FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Technology

Semester II

Course Code: 102310204

Course Title: Robotics and Autonomous Systems

Type of Course: Program Elective III

Course Objectives: To study the various parts of robots and fields of robotics, various kinematics and inverse kinematics of robots, the trajectory planning for robot and to provide the basic aspects of robot operations and robot motion control techniques.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	30 / 15	20 / 10	70 / 35	30 / 15	150 / 75

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Introduction: Definition and origin of robotics, different types of robotics, Various generations of robots, degrees of freedom, Asimov's laws of robotics, dynamic stabilization of robots.	04
2	Power Sources and Sensors: Hydraulic, pneumatic and electric drives, Determination of HP of motor and gearing: ratio, variable speed arrangements, path determination, micro machines in robotics, Machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors	07
3	Robot and End Effectors: Introduction, classification of end effectors, Types of Grippers Hooks, scoops and other devices, Gripper force analysis and design of Drive system for gripper.	07
4	Kinematics and Path Planning: Solution of inverse kinematics problem Multiple solution Jacobian work envelop, hill climbing techniques	06
5	Robot Languages and Programming: Programming – powered, manual. Textual robo languages – first generation, second, future generation – VAL, VAL II, simple programming – exercises.	06
6	Robot Control: Linear methods, Non-linear methods. Manufacturing and non-manufacturing applications	04
7	Drones and Autonomous Systems: Classification of drones (UAVs), Working of Drone, Working of Autonomous systems, Critical technology, Case study – Driverless car, Delivery drone	06

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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
20%	40%	30%	10%	--	--	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G. "Industrial Robotics", McGraw-Hill Singapore, 1996
2	Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998
3	Deb.S.R., "Robotics technology and flexible Automation", John Wiley, USA 1992
4	Asfahl C.R., "Robots and manufacturing Automation", John Wiley, USA 1992
5	Francis N. Nagy, AndrasSiegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987
6	Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice Hall of India Pvt. Ltd., 1989
7	A. Janaki Raman, Robotics and Image Processing an Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995
8	S.R. Deb, Robotics Technology and flexible automation, Tata Mc Graw Hill Publishing company Ltd., 1994

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understanding of how robot operates and to give easily applicable theories that can form the basis of usable design methods for robot operations	**35**
CO-2	Obtain forward, reverse kinematics and dynamics model of the industrial robot arm.	**30**
CO-3	Propose and synthesize control law for a given application	**10**
CO-4	Classify robots and decide specifications depending on the applications	**25**

List of Practicals / Tutorials:

1	Study components of a real robot and its DH parameters.
2	Forward kinematics and validation using software. (RoboAnalyser or any free software tool).
3	Inverse Kinematics of the real robot and validation using any software.
4	Study how to use Open source computer vision programming tool openCV.
5	Image processing using openCV.
6	Image processing for color detection.
7	Image processing for shape detection.
8	Study of Positioning and orientation of robot arm.

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9	Control experiment using available hardware or software.
10	Study of Integration of assorted sensors (IR, Potentiometer, Strain gages etc.), Micro controllers and ROS (Robot Operating System) in a robotic System.

Supplementary learning Material:	
1	NPTEL: Introduction to Robotics https://nptel.ac.in/courses/107/106/107106090/

Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22

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