DYNAMICS OF MACHINERY

Course Code:13ME1119

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Pre requisites: Engineering Mechanics

Course Educational Objectives:

To make the student

- ❖ Understand the forces, torques and energy involved in different machine members
- ❖ Understand theory involved in the analysis of clutches, brakes, dynamometers and flywheels
- ❖ Aware of situations like speed fluctuations, rotor imbalance and machine vibration which appear in industry

Course Outcomes:

The student will be able to

- ❖ Analyze the effect of a gyroscope on ships, aeroplanes and automobile
- ❖ Explain the working of important machine elements like clutches, brakes, flywheels, governors
- ❖ Analyze the theory involved in balancing of rotating and reciprocating members
- ❖ Estimate the unbalanced forces in a multi-cylinder reciprocating engine
- ❖ Understand longitudinal, transverse and torsional vibrations so as to avoid resonance

UNIT-I (14 Lectures)

FRICTION AND FRICTION CLUTCHES:

Basics, inclined planes, screw thread forms (square, v), screw jack, rolling friction, journal friction. Friction axis of a link, four-bar mechanism, film friction. pivots and collars, uniform pressure, uniform wear. Types of clutches – disc, multiplate, cone and centrifugal.

BRAKES AND DYNAMOMETERS:

Types of brakes – Block brake, band brake, disc brake, band and block brake, internal expanding shoe brake, effect of brake. Types of dynamometers - Prony, rope brake, belt transmission, epicyclic train, Bevis-Gibson torsion dynamometers.

UNIT-II (14 Lectures)

FLYWHEELS:

Engine force analysis, turning moment of crankshaft, dynamically equivalent system, inertia of connecting rod. Turning moment diagrams, fluctuation of energy, flywheels, dimensions of flywheel rim, applications.

GOVERNORS:

Types - Watt, Porter, Proell, Hartung. Wilson-Hartnell, spring-controlled gravity governor, inertia governor. Sensitiveness, hunting, isochronism, stability, power, effort, controlling force of a governor.

UNIT-III (10 Lectures)

BALANCING:

Static and dynamic balancing of rotating masses, force balancing of fourbar linkage, Primary and Secondary balancing of reciprocating engine, balancing inline engine (2,4,6, cylinders), V-engines, W-engines and radial engines, direct and reverse crank method, balancing machines – static, dynamic. theory of field balancing.

UNIT-IV (10 Lectures)

GYROSCOPES:

Angular velocity, angular acceleration, gyroscopic couple, gyroscopic effect on Aeroplanes, ships. Static and dynamic force analysis of planar mechanisms, Stability of four-wheel and two- wheel automobiles, rigid disc at an angle fixed to a rotating shaft.

UNIT-V (11 Lectures)

VIBRATIONS:

Definitions, types, basic features, degrees of freedom, free longitudinal vibration – equilibrium method, energy method, Rayleigh's method,

displacement, velocity, acceleration, effect of mass of spring, damped vibration, logarithmic decrement. forced longitudinal vibrations - harmonic excitation, magnification factor, vibration isolation and transmissibility.

Transverse vibrations, single concentrated load, uniformly distributed load, several loads, Dunkerley's method, whirling of shafts. Torsional vibrations – single rotor.

TEXT BOOK:

S.S Rattan, *"Theory of Machines"*, Third Edition, Tata McGraw Hill, New Delhi, 2011.

REFERENCES:

1. Thomas Bevan, *"The Theory of Machines: A textbook for Engineering students"*, Pearson, New Delhi, 2010.
2. Norton RC, *"Kinematics and Dynamics of Machinery"*, Third Edition in SI Units, Tata McGraw Hill Education Pvt Ltd, 2011.