GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Mechanical Engineering
SUBJECT NAME: Machine Design
SUBJECT CODE: 2171909
B.E. 7th SEMESTER

Type of course: Under Graduate
Prerequisite: Machine Design and Industrial Drafting, Design of Machine Elements.
Rationale: The course aims to provide fundamental knowledge for analysis and design gear systems, Bearings, Internal Combustion engine components and cranes.

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		
3	2	0	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Learning Objectives:

1. To introduce design considerations for various types of gears.
2. Learn design procedure for journal bearing selection of antifriction bearings.
3. Learn design of IC engine components and crane components.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Gear Design:** Recitation: Classification of gears, Selection of type of gears, Law of Gearing, Gear terminology, Standard system of gear tooth, force analysis, Interference and undercutting, number of teeth, gear tooth failures, selection of material. Spur and Helical Gears: Stress in gear tooth: Lewis formula, AGMA bending stress equation and AGMA pitting resistance formula, Gear quality and selection aspects. Bevel and Worm gears: Specifications and design of bevel and worm gears.	11	20
2	**Design of Gear Box for Machine Tools:** Comparison and Choice of progression (Arithmetic, Geometric, Harmonic and Logarithmic), general design procedure, determination and fixation of spindle speeds, selection of the best structure diagram, selection of gear layout and ray diagram, determination of number of teeth on gears.	5	10
3	**Journal Bearings:** Classification of bearings. Journal bearing Types, Lubrication: types of lubrication, Lubricants, Effect of pressure and temperature on viscosity, Stable lubrication, Thin and thick film lubrication. Hydraostatic Bearing: Viscous flow through rectangular slot, step bearing, energy losses. Hydrodynamic Bearing: Lubrication theory (Petroff's Equation, Reynolds' Equation), Design of bearings with Raimondi and Boyd method, power and heat generation, bearing materials.	7	18
4	**Rolling Contact Bearings:**	4	16

	Classification, Static load carrying capacity, Stribeck's equation, Dynamic load carrying capacity, Equivalent bearing load, Load-Life relation, Selection of bearing life, Load factor, Selection of bearing from catalogue, Design for cyclic loads and speeds, Bearing with probability of survival other than 90%, Selection of taper roller bearing, Bearing failure, Lubrication of rolling contact bearing.		
5	**IC Engine Components:** Design of cylinder and Cylinder head, Design of piston, Design of connecting rod, Design of crankshaft and Design of valve-gear mechanism.	9	20
6	**Design of Cranes:** Basic objectives of material handling system, Types of load, Classification and application of various Material handling equipment, Basic principles in selection of material handling system, Classification of cranes, Stress analysis and selection of Hooke (IS 15560, 2005), Pulley System (hoisting tackle analysis), Steel Wire ropes: Classification and coding, stress analysis and selection, Design of Sheave and drums.	8	16

<u>Note:</u> Use of Design data book should be permitted during the examination.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	15	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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. R L Norton, Machine Design An Introduction, Pearson.
2. R G Budynas, and K J Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill
3. V B Bhandari, Design of Machine Elements, 3/e, McGraw Hill.
4. V B Bhandari, Machine Design Databook, McGraw Hill.
5. R C Juvinall, Fundamentals of Machine Component Design, 4/e, Wiley.
6. P C Gope, Machine Design: Fundamentals and Applications, 1/e PHI.
7. K Hoga, B Dondlinger, Vehicular Engine Design, Springer.

Course Outcome:

After learning the course the students should be able to:

- Design gears of various types.
- Design gearboxes for machine tools.
- Design journal bearing and select antifriction bearing for state application.
- Design IC engine components and crane parts.

List of Tutorials:

1. Design of Spur Gears.
2. Design of Helical Gears.
3. Design of Bevel Gear.
4. Design of Worm gear.
5. Design of Gearbox.
6. Design of Journal Bearing.
7. Selection of Rolling Contact bearing.
8. Design of IC engine components.
9. Design of Crane components.

Design based Problems (DP)/Open Ended Problem:

1. From the stated requirement of a machine tool, design a gearbox and gears for the same. Compare your design with the one available in machine tool and reason differences.
2. Design IC engine component and prepare a CAD model. Verify the kinematic performance of the assembly in CAD software.

Major Equipment:

Students may be exposed to following software/tools used for the design of various components.

1. http://www.mitcalc.com
2. http://www.kisssoft.ch/english/home/index.php
3. https://www.machinedesignonline.com/

List of Open Source Software/learning website:

1. www.nptel.ac.in/