GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL ENGINEERING (19)
TRIBOLOGY
SUBJECT CODE: 2181926
B.E. 8TH SEMESTER

Type of course: Undergraduate

Prerequisite: Zeal to learn the Subject

Rationale: Majority of mechanical equipment / mechanisms involve relative motion of links or parts. The course intends to impart concepts of friction, wear and lubrication and application of tribology in design of mechanical components is also introduced.

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	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to Tribology:** Introduction to tribology and Factors influencing Tribological phenomena, Properties of materials relevant to friction and wear,	03	5%
2	**Surfaces, Friction and Wear:** Engineering surfaces - Surface characterization, Contact of engineering surfaces: Hertzian and nonhertzian contact, Contact pressure and deformation in non-conformal contacts. Causes of friction, Stick-slip friction behaviour and friction instability, sliding and rolling friction, frictional heating and temperature rise, Friction measurement techniques. Wear and wear types, Mechanisms of wear, Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear measurement and controlling techniques.	12	30%
3	**Lubrication:** Lubricants and their physical properties, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, oil emulsion, Selection of Lubricants, Hydrodynamic lubrication: Reynolds Equation, Infinite bearing, short bearing Elastohydrodynamic Lubrication: Principle and application, pressure - viscosity term in Reynold,,s equation, Hertz theory, Ertel-Grubin Equation. Gas lubrication: Introduction, merits and demerits, applications. Lubrication in metal working: Rolling, forging, drawing and extrusion. Bearing materials, bearing constructions, oil seals, shields and gaskets	12	30%
4	**Design of Tribological Elements:**	16	35%

	Tribological consideration in design, Mechanisms of tribological failures in machines, Design Hydrodynamic bearings, and Performance analysis of gears, seals, piston rings, machine tool slide ways, cams and follower. Surface Engineering for Wear and Corrosion resistance: Diffusion, coating, electro and electro-less plating, hot deep coating, metal spraying, cladded coating, crystallizing coating, selection of coating for wear and corrosion resistance, potential properties and parameters of coating.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	**Understanding U Level**	**Application A Level**	**Analyse N Level**	**Evaluate E Level**
12	**20**	**15**	**15**	**8**

Legends: R: Remembrance; U: Understanding; A: Application 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. Principles and Application of Tribology, B. Bhushan, Wiley.
2. Basic Lubrication Theory, A. Cameron, Ellis Hardwoods Ltd., UK.
3. Fundamentals of Tribology, S. K. Basu, S. N.Sengupatha and D. B.Ahuja, PHI.
4. Engineering Tribology, J. A. Williams, Oxford Univ. Press.
5. Introduction to Tribology in bearings, B. C. Majumdar, Wheeler Publishing.
6. Tribology, Friction and Wear of Engineering Material, I. M.Hutchings, Edward Arnold, London.
7. Engineering Tribology, G. W. Stachowiak and A. W. Batchelor, Butterworth-Heinemann.
8. Engineering Tribology, P. Sahoo, PHI, New Delhi.
9. Applied Tribology: Bearing Design and Lubrication, M. M. Khonsari, E. R. Booser, Wiley.

Course Outcome:

After learning the course the students should be able to:

1. Understand the fundamentals of tribology and associated parameters.
2. Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.

List of Experiments:

1. Determine the coefficient of friction for different conditions and different material pairs.
2. Assess rolling type abrasion resisting life for various types of industrial materials
3. Experiments on wear measurement.
4. Study effect of lubricants and their properties on friction and wear.
5. Study effect of additives on lubricant performance.
6. Experiment on gas lubricated bearing.
7. Experimental study on Journal bearing performance.

Design based Problems (DP)/Open Ended Problem:

1. Tribological design of the system Rolling Mill.
2. Modelling of tool wear.
3. Study wear mechanism in ceramics and polymers.

Major Equipment:

1. Universal tribometer.
2. Linear abrasive Wear test rig.
3. Pin-to-disc test rig.
4. Oil Journal Bearing Apparatus.

List of Open Source Software/learning website:

http://www.nptel.ac.in/syllabus/112102014/

http://www.tribology-abc.com/

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.