

**ME209: THEORY OF MACHINES**  
**CREDITS = 5 (L=3, T=0, P=2)**

**Course Objective:**

To provide concepts of static and dynamic force analysis, balancing of rotary & reciprocating mass, friction devices and gyroscopic effect in various systems.

**Teaching and Assessment Scheme:**

Teaching Scheme			Credits	Assessment Scheme				
L	T	P		Theory		Practical		Total Marks
			ESE	CE	ESE	CE		
3	0	2	5	70	30	30	20	150

**Course Contents:**

Unit No.	Topics	Teaching Hours
1	<p><b><u>Friction Devices: Clutches, Brakes and Dynamometers:</u></b>            Classification of clutches, Torque transmission capacity, Considerations for uniform wear and uniform pressure theory, Analysis of Clutches: Single plate, Multi-plate, Cone and Centrifugal clutches.</p> <p>Classification of brakes, Braking effect, Analysis of Mechanical Brakes: Block brake, Band brake, Band and block brake, Internal expanding shoe brake; Braking analysis of four wheelers.</p> <p>Classification of Dynamometers, Analysis of Dynamometers: Prony brake, Rope brake, Belt Transmission, Epicyclic-Train and Torsional (Bevis-Gibson) dynamometers.</p>	09
2	<p><b><u>Gyroscope:</u></b>            Principle of gyroscope, Definition of axes, active and reactive couples; Roll, Yaw and Pitch motions; Gyroscopic effect on: aero-planes, Naval ships, Four wheeler and Two wheeler vehicles, Shaft-rotor system and Rigid disc mounted at an angle on a shaft.</p>	08
3	<p><b><u>Static Force Analysis of Mechanisms:</u></b>            Static equilibrium, Equilibrium of two, three and four force members, Free body diagrams, Superposition, Principle of virtual work.</p>	04

Unit No.	Topics	Teaching Hours
4	<p><b><u>Dynamic Force Analysis:</u></b> Equation of motion using Newton-Euler and Energy methods, Dynamic analysis of slider-crank mechanism, Engine force analysis, Turning moment on crank shaft, Dynamically equivalent system, Inertia of connecting rod, Turning moment diagrams. Flywheels: types of flywheels, fluctuation of speed and energy, coefficient of fluctuation of speed and energy, dimensions of flywheel rim, punching press.</p>	07
5	<p><b><u>Balancing:</u></b> Balancing of rotating masses: Concept of static and dynamic balancing, Analysis of effect of unbalanced masses in single and multiple planes in rotating systems, Bearing reactions. Balancing of reciprocating masses: Primary and secondary balancing, Balancing of single and multi-cylinder engines (In-line, Radial and V engines). Descriptive treatment of static and dynamic balancing machines.</p>	12
6	<p><b><u>Governors:</u></b> Necessity of governor, Classification of Governors, Working principle of centrifugal governors, Concept of control force, Characteristics of governors.</p>	05
<b>TOTAL</b>		<b>45</b>

#### List of References:

1. Rattan S. S., “*Theory of Machines*”, Tata McGraw-Hill, 3rd Edition.
2. Ambekar, A G, “*Mechanism and Machine Theory*” (2013 Reprint), Prentice Hall.
3. Singh Sadhu, “*Theory of Machines*”, Pearson Education.
4. Ballaney P L, “*Theory of Machines and Mechanisms*”, Khanna Publication.
5. Singh V P, “*Theory of Machines*”, Dhanpat Rai & Co.
6. Uicker J J Jr., Pennock G R and Shigley J E, “*Theory of Machines and Mechanisms*”, Oxford University Press.

#### Course Outcomes (COs):

At the end of this course students will be able to ...

1. Analyze friction devices such as clutch, brake and dynamometer.
2. Determine gyroscopic effect on naval ship, airplane and vehicles.
3. Analyze static force involved in mechanisms.
4. Analyze dynamic force involved in mechanisms.
5. Determine unbalance in rotating and reciprocating systems and to balance the systems.
6. Interpret function and characteristics of governors.