PRASAD V.POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous)

KANURU, VIJAYAWADA-520007

III B.Tech–II Semester
Department of CSE(Data Science)

Reinforcement Learning

Course Code	20DS4601A	**Year**	III	**Semester**	II
Course Category	PEC	**Branch**	CSE(Data Science)	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre requisites**	Machine Learning
Continuous Internal Evaluation	30	**Semester End Examinatio**	70	**Total Marks**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Describe the fundamental concepts and principles of reinforcement learning	**L2**
CO2	Apply Dynamic Programming and classical Reinforcement Learning methods, such as Q-Learning, SARSA, and Temporal Difference Learning, to solve simple problems.	**L3**
CO3	Apply advanced Reinforcement Learning techniques to solve real- world problems.	**L3**
CO4	Analyze the performance of different models in reinforcement learning, identifying their strengths, weaknesses, and appropriate applications.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations (3: High,2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2	2											2	2	
CO3	3											2	3	
CO4		3										2		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Overview of Reinforcement Learning(RL), Reinforcement Learning Components (Agent, Environment, State, Action, Reward), Characteristics, Limitation and Scope of RL, Differences between RL, supervised learning, and unsupervised learning, Applications of RL **Markov Decision Processes (MDPs):** Elements of MDPs: states, actions, transitions, rewards, discount factor. **Overview of Evaluation Metrics:** Understanding metrics like reward per episode, success rate, and discounted return for evaluating RL agents.	CO1
II	**Dynamic Programming:** Policy evaluation, improvement, iteration, Bellman equations for policy evaluation and improvement, Value Iteration and Policy Iteration, Advantages and Disadvantages. **Monte Carlo Methods:** Monte Carlo prediction, control methods, On-policy vs. off-policy learning, Temporal-Difference(TD) learning-TD(0), SARSA, and Q- Learning	CO1,CO2
III	**Deep Reinforcement Learning**: Introduction, Deep Q-Networks (DQN), DQN Overview, Experience replay, replay buffer and target networks. **Improvements to DQN**: Double DQN, Dueling DQN, Prioritized Experience Replay.	CO1, CO3, CO4
IV	**Policy-Based Methods**: Introduction, The role of policy approximation in RL, Types of Policy approximation , Deterministic Vs Stochastic policies, Bias-variance trade-off policy in RL.	CO1, CO3, CO4
V	**Model-Based Reinforcement Learning**: Introduction, Differences between model- free and model-based methods, Learning and using models of the environment ,Role of Perfect Model and Approximation model in RL.	CO1, CO3, CO4

Learning Resources
Text books
1. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto Second Edition, 2018, MIT Press 2. Reinforcement Learning and Optimal Control, Dimitri P. Bertsekas,2019, United States: Athena Scientific.
Reference Books
1. Handbook of Reinforcement Learning and Control, Derya Cansever, Frank L. Lewis, Kyriakos G. Vamvoudakis, Yan Wan, First Edition, 2021, Springer 2. Deep Reinforcement Learning with Python: With PyTorch, Tensor Flow and Open AI Gym: Nimish Sanghi 2021, Springer.
e-Resources & other digital material

1. ReinforcementLearning: https://nptel.ac.in/courses/106106143
2. Deep-RLBootcamp: https://sites.google.com/view/deep-rl-bootcamp/lectures
3. IntroductiontoReinforcementLearning : https://www.youtube.com/watch?v=JgvyzIkgxF0
4. NPTELCourseon ReinforcementLearning2023: https://www.youtube.com/watch?v=QekwkCVavAs&list=PLpKrAXMumEsjAR1Ybb0qbTKGYd9RY0vxa&index=1
5. CourseraReinforcementLearning: https://www.coursera.org/specializations/reinforcement-learning
6. SpinningUp in Deep RL: https://spinningup.openai.com/en/latest