

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (MACHINE DESIGN) (09)

TRIBOLOGY

SUBJECT CODE: 2720911

SEMESTER: II

Type of course: Post Graduate

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 tribology. Application of tribology in design of mechanical components is also introduced.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
		ESE	OEP			PA	RP			
4	0	2 [#]	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<p>Introduction to Tribology: Introduction to tribology and its historical background. Factors influencing Tribological phenomena. Introduction to tribological processes and tribological relevant properties of materials. An overview of engineering materials having potential for tribological application.</p>	06	10%
2	<p>Surfaces, Friction and Wear: Engineering surfaces - Surface characterization, Computation of surface parameters. Surface measurement techniques, Apparent and real area of contact. Contact of engineering surfaces- Hertzian and nonhertzian contact. Contact pressure and deformation in non-conformal contacts. Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, Various laws and theory of friction. Stick-slip friction behaviour, frictional heating and temperature rise. Friction measurement techniques. Wear and wear types. Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., 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 controlling techniques.</p>	16	25%
3	<p>Lubrication: Lubricants and their physical properties, lubricants standards – Additives and selection of Lubricants-Lubrication regimes, Hydrodynamic lubrication – Reynolds Equation – Thermal - Inertia and turbulent effects –Elasto hydrodynamic and plasto hydrodynamic theory-soft and hard EHL-Reynolds equation-film shape and thickness within and outside contact zones-Hydro static lubrication – Gas Lubrication.</p>	12	20%

4	Design of Tribological Elements: Tribological consideration in design, Mechanisms of tribological failures in machines, Design of Fluid Frictional Elements- Fluid friction concepts, Design of hydrodynamically loaded journal bearings, externally pressurized bearings, Rolling elements bearings, Performance analysis of bearings, gears, seals, piston rings, machine tool slide ways, cams and follower.	20	45%
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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 its importance
2. Apply in long life product development areas and strengthen the skills in failure analysis.

List of Experiments:

1. Determine the coefficient of friction for different conditions and different material pairs.
2. Experiments for wear measurement.
3. Experimental study on Journal bearing.
4. Exercises for design and tribological analysis of components subjected to relative motion.

Design based Problems (DP)/Open Ended Problem:

1. Performance improvement of hydro-dynamic lubrication journal bearing.
2. Optimizing lubrication parameters for gears for performance and life improvement.

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/>

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers,

integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website