3ME01: DYNAMICS OF MACHINES
CREDITS - 4 (LTP: 3,0,1)

Course Objective:

1. To analyze the effects of forces on motion of system components used in mechanisms.
2. To analyze the effects of unbalance and vibrations on the systems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				
L	T	P	C	Theory Marks		Practical Marks		Total Marks
				ESE	CE	ESE	CE	150
3	0	2	4	60	40	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Dynamic Force Analysis:** Equation of motion using Newton-Euler and Energy methods, D'Alembert's principle, 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, flywheels of punching press	07
2	**Balancing:** 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), ISO standards.	08
3	**Free and Free-Damped Vibration of Single DoF Systems:** Periodic and Simple harmonic motion, Degree of freedom (DoF), Equation of motion, Natural frequency, Damped vibrations, Different damping models, Damped natural frequency, Torsional vibrations of the two and three rotor shaft systems, Critical speed of the shaft.	08
4	**Forced-Damped Vibration of Single Dof Systems:** Analytical solution of forced-damped vibrations with harmonic excitation and vector representation, Magnification factor, Phase difference, Transmissibility and Vibration isolation, Vibration measurements and ISO standards: Vibrometer, Accelerometer, Frequency measuring instruments, FFT analyzer.	07
5	**Introduction to Free Vibration of Multi-Dof Systems:** Equations of motion for linear, rectilinear and rotational systems of multi-DoF, Transverse vibration of beam, Torsional vibration of shaft, Different numerical methods (Dunkerley, Rayleigh, Stodola, Holzer).	08
6	**Mechanisms for Controls:** Governors: Types and Characteristics, Gyroscope and Gyroscopic couples: Gyroscopic effect in Automobiles, Ships and Airplanes.	04
	Total	**42**

List of References:

1. Rattan S. S., "*Theory of Machines"*, Tata McGraw-Hill, 4th edition, 2014.
2. Singh V. P., "*Mechanical Vibrations"*, Dhanpat Rai & Co., 4th edition, 2014.
3. Rao S. S., "*Mechanical Vibrations"*, Pearson Education, 4th edition, 2004.
4. Bansal R. K., Brar J. S., "*Theory of Machines"*, Laxmi Publication (P) Ltd., 4th edition, 2004.
5. Ambekar A. G., *"Mechanical Vibration and Noise Engineering"*, PHI Learning Pvt. Ltd., 2006.
6. Haideri F., "*Dynamics of Machinery"*, Nirali Publication, 10th edition, 2010.
7. Norton R. L., "*Kinematics and Dynamics of Machinery"*, McGraw-Hill, 2010.
8. Ghosh A., Mallik A. K., "*Theory of Mechanisms and Machines"*, East-West Press, 3rd edition, 2008.

Course Outcomes (COs):

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

1. Analyze static and dynamic forces on mechanisms.
2. Evaluate the balancing masses and their positions in rotary and reciprocating systems.
3. Analyze the free and free-damped vibrations of the single DoF systems.
4. Analyze the forced-damped vibrations of the single DoF systems.
5. Analyze the free vibrations of the multi DoF systems.
6. Examine the use of governors and estimate the effects of gyroscopic couples on the systems.