

DYNAMICS OF MACHINERY

B.Tech. III Year I Semester

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
23ME501	Core	L	T	P	3	CIA	SEE	TOTAL
		3	0	3		40	60	100
Contact Classes: 64	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:64		

Prerequisites: Kinematics of Machinery

I. COURSE OVERVIEW:

This course is intended to deal with the forces and their effects, while acting upon the machine parts in motion. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. Study of gyroscopes is very much helpful to learn the precession and stability of moving vehicle such as aircrafts, Naval ships and automobiles. This course helps to analyse and evaluate the force and torques that causes of motions in mechanisms. It provides knowledge on clutches, brakes and dynamometers, balancing of machines and application of vibrations.

II. COURSE OBJECTIVES:

To learn

- The components mainly used in IC Engines and make analysis of various forces involved.
- Inertia forces in slider crank mechanism; IC Engine components & the analysis like governors.
- The balancing of rotating & reciprocating parts and about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing.
- The linear, longitudinal, & torsional vibrations and the concept of natural frequency and the importance of resonance and critical speeds.

III. COURSE OUTCOMES:

After completing this course, the student must:

CO1: Analyze gyroscopic effects and perform static and dynamic force analysis of planar mechanisms using D'Alembert's principle.

CO2: Evaluate turning moment diagrams and design flywheels for energy fluctuation in reciprocating engines

CO3: Examine friction in machine elements and explain the working of clutches, brakes, and dynamometers.

CO4: Analyze different governors and perform balancing of rotating and reciprocating systems in engines.

CO5: Determine natural frequencies, critical speeds, and torsional vibrations in mechanical systems.

IV. COURSE SYLLABUS:

UNIT - I:

Precession: Gyroscopes - effect of precession - motion on the stability of moving vehicles such as motorcycle - motorcar - aeroplanes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms - Analytical Method - Dynamic Force Analysis - D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT - II:

Turning Moment Diagram and Flywheels: Engine Force Analysis - Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine - Graphical Method - Turning moment diagram - fluctuation of energy - flywheels and their design - Inertia of connecting rod - inertia force in reciprocating engines - crank effort and torque diagrams

UNIT - III:

Friction: pivots and collars - uniform pressure, uniform wear - friction circle and friction axis: lubricated surfaces - boundary friction - film lubrication. Clutches - Types - Single plate, multi-plate and cone clutches.

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake - internal expanding shoe brake - effect of braking of a vehicle. Dynamometers - absorption and transmission types. General description and methods of operation.

UNIT - IV:

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors - Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting - stability - effort and power of the governors.

Balancing: Balancing of rotating masses - Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing - locomotive balancing - Hammer blow - Swaying couple - variation of tractive effort.

UNIT - V:

Vibrations: Free Vibration of mass attached to vertical spring - Transverse loads - vibrations of beams with concentrated and distributed loads. Dunkerly's method - Raleigh's method. Whirling of shafts - critical speed - torsional vibrations - one, two and three rotor systems.

TEXT BOOKS:

1. Theory of Machines /S.S.Rattan / Mc Graw Hill.
2. Theory of Machines /Sadhu Singh/ Pearson.

REFERENCE BOOKS:

1. Theory of Machines and Mechanisms/ Joseph E. Shigley / Oxford.
2. Theory of Machines / Rao, J.S & R.V. Duggipati/ New Age.