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SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

Year: B. Tech II (Semester IV)

Subject Name: Introduction to Artificial Intelligence and Robotics **Subject Code:** BTEA19422
Type of course: Honors (Group: Artificial Intelligence and Machine Learning)
Prerequisite (if any): Data Structures, Mathematics

Rationale: In this subject students will learn fundamentals of Artificial Intelligence and Robotics, and explore its applications via case studies. They will learn to solve various problems using state space search. Students will also learn about robotic control through sensors, navigation, perception and decision making based on probabilistic models etc.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Contents	Total Hours
1.	Introduction to AI: What is AI? Turing Test, The cognitive modeling approach, The laws of thought approach, The rational agent approach, The foundation of AI, The History of AI, and Learning: what is learning? Types of learning-unsupervised learning, supervised learning, reinforcement learning Intelligent Agents-How Rational agents should act, Structure of Intelligent Agents, Types of Agents, Environments, environment characteristics.	05
2.	**Search techniques for problem solving :** Problem-Solving Agents, Formulating Problem, State Space search, Toy Problems- Vacuum World, 8-Puzzle, 8-Queen, Real-World Problems- Route-Finding Problem, Traveling Salesperson Problem, Robot Navigation, Uninformed Search- Breadth-First Search, Depth-First Search, Informed Search- Best-First Search, A* Search, Heuristic Functions, Searching With Nondeterministic Actions	08

3.	**Planning:** Planning Domain Definition Language- state, set semantics, actions schema, block world problem, Algorithms for Planning as state space search, Heuristics for planning, planning graphs, the GRAPHPLAN algorithm, planning as Boolean satisfiability, Situation calculus, Planning as constraint satisfaction, Solving scheduling problems, hierarchical planning, Planning and Acting in Nondeterministic Domains, Sensorless planning, execution monitoring, multi-agent planning	08
4.	**Fundamentals of Robotics:** What is a Robot? Tasks, what are Robots made of? Effectors, actuator, Degrees of Freedom, Locomotion, nonholonomic, holonomic, Manipulation- kinematics, Sensors: perception, Force sensing, Tactile sensing, Sonar, Camera data, cross-beam sensor and a parallel-beam sensor, architecture- Classical architecture, Situated automata, behavior-based robotic, Configuration Space, Navigation and Motion Planning, velocity constraint, Task Space and Workspace, Rigid-Body Motions, Rotations and Angular Velocities, Exponential Coordinate Representation, Twists, wrench, Transformation Matrices, Introduction to Forward and Inverse Kinematics, Wheel Mobile Robots-types.	10
5.	**Perception-** Sensors, Image formation-Pinhole camera- lens systems, photometry of image formation, spectrophotometry of image formation image-processing operations for early vision- convolution with linear filters, edge detection, extracting 3-d information using vision- segmentation, position and orientation, motion, texture gradients, shading, contour, polyhedral scene analysis, Using vision for manipulation and navigation, object representation and recognition, speech recognition- speech understanding homophones, signal processing, speech recognition model-bayes' rule, hidden markov model	10
6.	**Applications and Case Studies:** Relevant applications of AI and robotics, Examples (demo only) line followers, maze robots, Robo war, spider, wall climbing	04

Suggested Specification table with Marks (Theory): (For B.Tech only)

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	20	20	10	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr No	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Artificial Intelligence:A Modern Approach	Stuart Russel, Peter Norvig	Prentice Hall, 0136042597	2010	
2.	Artificial Intelligence	Elaine Rich And Kevin Knight	Tata Mcgraw-Hill, 9780070087705	2017	3rd Edition
3.	Modern Robotics: Mechanics, Planning, and Contro	F. C. Park and K. M. Lynch	Cambridge University Press	2017	1st edition
4.	Introduction to Robotics: Mechanics and Control	Craig J.J.	Pearson	2005.	3rd Edition
5	Robotics: Control, Sensing, Vision and Intelligence, ,	Fu. K.S., Gonzalez R.C. and Lee C.S.G.,	Tata McGraw Hill	2008	

Course Outcomes:

Sr. No.	CO statements	Marks % weightage
CO-1	Compare and select appropriate A.I. based technique for problem solving	10
CO-2	Examine various uninformed and heuristic search techniques	20

CO-3	Devise suitable planning strategy for problem solving	20
CO-4	Explain concepts of robotics practiced in AI based applications	20
CO-5	Explain concepts of perception used in various applications	30

List of Open learning website:

- NPTEL online course: An Introduction to Artificial Intelligence (https://nptel.ac.in/courses/106105077)
- NPTEL online course: Artificial Intelligence: Introduction (https://nptel.ac.in/courses/106106126)

For Lab Sessions:

List of Experiments:

Sr. No	Practical
1.	Write a program to implement BFS for the given application.
2.	Write a program to implement DFS for the given application.
3.	Write a program to implement 8-puzzle problem using a suitable heuristic function.
4.	Write a program to Implement A* Algorithm for the given application.
5.	Implementation of forward kinematics in a given programming environment.
6.	Implementation of Inverse kinematics in a given programming environment.
7.	Demonstration of selected E-Yantra Robotic applications.