

Prospective external Experts: (i) Prof. S.K. Saha, Professor, IIT Delhi (ii) Prof. Asish Dutta, IIT Kanpur (iii) Dr. Debanik Roy, BARC, Mumbai  
Experts from host Institutes- (iv) Prof. Vijay Kumar Gupta, IIITDM Jabalpur (v) Prof. R. B. V. Subramanyam, NITW

**Course Objectives:** This course is designed to provide an exposure to the fundamentals of Robotics and Artificial Intelligence. Participants will learn kinematics and dynamics of industrial manipulators, kinematics of mobile robots, trajectory planning, path planning and control and how to embed intelligence in robotic tasks. Hands-on training and practice sessions will help participants gain confidence on robotic concepts, their simulation and implementation including sessions on intelligent agents. The course will be useful for faculty of engineering and sciences who are interested in the learning robotics and intelligent systems.

### Contents of Modules of Robotics & AI

S.No.	Module Name	Topics
1.	<b>Introduction to Robotics and Robot Simulators</b>	Introduction to Robotics: Robot Manipulators, Mobile Robots, Legged Robot, Aerial Robots, Applications. Components and mechanisms of a robotic system, sensors and actuators. Introduction to Manipulator, Coordinate System, classification, reachable and dexterous space, Forward and Inverse kinematics, DH Parameter Velocity Kinematics. <b>Hands on:</b> Robot Simulation Software, Tutorials on Coordinate systems and Robot Kinematics : Webots, Robo Analyzer
2.	<b>Kinematics, Dynamics and Control</b>	Mobile robots and their kinematics, Holonomic and Non-holonomic robots. Basics of trajectory planning, configuration space and dimension. Linear and nonlinear robot control: Feedback and motion control, Path Planning and Obstacle Avoidance in known and unknown environment. Intelligence path planning. <b>Hands on:</b> Practice on Webots for Trajectory Planning using different types of robots
3.	<b>Artificial Intelligence and Robotics</b>	Introduction to Artificial Intelligence and Machine Learning. Artificial Neural Networks and Fuzzy logic. Vision based planning and control, Learning based motion planning, <b>Hands on:</b> Implementation of ANN and Fuzzy logic for motion planning and simulation, Implementing on hardware using Raspberry Pi boards.
4.	<b>More on AI and Machine Learning: Reinforcement Learning</b>	Introduction to Reinforcement Learning, Tabular Solution Methods – Multi-armed Bandits, Finite Markov Decision Processes, Dynamic Programming, Monte Carlo Methods, Temporal Difference Learning.
5.	<b>Applications, Research Directions and case studies</b>	Research Directions and Case Studies, Mobile robotics – multi-terrain robots, humanoid robots. Biped locomotion; Applications in Agriculture, and Social robotics. Brain Computer Interface (BCI) and gesture control <b>Hands on–</b> Simulation of robot tasks and motion planning, Industrial manipulators and motion planning and hardware implementation.

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