NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	
Course Title:	Design and Dynamics of Machines
Course Type:	Core
Year of introduction:	2024-25

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Course Learning Outcomes (CLOs):

After successful completion of the course, the student will be able to –

1 explain the concepts of design philosophy, (BL2)

2 design welded joints, riveted joints, transmission shafts and its components, levers, power screws and springs, (BL6)

3 evaluate the fatigue life of mechanical components. (BL5)

4 estimate vibration of the mechanical system and the unbalance in different rotating systems. (BL5)

Unit	**Contents**	**Teaching hours (Total 45)**
Unit I	**Design Philosophy:** Fail-safe and safe life design concepts, factor of safety, design for assembly, design for manufacturing, design for ergonomics, standardization, theories of failures, thermal stress, creep, concurrent engineering.	06
Unit II	**Levers, Shaft keys and coupling and Power Screws** Classes of levers, force analysis of lever, design of lever arms, design of fulcrum pin.Types of transmission shafts, shaft design based on strength, shaft design based on torsional rigidity, shaft design as per ASME code, design of hollow shaft based on strength and rigidity, Types of keys,	12

design of square and flat keys, design of splines, design of muff, clamp and rigid flange coupling, design of flexible coupling.

Torque requirement of lifting and lowering the load, self-locking screw, efficiency of a square threaded and self-locking screw, collar friction torque, overall efficiency, design of screw and nut.

Unit III	**Design against fluctuating load**	13

Stress concentration and stress concentration factors, Methods of reduction of stress concentration, mechanism of fatigue failure, estimation of endurance limit, Design for finite and infinite life for completely reversed load, Design based on Gerber, Goodman and Soderberg criteria, fatigue design under combined stresses, cumulative fatigue damage, application of fatigue loading for design of shafts, axles, various mechanical components etc.

Unit IV	**Welded and Riveted connections**	10

Design of butt weld joints, Design of parallel and transverse fillet joints, Design of welded joints subjected to eccentric loading, Design of riveted joints for various configurations, efficiency estimation of riveted connections.

Unit V	**Springs**	04

Types of springs, terminology of helical spring, stress and deflection equation of springs, design of helical springs, design of springs using trial and error methods.

Self – Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Laboratory Work: Laboratory work will be based on the topics of dynamics of machines with a minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Shigley, Budnyas, Nisbett, Mechanical Engineering Design, Tata McGraw Hill.
2. R. L. Norton, Machine Design, Pearson Education.
3. R. C. Juvinall, K. M. Marshek, Fundamentals of Machine Component Design, John Wiley & Sons.
4. S S Rao, Mechanical Vibrations, Person Education.
5. V. B. Bhandari, Design of Machine Element, Tata McGraw Hill.
6. Shigley, Uicker, Theory of Machines and Mechanism, Tata McGraw Hill.

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	To derive the equations of motion for arbitrary linear single D.O.F. free, damped and forced vibratory systems.	06
2.	To compare the experimental and theoretical vibration response of longitudinal vibrations for spring mass system.	02
3.	To measure the natural frequency of undamped free torsional vibrations of a single rotor shaft system.	02
4.	To determine the natural frequency of damped torsional vibrations of a single rotor shaft system.	02
5.	To locate the node point for two-rotor system experimentally and theoretically.	02
6.	To observe the whirling of shaft phenomenon.	02
7.	To analyse the effect of damping on the forced vibrations of the beam.	02
8.	To determine the natural frequency of vibrations of a double pendulum.	02
9.	To perform the experimental stress analysis of a beam using strain-gauge methods.	02
10.	To identify the location of balancing masses to eliminate the static and dynamic unbalance in a rotating mass system.	06