

## IAGE - 315

### Kinetics and Dynamics of Robotics

(02 credits – 50 marks)

#### Course Outcomes:

On completion of the Course, students should be able to

1	Recall the fundamental aspects of automation and robotics
2	Discuss various co-ordinate systems
3	Use the robots in various manufacturing processes
4	Explain the kinematic and Dynamic model
5	Model the Robot
6	Develop programs for pick and place operation with a six axis industrial robot, for stacking operation with a six axis industrial robot and for other industrial applications

#### Course Contents:

##### **Module- I: Coordinate Frames, Mapping and Transformation of Robots (04 Hrs)**

Introduction, Anatomy of Robot in brief, Co-ordinate frames: mapping ; transformation of vectors: rotation, translation and combined; Fundamentals of Rotational Matrices: principal axis rotation, fixed angle, Euler angle.

##### **Module- II: Symbolic Modelling of Robots- Direct Kinematic Models (07 Hrs)**

Mechanical Structure and Notations, Description of links and joints, Kinematic modeling of the Manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent joints, manipulator transformation matrix.

##### **Module- III: Inverse Kinematics (05 Hrs)**

Manipulator Workspace, Solvability of Inverse Kinematic Model, Solution Techniques, Closed Form Solution

##### **Module- IV: Dynamic modeling of Robotics (06 Hrs)**

Lagrangian Mechanics, Two degree of freedom manipulator-Dynamic Model, Lagrange-Euler Formulation, Newton-Euler Formulation, Comparison of Lagrange-Euler and Newton-Euler Formulation, Inverse Dynamics

##### **Module- V: Tutorials, assignments and presentation based on Module I to IV**

## References:

1. Robotics: Control Sensing. Vis. By K S Fu,Ralph Gonzalez,C S G Lee Tata McGraw-Hill Education, 2008, ISBN-978-0-07-026510-3, ISBN: 0-07-026510-0
2. Industrial Robotics-Technology Programming and Applications by Mikell P Groover, Mitchell Weiss, Nagel and Odrey ISBN-13:978-0-07-026509-7 ISBN- 10: 0-07-026509-7
3. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
4. 3. P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995.
5. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
6. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.
7. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press. 2003.
8. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008.
9. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999
10. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishing company limited, 1994