ARTIFICIAL INTELLIGENCE FOR ROBOTICS

(PROFESSIONAL ELECTIVE-IV)

Course Code: 20ME1256

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Course Outcomes: At the end of the course, the student will be able to

CO1: discuss artificial intelligence, software components and control system of advanced robotics (L2)
CO2: explain robot design process with an example including its software and hardware requirements (L2)
CO3: use neural networks in image recognition training and deployment process (L3)
CO4: apply speech recognition and genetic algorithms in task analysis for picking up the toys (L3)
CO5: apply the task analysis for avoiding the stairs and putting things away (L3)

UNIT I **10 Lectures**

Foundation for advanced robotics and AI: What is AI (and what is it not), The example problem – clean up this room. Artificial intelligence and advanced robotics techniques, Introducing the robot and our development environment, Software components (ROS, Python, and Linux), Robot control systems and a decision-making framework, Soft real-time control, Control loops. The robot control system – a control loop with soft real-time control, Reading serial ports in a real-time manner.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain artificial intelligence and advanced robotics techniques (L2)
2. discuss various software components (L2)
3. describe the concept of reading serial ports in a real-time manner (L2)

UNIT II **10 Lectures**

Setting up your robot: Technical requirements, Robot, Robot anatomy, Subsumption architecture.
Software setup: Laptop preparation, Installing Python, Installing ROS on the laptop, Setup of Raspberry Pi 3.
A concept for a practical robot design process: A systems engineering-based approach to robotics, Example – cleaning up the playroom, Use cases –how the robot will be used and storyboards (step-by-step illustrations). Decomposing hardware needs, breaking down software needs.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain subsumption architecture (L2)
2. differentiate between a storyboard for a movie or cartoon software program (L2)
3. describe software and hardware needs in robot design process (L2)

UNIT III **10 Lectures**

Object recognition using Neural Networks and Supervised Learning: Technical requirements. **The image recognition process**: The image recognition training and deployment process – step by step, image processing, convolution, artificial neurons, the convolution neural network process, build the toy/not toy detector, using the neural network.

Learning Outcomes: At the end of this unit, the student will be able to

1. discuss the features of a real neuron and an artificial neuron (L2)
2. illustrate an artificial neuron and label the parts. (L2)
3. describe image recognition process using neural network (L2)

UNIT IV **10 Lectures**

Picking up the toys: Technical requirements, Task analysis, **Teaching the robot arm:** Action state reinforcement learning, Adaptive learning rate, Genetic algorithms.
Teaching a robot to listen: Technical requirements, **Robot speech recognition:** What are we doing, Speech to text, Intent, skills.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain the terms related to Genetic Algorithms (L2)
2. apply genetic algorithms in task analysis for picking up the toys (L3)
3. describe the list of commands used to teach the robot (L2)

UNIT V **10 Lectures**

Avoiding the stairs: Technical requirements**,** Task analysis: Simultaneous Localization and Mapping (SLAM), Alternatives for navigation, Neural networks, Processing the image.
Putting things away: Technical requirements**,** Task analysis: Decision trees, pruning.

Learning Outcomes: At the end of this unit, the student will be able to

1. explain the weaknesses of SLAM (L2)
2. describe alternatives for navigation (L2)
3. apply task analysis techniques for putting things away (L3)

Textbook:

1. Francis X. Govers, *Artificial Intelligence for Robotics*, Packt Publishing, 2018.

References:

1. Huimin Lu, *Artificial Intelligence and Robotics*, Springer Nature, 2020
2. Robin R. Murthy, *Introduction to AI Robotics*, 1st Edition, MIT Press, 2001.
3. Michael Brady, L.A. Gerhardt, H.F. Davidson, *Robotics and Artificial Intelligence*, Springer, 2012.