



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code:3720911
TRIBOLOGY IN DESIGN
SEMESTER: II

Type of course: Program Elective

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	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	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.	03
2	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.	12
3	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.	12



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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.	16
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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 students will be able to:.

Sr. No.	Course Outcome	Percentage weightage
CO-1	Students will be able to understand the fundamentals of tribology and its importance	25%
CO-2	Students will be able to apply concepts of tribology in long life product development.	25%
CO-3	Students will be able to strengthen the skills in failure analysis.	25%
CO-4	Students will be able to improve performance of existing mechanical products by means of improvement in design.	25%

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.

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: NPTEL Course