Lingaya's Vidyapeeth

Deemed-to-be-University u/s 3 of UGC Act 1956, Government of India
NAAC ACCREDITED
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COURSE PLAN & COURSE DATA SHEET

PROGRAM: MCA	DEGREE: PG
COURSE: Artificial Intelligence & Robotics	SEMESTER: VI CREDITS: 3
COURSE CODE: MCA-128 REGULATION: NA	COURSE TYPE: CORE
COURSE AREA/DOMAIN: IT	CONTACT HOURS: 3+1 (Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NA	LAB COURSE NAME (IF ANY): NA

PROGRAM EDUCATIONAL OBJECTIVES:

- Graduates will have a strong foundation in AI and robotics technologies, enabling them to design, implement, and deploy intelligent systems.
- Graduates will demonstrate the ability to apply AI and robotics concepts to solve complex, real-world problems effectively.
- Graduates will be innovative thinkers capable of developing novel AI and robotics solutions to address emerging challenges.
- Graduates will possess interdisciplinary knowledge, allowing them to collaborate across various domains and industries.
- Graduates will understand the ethical implications of AI and robotics and apply responsible practices in their work.
- Graduates will have the motivation and skills to engage in lifelong learning to keep pace with evolving AI and robotics technologies.
- Graduates will be prepared to contribute to AI and robotics research, development, and innovation.
- Graduates will communicate technical ideas effectively to both technical and non-technical stakeholders.
- Graduates will demonstrate leadership skills and work effectively as part of multidisciplinary teams.
- Graduates will adapt to changing technological landscapes and emerging trends in AI and robotics.
- Entrepreneurship: Graduates will have the entrepreneurial mindset and skills to create AI and robotics startups and contribute to the industry's growth.
- Graduates will appreciate the global impact of AI and robotics and consider societal, economic, and cultural factors in their work.

SYLLABUS:

UNIT	DETAILS	HOURS
I	**INTRODUCTION TO AI AND SEARCH TECHNIQUES:** Foundation and history of AI; data, information and knowledge; AI problems and techniques – AI programming languages,	7

	problem space representation with examples; blind search strategies, breadth first search, depth first search, heuristic search techniques: hill climbing: best first search, A * algorithm AO* algorithm, Minimax search procedure for Game Playing.	
II	**KNOWLEDGE REPRESENTATION ISSUES AND TECHNIQUES:** Predicate logic; representing knowledge using rules. Semantic nets, partitioned nets, parallel implementation of semantic nets; frames, forward and backward chaining; frame based systems. Reasoning under uncertainty, non-monotonic reasoning; Review of probability; Baye's probabilistic interferences and Dumpster Shafer theory; statistical reasoning, fuzzy reasoning.	6
III	**ROBOTICS SYSTEM:** Introduction to robotics, Classification of Robots, Major components of robots, Robotics Applications, Artificial Intelligence in robotics, Basic components of a robot system, Functions of a robotic system, specification of a robotic system	5
IV	**MODELING AND END EFFECTORS:** Motion Conversion, Modeling of the mechanical System, Kinematics chain, Classification of end effectors-tools as end effectors-drive system for grippers, mechanical adhesive, vacuum magnetic, grippers, hooks and scoops, gripper force analysis, and gripper design, active and passive grippers	8
V	**ROBOT PROGRAMMING:** Software and hardware considerations, Introduction to robotic programming, Robotic extension of general purpose programming, Robot specific programming languages, VAL – basic commands, command based programming, sample programs.	7
	TOTAL HOURS	33

Teacher Centric Approach **TC1: Chalk and Talk, TC2: PPT, TC3: Video Lectures TC4: Blended learning**
Learner Centric Approach: **LC1: Assignment. LC2: Mini project. LC3: Quiz/Class test. LC 4: Seminar on recent trends.** **LC5: Group Task. LC6: Others**

DETAILED SESSION PLAN

Lecture session/ Number	Topics to be covered	CO addressed	Teacher Centric Approach	Learner Centric Approach	References	Relevance with POs and PSOs
1	Foundation and history of AI; data, information and knowledge	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2
2	AI problems and techniques – AI programming languages, problem space representation with examples	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
3	blind search strategies, breadth first search, depth first search	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
4	heuristic search techniques: hill	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2

	climbing					
5	heuristic search techniques: best first search	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
6	A * algorithm AO* algorithm	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
7	Minimax search procedure for Game Playing	1	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2
8	KNOWLEDGE REPRESENTATION ISSUES AND TECHNIQUES: Predicate logic; representing knowledge using rules	2	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
9	Semantic nets, partitioned nets, parallel implementation of semantic nets	2	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
10	frames, forward and backward chaining; frame based systems	2	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2
11	Reasoning under uncertainty, non-monotonic reasoning	2	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
12	Review of probability; Baye's probabilistic	2	TC1, TC2	LC3	T1/T2/R1	2

	interferences and Dumpster Shafer theory					
13	statistical reasoning, fuzzy reasoning	2	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
14	ROBOTICS SYSTEM Introduction to robotics,	3	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	3
15	Classification of Robots	3	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2
16	Major components of robots, Robotics Applications	3	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2
17	Artificial Intelligence in robotics, Basic components of a robot system	3	TC1, TC2	LC3	R1/R2/R3	2
18	Functions of a robotic system, specification of a robotic system	3	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3
19	MODELING AND END EFFECTORS Motion Conversion, Modeling of the mechanical System	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
20	Kinematics chain, Classification of end effectors-tools as end effectors-drive system for grippers	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3

21	mechanical adhesive, vacuum magnetic	4	TC1, TC2	LC1,LC2,LC3,LC4	R1/R2/R3	2
22	grippers	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3
23	hooks and scoops	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
24	gripper force analysis	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3
25	gripper design	4	TC1, TC2	LC3	R1/R2/R3	2
26	active and passive grippers	4	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
27	ROBOT PROGRAMMING Software and hardware considerations	5	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3
28	Introduction to robotic programming	5	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	3
29	Robotic extension of general purpose programming	5	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
30	Robot specific programming languages	5	TC1, TC2	LC1,LC2,LC3,LC4	R1/R2/R3	3
31	VAL – basic commands	5	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
32	command based programming	5	TC1, TC2	LC1,LC2,LC3	R1/R2/R3	2
33	sample programs	5	TC1, TC2	LC1,LC2,LC3	T1/T2/R1	2

34	Quiz		TC1, TC2	LC3	T1/T2/R1	3

TEXT/REFERENCE BOOKS:

T/R	
1	Rich Elaine and Knight Kevin, —Artificial Intelligence 3rd Edition, Tata McGraw Hill, 1991
2	Richared D.Klafter.Thomas Achmielewski and Mickael Negin, Robotic Engineering an Integrated approach prentice hall India-newdelhi-2001
3	John Craig, Introduction to Robotics Mechanics and Control, Pearson, 4th Edition, 2022
4	Siciliano, Khatib, Springer Handbook on Robotics
5	Saeed B.Nikku, Introduction to Robotics, analysis, control and applications Wiley-India2nd edition-2011
6	Danny Staple, Learn Robotics Programming: Build and control AI-enabled autonomous robots using the Raspberry Pi and Python, 2nd Edition

 # WEB SOURCE REFERENCES (W):

1	https://www.javatpoint.com/software-engineering-tutorial
2	https://www.tutorialspoint.com/software_engineering/index.htm
3	W3schools.com

COURSE PRE-REQUISITES: Data Structure, Electronics and Mechanics Concepts

C.CODE	COURSE NAME	DESCRIPTION	SEM
MCA-128	Artificial Intelligence & Robotics	This course explores AI fundamentals, machine learning, robotics development, and ethical considerations, preparing students for cutting-edge technology applications.	II

COURSE OBJECTIVES:

1	To introduce foundational knowledge about robotics and application of robotics
2	To make the students familiar with concepts of Artificial Intelligence and reasoning.
3	To discuss the implementation of robots
4	To provide students with a solid foundation in the core principles, algorithms, and techniques of artificial intelligence, including machine learning, natural language processing, and computer vision.
5	To equip students with the practical skills necessary for designing, building, and programming robotic systems.

COURSE OUTCOMES:

S.NO	DESCRIPTION	PO(1..12) MAPPING	PSO(1..3) MAPPING
CO1	Demonstrate fundamental understanding of artificial intelligence (AI) and expert	PO1, PO2,	PSO1

	systems. Solve basic AI based problems	PO5, PO9	
CO2	Define the concept of Artificial Intelligence and Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	PO3, PO4, PO5, PO6	PSO3
CO3	Understand the basic concepts of working of robot.	PO3, PO4, PO5, PO6	PSO3
CO4	Understand the various robot programming languages.	PO10, PO11	PSO2, PSO3
CO5	Use and apply techniques for robot programming.	PO1, PO2, PO5, PO9	PSO1
COURSE OVERALL PO/PSO MAPPING: 2/2			

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1								2		2		
CO2	1	1	1								1		1	2	
CO3	2	1									1			1	1
CO4	1	1									1		1		1
CO5	1	1									1				1
CO1	1	1	1								2		2		

** For Entire Course, PO & PSO Mapping*

POs & PSO REFERENCE:

PO 1	Apply the knowledge of mathematics, science, engineering and Application fundamentals, and an engineering and Application specialization to the solution of complex engineering problems.	PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PSO1	To equip the students with theoretical and implementation knowledgebase in all the latest areas of Computer Science & Engineering for a successful career in software industries, pursuing higher studies, or entrepreneurial establishments.
PO 2	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	PSO2	To nurture the students with the critical thinking abilities for better decision making by offering them a socially acceptable solutions to real life problems through computing paradigm.
PO 3	Design solutions for complex engineering problems and design system components or processes	PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PSO3	To nurture the students with the comprehensive analytical and design abilities by offering them

	that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.				techno-commercially feasible solutions of real business problems through computing.
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.		
PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	PO11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.		
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.		

COs VS POs MAPPING JUSTIFICATION:

S.NO	PO/PSO MAPPED	LEVEL OF MAPPING	JUSTIFICATION
CO1	2/1	1	It signifies that students will acquire fundamental knowledge in AI and robotics, laying the groundwork for advanced learning and specialization.
CO2	3/3	2	It aligns with the course's focus on developing analytical and problem-solving skills, essential for designing and implementing advanced AI and robotics solutions.
CO3	3/3	2	It delvs into advanced software engineering practices, methodologies, and project management, equipping students for challenging real-world software development scenarios. ensures that students acquire advanced technical knowledge and practical skills, enabling them to design innovative AI and robotics solutions, contributing to technological advancements.
CO4	2/3	1	It ensures students grasp fundamental AI and robotics principles, providing a comprehensive knowledge base for advanced studies and practical applications.
CO5	2/1	2	It ensures that students gain a strong foundational understanding of AI and robotics concepts, fostering their problem-solving abilities and practical skills.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS, POs & PSOs:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Lack of Hands-On Robotics Experience: The syllabus lacks sufficient hands-on experience in building and programming physical robots.	Introduce dedicated lab sessions where students work on robotics projects, building and programming robots to apply AI concepts practically.
2	Limited Exposure to Real-World Data: The course primarily focuses on theoretical AI concepts, but lacks exposure to real-world data and scenarios.	Incorporate case studies and projects that involve real-world datasets, enabling students to address practical AI challenges.
3	Ethical and Responsible AI Emphasis: The syllabus may not adequately emphasize ethical and responsible AI practices.	Integrate ethics modules into the curriculum, discussing the societal impact of AI and robotics, and promoting responsible AI development.
4	Industry-Relevant Tools and Technologies: The course may not cover the latest industry-standard AI and robotics tools and technologies.	Update the syllabus to include training on cutting-edge AI and robotics tools and platforms used in the industry.
5	Limited Interdisciplinary Collaboration: The curriculum may not encourage interdisciplinary collaboration with other fields	Foster collaboration by

		introducing joint projects or courses with related disciplines, reflecting real-world multidisciplinary AI and robotics applications.

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

 # TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Reinforcement Learning and Autonomous Systems Design
2	Deep Reinforcement Learning for Robotics
3	Bio-Inspired Robotics:
4	Human-Robot Interaction and Collaboration
5	AI in Healthcare Robotics
6	Robotic Perception and Computer Vision
7	AI Ethics and Responsible Robotics

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☐ STUD. ASSIGNMENT	☐ WEB RESOURCES	☐ NPTEL/OTHERS
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	☐ WEBNIARS

ASSESSMENT METHODOLOGIES-DIRECT

☐ ASSIGNMENTS	☐ STUD. SEMINARS	☐ TESTS/MODEL EXAMS	☐ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

 # INNOVATIONS IN TEACHING/LEARNING/EVALUATION PROCESSES:

1. Partner with industry organizations to provide real-world projects as part of the course. Students work on industry-relevant challenges, gaining practical experience and networking opportunities.
2. Implement a flipped classroom approach where lectures are delivered online, and in-class time is dedicated to hands-on lab work. Maximizes hands-on learning, encourages self-paced study, and provides flexibility for students.
3. Implement AI-driven chatbots that provide personalized learning recommendations, answer queries, and track student progress. Enhances student engagement, offers immediate support, and tailors learning to individual needs.
4. Integrate VR and robotics simulations to allow students to experiment with robots and AI algorithms in a virtual environment. Provides a safe and cost-effective way to experiment with robotics concepts and algorithms.

5. Shift from traditional exams to competency-based assessments, where students demonstrate their skills through practical projects and presentations. Focuses on applied skills, fosters critical thinking, and prepares students for real-world challenges.

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 # Additionally, the details to be compiled separately by the Departmental Coordinator for the entire Department.