GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3142508
Semester – 4
Subject Name: Industrial Drafting and Machine Design

Type of course: Professional Core

Prerequisite: None**.**

Rationale: The course aims to impart basic skills for force/stress analysis and production drawing of machine elements.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Basics of stress and strain**: 3 -D state of stress (Concept only) Normal/axial stresses: Tensile & compressive Stresses: Shear and complementary shear Strains: Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation.	05
2	**Moment of inertia of planar cross -sections:** Derivation of equation of moment of inertia of standard lamina using first principle, Parallel & perpendicular axes theorems, polar moment of inertia,	03
3	**Flexural stresses** – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T, Angle, channel sections	03
4	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity	03
5	**Introduction to Machine Design**: Design procedure, Selection of preferred sizes, Aesthetic and Ergonomic considerations in Design, Manufacturing considerations in Design, Mechanical Properties of Materials, Effect of Alloying elements and heat treatment on properties of steels, Materials Selection in Machine Design, Standardization	05
6	**Design Against Static Load**: Concepts of stresses and Strain, Combinations of Axial, Shear, Torsional and Bending loads; Theories of Failures: Distortion energy (von Mises), Maximum-Shear stress, Maximum Principal stress, Selection and Use of theories of failures; Factor of safety, Contact stresses, Crushing and Bearing stress. Application Problems: Eccentric Loading; Cotter and Knuckle Joints; Design and analysis of levers: Cranked, Bell crank, Foot, Rocker arm.	10
7	**Beams and Columns:** Different types of supports / end conditions, Revision of Stresses in beams: Effect of Section, Orientation, and type of loading; Deflection of beams for different loading conditions. Compressive axial loading of columns and struts,	05

	Slenderness ratio, Compressive stress and Buckling of members, Effect of end conditions; Euler's Formula, Applications, validity and limitations; Rankine's Formula, stresses in curved beam	
8	**Shafts, Keys and Couplings:** Design of solid and hollow circular shaft subjected to torque and combined loading for rigidity and stiffness; Design of Keys and splines, Design of Couplings: Concept of rigid and flexible couplings, Design of: Clamp, Rigid flange and Flexible couplings.	08
9	**Power Screws and Threaded Joints:** Forms of thread, Single and Multiple threaded screw, Terminology of power screw, Torque requirement of lifting/lowering, Self-locking, Efficiency of threads, coefficient of friction, design of screw and nut. Basic types of screw fastening, Cap and Set screw, Bolt of Uniform strength, locking devices, Terminology of Screw thread, Bolted Joint: Simple and Eccentric loading, Torque requirement for bolt tightening.	07
10	**Springs:** Types of springs, Styles of ends, Stress and deflection equations, Series and parallel connections, Spring materials, Design of helical springs, Concentric springs, Helical torsion spring, Multi leaf spring, Nipping of leaf springs	05
11	**Intersection of Surfaces:** Introduction, Line of intersection, Intersection of two prisms, Intersection of two cylinders, Intersection of prism and cylinder, Intersection of cone, Intersection of cone and prism, Intersection of cone and cone, Intersection of sphere and cylinder or prism	03
12	**Elements of Production Drawing Tolerances, Limits and Fits:** Introduction, Basic Definitions, Maximum Metal Condition, Least Metal Condition, Grade of tolerance, Linear and Angular Tolerances, Fundamental deviations, Types of Fits and its basis, Gauge design. Basic terminology of GD & T, Different tolerance characteristics, symbols and tolerance modifiers, Different aspects of datums, Parameters of surface texture and qualifications, Relation of surface roughness and various manufacturing processes, Surface Lay Indication. Discussion related to various Indian standards/conventions used in design and drawings.	04

Reference Books:

1. Design of Machine Elements, V B Bhandari, 3/e, McGraw Hill.
2. A Textbook of Machine Design, P C Sharma and D K Aggarwal,S K Kataria & sons.
3. Shigley's Mechanical Engineering Design, R G Budnyas, J K Nisbett, McGraw Hill.
4. Fundamentals of Machine Component Design, R C Juvinall, 4/e, Wiley.
5. Machine Design: An Integrated Approach, R L Norton, Pearson
6. Strength of Materials, Part I & II, S Timoshenko, CBS publishers and distributers Pvt. Ltd.
7. Strength of Materials, Bansal R K, Laxmi publication.
8. Strength of Materials, Patnaik S, Hopkins D, Elsevier.
9. Engineering Mechanics, Bansal R K, Laxmi Publication.
10. Machine Drawing, K C John, PHI.
11. Engineering Drawing, N D Bhatt, Charotar Publishing House.

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	15
Comprehension	10
Application	35
Analysis	40
Evaluate	00
Create	00

Course Outcomes:

After learning the course the students will be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Interpret fundamentals of material selection, strength of materials and loading patterns of machine elements.	20
CO-2	Identify basic failure modes of machine elements.	15
CO-3	Estimate stresses and deflection in beams, columns and springs.	15
CO-4	Design and analyse shafts, keys, levers, joints, power screw and fasteners.	40
CO-5	Recognize and prepare production drawing used in industries.	10

List of Experiments:

Practical should be designed to include following drawing sheets:

1. Detail and assembly of mechanism/machine which include fundamentals of production drawings, tolerances, fits and surface roughness.
2. Drawings related to intersection of surfaces.
3. Problems related to fundamentals of machine design (topic no. 1 to 4)
4. Design and drawing of Joints and levers.
5. Design and drawing of bolted joints and couplings.
6. Design and drawing of screw jacks.

List of Open Source Software/learning website:

1. http://nptel.ac.in

w.e.f. AY 2018-19