FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester II

Course Code: 102320209

Course Title: Robotics

Type of Course: Program Elective IV

Course Objectives: The course is intended to provide comprehensive knowledge of robotic configurations, kinematics, singularity, dynamics, Trajectory planning and control of robot manipulators.

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: Robots anatomy, Various configurations, Classification of robots, Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom etc., Generalized rotations, RPY and Euler angle, Applications of Robots.	6
2	Drive systems and Sensors: Hydraulic, pneumatic and electric systems, Stepper and Servo motors Touch sensors, Tactile sensor, Proximity and range sensors, Force sensor, Light sensors, Pressure sensors, Image grabbing, Image processing and analysis, Image segmentation, Pattern recognition, Robot vision system.	5
3	Kinematics of Robots: Homogeneous coordinates and transformations, multiple transformations of 3D frames, Forward and Inverse Kinematics of open and closed architecture, D-H representation of robots.	8
4	Dynamics of Robots: Robot Arm dynamics, Dynamics formulations using Newtonian, Lagrangian and Hamiltonian principle, Properties of dynamic equations.	7
5	Trajectory Planning: Path and Trajectory, Joint space versus Cartesian space trajectories, Linear function with parabolic blends; numerical based on different motion trajectories.	5

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6	End effectors: Types of Grippers, Selection criteria of grippers, Mechanical gripper design and design considerations.	**3**
7	Robot Control, Programming and Applications Robot Controls: Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control, Artificial intelligence, Basics, Goals of artificial intelligence, AI techniques, introduction to Robotic Programming, On-line and off-line programming, programming examples.	**5**

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**	
25	20	20	15	10	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	Industrial Robotics, Technology programming and Applications, Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill.
2	Introduction to Robotics- mechanics and control, Craig. J. J., Addison- Wesley.
3	Robotics Technology and flexible automation, S.R. Deb, Tata McGraw-Hill Education.
4	Robotics Engineering an Integrated Approach, Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, PHI Learning.
5	Engineering foundation of Robotics, Francis N. Nagy, Andras Siegler, Prentice Hall Inc.
6	Robotics and Image Processing an Introduction, P.A. Janaki Raman, Tata McGraw Hill Publishing company Ltd.
7	Kinematic Analysis of Robot manipulators, Carl D. Crane and Joseph Duffy, Cambridge University press.
8	Robotics control, sensing, vision and intelligence, Fu. K. S., Gonzalez. R. C. & Lee C.S.G., McGraw Hill Book co.
9	Robots and Manufacturing Automation, Ray Asfahl. C., John Wiley & Sons Inc.

Course Outcomes (CO):

Sr.	**Course Outcome Statements**	**%weightage**
CO-1	Conceptulize robot configurations, applications and associated terminology.	**20**
CO-2	Explaination of various sensors and End effectors.	**25**
CO-3	Illustrate kinematics and dynamics of robotics.	**30**
CO-4	Apply concept of trajectory planning and Robot programming.	**25**

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List of Practicals / Tutorials:

1	Introduction of Pro/Mechanism – A mechanism design module.
2	To use cylindrical joint, planar joint, ball joint, gear connection for a given mechanism using Pro/Mechanism software.
3	To develop a given robot configuration using mechanism constraints.
4	To develop a reachable workspace for a given developed configuration.
5	To formulate DH- Parameters of the robot configurations.
6	To use RoboAnalyzer -3D Model Based Robotics Learning open source Software.
7	To learn and implement robot programming knowledge along with sensors using Qu-Bot robot kit.
8	To design trajectory using various trajectory planning techniques.
9	Lagrangian formulation of the given robotic configuration.
10	Robot Vision System as a sensory unit in robot controlled cell.

Supplementary learning Material:

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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