ADVANCED MECHANISMS
(PROFESSIONAL ELECTIVE-VI)

COURSE CODE: 15ME1153

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Pre-requisites:

Kinematics of Mechanisms

Course Outcomes:

At the end of the Course, the Student will be able to:

CO 1 analyze planar complex mechanisms.

CO 2 determine the inertia forces in simple planar mechanisms.

CO 3 synthesize four bar and slider-crank mechanisms.

CO 4 analyze simple spatial mechanisms such as RSSP etc.

CO 5 perform inverse kinematics of simple parallel mechanisms.

UNIT-I   (8 Lectures)

Introduction to analysis, synthesis and tasks of kinematic synthesis.

COMPLEX MECHANISMS:

Types of planar, spherical and spatial mechanisms, Mobility or Degrees of freedom, Kutzbach and Gruebler's criteria, Velocity - Acceleration analysis of planar complex mechanisms by Hall & Ault's auxiliary point method and Goodman's indirect method.

UNIT-II   (10 Lectures)

DYNAMIC FORCE ANALYSIS OF PLANAR MECHANISMS:

Dynamic force analysis of four bar and slider-crank mechanisms, Analysis of elastic mechanisms - beam element, displacement fields for beam element, element mass and stiffness matrices, system mass and stiffness matrices, Elastic linkage model. Equations of motion.

UNIT-III   (12 Lectures)

SYNTHESIS OF PLANAR MECHANISMS:

Type, number and dimensional synthesis. Function generation, path generation and rigid body guidance problems. Accuracy (precision) points, Chebyshev spacing, types of errors. Synthesis by method of complex numbers for motion, path, and function generation (three prescribed positions). Synthesis of four-bar and slider-crank mechanisms using Freudenstein's equation.

UNIT-IV   (10 Lectures)

SPATIAL MECHANISMS:

Transformations describing planar finite displacements, planar finite transformations, identity transformation, rigid-body transformations, spatial transformations, Denavit - Hartenberg parameters, Kinematic analysis by matrix method, Kinematic analysis of spatial Revolute-Spherical-Spherical-Revolute mechanism.

UNIT-V   (10 Lectures)

PARALLEL MECHANISMS:

Types of Parallel mechanisms, Degrees of freedom, Position and Velocity analyses (inverse kinematics only) of planar 3-RRR manipulator and 6-SPS general Stewart - Gough platform.

TEXT BOOKS:

1.   G. N. Sandor and A. G. Erdman, "Advanced Mechanism Design: Analysis and Synthesis", Vol. 2, Pearson Education 2005 (for Unit I to IV).

2.   Lung-Wen Tsai, "Robot Analysis: The Mechanics of Serial and Parallel Manipulators", John Wiley & Sons, Inc., 1999 (Unit V).

REFERENCES:

1.   Asok Kumar Mallik, Amitabha Ghosh and Gunter Dittrich "Kinematic Analysis and Synthesis of Mechanisms", 1st Edn., CRC-Press, USA, 1994.

2. Robert L. Norton, "Kinematics and Dynamics of Machinery", 3rd Edition in SI Units, Tata McGraw-Hill Education Pvt. Ltd, 2011.

3. J. E. Shigley and J. J. Uicker, "Theory of Machines and Mechanisms", 4th Edn., Oxford University Press, Intl. Version, 2015.

4. R. S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill., 1964.

5. A. S. Hall, "Kinematics and Linkage Design", Prentice Hall of India, 1964.