Course plan for: Robotics and Automation

Lecture plan of: Robotics and Automation (HPME-611)

Theory

Main Topics	Course outlines	Lecture(s)	Date
1. Introduction to Robotics	1.1 Types and components of a robot, Classification of robots	2 Hr.	01/10/2020
	1.2 Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom	1 Hr.	01/10/2020
2. Robot Kinematics and Dynamics	2.1 Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics	7 Hr.	02,03,05/10/2020
	2.2 Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation	4 Hr.	08,09/10/2020
3. Sensors	3.1 Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc.	2 Hr.	13/10/2020
	3.2 Introduction to Cameras, Camera calibration,	1 Hr.	16/10/2020
	3.3 Geometry of Image formation, Euclidean /Similarity/ Affine/Projective transformations	4 Hr.	20,21/10/2020
	3.4 Vision applications in robotics.	1 Hr.	16/10/2020
4. Robot Actuation Systems	4.1 Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.	4 Hr.	22,23/10/2020
5. Robot Control	5.1 Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID	4 Hr.	27, 28/10/2020
	5.2 Linear and Non-linear controls	1 Hr.	29/10/2020
6 Control Hardware and Interfacing	6.1 Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II	4 Hr.	02,03/11/2020
7.	7 AI in Robotics: Applications in unmanned systems, defense, medical, industries, etc.	2 Hr.	06/11/2020
8.	8 Robotics and Automation for Industry 4.0	1 Hr.	29/10/2020
9.	9 Robot safety and social robotics.	2 Hr.	10/11/2020

PRACTICALS (FOCUSSED ON INDUSTRIAL ROBOTICS) plan

Practical . No.	Practical title	Lecture(s)	Date
i.	Study components of an industrial robot (PUMA, KUKA, FANUC, MTAB, UR, etc.) and its DH parameters / Simpler laboratory version of robotic arm having 4 or 5 DOF.	4 Hr.	06,07/10/2020
ii.	Forward kinematics and validation using a software (Robo Analyser/MathLab or any other free software tool).	4 Hr.	10,12/10/2020
iii.	Inverse kinematics of an industrial robot and validation using any open source software/ Simpler laboratory version of robotic arm.	4 Hr.	14,15/10/2020
iv.	Industrial Robot programming using VAL II or equivalent / simpler laboratory version of robotic arm.	4 Hr.	17,19/10/2020
v.	Microcontroller lab – programming (free software /open source)	4 Hr.	24,26/10/2020
vi.	Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system. (Free software, Matlab)	4 Hr.	30,31/10/2020
vii.	Control experiment using available hardware or software. (Open source or Matlab).	4 Hr.	04,05/11/2020
viii.	Use of open source computer vision programming tool/ MatLab, open CV.	4 Hr.	07,09/11/2020
ix.	Research related experiment in AI, e.g. multi agent system, unmanned systems control using ROS, etc.	4 Hr.	11,12/11/2020
x.	Small group project work relevant to Industrial automation.	4 Hr.	13,14/11/2020