**Co-Requisite Course(s)**		**Learning Hours**					32		32
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. To understand Python programming concepts, syntax, and foundational constructs clearly.
2. To enable students to write, debug, and execute modular Python programs proficiently.
3. To apply Python data structures, operators, and functions to design and build structured software applications across different problem domains.

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Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate Python syntax, variables, data types, input/output operations and operators to solve basic problems.	3	70%	65%
Outcome 2	Apply decision-making and looping constructs to develop simple Python programs.	3	70%	65%
Outcome 3	Examine programs using strings, lists, tuples, dictionaries and sets.	4	70%	65%
Outcome 4	Examine user-defined functions and perform basic file handling operations.	4	65%	65%
Outcome 5	Devise and test small Python applications integrating fundamental programming concepts.	4	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech

Program Learning Outcomes (PLO)															
CLOs	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2		3				2				3		
Outcome 2	3	2	3		3				2				3		
Outcome 3	3	3	2		3				2				3		
Outcome 4	2	3	2		3				2				2		
Outcome 5	3	3	3		3				3				3		
Average	2.8	2.6	2.4		3				2.2				2.8		

Correlation : **3** = High, **2** = Medium, **1** = Low

Course Unitization Plan Lab

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Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Introduction to Programming and Python	1	CO1	1
2	Python keywords, identifiers, variables, data types, input and output	2	CO2	1
3	Operators and Expressions	2	CO2	1,2
4	Decision Making using if, if-else	2	CO2	1,2
5	Nested if and if-elif-else	2	CO2	1,2
6	Loops using for, while	2	CO2	1,2
7	break, continue and pass	2	CO2	1,2
8	Basic pattern printing and number-based programs	2	CO2	1,2
9	Strings: creation, indexing, slicing and methods	2	CO2	1,2
10	Lists and Tuples operations	2	CO3	1,2
11	Dictionaries and Sets operations	2	CO3	1,2
12	Functions: defining, calling	2	CO3	2,3
13	Functions: arguments and return statement	2	CO3	2,3
14	Basic File Handling: opening, closing, reading,	2	CO4	2,3
15	Basic File Handling: writing, appending, and file applications	2	CO4	2,3
16	Mini Project: Integrating Python Fundamentals	3	CO5	1,2,3,4
Total Contact Hours		**32**		
Total Learning Hours		**32**		

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed					1, 2,3,4		1, 2,3,4	1, 2,3,4,5		1, 2,3,4	
1) Remember					30%		30%	20%		20%	
2) Understand					20%		20%	20%		20%	
3) Apply					30%		30%	30%		30%	
4) Analyze					20%		20%	30%		30%	
5) Evaluate											
6) Create											
Total					100 %		100 %	100 %		100 %	

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed					1, 2,3,4		1, 2,3,4	1, 2,3,4,5		1, 2,3,4	
Conducting Marks					10		20	20		50	
Converting Marks					10		20	20		50	
Total Converting Marks					30			20	50		
Total Marks	100										

Recommended Resources

1. Python Crash Course – Eric Matthes
2. Automate the Boring Stuff with Python – Al Sweigart
3. Artificial Intelligence: A Modern Approach – Russell & Norvig (Introductory Topics)
4. Python for Data Analysis – Wes McKinney

Course Designers

1. Dr. Kailash Pati Mandal, Assistant Professor, Department of CSE, SRM AP

SEMESTER II

Database Management Systems

Course Code		**Course Category**	**CC**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Learning Rationales (CLRs) Course Objectives (COs)

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1. Provide fundamental understanding of database systems, data models, and the relational model, including their role in modern AI-driven applications.
2. Develop proficiency in relational query languages, especially SQL, for data definition, manipulation, and preparation of datasets for analytical and AI tasks.
3. Equip students with conceptual modeling techniques and normalization principles for designing efficient and scalable database schemas.
4. Impart knowledge of transaction processing, concurrency control, and recovery mechanisms to ensure data consistency, reliability, and integrity.
5. Introduce storage structures, indexing techniques, NoSQL databases, and modern data retrieval methods supporting AI and large-scale data systems.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Explain DBMS concepts, architecture, data models, and relational database principles, including their applications in AI systems.	**2**	**70%**	**65%**
Outcome 2	Apply relational algebra and SQL to perform data definition, querying, and transformation for real-world and AI-oriented datasets.	**3**	**65%**	**65%**
Outcome 3	Design ER/EER models and normalize relational schemas to eliminate redundancy and ensure data integrity.	**4**	**60%**	**55%**
Outcome 4	Analyze transaction processing mechanisms and implement concurrency control and recovery strategies to maintain database reliability.	**4**	**60%**	**55%**
Outcome 5	Apply indexing, storage techniques, NoSQL models, and modern retrieval methods for scalable data management.	**3**	**60%**	**55%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)		
	PO	**PSO**

CLOs

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	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO1	PSO2	PSO3
Outcome 1	3	2			1							1			
Outcome 2	3	3	2		2				1			1			
Outcome 3	2	3	3	2	1				1			1			
Outcome 4	3	3	2	3	1							1			
Outcome 5	3	3	2	2	3							2			
Average															

Correlation : **3** = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	**Unit Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
UNIT 1: Introduction to DBMS and Relational model				
	File processing systems, advantages of DBMS, database system applications, and role of databases in AI systems	1	1	1,2,4
	DBMS architecture: three-schema architecture, data independence:	2	1	1,2,4

	logical and physical			
	Data models: relational, semi-structured, document, graph, and overview of data used in AI applications	1	1	1,2,4
	Introduction to relational model: domain, attribute, tuple, relation, schema, keys, and null values	2	1	1,2,4
	Database constraints: domain, key, entity integrity, referential integrity, data quality, and metadata for AI datasets	2	1	1,2,4
UNIT 2: Relational Query Languages, SQL, and Data Preparation		**10**		
	Relational algebra: selection, projection, union, set difference, Cartesian product, join, and division	2	2	1,2,3,5
	Relational calculus and its relationship with declarative query formulation	1	2	1,2,3,5
	SQL DDL: schema definitions, table creation, constraints, and database objects	1	2	1,2,3,5
	SQL DML: insert, select, update, delete, joins, nested queries, and set operations	2	2	1,2,3,5
	Aggregate functions, grouping, null values, views, and analytical query formulation	1	2	1,2,3,5
	Transaction support in SQL and complex integrity constraints	1	2	1,2,3,5
	Assertions, triggers, stored routines, and database-side automation	1	2	1,2,3,5
	SQL for AI feature preparation: summarization, filtering, sampling, window-function overview, and exporting clean datasets	1	2	1,2,3,5
UNIT 3: Conceptual Modeling, Normalization, and Analytics-Oriented Design		**9**		
	Entity Relationship model: entity types, entity sets, attributes, keys, relationships, relationship constraints, and weak entity types	3	3	1,2,3,4
	Enhanced ER modeling: super/sub classes, specialization, generalization, constraints, and example EER schema	2	3	1,2,3,4
	Mapping ER/EER models to relational schemas and preserving constraints	1	3	1,2,3,4
	Functional dependencies and basics of normalization: 1NF, 2NF, and 3NF	2	3	1,2,3,4
	BCNF, 4NF, denormalization overview, star schema basics, and data warehouse/data lake introduction	1	3	1,2,3,4

UNIT 4: Transaction Processing, Concurrency Control, Recovery, and Data Reliability		**8**		
	Introduction to transaction processing, ACID properties, advantages and limitations of transaction processing systems	2	4	1,2,3
	Serializability, conflict serializability, view serializability, and recoverability of transactions	1	4	1,2,3
	Concurrency control: lock-based protocols, two-phase locking, deadlocks, and multiple granularity locking	2	4	1,2,3
	Timestamp-based protocols, validation-based protocols, isolation levels, and transaction anomalies	2	4	1,2,3
	Recovery techniques: log-based recovery, checkpoints, database backup, auditability, privacy, and reliability in AI/data pipelines	1	4	1,2,3
UNIT 5: Storage, Indexing, NoSQL, and AI-Oriented Retrieval		**10**		
	Data on external storage, file organization, record organization, clustered, primary, and secondary Indexes	2	5	1,2,3,5
	Indexed Sequential Access Method and B+ trees: tree structure, search, insert, and delete	2	5	1,2,3,5
	Hash-based indexing: static hashing, extendible hashing, linear hashing, and comparison with tree indexes	2	5	1,2,3,5
	NoSQL overview: key-value, document, column-family, and graph databases; use cases in AI data management	1	5	1,2,3,5
	Full-text search, inverted indexes, vector embeddings, vector indexing overview, and retrieval support for semantic search/RAG systems	1	5	1,2,3,5
	Advanced data warehousing storage techniques: star schema, snowflake schema, columnar storage, partitioning, and materialized views	2	5	6
Total Contact Hours		**45**		
Total Learning Hours		**45**		

Course Unitization Plan Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
Lab 1	Implementation of data storage, file organization, and simple indexing methods using files.	**3**	5	1,2,3
Lab 2	DDL and DML queries on single and multiple tables using a relational DBMS.	3	2	1,2,5
Lab 3	SQL queries using joins, aggregate functions, grouping, nested queries, and views.	3	2,3	1,2,4,5
Lab 4	Creation of indexes, constraints, sequences, access privileges, and query performance observation.	3	2,5	1,2,3,5
Lab 5	Triggers, assertions/constraint handling, stored procedures, and database-side automation.	3	2,3	1,2,4,5
Lab 6	SQL transactions, isolation levels, concurrency scenarios, and recovery demonstration	3	4	1,2,3
Lab 7	Python/Java database connectivity for loading, cleaning, and extracting datasets for AI/analytics	3	2,5	2,5
Lab 8	Mini project: design and develop a database-backed AI/data application using SQL analytics and retrieval features.	9	3,4,5	1,2,3,4,5
Total Contact Hours		**30**		
Total Learning Hours		**30**		

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO2, CO3
1) Remember	40%	10%	40%	20%					10%		
2) Understand	30%	40%	30%	20%	10%				20%		10%
3) Apply	20%	30%	20%	30%	60%				40%		60%
4) Analyze	10%	20%	10%	30%	30%				30%		30%
5) Evaluate											
6) Create											
Total	100 %	100 %	100 %	100 %	100%				100%		100%

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO 1	CO1 , CO2	CO 3	CO4 , CO5	CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO2, CO3
Conducting Marks	10	25	10	10	50				50		50
Converting Marks	5	15	5	5	20				30		20

Total Converting Marks	30	20		50
Total Marks	100			

Recommended Resources

1. Database System Concepts, A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 7th ed., New York, USA: McGraw-Hill, 2019.
2. Fundamentals of Database Systems, R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, 7th ed., Boston, USA: Pearson, 2016.

Other Resources

3. Database Management Systems, R. Ramakrishnan and J. Gehrke, Database Management Systems, 3rd ed., New York, USA: McGraw-Hill, 2003.
3. An Introduction to Database Systems, C. J. Date, An Introduction to Database Systems, 8th ed., Boston, USA: Pearson, 2003.
3. Database Systems A Practical Approach to Design Implementation and Management, T. Connolly and C. Begg, Database Systems: A Practical Approach to Design, Implementation, and Management, 6th ed., Boston, USA: Pearson, 2015.
3. Fundamentals of Data Engineering: Plan and Build Robust Data Systems, Reis, J., & Housley, M., O'Reilly Media, 2022.

Course Designers

1. Dr. Saleti Sumalatha, Assistant Professor, CSE.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Data Structures

Course Code		Course Category	CC	Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)	Fundamentals of C Programming	Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by	AiTI	Progressive Course(s)		Professional / Licensing Standards							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. To explain the basic concepts such as abstract data types, linear and non-linear data structures
2. To describe the behavior of data structures such as arrays, linked lists, stacks, queues, trees, hash tables, search trees, graphs, and their representations
3. To provide an independent view of data structures, including its representation and operations performed on them, which are then linked to sorting, searching and indexing methods to increase the knowledge of usage of data structures in an algorithmic perspective
4. To choose an appropriate data structure for a specified application

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Compare and contrast the algorithms for linked list, stack and queue operations.	1, 2	70%	60%
Outcome 2	Illustrate algorithms for Binary Search Trees and AVL Trees.	2	70%	60%
Outcome 3	Apply graph traversal and minimum cost spanning tree algorithms.	3	70%	60%
Outcome 4	Distinguish searching and sorting techniques.	4	70%	60%

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Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO1	PSO2	PSO3
Outcome 1	3	3	2	-	-	-	-	-	-	-	-	1	3	3	
Outcome 2	3	3	2	1	-	-	-	-	-	-	-	1	3	3	
Outcome 3	3	3	2	1	-	-	-	-	-	-	-	1	3	3	
Outcome 4	3	3	1	-	-	-	-	-	-	-	-	1	3	3	
Average	3	3	2	1	-	-	-	-	-	-	-	1	3	3	

Correlation : **3** = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	**Introduction to Data Structures**	**9**		
	Abstract Data Type (ADT), Time and space requirements of algorithms	1	1	1
	Array ADT, Representing polynomials	1	1	1,2
	Sparse matrix using arrays and its operations	1	1	1
	Stacks: representation and application, implementation of stack operations using C.	2	1	1
	Example applications on Stacks	2	1	
	Queues: representation and application, implementation of queue operations using C.	1	1	1,2
	Example applications on Queues	1	1	1,2

2	**Linked lists**	**9**		
	Linked lists: Single linked lists representation	1	1	1,2
	Implementation of linked list various operation using C	3	1	1
	Doubly linked list representation and Implementation of doubly linked list various operation using C	2	1	5
	Implementation of Circular linked list various operations using C	2	1	4,5
3	**Trees**	**9**		
	Tree terminology	1	2	1
	Binary tree, Representation of Binary Trees using Arrays and Linked lists	1	2	1
	Binary search tree	2	2	1
	Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion	1	2	1
	Tree Traversals, Construction of tree using traversals	1	2	
	Applications, Expression tree	1	2	1
	General tree	1	2	1
	Heap Sort, Balanced Binary Trees, AVL Trees, Insertion, Deletion and Rotations.	1	2	1
4	**Graphs**	**9**		
	Graph terminology, Representation of graphs, path matrix	1	3	3
	BFS (breadth first search)	2	3	3
	DFS (depth first search)	1	3	3
	Topological sorting	1	3	3
	Priority Queues: Heap structures	1	3	5
	Binomial heaps, leftist heaps	1	3	2
	Shortest path algorithms.	1	3	2
	Implementation of shortest path algorithm using C	1	3	2
5	**Sorting and Searching techniques**	**9**		
	Bubble sort, selection sort and their algorithm analysis	1	4	2
	Insertion sort and its algorithm analysis	2	4	2
	Quick sort and its algorithm analysis	1	4	2,3
	Merge sort and its algorithm analysis	1	4	3
	Heap sort and its algorithm analysis	1	4	3
	Radix sort and its algorithm analysis	1	4	5
	Linear and binary search methods and its algorithm analysis.	1	4	5
	Hashing techniques and hash functions	1	4	5

Total Contact Hours	**45**
Total Learning Hours	

Course Unitization Plan Lab

Exp. No.	**Experiment Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
1	Write a program to implement stack operations such as push, pop, and peek using arrays.	2	CLO1	1
2	Write a program to convert an infix expression into postfix form using a stack. The program must correctly handle operator precedence, associativity, and parentheses.	1	CLO1	1
3	Develop a program to evaluate an arithmetic expression using stack-based logic (typically by evaluating a postfix expression). The program should support basic operators and produce the final computed result.	1	CLO1	1
4	Write programs to implement queue operations such as insertion, deletion, and search using arrays. Demonstrate the same for (i) linear queue, and (ii) circular queue with arrays.	2	CLO1	1,2
5	Create a singly linked list and implement insertion, deletion, searching for a key, and finding the middle element. Extend the same structure to perform polynomial addition and sparse matrix operations.	2	CLO1	1,2
6	Write a program to create a doubly linked list and perform insertion at the beginning/middle/end/at a given position and deletion from the beginning/middle/end/of a given key. Also implement forward and backward traversal.	2	CLO1	5
7	Write a program to create a circular linked list and perform insertion at the beginning/end/at a given position and deletion from the beginning/end/of a given key. Demonstrate traversal starting from any node (ensuring full cycle traversal without infinite looping) and implement searching for a key element, highlighting the circular nature of links.	1	CLO1	4,5
8	Write a program to verify whether a given tree satisfies the binary tree property by ensuring each node has at most two children. The input may be represented using links or any standard tree representation.	1	CLO2	1

9	Binary Tree Traversals: Construct a binary tree and implement its traversal techniques: preorder, inorder, and postorder. Display the traversal sequences for the created tree.	**2**	CLO2	**1**
10	Binary Search Tree (BST) and Operations: Write a program to create a Binary Search Tree (BST) and perform fundamental operations such as insertion, deletion, and searching of elements while maintaining the BST property. Implement inorder traversal to verify the structure of the tree and demonstrate how the inorder traversal produces elements in sorted order.	2	CLO2	1
11	AVL Tree and Operations: Implement an AVL tree with insertion and required rotations to maintain balance after each insertion. Demonstrate that the tree remains height-balanced by performing operations and traversals.	2	CLO2	1
12	Write a program to create a graph using either an adjacency matrix and adjacency list representation. Implement basic operations such as adding a vertex, adding an edge, deleting an edge, and displaying the graph structure.	2	CLO3	3
13	Graph Traversals (BFS and DFS): Create a graph using adjacency matrix or adjacency list representation and implement BFS and DFS traversals. Show the traversal order starting from a given source vertex.	2	CLO3	3
14	Implement Dijkstra's algorithm to find the shortest path between a given source and destination vertex in a weighted graph with non-negative edge weights. Also display the final shortest distance and path.	2	CLO3	2
15	Linear Search vs Binary Search with Complexity: Write programs for linear search and binary search to find an element in an array. Compare their best-case and worst-case time complexities and relate them to the observed behavior.	1	CLO4	5
16	Implement Selection sort, bubble sort and insertion sort to arrange an array in sorted order. Include brief notes on its best-case and worst-case time complexity.	2	CLO4	2,3
17	Develop a quick sort and merge sort programs and brief notes about average-case performance and the worst-case scenario.	2	CLO4	2,3
Total Contact Hours		**30**		
Total Learning Hours				

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Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
1) Remember	–	–	–	–	–	–	–	–	–	–	–
2) Understand	CO1	CO1	–	–	CO1	CO1	CO1	–	CO1	CO1	CO1
3) Apply	CO2	CO2	CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2, CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2
4) Analyze	–	–	–	–	–	–	–	–	–	–	–
5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
6) Create	–	–	–	–	–	–	–	–	–	–	–
Total	**5**	**15**	**5**	**5**	**10**	**-**	**-**	**10**	**30**	**20**	**-**

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project

COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Tenenbaum, A. M. (1990). Data structures using C. Pearson Education India
2. Mark, A. W. (1992). Data structures and algorithm analysis in C
3. Anderson-Freed, S., Horowitz, E., & Sahni, S. (2007). Fundamentals of Data Structures in C
4. Lipschutz, (2002) "Data Structures", ***Schaum's outline series***, ***Tata McGraw Hill*** Edition
5. Pai, G. V. (2008). Data Structures and Algorithms. Tata McGraw-Hill
6. Kruse, R., & Tondo, C. L. (2007). Data structures and program design in C. Pearson Education India

Other Resources

1. Gottfried, B. (2016) Programming with C Mcgraw hill Education, Fourteenth reprint
2. Dey, P. and Ghosh, M. (2012) Programming in C Second Edition, Oxford University Press

Course Designers

1. Dr. Ashok Kumar Pradhan, Associate Professor, Dept of CSE, SRM University – AP.

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

AI Engineering lab (Advanced Python)

Course Code		Course Category	CC	Credit	L	T	D	P	Pr	TW + SL	Total
					0	0	0	2	0	0	2
Pre-Requisite Course(s)	AI Foundation lab (Python)	Co-Requisite Course(s)		Learning Hours				16		0	32
Course Offering by	AiTI	Progressive Course(s)		Professional / Licensing Standards							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. Strengthen core and advanced Python programming skills (data types, functions, modular programming, decorators, and generators) essential for AI development.
2. Develop efficient data processing pipelines using advanced features of NumPy and Pandas essential for building scalable AI and Machine Learning applications.
3. Apply fundamental Object-Oriented Programming (OOP) principles to design modular and reusable Python code.
4. Handle errors and exceptional situations effectively using Python's exception handling mechanisms to write robust programs.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Apply core and advanced Python features including data types, functions, modular programming, decorators, and generators	1,2	80%	75%

Outcome 2	Build efficient data processing pipelines using advanced NumPy and Pandas techniques	2,3	70%	65%
Outcome 3	Apply fundamental OOP concepts to design modular Python code	3	70%	65%
Outcome 4	Implement exception handling mechanisms to write robust Python programs	3,4	65%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	2	3							2	3	2	1
Outcome 2	3	3	2	2	3							2	3	2	1
Outcome 3	3	3	2	2	2							3	3	2	1
Outcome 4	3	2	2	2	2							3	3	2	1
Average	3	2.5	2.0	2.0	2.5							2.5	3	2	1

Correlation : **3** = High, **2 =** Medium, **1** = Low

Course Unitization Plan Lab

Exp. No.	**Experiment Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
1	Functions with *args, **kwargs and lambda expressions	**1**	1	1,2
2	Modular Programming, Packages and Import Mechanisms	1	1	1,2

3	Decorators – Creating and Using Decorators	2	1,2	1,2
4	Generators and Iterators	2	1	1,2
5	Context Managers in Python	2	1	1,2
6	Working with JSON and Making API Calls using requests	2	2,3	1,4
7	Introduction to NumPy – Creating Arrays and Basic Operations	2	2	3,4
8	NumPy Multidimensional Arrays and its Operations	2	2	3,4
9	Pandas Basics – Series and DataFrame	2	2,3	3,4
10	Data Cleaning and Preprocessing (Missing Values, Filtering, Sorting) using pandas	2	3	3,4
11	Grouping, Aggregation and Basic Data Analysis using Pandas	2	3	3,4
12	Introduction to Data Visualization using Matplotlib	2	2,3	3,4
13	Classes and Objects – Creating and Using Classes	1	3	1,2
14	Methods, Attributes and Constructors (__init__ method)	2	3	1,2
15	Inheritance and Basic Polymorphism	2	3	1,2
16	Encapsulation and Special Methods (__str__, __len__, etc.)	1	3	1,2
17	Understanding Errors and Exceptions in Python	1	4	1,2
18	Using try, except, else and finally Blocks	2	4	1,2
19	Raising Exceptions	1	4	1,2
Total Contact Hours		**32**		
Total Learning Hours		**32**		

Learning Assessment

Bloom's Level	**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	-	-	-	-	1,2,3	1,2,3	2,3,4			2,3,4	3,4
1) Remember					30%	30%	-			-	-
2) Understand					30%	30%	30%			30%	-
3) Apply					40%	40%	40%			40%	60%
4) Analyze					-	-	30%			30%	40%
5) Evaluate					-	-	-			-	-

6) Create					-	-	-			-	-
Total					100%	100%	100%			100%	100%

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed					1,2,3	1,2,3	2,3,4			2,3,4	3,4
Conducting Marks					30.0	20.0	50.0		-	50.0	50.0
Converting Marks					10.0	10.0	30.0		-	30.0	20.0
Total Converting Marks					50				50		
Total Marks	100										

Recommended Resources

1. Python Cookbook (3rd Edition) – David Beazley & Brian K. Jones.
2. Fluent Python (2nd Edition) – Luciano Ramalho.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron.
4. Official Documentation: NumPy, Pandas, scikit-learn.
5. Kaggle Notebooks and GitHub repositories for Advanced Python in AI.

Other Resources

1. NPTEL : Python for Data Science, IIT Madras. Prof. Ragunathan Rengasam: https://nptel.ac.in/courses/106106212

2. NPTEL: The Joy of Computing using Python, IIT Ropar, Prof. Sudarshan Iyengar: https://nptel.ac.in/courses/106106182
3. YOUTUBE: Basic Python, Corey Schafer: https://www.youtube.com/playlist?list=PL-osiE80TeTt2d9bfVyTiXJA-UTHn6WwU

Course Designers

Dr. Dipankar Kundu, Assistant Professor, Department of CSE, SRM AP

SEMESTER III

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Digital Logic with Computer Organization and Architecture

Course Code		**Course Category**	**CC**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Objectives / Course Learning Rationales (CLRs)

1. To understand number systems, Boolean algebra, logic gates, and digital circuit fundamentals.
2. To design and analyze combinational and sequential logic circuits used in digital systems.
3. To understand the organization of computer systems, including functional units, instruction execution, and processor architecture.
4. To analyze datapath organization, control unit design, and performance enhancement techniques in processors.
5. To examine memory hierarchy, storage systems, and input/output organization in modern computing systems.
6. To apply digital logic and computer organization principles for designing computer subsystems and solving engineering problems.

Course Outcomes / Course Learning Outcomes (CLOs)

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Guntur District, Mangalagiri, Andhra Pradesh - 522240.

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain number systems, Boolean algebra, and logic gates.	2	75%	65%
Outcome 2	Design combinational and sequential circuits.	3	75%	65%
Outcome 3	Explain processor organization and instruction execution.	2	75%	65%
Outcome 4	Analyze datapath, control unit, and pipelining concepts.	4	75%	65%
Outcome 5	Analyze memory hierarchy and I/O organization.	4	75%	65%
Outcome 6	Apply digital logic principles in computer subsystem design.	**3**	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)														
	PO												PSO		
CLOs	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	2	1	1	1										
Outcome 2	2	2	2	2	2							3			
Outcome 3	2	2	2	3	2							3			
Outcome 4	2	2	2	3	2							3			
	2	2	2	2	2							3			
Average	**2**	**2**	**2**	**2**	**2**							**3**			

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Number Systems and Boolean Algebra**	**8**		

	Number Systems and Conversions	2	1	1
	Signed Number Representation	1	1	1
	Binary Arithmetic	1	1	1
	Boolean Algebra and Laws	2	1	1
	Logic Gates and Universal Gates	2	1	1
Unit 2	**Combinational and Sequential Logic Design**	**10**		
	SOP and POS Forms	1	2	1
	Karnaugh Maps	2	2	1
	Combinational Circuits (Adder, Subtractor, MUX, DEMUX, Encoder, Decoder)	3	2	1
	Latches and Flip-Flops	2	2	1
	Registers and Counters	2	2	1
UNIT 3	**Processor Organization**	**8**		
	Functional Units of Computer	1	3	2,3
	Bus Structures	1	3	2,3
	Von Neumann Architecture	1	3	2,3
	Instruction Formats	1	3	2,3
	Addressing Modes	2	3	2,3
	Instruction Cycle	2	3	2,3
UNIT 4	**Memory Organization**	**9**		
	Register Transfer Language	1	4	2
	Datapath Organization	2	4	2
	ALU Design Concepts	1	4,6	1,2
	Hardwired Control	2	4	2
	Microprogrammed Control	2	4	2
	Introduction to Pipelining	1	4	2
UNIT 5	**I/O Organization and Parallel Architectures**	**10**		
	Semiconductor Memories	2	5	2
	Cache Memory	2	5	2
	Virtual Memory	2	5	2
	Memory Hierarchy	1	5	2
	Interrupts and DMA	2	5	2
	Design Applications using Digital Logic	1	6	1,2,3

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Total Contact Hours	45

Course Unitization Plan Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Number System Conversions and Binary Arithmetic	2	1	1
2	Verification of Basic Logic Gates and Universal Gates	2	1	1
3	Implementation of Boolean Functions using K-Maps	2	1, 2	1
4	Design and Simulation of Combinational Circuits (Adder, Subtractor, MUX, DEMUX)	2	2	1
5	Design and Simulation of Encoders and Decoders	2	2	1
6	Implementation of Flip-Flops and Timing Analysis	2	2	1
7	Design of Registers and Counters	2	2, 6	1
8	Data Representation and Computer Arithmetic Operations	2	3	2
9	Instruction Execution Simulation	2	3	2
10	ALU Design and Operations	2	4, 6	1, 2
11	Control Unit Simulation (Hardwired/Microprogrammed)	2	4	2
12	Pipeline Simulation and Hazard Analysis	2	4	2, 3
13	Cache Memory Simulation	2	5	2
14	Virtual Memory and Page Replacement Simulation	2	5	2, 3
15	Memory Hierarchy Performance Analysis	2	5	2, 3
Total hours			**30 hours**	

Learning Assessment (Theory)

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (5 %)	Mid - 1	CLA - 2 (5 %)	CLA - 3 (5 %)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)

		(15 %)									
COs Addressed											
1) Remember	20%	20%	20%	20%							15
2) Understand	20%	20%	20%	20%							15
3) Apply	30%	30%	30%	30%							35
4) Analyze	30%	30%	30%	30%							35
5) Evaluate	0	0	0	0							0
6) Create	0	0	0	0							0
Total	100	100	100	100							100

Learning Assessment (Lab)

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Projec t**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Mano, M. M., & Ciletti, M. D. (2017). Digital design (6th ed.). Pearson.
2. Hamacher, V. C., Vranesic, Z. G., & Zaky, S. G. (2002). Computer organization (5th ed.). McGraw-Hill.
3. Tanenbaum, A. S., & Austin, T. (2021). *Structured computer organization* (6th ed.). Pearson.

Other Resources

1. Stallings, W. (2003). Computer organization and architecture: designing for performance. Pearson Education India.
2. Patterson, D. A., & Hennessy, J. L. (2016). Computer organization and design ARM edition: the hardware software interface. Morgan kaufmann.
3. Hayes, J. P. (2002). Computer architecture and organization. McGraw-Hill, Inc..

Course Designers
Dr Naveen Kumar Mahamkali

Operating Systems

Course Code		**Course Category**	**CC**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the structure, components, and functions of an operating system.
2. To study and analyze process management and CPU scheduling techniques.
3. To understand and apply inter-process communication and synchronization mechanisms.
4. To learn and implement memory management policies, including virtual memory techniques.
5. To analyze the role of the operating system as a resource manager, including file systems, storage, and performance aspects.

Course Outcomes / Course Learning Outcomes (CLOs)

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	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the structure and functions of operating systems	2	70%	70%
Outcome 2	Develop shell scripts for basic system-level programming tasks.	3	70%	70%
Outcome 3	Analyze process states and evaluate CPU scheduling algorithms.	4	70%	70%
Outcome 4	Apply process synchronization techniques.	3	70%	65%
Outcome 5	Implement and analyze memory management techniques.	4	70%	65%
Outcome 6	Implement storage and file management operations in an operating system	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	1	2							2			
Outcome 2	3	2	1	1	2							2			
Outcome 3	2	3	3	3	2							1			
Outcome 4	2	3	3	3	2							1			
Outcome 5	2	3	3	3	2							1			
Outcome 6	2	3	3	3	2							1			
Average	**2**	**3**	**3**	**3**	**2**							**1**			

Course Unitization Plan Theory

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Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1	Introduction	**6**		
	Operating System overview-objectives and functions	1	1	1,2
	Evolution of Operating System	1	1	1,2
	System Calls	1	1,2	1,3
	Operating System Design and Implementation	1	1	1,2
	Operating System Structure	1	1	1,2
	Building and Booting an Operating System	1	1	1,2
UNIT 2	Process Management	10		
	Process Concepts	1	3	1,2
	Process scheduling	1	3	1,2
	Operations on Processes	1	3	1,2
	Inter process Communication	2	3,4	1,2
	Threads- Overview	1	4	1,2
	Multithreading Models	1	4	1,2
	CPU Scheduling Algorithms	2	3	1,2
	Case studies of scheduling policies in Linux, Windows, and Solaris.	1	3	1,2
UNIT 3	Process Synchronization and Deadlocks	9		
	Process Synchronization: Critical section problem.	1	4	1,3
	Mutex Locks	1	4	1
	Semaphores	1	4	1,2
	Monitors	1	4	1,2
	POSIX Synchronization	1	4	1
	Deadlocks Characterization	1	4	1,3
	Deadlock Prevention	3	4	1,3
	Deadlock Avoidance		4	1,3
	Deadlock Detection		4	1,3
	Recovery from Deadlock		4	1,3
UNIT 4	Memory Management	10		
	Main Memory Management.	1	5	1,2
	Contiguous Memory Allocation.	1	5	1,2
	Paging	1	5	1,2
	Virtual Memory	1	5	1,3

	Demand Paging.	1	5	1,2
	Page Replacement Algorithms.	1	5	1,3
	Frame Allocation Techniques	1	5	1,2
	Thrashing	1	5	1,2
	Case studies of virtual memory management in Linux, Windows, and Solaris.	1	5	1,3
UNIT 5	Storage and File Management	10		
	Mass Storage Structure- Overview	1	6	1
	HDD Scheduling	1	6	1
	RAID Structure	1	6	1
	File Concept and Access Methods	2	6	1,3
	Directory Structure	1	6	1,3
	File System Implementation	2	6	1,3
	Free Space Management	1	6	1,3
	Case study of the WAFL (Write Anywhere File Layout) file system.	1	6	1,3
Total Contact Hours		45		
Total Learning Hours				

Course Utilization Plan – Lab

Experiment No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Linux Basic Commands and Shell Programming exercises	4	1, 2	5
2	Implementation of Linux system calls (file operations)	4	1, 2	4
3	Implementation of CPU scheduling algorithms	4	3	1,2,3
4	Implement producer, consumer problem using semaphores.	4	4	1,2
5	Implement deadlock avoidance and detections algorithms.	4	4	1,2
6	Implementation of page replacement algorithms (FIFO, LRU, Optimal)	4	5	1,3
7	Simulation of Demand Paging System.	4	5	1,3
8	HDD scheduling	2	6	1,2

Total Contact Hours	30

Learning Assessment Theory

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
1) Remember	40%	10%	40%	20%					10%		
2) Understand	30%	40%	30%	20%	10%				20%		30%
3) Apply	20%	30%	20%	30%	60%				50%		40%
4) Analyze	10%	20%	10%	30%	30%				20%		20%
5) Evaluate											10%
6) Create											
Total	100 %	100 %	100 %	100 %	100%				100%		100%

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO 1	CO1 , CO2	CO 3	CO4 , CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
Conducting Marks	10	25	10	10	50				50		50
Converting Marks	5	15	5	5	20				30		20
Total Converting Marks	30				20				50		
Total Marks	100										

Recommended Resources

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. (2018). Operating System Concepts, 10th ed. John Wiley and Sons Inc.
2. William Stallings, (2018). Operating Systems – Internals and Design Principles, 9th ed. Pearson Publications.
3. Tanenbaum, A. S., & Bos, H. (2015). Modern Operating Systems (4th ed.). Pearson Education.

Other Resources:

4. Love, R. (2010). Linux System Programming: Talking Directly to the Kernel and C Library (2nd ed.). O'Reilly Media.
4. Michael, R. K. (2008). Mastering UNIX Shell Scripting (2nd ed.). Wiley Publishing.

Course Designers

Dr. Naveen Kumar Mahamkali

Artificial Intelligence and Machine Learning-I

(AI: Representation and Problem Solving)

Course Code		**Course Category**	**CC**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)	Python Programming	**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60
Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**							

Course Objectives / Course Learning Rationales (CLRs)

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

1. To provide a strong foundation in AI problem representation using state space, graphs, and logic-based formalisms grounded in Agriculture, Energy, Robotics, and Healthcare domains.
2. To introduce the concept of a Rational Intelligent Agent and develop the ability to design agents for domain-specific problem solving.
3. To develop proficiency in uninformed and informed search strategies, heuristic design, and optimization techniques applied to real-world domain problems.
4. To build competency in Constraint Satisfaction Problem modelling for scheduling, resource allocation, and planning across target application domains.
5. To impart knowledge of knowledge representation using propositional and first-order logic, inference mechanisms, and rule-based reasoning for intelligent systems.
6. To introduce planning algorithms and integrate planning with learning methods such as reinforcement learning and neural networks for autonomous intelligent systems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Identify and formalize real-world problems (in Agriculture, Energy, Robotics, Healthcare) as state space representations.	**2**	**75%**	**65%**
Outcome 2	Analyze and compare uninformed and informed search strategies for domain-specific problem solving.	**4**	**75%**	**65%**
Outcome 3	Design heuristic functions and apply A*, greedy, and local search methods to domain problems.	**5**	**75%**	**65%**
Outcome 4	Develop constraint satisfaction models for scheduling, resource allocation, and planning problems in target domains.	**5**	**75%**	**65%**
Outcome 5	Implement knowledge representation using propositional and first-order logic for intelligent systems.	**3**	**75%**	**65%**
Outcome 6	Evaluate planning algorithms and apply them to autonomous robotic and agricultural management scenarios.	**6**	**75%**	**65%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

CLOs	Program Learning Outcomes (PLO)														
	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3

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Outcome 1	3	3	3	3	2	1			2		2	2	2	2	2
Outcome 2	3	3	3	3	2	1			2		2	3	2	2	2
Outcome 3	3	3	3	3	3	1			2		2	2	2	2	2
Outcome 4	3	3	3	2	3	1	2	2	2	2	3	3	3	2	3
Outcome 5	3	3	3	3	2	1	2	2	2	2	2	3	2	2	2
Outcome 6	3	3	3	3	2	1	2	2	2	2	2	2	3	3	2
Average	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

Correlation : **3** = High, **2** = Medium, **1** = Low

Course Unitization Plan – Theory

Unit No.	**Topic**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
Unit 1: Foundations of AI & Problem Representation				
	Introduction to AI: Definitions, History and Scope	1	1	1, 2
	AI Applications in Agriculture, Energy, Robotics and Healthcare	1	1, 2	1, 2
	Intelligent Agents: Types, Structure and PEAS Description	1	1, 2	1, 2
	Rational Agents and Task Environments	1	2	1, 2
	Problem Formulation: States, Actions, Goal and Path Cost	1	1, 2	1, 2
	State Space Representation	1	1, 2	1, 2
	Overview of ML, Deep Learning and Reinforcement Learning	1	1, 2	1, 2
	Knowledge Representation Overview	1	2	1, 2
	Introduction to Planning and Decision Making	1	2	1, 2
Unit 2: Uninformed and Informed Search Strategies				
	Problem Solving by Searching	1	1, 2	1, 2

	Uninformed Search: BFS, DFS and Uniform Cost Search	1	2, 3	1, 2
	Depth-Limited Search and Iterative Deepening DFS	1	2, 3	1, 2
	Bidirectional Search	1	3	1, 2
	Greedy Best-First Search	1	3	1, 2
	A* Search: Admissibility and Consistency	1	3	1, 2
	Heuristic Design for Domain Problems	1	3	1, 2
	Memory-Bounded Search: IDA* and SMA*	1	3, 4	1, 2
	Bidirectional Heuristic Search and Performance Analysis	1	3, 4	1, 2
Unit 3: Local Search, Adversarial Search & Constraint Satisfaction				
	Local Search: Hill Climbing and Simulated Annealing	1	3, 4	1, 2
	Genetic Algorithms for Optimisation	1	3, 4	1, 2
	Beam Search and Stochastic Local Search	1	4	1, 2
	Adversarial Search: Minimax Algorithm	1	3, 4	1, 2
	Alpha-Beta Pruning	1	4	1, 2
	Imperfect Real-Time Decisions and Evaluation Functions	1	4	1, 2
	Constraint Satisfaction Problems (CSP)	1	4	1, 2
	Backtracking, Forward Checking and Arc Consistency	1	4	1, 2
	CSP Applications: Crop Rotation and Robot Scheduling	1	4, 5	1, 2
Unit 4: Knowledge Representation and Reasoning				

	Propositional Logic: Syntax, Semantics and Inference Rules	1	5	1,2
	Predicate Logic (First-Order Logic)	1	5	1,2
	Quantifiers, Functions and Predicates	1	5	1,2
	Inference in FOL: Unification and Resolution	1	5	1,2
	Forward and Backward Chaining	1	5	1,2
	Rule-Based Systems and Knowledge Bases	1	5	1,2
	Ontologies and Semantic Web for Agriculture and Healthcare	1	5, 6	1,2
	Uncertainty and Bayesian Networks	1	5, 6	1,2
	AI Languages: LISP and PROLOG Overview	1	5	1,2
Unit 5: Planning, Learning, and Domain Applications				
	Classical Planning: STRIPS Representation	1	6	1,2
	Plan Space and Partial Order Planning	1	6	1,2
	Planning Algorithms: GraphPlan and SatPlan	1	6	1,2
	Hierarchical Task Network (HTN) Planning	1	6	1,2
	Inductive Learning and Decision Trees	1	5, 6	1,2
	Reinforcement Learning for Robotics and Energy	1	5, 6	1,2
	Neural Networks and Deep Learning Fundamentals	1	5, 6	1,2

	Domain Case Studies: Smart Farming, Energy, Robotics and Healthcare	1	5, 6	1,2
	Responsible AI in Critical Domains	1	6	1,2
Total Contact Hours		**60**		
Total Learning Hours				

Course Unitization Plan – Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Problem identification in Agriculture/Healthcare domains; PEAS description	2	1	1,2
2	Facts, predicates, variables, arithmetic operators, I/O. Model a crop-disease knowledge base.	2	1, 2	1, 2
3	Implement BFS and DFS in Python. Apply to maze-solving (Robotics path planning scenario).	4	1, 2	1,2
4	Implement A* Search with a domain heuristic (Energy grid routing / hospital floor navigation).	4	2, 3	1, 2
5	Implement Constraint Satisfaction Problem solver: crop rotation scheduling / nurse duty allocation.	4	3, 4	1,2
6	Implement Minimax with Alpha-Beta Pruning. Apply to a resource-bidding game for energy markets.	4	4, 5	1,2
7	Solve domain-specific problems using PROLOG and LISP: Water Jug, 8-Queens, Farmer-Wolf-Goat, 8-Puzzle (simulate robot arm pick-and-place). Implement a simple backward chaining expert system for plant disease diagnosis.	6	4	1,2
8	Q-Learning for path planning/energy routing	2	5, 6	1, 2

9	Implement Responsible AI techniques (bias detection, fairness evaluation, and explainability) for a healthcare prediction system	2		
Total Contact Hours				30
Total Learning Hours				

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
1) Remember	40%	10%	40%	20%					10%		
2) Understand	30%	40%	30%	20%	10%				20%		30%
3) Apply	20%	30%	20%	30%	60%				50%		40%
4) Analyze	10%	20%	10%	30%	30%				20%		20%
5) Evaluate											10%
6) Create											
Total	100 %	100 %	100 %	100 %	100%				100%		100%

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO 1	CO1 , CO2	CO 3	CO4 , CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
Conducting Marks	10	25	10	10	50				50		50

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Converting Marks	5	15	5	5	20				30		20
Total Converting Marks	30				20				50		
Total Marks	100										

Recommended Resources

1. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Prentice Hall. (http://lib.ysu.am/disciplines_bk/efdd4d1d4c2087fe1cbe03d9ced67f34.pdf)
2. Rich, E., Knight, K., & Nair, S. B. (2017). Artificial Intelligence (3rd ed.). McGraw Hill Education. (https://shorturl.at/JaESW)

Other Resources

- Domain-specific datasets, simulation environments (OpenAI Gym for Robotics, AgML for Agriculture, OpenEI for Energy datasets), and clinical AI repositories for Healthcare.
- Charniak, E., & McDermott, D. (2002). Introduction to Artificial Intelligence. Pearson Education.
- Nilsson, N. J. (2002). Artificial Intelligence: A New Synthesis. Morgan Kaufmann.
- Shoham, Y., & Leyton-Brown, K. (2008). Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations. Cambridge University Press.
- Ghallab, M., Nau, D., & Traverso, P. (2004). Automated Planning: Theory and Practice. Morgan Kaufmann.

Course Designers

1. Dr. Ashu Abdul, Associate Professor, CSE

Design and Analysis of Algorithms

Course Code		**Course Category**	**C C**	**Credit**	**L**	**T**	**D**	**P**	**P r**	**TW + SL**	**Total**
					3	0	0	1	0	0	4
Pre-Requisite Course(s)	**Data Structures**	**Co-Requisite Course(s)**		**Learning Hours**	15	0	0	15	0	0	60

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Course Offering by	AiTI	**Progressive Course(s)**		**Professional / Licensing Standards**	

Course Learning Rationales (CLRs) Course Objectives (COs)

1. Explain algorithmic foundations, complexity measures, and asymptotic analysis for evaluating algorithm efficiency
2. Apply divide-and-conquer, greedy, and dynamic programming paradigms to design and solve computational problems
3. Analyze and select appropriate graph algorithms and advanced algorithmic techniques to solve complex computational problems
4. Evaluate efficient solutions for real-world and AI-related problems using advanced techniques such as approximation and randomized algorithms

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Explain algorithmic foundations, complexity measures, and asymptotic analysis for evaluating algorithm efficiency.	2	70%	65%
Outcome 2	Apply divide-and-conquer, greedy, and dynamic programming paradigms to design and solve computational problems.	3	70%	65%
Outcome 3	Analyze and select appropriate graph algorithms and advanced algorithmic techniques to solve complex computational problems.	4	70%	65%
Outcome 4	Evaluate efficient solutions for real-world and AI-related problems using advanced techniques such as approximation and randomized algorithms.	5	65%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

	Program Learning Outcomes (PLO)	
	PO	**PSO**

CLOs

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	2									2		
Outcome 2	3	2	3	3									2		
Outcome 3	3	3	3	3									2		
Outcome 4	3	2	2	2									3		
Average	**3**	**2**	**3**	**3**									**2**		

Correlation : **3** = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	**Foundations of Algorithm Analysis and Complexity**	**9**		
	Review of algorithm design principles and problem-solving strategies	1	1	1
	Asymptotic notations (Big-O, Ω, Θ) and complexity classes	1	1	1
	Recurrence relations and Master Theorem	2	1	1,2
	Best, worst, and average case analysis	1	1	1,2
	Introduction to NP-Completeness and computational hardness	2	1	1,2
	Case studies of scalable algorithm design (industry examples)	2	1	1,2
2	**Advanced Algorithm Design Paradigms**	**9**		
	Divide and Conquer (Merge Sort, Quick Sort, Strassen's Matrix Multiplication)	2	2	1,2
	Greedy Algorithms (Activity Selection, Huffman Coding)	2	2	1,2
	Dynamic Programming (Knapsack, Longest Common Subsequence, Matrix Chain Multiplication)	3	2	1,2
	Memoization vs Tabulation (optimization techniques)	1	2	1,2
	Real-world applications (resource allocation, scheduling)	1	2	1,2
3	**Graph Algorithms and Network Optimization**	**10**		

	Graph representations and traversal (BFS, DFS)	1	3	1
	Shortest path algorithms (Dijkstra, Bellman-Ford, Floyd-Warshall)	1	3	1,2
	Minimum Spanning Trees (Prim's, Kruskal's)	2	3	1,2
	Network flow algorithms (Ford-Fulkerson method)	2	3	1,2
	Applications in social networks, recommendation systems	2	3	1,2
4	**Advanced and Intelligent Algorithmic Techniques**	**8**		
	Backtracking and constraint satisfaction problems (N-Queens, Sudoku)	2	4	1,2
	Branch and Bound (TSP and optimization problems)	2	4	1,2
	Heuristic and informed search (A* algorithm)	2	4	1,3
	Approximation algorithms (Set Cover, Vertex Cover)	1	4	1,2
	Randomized algorithms (Las Vegas, Monte Carlo methods)	1	4	1,2
5	**Algorithms for AI and Large-Scale Systems**	**9**		
	String matching algorithms (KMP, Rabin-Karp) in NLP applications	3	4	1,2
	Algorithmic foundations of Machine Learning (gradient descent intuition)	2	4	3
	Graph-based learning and search (intro to PageRank, recommendation systems)	2	4	3
	Case studies: Google search, Netflix recommendation, route optimization	2	4	3
Total Contact Hours		**45**		
Total Learning Hours				

Course Unitization Plan Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used

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1	**Lab Experiment 1:** Empirical analysis of time complexity (compare iterative vs recursive algorithms)	2	1	1
2	**Lab Experiment 2:** Implement and analyze divide-and-conquer algorithms (Merge Sort, Quick Sort) with runtime comparison	2	1	1,2
3	**Lab Experiment 3:** Binary Search vs Linear Search - performance benchmarking on large datasets	2	1	1,2
4	**Lab Experiment 4:** Greedy algorithms - Activity selection and Fractional Knapsack with real datasets	2	2	1,2
5	**Lab Experiment 5:** Dynamic Programming - Fibonacci (DP vs recursion), Knapsack problem	2	2	1,2
6	**Lab Experiment 6:** Longest Common Subsequence (LCS) and Edit Distance (used in NLP applications)	2	2	1,3
7	**Lab Experiment 7:** Graph algorithms - BFS and DFS with applications (social network traversal)	2	3	1,2
8	**Lab Experiment 8:** Shortest path algorithms - Dijkstra and Bellman-Ford (route optimization use case)	2	3	1,2
9	**Lab Experiment 9:** Minimum Spanning Tree - Prim's and Kruskal's (network design problems)	2	3	1,2
10	**Lab Experiment 10:** Backtracking - N-Queens and Sudoku Solver (constraint satisfaction problems)	2	4	1,2
11	**Lab Experiment 11**: Branch and Bound - Traveling Salesman Problem (TSP)	2	4	1,2
12	**Lab Experiment 12**: String matching algorithms - KMP and Rabin-Karp (pattern matching in search engines)	2	4	1,2
13	**Lab Experiment 13**: Introduction to Approximation Algorithms (Set Cover problem)	2	5	1,2
14	**Lab Experiment 14:** Algorithmic problems in AI - Implement A* Search (pathfinding in robotics/games)	2	5	1,3
15	**Mini Project:** Develop an AI-driven or real-world optimization system (e.g., recommendation engine, route planner, scheduling system using algorithms learned)	2	5	1,2,3
Total Contact Hours		**30**		
Total Learning Hours				

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA -	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)

				3 (%)							
COs Addressed	CO1 , CO2	CO1 , CO2	CO3 , CO4	–	CO1–CO 4	CO1–CO 4	CO1 –CO 4	–	CO1 –CO 4	CO1– CO4	CO1 , CO2
1) Remember	–	–	–	–	–	–	–	–	–	–	–
2) Understand	CO1	CO1	–	–	CO1	CO1	CO1	–	CO1	CO1	CO1
3) Apply	CO2	CO2	CO3 , CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2, CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2
4) Analyze	–	–	–	–	–	–	–	–	–	–	–
5) Evaluate	CO1 , CO2	CO1 , CO2	CO3 , CO4	–	CO1–CO 4	CO1–CO 4	CO1 –CO 4	–	CO1 –CO 4	CO1– CO4	CO1 , CO2
6) Create	–	–	–	–	–	–	–	–	–	–	–
Total	**5**	**15**	**5**	**5**	**10**	**-**	**-**	**10**	**30**	**20**	-

Continuous Assessments (CA) and End Semester Examination

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Project**
COs Addressed	CO1 , CO2	CO1 , CO2	CO3 , CO4	–	CO1–CO4	CO1–CO4	CO1 –CO 4	–	CO1–CO 4	CO1–CO 4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Introduction to Algorithms - Thomas H. Cormen et al.
2. Algorithm Design - Jon Kleinberg & Éva Tardos
3. The Algorithm Design Manual - Steven S. Skiena

Course Designers

1. Dr. Ashok Kumar Pradhan, Associate Professor, Dept of CSE, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Foundations of Cryptography and Cybersecurity

Course Code	TBD	**Course Category**	**Minor**	**Credit**	**L**	**T**	**D**	**P**	**Pr**	**TW + SL**	**Total**
					3	0	0	0	0	0	3
Pre-Requisite Course(s)	-	**Co-Requisite Course(s)**	-	**Learning Hours**	15	0	0	0	0	0	45
Course Offering by	AiTI	**Progressive Course(s)**	-	**Professional / Licensing Standards**		-					

Course Learning Rationales (CLRs) Course Objectives (COs)

1. To introduce the fundamental concepts of cybersecurity, information security, and cryptography.
2. To provide mathematical foundations required for modern cryptographic techniques.
3. To explain symmetric and asymmetric cryptographic algorithms used in secure communication.
4. To familiarize students with authentication mechanisms, digital signatures, hash functions, and key management.
5. To introduce emerging cryptographic technologies such as blockchain, zero-knowledge proofs, and post-quantum cryptography.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the principles of cybersecurity, cryptography, threats, vulnerabilities, and mathematical foundations of secure communication.	**1, 2**	**70%**	**60%**
Outcome 2	Apply classical and symmetric key cryptographic techniques for securing information.	**3**	**70%**	**60%**
Outcome 3	Analyze public key cryptographic algorithms, authentication mechanisms, and digital signature schemes.	**3,4**	**70%**	**60%**
Outcome 4	Evaluate modern cryptographic applications including blockchain, zero-knowledge proofs, and post-quantum cryptography for securing digital systems.	**4,5**	**70%**	**60%**

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Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	-	-	-	-	2	-	-	-	1	3	2	
Outcome 2	3	3	2	1	1	-	-	1	-	-	-	1	3	3	
Outcome 3	3	3	2	2	2	-	-	2	-	-	-	1	3	3	
Outcome 4	3	3	2	1	1	-	-	3	-	-	-	2	3	2	
Average	3	3	2	1	1	-	-	2	-	-	-	1	3	3	

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	**Foundations of Cybersecurity and Mathematical Principles**	**9**		
	Introduction to Information Security and Cybersecurity	1	1	1
	CIA Triad, Security Services, Threats, Vulnerabilities and Risk	1	1	1
	Introduction to Cryptography and Security Goals	1	1	1
	Number Theory: Prime and Composite Numbers, Divisibility	2	1	2
	Euclidean Algorithm and Modular Arithmetic	2	1	2
	Fermat's Theorem, Euler's Theorem, Chinese Remainder Theorem	2	1	2
2	**Network Security Fundamentals**			
	Classical Encryption Techniques: Caesar, Monoalphabetic, Playfair, Vigenère	2	2	2
	Transposition Ciphers and Cryptanalysis	1	2	2
	Symmetric Cipher Model	1	2	1
	Block Cipher Principles	1	2	1
	Data Encryption Standard (DES)	1	2	1
	Advanced Encryption Standard (AES)	2	2	1
	Stream Ciphers and RC4 (Overview)	1	2	3
3	**Public Key Cryptography**	**9**		
	Principles of Public Key Cryptography	1	3	1
	RSA Algorithm and Security	2	3	1
	Diffie-Hellman Key Exchange	1	3	2
	Elliptic Curve Cryptography (ECC)	2	3	2
	ElGamal Cryptosystem	1	3	3

	Public Key Infrastructure (PKI) and Digital Certificates	1	3	3
	Man-in-the-Middle Attack and Secure Key Exchange	1	3	3
4	**Authentication and Integrity Mechanisms**	**9**		
	Cryptographic Hash Functions	1	3	1
	SHA Family (SHA-2, SHA-3)	2	3	2
	Message Authentication Codes (MAC) and HMAC	2	3	2
	Digital Signatures and ElGamal Digital Signature Scheme	2	3	3
	Password Security, Salting and Multi-Factor Authentication	1	3	4
	Applications of Hash Functions in Cybersecurity	1	3	3
5	**Emerging Trends in Cryptography and Cybersecurity**	**9**		
	Blockchain Fundamentals and Decentralized Security	2	4	4
	Bitcoin, Ethereum and Smart Contracts (Overview)	2	4	4
	Hyperledger Fabric (Introduction)	1	4	5
	Zero Knowledge Proofs	1	4	5
	Post-Quantum Cryptography	2	4	5
	Applications of Cryptography in AI, Cloud Computing and IoT Security	1	4	5
Total Contact Hours		**45**		
Total Learning Hours		**45**		

Learning Assessment

Bloom's Level	**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
1) Remember	–	–	–	–				–	–		
2) Understand	CO1	CO1	–	–				CO1	CO1		
3) Apply	CO2	CO2	CO3, CO4	–				CO2	CO2, CO3, CO4		
4) Analyze	–	–	–	–				–	–		
5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–				CO3, CO4	CO1–CO4		
6) Create	–	–	–	–				–	–		
Total	**5**	**15**	**5**	**5**				**20**	**50**		

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
Conducting Marks	**10**	**25**	**10**	**10**				**50**	**50**		
Converting Marks	**5**	**15**	**5**	**5**				**20**	**50**		
Total Converting Marks	**30**							**20**	**50**		
Total Marks	**100**										

Recommended Resources

1. William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson.
2. Bernard Menezes, Network Security and Cryptography, Cengage Learning.
3. Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, 6th Edition, Pearson.
4. Behrouz A. Forouzan, Cryptography and Network Security, McGraw-Hill.
5. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.

Other Resources

Course Designers

1. Dr. Ashok Kumar Pradhan, Associate Professor, Dept. of CSE, SRM University AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Introduction to Artificial Intelligence

Course Code	TBD	Course Category	Minor	Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	0	0	0	3
Pre-Requisite Course(s)	-	Co-Requisite Course(s)	-	Learning Hours	15	0	0	0	0	0	45
Course Offering by	AiTI	Progressive Course(s)	-	Professional / Licensing Standards	-						

Course Learning Rationales (CLRs) Course Objectives (COs)

1. To introduce the fundamental concepts, history, scope, and applications of Artificial Intelligence, along with intelligent agents and problem formulation techniques.
2. To explain uninformed, informed, heuristic, and optimization-based search techniques for solving AI problems efficiently.
3. To develop an understanding of adversarial search, constraint satisfaction, and optimization methods used in intelligent decision-making systems.
4. To familiarize students with knowledge representation, logical reasoning, inference mechanisms, planning, and uncertainty handling in intelligent systems.
5. To provide an overview of machine learning, reinforcement learning, deep learning, and their applications in solving real-world engineering problems using responsible AI principles.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the fundamental concepts of Artificial Intelligence, intelligent agents, problem formulation, and state-space representation used in intelligent systems.	1, 2	70%	60%
Outcome 2	Apply uninformed, informed, heuristic, adversarial, and constraint satisfaction search techniques to solve AI problems.	3	70%	60%
Outcome 3	Apply knowledge representation, logical reasoning, inference, and planning techniques for intelligent decision-making under certainty and uncertainty.	3,4	70%	60%
Outcome 4	Analyze machine learning, reinforcement learning, deep learning, and responsible AI techniques for solving domain-specific engineering problems.	4,5	70%	60%

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Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	-	-	-	-	2	-	-	-	1	3	2	
Outcome 2	3	3	2	1	1	-	-	1	-	-	-	1	3	3	
Outcome 3	3	3	2	2	2	-	-	2	-	-	-	1	3	3	
Outcome 4	3	3	2	1	1	-	-	3	-	-	-	2	3	2	
Average	3	3	2	1	1	-	-	2	-	-	-	1	3	3	

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
1	**Foundations of AI & Problem Representation**	**9**		
	Introduction to AI: Definitions, History and Scope	1	1	1, 2
	AI Applications in Agriculture, Energy, Robotics and Healthcare	1	1	1, 2
	Intelligent Agents: Types, Structure and PEAS Description	1	1	1, 2
	Rational Agents and Task Environments	1	1	1, 2
	Problem Formulation: States, Actions, Goal and Path Cost	1	1	1, 2
	State Space Representation	1	1	1, 2
	Overview of ML, Deep Learning and Reinforcement Learning	1	1	1, 2
	Knowledge Representation Overview	1	1	1, 2
	Introduction to Planning and Decision Making	1	1	1, 2
2	**Uninformed and Informed Search Strategies**	**9**		
	Problem Solving by Searching	1	2	1, 2
	Uninformed Search: BFS, DFS and Uniform Cost Search	1	2	1, 2
	Depth-Limited Search and Iterative Deepening DFS	1	2	1, 2
	Bidirectional Search	1	2	1, 2
	Greedy Best-First Search	1	2	1, 2
	A* Search: Admissibility and Consistency	1	2	1, 2
	Heuristic Design for Domain Problems	1	2	1, 2
	Memory-Bounded Search: IDA* and SMA*	1	2	1, 2
	Bidirectional Heuristic Search and Performance Analysis	1	2	1, 2
3	**Local Search, Adversarial Search & Constraint Satisfaction**	**9**		
	Local Search: Hill Climbing and Simulated Annealing	1	2	1, 2
	Genetic Algorithms for Optimisation	1	2	1, 2

	Beam Search and Stochastic Local Search	1	2	1, 2
	Adversarial Search: Minimax Algorithm	1	2	1, 2
	Alpha-Beta Pruning	1	2	1, 2
	Imperfect Real-Time Decisions and Evaluation Functions	1	2	1, 2
	Constraint Satisfaction Problems (CSP)	1	2	1, 2
	Backtracking, Forward Checking and Arc Consistency	1	2	1, 2
	CSP Applications: Crop Rotation and Robot Scheduling	1	2	1, 2
4	**Knowledge Representation and Reasoning**	**9**		
	Propositional Logic: Syntax, Semantics and Inference Rules	1	3	1, 2
	Predicate Logic (First-Order Logic)	1	3	1, 2
	Quantifiers, Functions and Predicates	1	3	1, 2
	Inference in FOL: Unification and Resolution	1	3	1, 2
	Forward and Backward Chaining	1	3	1, 2
	Rule-Based Systems and Knowledge Bases	1	3	1, 2
	Ontologies and Semantic Web for Agriculture and Healthcare	1	3	1, 2
	Uncertainty and Bayesian Networks	1	3	1, 2
	AI Languages: LISP and PROLOG Overview	1	3	1, 2
5	**Planning, Learning, and Domain Applications**	**9**		
	Classical Planning: STRIPS Representation	1	3,4	1, 2
	Plan Space and Partial Order Planning	1	3,4	1, 2
	Planning Algorithms: GraphPlan and SatPlan	1	3,4	1, 2
	Hierarchical Task Network (HTN) Planning	1	3,4	1, 2
	Inductive Learning and Decision Trees	1	3,4	1, 2
	Reinforcement Learning for Robotics and Energy	1	3,4	1, 2
	Neural Networks and Deep Learning Fundamentals	1	3,4	1, 2
	Domain Case Studies: Smart Farming, Energy, Robotics and Healthcare	1	3,4	1, 2
	Responsible AI in Critical Domains	1	3,4	1, 2
Total Contact Hours		**45**		
Total Learning Hours		**45**		

Learning Assessment

Bloom's Level	**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
1) Remember	–	–	–	–				–	–		
2) Understand	CO1	CO1	–	–				CO1	CO1		
3) Apply	CO2	CO2	CO3, CO4	–				CO2	CO2, CO3, CO4		
4) Analyze	–	–	–	–				–	–		

5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–				CO3, CO4	CO1–CO4		
6) Create	–	–	–	–				–	–		
Total	**5**	**15**	**5**	**5**				**20**	**50**		

Continuous Assessments (CA) and End Semester Examination

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Project**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
Conducting Marks	**10**	**25**	**10**	**10**				**50**	**50**		
Converting Marks	**5**	**15**	**5**	**5**				**20**	**50**		
Total Converting Marks	**30**							**20**	**50**		
Total Marks	**100**										

Recommended Resources

1. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Prentice Hall. (http://lib.ysu.am/disciplines_bk/efdd4d1d4c2087fe1cbe03d9ced67f34.pdf).
2. Rich, E., Knight, K., & Nair, S. B. (2017). Artificial Intelligence (3rd ed.). McGraw Hill Education. (https://shorturl.at/JaESW.

Other Resources

1. Domain-specific datasets, simulation environments (OpenAI Gym for Robotics, AgML for Agriculture, OpenEI for Energy datasets), and clinical AI repositories for Healthcare.
2. Charniak, E., & McDermott, D. (2002). Introduction to Artificial Intelligence. Pearson Education.
3. Nilsson, N. J. (2002). Artificial Intelligence: A New Synthesis. Morgan Kaufmann.
4. Shoham, Y., & Leyton-Brown, K. (2008). Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations. Cambridge University Press.
5. Ghallab, M., Nau, D., & Traverso, P. (2004). Automated Planning: Theory and Practice. Morgan Kaufmann.

Course Designers

1. Dr. Ashu Abdul, Associate Professor, Dept. of CSE, SRM University AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

SEMESTER IV

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Computer Networks

Course Code		Course Category	CC	Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by	AiTI	Progressive Course(s)		Professional / Licensing Standards							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. Provide a strong foundation in computer networking concepts, architectures, and protocols.
2. Develop understanding of data communication techniques and network layer operations.
3. Enable students to analyze transport and application layer protocols used in real-world systems.
4. Expose students to networking requirements of AI, cloud computing, and distributed systems.
5. Introduce network security principles and emerging networking technologies relevant to AI applications.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe fundamental networking concepts, architectures, and performance metrics.	2	70%	65%
Outcome 2	Analyze data communication methods, switching techniques, and routing algorithms.	4	70%	65%
Outcome 3	Explain the functioning of data link and transport layer protocols for reliable communication.	2	65%	60%
Outcome 4	Apply networking concepts to AI systems, cloud platforms, and distributed environments.	3	70%	65%

Outcome 5	Evaluate network security mechanisms and emerging trends for secure and efficient AI applications.	4	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1										1			
Outcome 2	3	3		2								1			
Outcome 3	2	2										1			
Outcome 4	3	2			3				1	1		2			
Outcome 5	2	2	2			1	1	2				2			
Average															

Correlation : 3 = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	**Unit Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
UNIT 1: Introduction to Computer Networks and AI Context		**9**		
	Overview of computer networks and applications in AI	1	1	1,2,3
	Types of networks: LAN, WAN, Cloud networks	2	1	1,2,3
	Network topologies and components	2	1	1,2,3
	Layered architecture: OSI and TCP/IP models	2	1	1,2,3
	Performance metrics: bandwidth, latency, throughput	1	1	1,2,3
	Role of networking in AI, IoT, and Big Data	1	1	1,2,3
UNIT 2: Data Communication and Network Layer		**9**		

	Transmission media and communication modes 1	1	2	1,2,3
	Switching techniques: Circuit and Packet switching	1	2	1,2,3
	Error detection and correction techniques	2	2	1,2,3
	IP addressing (IPv4, IPv6), subnetting	2	2	1,2,3
	Routing concepts and algorithms (Distance Vector, Link State)	2	2	1,2,3
	Introduction to Software Defined Networking (SDN)	1	2	1,2,3
UNIT 3: Data Link Layer and Transport Layer		**9**		
	Data Link Layer: Framing, flow control, error control	1	3	1,2,3
	MAC protocols: ALOHA, CSMA/CD	2	3	1,2,3
	Ethernet and LAN technologies	1	3	1,2,3
	Transport Layer: TCP and UDP protocols	1	3	1,2,3
	Congestion control and flow control	2	3	1,2,3
	Reliable data transfer mechanisms	1	3	1,2,3
	Quality of Service (QoS)	1	3	1,2,3
UNIT 4: Application Layer and AI Networking		**9**		
	Application layer protocols: HTTP, HTTPS, FTP, DNS, SMTP	2	4	1,2,4
	Web services and APIs	1	4	1,2,4
	Cloud computing and networking basics	1	4	1,2,4
	Data communication in AI pipelines	1	4	1,2,4
	Distributed systems and communication models	2	4	1,2,4
	Edge and Fog computing basics	2	4	1,2,4
UNIT 5: Network Security and Emerging Trends		**9**		
	Fundamentals of network security	1	5	1,2,3
	Cryptography basics	2	5	1
	Secure communication protocols (SSL/TLS)	1	5	1,2,3
	Firewalls and Intrusion Detection Systems	1	5	1,2,3
	Privacy and security in AI (federated learning basics)	2	5	1,2,3
	Emerging trends: IoT networking, 5G/6G, AI for networking	2	5	1,2,3
Total Contact Hours		**45**		
Total Learning Hours		**45**		

Course Unitization Plan Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
Lab 1	Explain the purpose of common networking commands such as ping, traceroute, ipconfig/ifconfig, and netstat. Execute these	**3**	1	1,3

	commands on your system and analyze the output to study network connectivity, latency, and routing path.			
Lab 2	Design and implement a TCP-based client-server program. The client should send a message to the server, and the server should respond with an acknowledgment. Explain the working of TCP connection establishment.	3	3	1,2
Lab 3	Develop a UDP client-server program to exchange messages. Compare the performance and reliability of UDP with TCP based on your observations.	3	3	1,2
Lab 4	Develop a server program that can handle multiple clients simultaneously using threads or processes. Explain how concurrency is achieved and analyze the performance.	3	4	1,3
Lab 5	Capture network packets using Wireshark and analyze at least three protocols (e.g., HTTP, DNS, TCP). Explain packet structure, headers, and communication flow.	3	5	1,4
Lab 6	Simulate a routing algorithm such as Distance Vector or Link State using NS3 or a programming language. Explain how routing tables are updated and how shortest paths are determined.	3	2	2,3
Lab 7	Implement an error detection method such as Checksum or CRC. Demonstrate how errors in transmitted data are detected and explain the algorithm used.	3	2	2
Lab 8	Design and implement a file transfer application using TCP sockets. Explain how reliable data transfer is ensured and discuss any limitations observed.	3	4	1,2
Lab 9	Develop a simple REST API using Python (Flask) and test it using Postman. Demonstrate sending and receiving JSON data and explain how APIs are used in AI applications.	**3**	4	1,4
Lab 10	Mini project: Example Capture and analyze network traffic data. Identify different protocols, measure packet statistics, and detect any anomalies. Optionally, apply a basic machine learning technique for traffic classification and discuss the results.	3	5	1,2,4
Total Contact Hours		**30**		

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Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Total Learning Hours	**30**

Learning Assessment

Bloom's Level	**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
1) Remember	40%	10%	40%	20%					10%		
2) Understand	30%	40%	30%	20%	10%				20%		30%
3) Apply	20%	30%	20%	30%	60%				50%		40%
4) Analyze	10%	20%	10%	30%	30%				20%		20%
5) Evaluate											10%
6) Create											
Total	100%	100%	100%	100%	100%				100%		100%

Continuous Assessments (CA) and End Semester Examination

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Project**
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
Conducting Marks	10	25	10	10	50				50		50
Converting Marks	5	15	5	5	20				30		20

Total Converting Marks	30	20		50
Total Marks	100			

Recommended Resources

1. Computer Networking: A Top-Down Approach, J. F. Kurose and K. W. Ross, Computer
2. Networking: A Top-Down Approach, 8th Edition, Pearson, 2024.
3. Data Communications and Networking, B. A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, 6th Edition, McGraw-Hill, 2022.

Other Resources

4. S. Tanenbaum, N. Feamster, and D. Wetherall, Computer Networks, 6th ed., Pearson, 2021.

5. O. Bonaventure, Computer Networking: Principles, Protocols and Practice, Latest ed., Open source.

Course Designers

1. Dr. Saleti Sumalatha, Assistant Professor, CSE.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Theory of Computation and Compiler Design

Course Code		Course Category	CC	Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	0	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	15	0	0	0	0	0	45
Course Offering by	AiTI	Progressive Course(s)		Professional / Licensing Standards							

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the mathematical foundations of computation including sets, relations, and formal languages.
2. To study and construct finite automata and regular expressions for language recognition
3. To analyse and design context-free grammars and pushdown automata.
4. To understand the power and limits of Turing machines and the concept of computability.
5. To explore computational complexity classes and the theory of NP-completeness

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the fundamental concepts of formal languages, automata, and computability.	2	70%	70%

Outcome 2	Construct finite automata and regular expressions for language recognition and conversion.	3	70%	70%
Outcome 3	Analyse context-free grammars, design pushdown automata, and apply parsing techniques.	4	70%	70%
Outcome 4	Design Turing machines to solve computational problems and evaluate decidability.	3	70%	65%
Outcome 5	Classify problems using computational complexity theory and analyse NP-completeness.	4	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	1	2							2			
Outcome 2	3	2	1	1	2							2			
Outcome 3	2	3	3	3	2							1			
Outcome 4	2	3	3	3	2							1			
Outcome 5	2	3	3	3	2							1			
Outcome 6	2	3	3	3	2							1			
Average	**2**	**3**	**3**	**3**	**2**							**1**			

Course Unitization Plan Theory

Unit No.	**Unit Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
UNIT 1	Introduction to Formal Languages and Automata	**9**		

	Mathematical Preliminaries: Sets, Relations, Functions, Proof Techniques	1	1	1,2
	Introduction to Formal Language Theory	1	1	1,2
	Chomsky Hierarchy of Formal Languages	1	1	1,2
	Deterministic Finite Automata (DFA) – Definition and Construction	2	1,2	1,2
	Non-deterministic Finite Automata (NFA) and Equivalence with DFA	2	1,2	1,2
	NFA with ε-transitions	1	1,2	1,2
	Applications of Finite Automata	1	1,2	1,3
UNIT 2	**Regular Languages and Regular Expressions**	**9**		
	Regular Expressions – Definition and Properties	1	2	1,2
	Equivalence of Regular Expressions and Finite Automata	2	2	1,2
	DFA Minimization using Myhill-Nerode Theorem	2	2	1,2
	Pumping Lemma for Regular Languages	1	2	1,2
	Closure Properties of Regular Languages	1	2	1,3
	Decision Problems for Regular Languages	1	2	1,3
	Lexical Analysis and Regular Expressions in Practice	1	2	1,3
UNIT 3	**Context-Free Grammars and Pushdown Automata**	**9**		
	Context-Free Grammars (CFG) – Definition and Derivations	1	3	1,2
	Parse Trees, Ambiguity, and Inherent Ambiguity	1	3	1,2
	Normal Forms: Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)	2	3	1,2
	Pushdown Automata (PDA) – Definition and Construction	2	3	1,2
	Equivalence of CFGs and PDAs	1	3	1,2
	Pumping Lemma for Context-Free Languages	1	3	1,3
	Closure Properties and Decision Problems for CFLs	1	3	1,3
UNIT 4	**Turing Machines and Computability**	**9**		

	Turing Machine – Definition, Variants, and Construction	2	4	1,2
	Multi-tape and Non-deterministic Turing Machines	1	4	1,2
	Church-Turing Thesis	1	4	1,3
	Decidability and Recognizability	1	4	1,3
	Undecidable Problems: Halting Problem	1	4	1,3
	Rice's Theorem	1	4	1,3
	Reductions and Mapping Reducibility	1	4	1,3
	Post's Correspondence Problem	1	4	1,3
UNIT 5	**Computational Complexity**	**9**		
	Time and Space Complexity of Turing Machines	1	5	1,2
	Complexity Classes: P and NP	2	5	1,2
	NP-completeness and Cook-Levin Theorem	2	5	1,2
	NP-complete Problems: SAT, 3-SAT, Clique, Vertex Cover	2	5	1,3
	Space Complexity: PSPACE and NPSPACE	1	5	1,3
	Savitch's Theorem and PSPACE-completeness	1	5	1,3
Total Contact Hours		45		

Learning Assessment Theory

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
1) Remember	–	–	–	–				–	–		
2) Understand	CO1	CO1	–	–				CO1	CO1		
3) Apply	CO2	CO2	CO3, CO4	–				CO2	CO2, CO3, CO4		
4) Analyze	–	–	–	–				–	–		
5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–				CO3, CO4	CO1–CO4		
6) Create	–	–	–	–				–	–		

Total	**5**	**15**	**5**	**5**				**20**	**50**		

Continuous Assessments (CA) and End Semester Examination

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Project**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–				CO1–CO4	CO1–CO4		
Conducting Marks	**10**	**25**	**10**	**10**				**50**	**50**		
Converting Marks	**5**	**15**	**5**	**5**				**20**	**50**		
Total Converting Marks	**30**							**20**	**50**		
Total Marks	**100**										

Recommended Resources

1. Michael Sipser. (2012). Introduction to the Theory of Computation, 3rd ed. Cengage Learning.

2. John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman. (2006). Introduction to Automata Theory, Languages, and Computation, 3rd ed. Pearson Education.

3. Peter Linz. (2016). An Introduction to Formal Languages and Automata, 6th ed. Jones & Bartlett Learning.

Other Resources:

1. Christos Papadimitriou. (1994). Computational Complexity. Addison-Wesley.
2. Harry Lewis and Christos Papadimitriou. (1997). Elements of the Theory of Computation, 2nd ed. Pearson Education.

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Course Designers

Dr. Naveen Kumar Mahamkali

Artificial Intelligence and Machine Learning II

(Introduction to Machine Learning)

Course Code		Course Category	CC	Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by	AiTI	Progressive Course(s)		Professional / Licensing Standards							

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce Machine Learning, the various tasks in the ML pipeline, and the types of learning paradigms relevant to Agriculture, Energy, Robotics, and Healthcare domains.
2. Develop understanding of a wide variety of regression, classification, and clustering algorithms along with their theoretical foundations and domain applicability.
3. Apply ML algorithms to real-world domain problems in Agriculture (crop yield prediction, plant disease detection), Energy (load forecasting, fault detection), Robotics (object recognition, gesture classification), and Healthcare (clinical diagnosis, patient segmentation).
4. Introduce Reinforcement Learning fundamentals — MDPs, Bellman equations, Dynamic Programming, Monte Carlo, TD-learning, and Q-Learning — with applications to robot navigation, smart energy grids, precision agriculture, and clinical decision support.
5. Enable learners to keep pace with rapid advances in Machine Learning by building a solid conceptual foundation and reading familiarity with research literature.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

Outcomes	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency %	Expected Attainment %
Outcome 1	Demonstrate the phases of machine learning application development with reference to Agriculture, Energy, Robotics, and Healthcare use cases.	2	75%	70%
Outcome 2	Describe and compare supervised, unsupervised, and reinforcement learning algorithms applicable to domain-specific datasets.	2	75%	70%
Outcome 3	Explain techniques to handle data quality, feature engineering, and dimensionality reduction for real-world domain data.	2	70%	65%
Outcome 4	Apply regression, classification, clustering, and reinforcement learning models to solve problems in crop yield prediction, energy management, robotic navigation, and clinical diagnosis.	4	70%	65%
Outcome 5	Evaluate and optimize ML models using appropriate metrics, validation strategies, and ensemble methods for domain-specific performance requirements.	5	70%	65%

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Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	-	-	-	-	-	-	-	-	-	3	2	2
Outcome 2	3	3	3	-	2	-	-	-	-	-	-	-	3	3	2
Outcome 3	3	3	2	-	2	-	-	-	-	-	-	-	3	2	2
Outcome 4	3	3	2	-	3	-	2	2	2	-	-	-	3	3	3
Outcome 5	3	3	3	-	2	-	2	2	2	2	2	-	3	3	2
Average	**3**	**3**	**3**	**-**	**2**	**-**	**2**	**2**	**2**	**2**	**2**	**-**	**3**	**3**	**2**

Course Unitization Plan – Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT I: Introduction to Machine Learning				
	Introduction to ML: Definitions, Goals and Scope	1	1	1
	Types of ML: Supervised, Unsupervised and Reinforcement Learning	1	1	1
	ML Pipeline: Data Collection, Preprocessing, Modelling and Deployment	1	1	1
	Hypothesis Space and Inductive Bias	1	1	1
	Training, Validation and Testing; Cross-Validation	1	3	1
	Overfitting and Underfitting; Bias-Variance Tradeoff	1	3	1
	Simple and Multiple Linear Regression	1	2,4	1
	Polynomial Regression, Ridge and Lasso; MSE, RMSE, R^2	1	2,4	1
	Logistic Regression for Binary Classification	1	2,4	1
	Model Selection: Grid Search, Random Search and Learning Curves	1	3,5	1
UNIT II: Classification and Dimensionality Reduction				
	Decision Tree Learning: Introduction and Representation	1	2,4	1
	DT Algorithm: Hypothesis Space, Inductive Bias and Pruning	1	2,4	1
	ID3 Algorithm and Plant Disease Classification	1	2,4	1
	K-Nearest Neighbour and Distance Metrics	1	2,4	1
	Curse of Dimensionality; Feature Selection: Filter, Wrapper and Embedded	1	3,4	1

	Univariate and Multivariate Feature Selection; Mutual Information	1	3,4	1
	PCA: Theory, Eigenvectors and Explained Variance	1	3,4	1
	PCA: Numerical Problems and Domain Applications	1	3,4	1
	Linear Discriminant Analysis (LDA)	1	3,4	1
	t-SNE for Non-Linear Dimensionality Reduction	1	3,4	1
	Recommender Systems: Content-Based and Collaborative Filtering	1	2,4	1
UNIT III: Probabilistic Learning and Support Vector Machines				
	Probability Review: Conditional Probability and Bayes' Theorem	1	2	1
	Bayesian Learning: MLE and MAP Estimation	1	2	1
	Naive Bayes: Gaussian, Multinomial and Bernoulli Variants	1	2,4	1
	Naive Bayes: Numerical Problems and Crop Pest Diagnosis	1	2,4	1
	Bayesian Networks: Structure and Conditional Independence	1	2	1
	Inference in Bayesian Networks: Variable Elimination	1	2,4	1
	SVM: Margin Maximisation and Hard-Margin Formulation	1	2,4	1
	Soft-Margin SVM, Dual Formulation and Kernel Trick	1	2,4	1
	SVM Numerical Problems; Multi-Class SVM (OvO, OvR)	1	2,4,5	1
UNIT IV: Ensemble Methods and Clustering				

	Ensemble Methods: Introduction and Bias-Variance Perspective	1	2,4,5	1
	Bagging and Random Forest: Feature Importance and OOB Error	1	2,4,5	1
	Boosting: AdaBoost Algorithm	1	2,4,5	1
	Gradient Boosting and XGBoost	1	2,4,5	1
	Fixed-Rule, Trained-Rule Fusion and Stacking Ensembles	1	2,4,5	1
	Clustering: Introduction; K-Means Algorithm	1	2,4,5	1
	Hierarchical Clustering: Agglomerative, Divisive and Dendrograms	1	2,4,5	1
	Cluster Evaluation: Silhouette, Davies-Bouldin and DBSCAN	1	2,4,5	1
UNIT V: Reinforcement Learning Fundamentals				
	Introduction to RL: Agent, Environment, Reward and Policy	1	2,4	2
	Markov Decision Processes (MDPs)	1	2,4	2
	Bellman Expectation and Optimality Equations	1	2,4	2
	Dynamic Programming: Policy and Value Iteration	1	2,4	2
	Monte Carlo Methods; TD(0) and SARSA	1	2,4	2
	Q-Learning; Epsilon-Greedy and Softmax Exploration	1	2,4	2
	RL Applications: Agriculture, Energy, Robotics and Healthcare	1	2,4,5	2
Total Theory Contact Hours		**45**		
Total Learning Hours				

Course Utilization Plan – Lab

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Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1	Introduction to Python for ML: NumPy, Pandas, Matplotlib, Scikit-learn. Explore an Agriculture domain dataset (crop recommendation).	2	1,4	1
2	ML Pipeline in Python: Data loading, preprocessing, train-test split, and model evaluation. Dataset: Energy consumption records.	2	1,4	1
3	Implement Simple and Multiple Linear Regression. Apply to crop yield prediction (Agriculture) and solar irradiance forecasting (Energy).	2	2,4	1
4	Compute Euclidean, Manhattan, and Minkowski distance measures. Explore feature-space distances on a Robotics sensor dataset.	2	3,4	1
5	Implement K-Nearest Neighbour (KNN). Apply to medical diagnosis classification (Healthcare). Print correct and incorrect predictions.	2	2,4	1
6	Implement ID3 Decision Tree. Build and visualise a decision tree for plant disease classification (Agriculture). Classify new samples.	2	2,4	1
7	Compute Covariance and Correlation matrices for a Healthcare dataset (clinical features). Discuss multicollinearity among features.	2	3,4	1
8	Implement Principal Component Analysis (PCA). Apply to a high-dimensional Robotics sensor dataset; visualise explained variance.	2	3,4	1
9	Implement Naive Bayes Classifier (Gaussian and Multinomial). Train on a crop pest diagnosis dataset; compute precision, recall, F1-score, and compare variants.	2	2,4	1
10	Build and query a Bayesian Network using pgmpy. Model a Healthcare diagnosis scenario; perform variable elimination for inference.	2	2,4	1
11	Implement SVM with linear and RBF kernels using Scikit-learn. Apply to Energy fault detection; tune C and gamma via Grid Search; plot decision boundaries.	2	2,4,5	1

12	Implement Random Forest and AdaBoost. Apply to agricultural yield prediction; compare feature importances across ensemble models.	2	2,4,5	1
13	Implement Gradient Boosting / XGBoost. Apply to energy load forecasting or clinical risk scoring; tune n_estimators and learning rate.	2	2,4,5	1
14	Implement K-Means and Hierarchical Clustering (Agglomerative). Cluster agricultural soil samples and patient profiles; evaluate with Silhouette Score and Elbow Method; plot dendrograms.	2	2,4,5	1
15	Implement Q-Learning and SARSA on an OpenAI Gym environment (FrozenLake / Taxi-v3). Compare convergence; then apply Q-Learning to robot path planning or crop irrigation scheduling.	2	2,4,5	2
Total Lab Contact Hours				**30**
Total Learning Hours				

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1	CO1, CO2	CO3	CO4, CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
1) Remember	40%	10%	40%	20%					10%		
2) Understand	30%	40%	30%	20%	10%				20%		30%
3) Apply	20%	30%	20%	30%	60%				50%		40%
4) Analyze	10%	20%	10%	30%	30%				20%		20%
5) Evaluate											10%
6) Create											
Total	100 %	100 %	100 %	100 %	100%				100%		100%

Continuous Assessments (CA) and End Semester Examination

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Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO 1	CO1 , CO2	CO 3	CO4 , CO5	CO1, CO2, CO3, CO4, CO5				CO1, CO2, CO3, CO4, CO5		CO1, CO2, CO3, CO4, CO5
Conducting Marks	10	25	10	10	50				50		50
Converting Marks	5	15	5	5	20				30		20
Total Converting Marks	30				20				50		
Total Marks	100										

Recommended Resources

1. Alpaydin, E. (2020). Introduction to Machine Learning (4th ed.). MIT Press. (https://mitpress.ublish.com/book/introduction-to-machine-learning--4#toc)
2. Sutton, R. S., & Barto, A. G. (2018). Reinforcement Learning: An Introduction (2nd ed.). MIT Press. (https://web.stanford.edu/class/psych209/Readings/SuttonBartoIPRLBook2ndEd.pdf)

Other Resources

1. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer, New York.
2. Domain datasets: UCI ML Repository, Kaggle (Crop Recommendation, Energy Efficiency, ROS Robot Datasets, MIMIC-III Clinical Data).
3. Online platforms: Google Colab, Kaggle Notebooks, scikit-learn documentation (https://scikit-learn.org).
4. Géron, A. (2022). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd ed.). O'Reilly Media.
5. Swamynathan, M. (2017). Mastering Machine Learning with Python in Six Steps. Apress.

Course Designers

1. Dr. Ashu Abdul, Associate Professor, CSE

SEMESTER V

SRM University *AP*, Andhra Pradesh
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Natural Language Processing

Course Code		Course Category		Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by		Progressive Course(s)		Professional / Licensing Standards							

Course Learning Rationales (CLRs) Course Objectives (COs)

1. Introduce fundamental concepts of Natural Language Processing, including linguistic levels, text processing, and probabilistic language modelling.
2. Develop understanding of classical machine learning techniques and linguistic structures for core NLP tasks such as classification, tagging, and parsing.
3. Provide knowledge of neural network-based approaches and word representations for advanced NLP modelling.
4. Explain Transformer architectures and large language models, including training, fine-tuning, and responsible AI considerations.
5. Enable students to design and implement NLP applications using modern techniques such as retrieval, question answering, and conversational AI.

Course Outcomes (Cos) / Course Learning Outcomes (CLOs)

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	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Explain NLP fundamentals, linguistic structures, and probabilistic language models used in text processing.	2	70%	65%
Outcome 2	Apply classical machine learning and linguistic techniques for tasks such as text classification, tagging, parsing, and information extraction.	3	65%	60%
Outcome 3	Analyze neural NLP models, including embeddings, sequence models, and contextual representations, for performance and limitations.	4	60%	55%
Outcome 4	Analyze Transformer architectures and large language models in terms of design choices, training strategies, and ethical considerations.	4	60%	55%
Outcome 5	Analyze and compare NLP application techniques such as retrieval, generation, and conversational systems for different real-world scenarios.	4	60%	55%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO) B. Tech.

Program Learning Outcomes (PLO)															
CLOs	**PO**												**PSO**		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2			1							1			
Outcome 2	3	3	2	1	2				1			1			
Outcome 3	3	3	2	3	2				1			1			
Outcome 4	3	3	2	3	3			2				2			
Outcome 5	3	3	2	2	3			2	1	1		2			
Average															

Correlation : 3 = High, **2 =** Medium, **1** = Low

Course Unitization Plan Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT 1: Introduction to NLP and Language Modeling		**9**		
	NLP tasks in syntax, semantics, pragmatics, discourse, speech, and AI applications	1	1	1,2,3
	Text normalization, corpora, regular expressions, tokenization, byte-pair and subword tokenization	2	1	1,2,3
	Probability basics and information-theoretic foundations for language modeling	2	1	1,2,3
	N-gram language models, parameter estimation, smoothing, and perplexity-based evaluation	3	1	1,2,3
	Ethical issues, data quality, multilingual and Indian language challenges in NLP	1	1	1,2,3
UNIT 2: Classical Machine Learning and Linguistic Structure		**9**		
	Text classification using Naive Bayes, logistic regression, feature extraction, and evaluation metrics	2	2	1,2,3

	Part-of-speech tagging, named entity recognition, and sequence labelling	2	2	1,2,3
	Morphological analysis, spelling correction, edit distance, and finite-state methods	1	2	1,2,3
	Context-free grammars, constituency parsing, and dependency parsing	2	2	1,2,3
	Information extraction: relations, events, time expressions, and semantic role labeling	2	2	1,2,3
UNIT 3: Neural NLP and Representations		**9**		
	Word embeddings: distributional semantics, Word2Vec, GloVe, similarity, analogy, and bias	2	3	1,3,5
	Neural networks for NLP: feed-forward networks, loss functions, training, and regularization	2	3	1,3,5
	Sequence models: RNNs, LSTMs, encoder-decoder models, and attention motivation	2	3	1,3,5
	Contextual representations and masked language models including BERT-style pretraining	2	3	1,3,5
	Practical implementation and error analysis using Python NLP libraries	1	3	1,3,5
UNIT 4: Transformers and Large Language Models		**10**		
	Self-attention, multi-head attention, positional encoding, and Transformer architecture	2	4	1,4,5
	Encoder-only, decoder-only, and encoder-decoder architectures for NLP tasks	2	4	1,4,5
	Large language models: pretraining, scaling intuition, prompting, in-context learning, and evaluation	2	4	1,4,5
	Post-training: instruction tuning, alignment, preference learning concepts, and test-time compute	2	4	1,4,5

	Fine-tuning concepts, parameter-efficient adaptation overview, hallucination, safety, fairness, and responsible NLP	2	4	1,4,5
UNIT 5: NLP Applications in AI Systems		**8**		
	Information retrieval: lexical retrieval, dense retrieval, vector search, and evaluation	2	5	1,3,5
	Retrieval-Augmented Generation: indexing, retrieval, grounding, answer generation, and citation-aware responses	2	5	1,3,5
	Question answering, summarization, sentiment analysis, and conversational agents	1	5	1,3,5
	Machine translation: major approaches, neural machine translation, and translation involving Indian languages	1	5	1,3,5
	Overview of speech-related NLP: ASR, text-to-speech, and multimodal language applications	1	5	1,3,5
	Mini-project discussion: end-to-end NLP/LLM application design with responsible AI considerations	1	5	1,3,5
Total Contact Hours		**45**		
Total Learning Hours				

Course Unitization Plan Lab

Exp. No.	**Experiment Name**	**Required Contact Hours**	**CLOs Addressed**	**References Used**
Lab 1	Perform text preprocessing techniques including tokenization, stopword removal, stemming, and lemmatization.	**3**	1,2	1,2,3
Lab 2	Extract patterns and analyze textual data using regular expressions.	3	1,2	1,2,3

Lab 3	Build N-gram language models and evaluate them using perplexity.	3	1	1,2,3
Lab 4	Implement text classification using Naive Bayes or Logistic Regression.	3	2	1,2,3
Lab 5	Perform part-of-speech tagging and named entity recognition.	3	2,5	1,2,3
Lab 6	Implement edit distance algorithms for spelling correction.	3	2,5	1,2,3
Lab 7	Explore word embeddings and measure semantic similarity.	3	3	1,3,5
Lab 8	Implement sequence models for NLP tasks.	3	3	1,3,5
Lab 9	Apply Transformer models for text classification.	**3**	3,4	1,4,5
Lab 10	Design and develop an end-to-end NLP application.	3	3,4,5	1,2,3,4,5
Total Contact Hours		**30**		
Total Learning Hours				

Learning Assessment

Bloom's Level	**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**		
	CLA - 1 (%)	**Mid - 1 (%)**	**CLA - 2 (%)**	**CLA - 3 (%)**	**Lab Performance (%)**	**Observation Note (%)**	**Model Exam (%)**	**Project (%)**	**Theory (%)**	**Practical (%)**	**Project (%)**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
1) Remember	–	–	–	–	–	–	–	–	–	–	–
2) Understand	CO1	CO1	–	–	CO1	CO1	CO1	–	CO1	CO1	CO1
3) Apply	CO2	CO2	CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2, CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2
4) Analyze	–	–	–	–	–	–	–	–	–	–	–

5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
6) Create	–	–	–	–	–	–	–	–	–	–	–
Total	**5**	**15**	**5**	**5**	**10**	**-**	**-**	**10**	**30**	**20**	-

Continuous Assessments (CA) and End Semester Examination

Test Components	**CA - Theory**				**CA - Practical**			**CA -Project**	**End Semester Exam**		
	CLA - 1	**Mid - 1**	**CLA - 2**	**CLA - 3**	**Lab Performance**	**Observation Note**	**Model Exam**	**Project**	**Theory**	**Practical**	**Project**
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Speech and Language Processing, D. Jurafsky and J. H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd ed., 2023.
2. Natural Language Processing, P. Bhattacharyya and A. Joshi, Natural Language Processing, Wiley India, 2023.

Other Resources

1. Natural Language Processing A Textbook with Python Implementation, R. S. T. Lee, Natural Language Processing: A Textbook with Python Implementation, Springer, 2023.
2. Transformers for Natural Language Processing and Computer Vision, D. Rothman, Transformers for Natural Language Processing and Computer Vision, 3rd ed., Packt, 2024.
3. Mastering NLP from Foundations to LLMs, L. Gazit et al., Mastering NLP from Foundations to LLMs, Packt, 2024.

Course Designers

1. Dr. Saleti Sumalatha, Assistant Professor, CSE.

Artificial Intelligence and Machine Learning III
(Introduction to Deep Learning)

Course Code		Course Category		Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)	Intro to ML	Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by		Progressive Course(s)		Professional / Licensing Standards							

Course Objectives / Course Learning Rationales (CLRs)

1. Develop a thorough understanding of fundamental deep learning concepts: artificial neurons, activation functions, feedforward networks, backpropagation, and gradient-based optimisation, building directly on the ANN foundations from the Introduction to ML course.
2. Introduce TensorFlow as the primary deep learning framework, and build deep understanding of gradient-based optimisation algorithms — SGD, Momentum, NAG, AdaGrad, RMSProp, and Adam — along with regularisation and hyperparameter tuning strategies.
3. Study Convolutional Neural Networks (CNNs) in depth — architecture, convolution operations, pooling, landmark models — and apply them to image-based problems in Agriculture, Robotics, and Healthcare through transfer learning.
4. Study Recurrent Neural Networks (RNNs), LSTMs, and GRUs for sequential and time-series problems in Energy load forecasting, crop growth monitoring, and clinical patient monitoring.

5. Introduce advanced deep learning topics — autoencoders, GANs, object detection, image segmentation, and NLP — and apply them to domain-specific use cases across all four specializations.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency %	Expected Attainment %
Outcome 1	Illustrate the foundational concepts of deep learning: neurons, activation functions, ANN architecture, training, and the TensorFlow/Keras framework.	1	70%	68%
Outcome 2	Design and implement Convolutional Neural Network (CNN) models for image-based tasks in Agriculture, Robotics, and Healthcare domains.	2	70%	65%
Outcome 3	Design and implement Recurrent Neural Network (RNN), LSTM, and GRU models for sequential and time-series data in Energy and Healthcare domains.	2	70%	65%
Outcome 4	Apply advanced deep learning models — including Transformers (BERT, ViT), autoencoders, and GANs — to domain-specific problems in Agriculture, Energy, Robotics, and Healthcare.	3	70%	60%

Course Articulation Matrix (CLO to PLO)

Program Learning Outcomes (PLO)															
CLOs	PO												PSO		
	Engineering Knowledge	Problem Analysis	Design and Development	Analysis, Design and Research	Modern Tool and ICT Usage	Society and Multicultural Skills	Environment and Sustainability	Moral, and Ethical Awareness	Individual and Team work Skills	Communication Skills	Project Management and Finance	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	1	1	1	2								2	2	
Outcome 2	2	2	3	2	3								3	2	
Outcome 3	2	2	3	2	3								2	3	
Outcome 4	2	2	3	3	3		2	2	2			2	2	3	
Average	**2**	**2**	**3**	**2**	**3**		**2**	**2**	**2**			**2**	**2**	**3**	

Course Unitization Plan – Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1: Foundations				
	Overview of ML and Deep Learning	2	1	1
	History of Deep Learning	1	1	1
	Biological Motivation, McCulloch-Pitts Neuron and Perceptron	1	1	1,2
	Activation Functions: Sigmoid, Tanh, ReLU, Leaky ReLU, ELU, Softmax	2	1	1,2
	ANN Architecture, Forward Pass and Loss Functions	1	1	1,2
	Backpropagation: Chain Rule and Gradient Descent	2	1	1,2
	Vanishing and Exploding Gradients: Weight Initialisation and Batch Normalisation	1	1	1,2
	Introduction to TensorFlow: Graphs, Tensors and Eager Execution	1	1	1,3
Unit 2: Optimisation				
	Gradient Descent: Batch, Stochastic and Mini-Batch	1	1	1,2
	Momentum and Nesterov Accelerated Gradient (NAG)	1	1	1,2
	Adaptive Methods: AdaGrad and RMSProp	1	1	1,2
	Adam Optimiser and AMSGrad Variant	1	1	1,2

	Regularisation: L1/L2, Dropout and Early Stopping	1	1	1,2
	Hyperparameter Tuning: Learning Rate Schedules and Weight Initialisation	1	1	1,2
Unit 3: CNNs				
	Introduction to CNNs	2	1,2	1,2
	Convolutional Layer: Filters, Stride and Padding	1	1,2	1,2
	Pooling Layers and Fully Connected Layers	1	1,2	1,2
	CNN Principles: Local Connectivity, Weight Sharing and Translational Invariance	1	1,2	1,2
	CNN Architectures: LeNet, AlexNet, VGG, ResNet, InceptionNet	1	1,2	1,2
	Transfer Learning and Fine-Tuning for Domain Applications	2	1,2,4	1,2
Unit 4: RNNs & Sequence Models				
	Introduction to RNNs: Sequential Data and Hidden State	2	1,3	2
	Backpropagation Through Time (BPTT)	1	1,3	2
	Long Short-Term Memory (LSTM)	2	1,3	2
	Gated Recurrent Units (GRU)	1	1,3	2
	Seq2Seq Models and Encoder-Decoder Architecture	1	1,3	2
	RNN Domain Applications: Energy, Healthcare and Agriculture	1	1,3,4	2
Unit 5: Transformers & Applications				
	Attention Mechanism: Scaled Dot-Product and Query-Key-Value	1	3,4	3
	Multi-Head Attention, Positional Encoding and Transformer Architecture	2	3,4	3
	Training Transformers: Masked Self-Attention and Layer Normalisation	1	3,4	3
	BERT: Pre-training and Fine-tuning for NLP Applications	2	4	3
	Vision Transformer (ViT): Patch Embeddings and Image Classification	1	2,4	3
	Autoencoders and Denoising Autoencoders	1	4	3
	Generative Adversarial Networks (GANs)	1	4	3
	Object Detection (YOLO, SSD) and Image Segmentation (U-Net)	1	1,2,4	3
	Responsible AI: Explainability, Bias and Fairness	1	4	3
	Domain Case Studies: Agriculture, Energy, Robotics and Healthcare	1	1,2,3,4	3
Total Contact Hours 45				
Total Learning Hours				

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

Course Unitization Plan – Lab

Exp. No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
Lab 1	Implement a Multilayer Perceptron (MLP) using Keras/TensorFlow. Fine-tune hyperparameters for a regression problem: crop yield prediction (Agriculture).	3	1,2	1,2
Lab 2	Implement an MLP for a binary classification problem: heart disease risk prediction (Healthcare). Evaluate using precision, recall, F1, and ROC-AUC.	3	1,2,3	1,2
Lab 3	Implement a CNN for image classification: plant disease detection from leaf images (Agriculture) using TensorFlow/Keras.	3	2,3	1,2
Lab 4	Implement a CNN for handwritten digit recognition (MNIST). Visualise feature maps and kernel filters at each convolutional layer.	2	1,2,3	1,2
Lab 5	Apply Transfer Learning (ResNet/VGG pretrained on ImageNet) for object detection in a Robotics or Healthcare imaging dataset. Fine-tune top layers.	3	2,3,4	1,2
Lab 6	Implement an LSTM network to predict energy load time-series (Energy domain). Compare performance with a vanilla RNN baseline.	3	3,4	1,2
Lab 7	Implement a GRU model for crop growth time-series forecasting (Agriculture). Visualise hidden state evolution and loss curves.	3	3,4	1,2
Lab 8	Implement a Seq2Seq Encoder-Decoder model with Attention for a Neural Machine Translation task (e.g., English to regional language for farmer advisory systems).	3	3,4	3
Lab 9	Implement a Denoising Autoencoder for anomaly detection in smart energy grid sensor data. Visualise reconstruction error distributions.	3	2,3,4	3
Lab 10	Fine-tune a pre-trained BERT model using HuggingFace Transformers for a Healthcare text classification task (e.g., clinical note sentiment / ICD code prediction).	2	3,4	3
Lab 11	Implement YOLO / SSD object detection pipeline. Case Study 1: Robotic pick-and-place object detection. Measure mAP and inference speed.	3	1,2,3,4	1,2

Lab 12	Image Segmentation with U-Net. Case Study 2: Segment tumour regions in medical MRI/CT images (Healthcare). Evaluate with Dice coefficient and IoU.	3	1,2,3,4	1,2
Total Contact Hours				30
Total Learning Hours				

Learning Assessment

Bloom's Level	Continuous Learning Assessments (50%)								End Semester Exam (50%)		
	CLA - 1 (%)	Mid - 1 (%)	CLA - 2 (%)	CLA - 3 (%)	Lab Performance (%)	Observation Note (%)	Model Exam (%)	Project (%)	Theory (%)	Practical (%)	Project (%)
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
1) Remember	–	–	–	–	–	–	–	–	–	–	–
2) Understand	CO1	CO1	–	–	CO1	CO1	CO1	–	CO1	CO1	CO1
3) Apply	CO2	CO2	CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2, CO3, CO4	–	CO2, CO3, CO4	CO2, CO3, CO4	CO2
4) Analyze	–	–	–	–	–	–	–	–	–	–	–
5) Evaluate	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	CO1, CO2
6) Create	–	–	–	–	–	–	–	–	–	–	–
Total	**5**	**15**	**5**	**5**	**10**	**-**	**-**	**10**	**30**	**20**	**-**

Continuous Assessments (CA) and End Semester Examination

Test Components	CA - Theory				CA - Practical			CA -Project	End Semester Exam		
	CLA - 1	Mid - 1	CLA - 2	CLA - 3	Lab Performance	Observation Note	Model Exam	Project	Theory	Practical	Project
COs Addressed	CO1, CO2	CO1, CO2	CO3, CO4	–	CO1–CO4	CO1–CO4	CO1–CO4	–	CO1–CO4	CO1–CO4	–
Conducting Marks	10	25	10	10	50			50	50	50	
Converting Marks	5	15	5	5	10			10	30	20	
Total Converting Marks	**30**				**10**			**10**	**50**		
Total Marks	**100**										

Recommended Resources

1. Buduma, N., Buduma, N., & Papa, J. (2022). Fundamentals of Deep Learning (2nd ed.). O'Reilly Media. (https://shorturl.at/gxis1)
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. (https://aikosh.indiaai.gov.in/static/Deep+Learning+Ian+Goodfellow.pdf)
3. Tunstall, L., von Werra, L., & Wolf, T. (2022). Natural Language Processing with Transformers. O'Reilly Media. (https://shorturl.at/KkUJw)

Other Resources

1. TensorFlow official documentation and tutorials: https://www.tensorflow.org/tutorials
2. DeepLearning.AI TensorFlow Developer Professional Certificate: https://www.coursera.org/professional-certificates/tensorflow
3. Fast.ai Practical Deep Learning for Coders: https://course.fast.ai

4. Domain datasets: PlantVillage (Agriculture), MIMIC-III (Healthcare), UCI Energy datasets, ROS Robot datasets.
5. Chollet, F. (2021). Deep Learning with Python (2nd ed.). Manning Publications.

Course Designers

1. Dr. Ashu Abdul, Associate Professor, CSE

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh - 522240.

SEMESTER VI

AI Augmented Software Engineering and Project Management

Course Code		Course Category		Credit	L	T	D	P	Pr	TW + SL	Total
					3	0	0	1	0	0	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Learning Hours	15	0	0	15	0	0	60
Course Offering by		Progressive Course(s)		Professional / Licensing Standards							

Course Objectives / Course Learning Rationales (CLRs)

1. Develop proficiency in AI developer tools - including Vibe Coding, GitHub Copilot, LLM-based code assistants, and agentic coding frameworks - and apply them systematically across requirements engineering, development, testing, deployment, and monitoring.
2. Match the needs of AI software projects to the most appropriate development model - Agile-Scrum, iterative, or data-centric - and manage model-specific development and planning challenges.

3. Plan and manage AI projects at each stage of the AI-SDLC, from problem scoping and requirements elicitation through model development, validation, and production deployment.
4. Critically analyse the impact of AI tools on software productivity - at the level of individual developers, cross-functional teams, and organisations - using reflective practice and empirical evaluation.
5. Develop AI governance skills for tracking and controlling AI software deliverables using MLOps tools, model performance dashboards, responsible AI checklists, and regulatory compliance frameworks.

Course Outcomes / Course Learning Outcomes (CLOs)

Outcome	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency %	Expected Attainment %
Outcome 1	Use AI developer tools (Vibe Coding, GitHub Copil LLM-based code assistants) across the full softw development lifecycle - coding, code revie requirements engineering, automated testi deployment, and monitoring - to build functio software systems.	3	70%	65%
Outcome 2	Apply AI-specific software development lifecy (SDLC) models and iterative development process integrating AI tools into Agile-Scrum sprints, MLC pipelines, and CI/CD workflows for AI projects Agriculture, Energy, Robotics, and Healthc domains.	3	70%	65%

Outcome 3	Implement software engineering practices tailored AI-augmented development: AI-assist requirements gathering, user story generatic development specification creation, AI-assisted co review, and stakeholder communication.	3	70%	65%
Outcome 4	Apply AI project planning and estimation concept effort estimation, sprint planning for ML workflov cost modelling for compute and data, r management, and WBS/Gantt planning - usi AI-powered project management tools.	3	70%	65%
Outcome 5	Explain and apply AI quality management practic model performance metrics, fairness and b auditing, explainability (SHAP, LIME), AI governar frameworks (EU AI Act, IEEE Ethics), and responsil deployment using AI-assisted monitoring tools.	2	70%	65%