Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2020-2021

Course Handout Part II

Date: 17-08-2020

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **BITS F327**
Course Title : **Artificial Intelligence for Robotics**
Instructor-in-Charge : Dr. Arshad Javed
Instructors : Dr. Sandeep Vidyapu, Mr. G Laxmi Srinivas

Course Description:

BITS F327 Artificial Intelligence for Robotics 2 1 3

Introduction to AI, Application of AI in Robotics. Introduction to Robot Operating Systems (ROS), Python and programming with application of Raspberry-Pi and Arduino. Practical Robot Design Process, implementation of pick and place process. Basic robot sensing techniques (Vision and Listening), Beam Models of Range Finders, sensor models. Object Recognition Using Neural Networks and Supervised Learning. Robot learning process, Reinforcement learning and Genetic Algorithms. Basic concepts of speech recognition and natural language. Path planning, SLAM, decision trees, classification techniques, wave front, the A* (A star) and D" (D star) algorithms, and node-based planners. Non-deterministic simulation technique and Monte Carlo modeling, the Robot Emotion Engine, the Human Emotion Model.

Scope and Objective:

The objective of this course is to introduce basic Artificial Intelligence techniques applied in the domain of Robotics. The course is focused on experiential learning, where the programming languages/system such as Python and ROS are introduced. Hardware such as, Raspberry-Pi and Arduino are implemented to develop a real time mobile robot. Gradually, the AI techniques are implemented on the robot to enable pick and place, listen, vision, and pathfinding operations. In this experimental process the theoretical parts of robot vision sensing, localization, SLAM and MCL etc. are introduced.

Text Book:

(T) Francis X. Govers, ***Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques***, Birmingham, UK : Packt Publishing Ltd, 2018.

Reference Books:

(R1) Thrun, Sebastian, Wolfram Burgard, and Dieter Fox. ***Probabilistic robotics***. MIT press, 2005.
(R2) Murphy, Robin, and Robin R. Murphy. ***Introduction to AI robotics***. MIT press, 2000.
(R3) Russell, Stuart J., and Peter Norvig. ***Artificial intelligence: a modern approach*****.** Malaysia; Pearson Education Limited,, 2016.

Course Plan:

Lecturer No.	Learning Objectives	Topics to be covered	Reference Chap./Sec.
1-2	Students will become familiar with robotics and	Introduction to AI, Application of AI in Robotics.	T-1 R3-1

	artificial intelligence		
3-6	Enable the student to perform basic programming techniques and robot hardware	Introduction and hands-on with Robot Operating Systems (ROS), Python and hardware such as Raspberry-Pi and Arduino	T-2
7-10	Student will be able to apply simulation techniques to give the robot an artificial personality	Practical Robot Design Process, pick and place process. Object recognition, Structure and process of solving the problem using AI. Basic robot sensing techniques, Beam Models of Range Finders, sensor models	T-3 R1-6
11-15	Understand object recognition using neural networks and supervised learning techniques	Object Recognition Using Neural Networks and Supervised Learning, build an artificial neural network. Basics of image recognition as well as the training and evaluation of neural networks using Keras and Python.	T-4
16-18	Student will be able to develop a robot to Pick up objects using genetic algorithms for manipulation	Robot learning process. Reinforcement learning and Genetic Algorithms.	T-5
19-21	Know how to teach the robot to listen using NLP via an expert system	Basics of Robot to Listening, voice-based command system. Basic concepts of speech recognition and natural language processing are introduced, such as context, knowledge bases, intent recognition, and sentence reconstruction.	T-6
22-24	Students will be able to apply machine learning and computer vision for robot navigation	Avoiding the Stairs, robot navigation, including SLAM. Floor Finding for obstacle avoidance, and Neural Network Image recognition for learned navigation without a map	T-7 R1-10

25-27	Creating basic knowledge domain in AI techniques applied in mobile robotics	Path planning, decision trees, classification techniques, wave front, the A* (A star) and D" (D star) algorithms, and node-based planners.	T-8 R1-7
28-29	Enable the student to classify, select AI-algorithm based on non-deterministic scenarios	Non-deterministic simulation technique and Monte Carlo modeling, the Robot Emotion Engine, the Human Emotion Model.	T-9 R1-8

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Test1	30 min	15%	September 10 –September 20 (During scheduled class hour)	OB*
Test2	30 min	15%	October 09 –October 20 (During scheduled class hour)	OB*
Test3	30 min	15%	November 10 – November 20 (During scheduled class hour)	OB*
Quiz	---	10%	-----	OB*
Lab Project	--	15%	To be completed by November 20	OB*
Comprehensive-Examination	120 min	30%	As announced in the Timetable	OB*

***Close Book, Open Book**

Chamber Consultation Hour: To be decided based on Timetable.
Notices: All notices will be put up on CMS only.
Make-up Policy: Make-up will be given with prior concern and genuine reasons only.

INSTRUCTOR-IN-CHARGE