GUJARAT TECHNOLOGICAL UNIVERSITY

AUTOMOBILE ENGINEERING (02), INDUSTRIAL ENGINEERING (15) & MECHANICAL ENGINEERING (19)

MACHINE DESIGN & INDUSTRIAL DRAFTING

SUBJECT CODE: 2141907

B.E. 4th SEMESTER

Type of course: Under Graduate

Prerequisite: None**.**

Rationale: The course aims to impart basic skills for analysis of mechanical component and communicate assembly and production drawings for the components designed.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** 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, Coulomb-Mohr Theory, 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.	**13**	**25%**
2	**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, Slenderness ratio, Compressive stress and Buckling of members, Effect of end conditions; Euler's Formula, Applications, validity and limitations; Rankine's Formula, Johnson's equation; Eccentric loading of long columns.	**7**	**14%**
3	**Shafts, Keys and Couplings:** Design of solid and hollow circular shaft subjected to torque and combined loading; Design of shaft for rigidity and stiffness; Design of Keys: Saddle, Sunk, Woodruff, Square, Flat, Kennedy key and Splines. Design of Couplings: Concept of rigid and flexible couplings, Design of: Clamp, Rigid flange and Flexible couplings.	**10**	**22%**

4	**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, Design of turnbuckle, Elastic analysis of bolted joints.	**18**	**25%**
	Welded and Riveted Joints: Welded joints: stress relieving of welded joints, Strength of butt and fillet joint, Eccentric load in the plane of weld, Welded joint subjected to bending and torsion. Riveted joints: rivet materials, types of failure, strength and efficiency of joint, Caulking and Fullering, Longitudinal and Circumferential lap joint, Eccentrically loaded riveted joint.		
5	**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.	**6**	**14%**
	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.	******	

**** Should be covered during practical session with application to production/assembly drawings.**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
12	20	18	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. Design of Machine Elements, V B Bhandari, 3/e, McGraw Hill.
2. Machine Design: Fundamentals and Applications, P C Gope, 1/e PHI.
3. Fundamentals of Machine Component Design, R C Juvinall, 4/e, Wiley.
4. Machine Design: An Integrated Approach, R L Norton, Pearson
5. Machine Drawing, B Bhattacharyya, 1/e, Oxford Press.
6. Engineering Metrology and Measurements, N.V. Raghavendra & L. Krishnamurthy, Oxford Press.
7. Machine Drawing, K C John, PHI.
8. IS SP 46, 2003.

Course Outcome:

After learning the course the students should be able to:

1. Students will be able to analyse components subjected to various mechanical loads.
2. Students will be able to analyse beams and columns for stresses and deflection.
3. Students will be able to design and analyse shafts, keys and couplings.

4. Students will be able to select fasteners and design welded / riveted joints.
5. Students will be able to generate and interpret assembly and production drawings.

List of Experiments:

Practical should be designed to include followings:

1. Solve problems related to Eccentric Loading; Cotter and Knuckle Joints; Design and Analysis of Levers: Cranked, Bell Crank, Foot, Rocker arm. Also prepare 3D models and detailed drawings of Cotter and Knuckle Joints.
2. Case studied for design and analyse components which can be idealized as beams and columns.
3. Design of shafts, keys and Couplings. Design of Screw jack and Toggle jack.
4. Problems for design of joints using welding, riveting and fasteners.
5. Problems related to Limits, fits and tolerances.
6. Introduction to computer aided drafting tools.
7. Using drafting software, generate Assembly and Production drawings (emphasis should be to demonstrate guidelines of IS SP 46 2003).

Design based Problems (DP)/Open Ended Problem:

1. Design / Analyse a mechanical structure which may involve different components included in syllabus. Prepare assembly and production drawings.

Major Equipment:

1. Computational facility.
2. CAD Software like Fusion 360

List of Open Source Software/learning website:

1. http://nptel.ac.in
2. http://help.autodesk.com/view/fusion360/ENU/
3. https://academy.autodesk.com/course/108871/introduction-cad-engineers
4. http://help.autodesk.com/view/fusion360/ENU/?learn=assemble
5. http://help.autodesk.com/view/fusion360/ENU/?learn=simulate
6. https://academy.autodesk.com/curriculum/introduction-cad-and-cae
7. https://www.youtube.com/watch?v=XmBNKNIz0rY
8. https://www.youtube.com/watch?v=DmWHKkBnw6o

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.