

16AG208 THEORY OF MACHINES

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P	WA/RA	SSH/HSR	CS	SA	S	BS
30	-	30	5	40	5	8	5	-

Course Description and Objectives:

This course describes the anatomy of mechanisms, machine elements and their response to static and dynamic forces. The objective of this course is to introduce mathematical models used in kinematic and dynamic analysis of machineries. In addition it provides a basic knowledge on kinematic and dynamic designs of machinery as well as mechanical vibrations.

Course Outcomes:

The student will be able to :

- identify common mechanisms in machines used in everyday life.
- calculate mobility using different degrees of freedom.
- analyze velocity, acceleration mechanisms.
- understand gear design, mechanisms, classifications and standards.
- perform static and dynamic force analysis and balancing of masses.
- understand the types of vibrations developed during functioning of any mechanical system.

SKILLS:

- ✓ *Identify common mechanisms used in machines and their applications.*
- ✓ *Simulate various mechanisms using various modelling techniques.*
- ✓ *Measure vibrations in various mechanisms.*
- ✓ *Determine degree of freedom for mechanisms.*

UNIT - 1**L-5**

INTRODUCTION TO MECHANISMS: Links, Classifications of links, Kinematic pairs - Lower pairs, Higher pairs; Kinematic chain, Inversion, Four bar chain and slider crank mechanisms, Determination of Degree of freedom of simple mechanisms, Straight line motion mechanisms- Classification of straight line motion mechanisms, Peaucellier's, Tchebicheff's and pantograph mechanisms.

UNIT - 2**L-7**

VELOCITY AND ACCELERATION IN MECHANISMS: Motion of a link in machine, Velocity of a point on a link, Instantaneous center, Types of instantaneous centers, Kennedy's theorem, Velocity measurement by instantaneous center method, Relative velocity method, Acceleration of a point on a link, Acceleration in slider crank mechanism, Coriolis component of acceleration.

UNIT - 3**L-6**

GEARS AND GEAR TRAINS: Introduction, Friction wheels toothed gearing, Types of gears, Law of gearing, Condition for constant velocity ratio for transmission, Form of teeth, Cycloidal and involute profiles, Phenomena of interferences, Condition for minimum number of teeth to avoid interference, Expression for arc of contact and path of contact, Introduction to gear train, Train value, Simple, Compound, Reverted and epicyclic gear train, Method to find gear train value.

UNIT - 4**L-6**

BALANCING: Balancing of rotating masses, Primary, Secondary balancing, Balancing of reciprocating masses, Analytical and graphical methods, Unbalanced forces and couples, Hammer blow, Swaying couple, Variation of tractive effort.

UNIT - 5**L-6**

MECHANICAL VIBRATION: Basic Concepts, Types of vibrations, Determination of natural frequency of simple systems, Vibrations of beams due to point loads, Dunkerley's method, Rayleigh's method, Forced and damped vibrations, Vibration isolation and transmissibility, Whirling of shafts, Critical speeds, Torsional vibrations of two and three rotor systems.

LABORATORY EXPERIMENTS**LIST OF EXPERIMENTS**

Total hours: 30

1. Characteristics of four bar mechanism.
2. Variation in velocity and acceleration of the slider crank mechanism.
3. Dynamic balancing of the rotating mass system.
4. Study of the free vibration and determination of natural frequency of vibration of Two- Rotor system.
5. Longitudinal and torsional vibration and determination of natural frequency vibration of single rotor system.
6. Study of damped torsional vibration and determination of damping coefficient.
7. Verification of the relation $T = 2\pi\sqrt{l/g}$ for a simple pendulum.
8. Determination of whirling speed of shafts.

TEXT BOOKS:

1. Thomas Bevan, "Theory of Machines", 3rd edition, CBS Publishers, 2004.
2. S. S. Rattan, "Theory of Machines", 4th edition, Tata McGraw-Hill, New Delhi, 2014.

REFERENCE BOOKS:

1. R. L. Norton, "Kinematics and Dynamics of Machinery", 1st edition, Tata McGraw-Hill, 2009.
2. J. S. Rao and R.V. Dukkipati, "Mechanism and Machine Theory", 2nd edition, New Age Publications, 2007.
3. J. E. Shigley, "Theory of Machines", 3rd edition, Oxford Publishers, 2009.

WEB LINKS:

1. <http://nptel.ac.in/courses/112104121/>
2. <http://nptel.ac.in/courses/112101096/>
3. <http://ecoursesonline.iasri.res.in/course/view.php?id=37>

ACTIVITIES:

- *Design prototypes of different straight line motion mechanisms.*
- *Simulation and modelling of different mechanisms.*
- *Design of quick return motion mechanism.*
- *Measurement and analysis of vibration in different systems.*