Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2021-2022

(COURSE HANDOUT PART II)

Dated: 06-01-2022

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives specific details regarding the course.

Course No.	:	DE G513
Course Title	:	Tribology
Instructor-in-charge	:	Dr. Prabakaran Saravanan (PS)
Instructors	:	Dr. Nikhil Tambe (NT)

Course Description:

Introduction, lubricants and lubrication, surface texture, bearing materials, fundamentals of viscous flow, Reynolds equation and applications, thrust bearings, journal bearings, squeeze-film bearings, hydrostatic bearings, gas bearings, dry and starved bearings, selecting bearing type and size, principles and operating limits, friction, wear and lubrication.

Scope and Objective of the Course:

This course will give you the basic principles, concepts and practice of friction, wear and lubrication in an industrial context. This course addresses the design of tribological systems: the interfaces between two or more bodies in relative motion. Fundamental topics include: geometric, chemical, and physical characterization of surfaces; friction and wear mechanisms for metals, polymers, and ceramics, including abrasive wear, delamination theory, tool wear, erosive wear, wear of polymers and composites; and boundary lubrication and solid-film lubrication.

Learning outcome: On successful completion of this course, students will be able to:

- Explain about the fundamentals of friction, wear and lubrication.
- Explain about the wear types, lubrication types and applications elaborately
- Demonstrate how to approach a tribological problem from design perspective
- Understating on different types of bearings and fundamental governing equations.
- Explain key issues and recent developments in the area of tribology.

Textbooks

1. Stachowiak G. W. and Batchelor A. W., Engineering Tribology, 3rd Edition (Indian), Butterworth-Heinnmann (Elsevier), 2010.
2. Prasanta Sahoo, Engineering tribology, PHI Learning Pvt. Ltd., 2005.

Reference Books

1. Bharat Bhushan, Introduction to Tribology, John Wiley & Sons, 2002.
2. S. K. Basu, S. N. Sengupta, B. B. Ahuja, Fundamentals of Tribiology, PHI Learning Pvt. Ltd., 2005.
3. Sushil Kumar Srivastava, Tribology in Industries: Textbook for Undergraduate, Graduate and Postgraduate Students, S. Chand Limited, 2004.

Course Plan:

Topic	Learning Objectives	No of Lectures	Text Book	Instructor
Introduction	Meaning of tribology; friction, wear and Lubrication; Cost of friction and wear;	2	T1& T2	PS
Friction, wear and lubrication.	Origin of friction; history, adhesion, deformation; Laws of friction; Theories of friction; Types of wear; Factors affecting the wear; Basic modes of lubrication	4	T1& T2	PS
Lubricants and lubrication	Introduction, Properties of lubricants; Types of lubricants; Viscosity: effect of temperature, pressure and shear rates on viscosity; viscosity measurement; Other Properties; Additives;	5	T1& T2	PS - 4 **NT - 1**
Surface textures	Introduction, Measurement Methods: surface profilometer, optical microscopy, electron microscopy, Statistical Description: centre line average(CLA), root mean square (RMS) roughness, abbott bearing area curve, probability distribution function (ACF), slope and curvature, power spectral density function (PSDF), Fractal Description,	5	T1& T2	PS – 4 **NT - 1**
Bearing materials and fundamentals of viscous flow	Introduction and different types of bearing materials; Introduction to fundamentals of viscous flow: Reynolds equation, Navier-Stroke equations; Laws of viscous flow	3	T1& T2	PS
Thrust bearings	Introduction, Pressure Development Mechanism, Plane Slider Bearing with Experimental Film profile, Fixed Inclination Slider Bearing, Parallel Step Slider Bearing, Design Procedure	2	T1& T2	NT
Journal bearings	Introduction, Infinite long journal bearing: full-sommerfeld boundary condition, half-sommerfeld boundary condition, reynolds boundary condition, Effective temperature of lubricants, Design procedure, Hydrodynamic instability, Oil supply grooves	4	T1& T2	NT **PS**
Hydrostatic bearings; Gas bearings	Introduction, Circular step thrust bearings, Annular thrust bearings, Rectangular thrust bearings, Hydrostatic journal bearings Introduction, Governing equation: extremely low velocity, extremely high velocity, slip flow, surface roughness effects, Squeeze film	4	T1& T2	NT

Topic	Learning Objectives	No of Lectures	Text Book	Instructor
	lubrication, Instabilities in gas-lubricated bearings.			
Dry and starved bearings; Selecting bearing type and size, principles and operating limits; Coating Tribology	Introduction and different types of dry and starved bearings. Bearing type and size, principles and operating limit Tribology of coating (soft coatings, Lamellar coatings, Hard coatings, carbon and carbon based coatings, combined coatings), Coating characterization and evaluation, coating selection.	4	T1& T2	NT
Tribology of Polymeric materials	Friction and sliding wear of polymers; Transfer layers; Influence of counerface properties on polymer tribology; PV limit; Friction and wear trends of polymer composites; Other related topics.	4	T1& T2	NT
Introduction to Nano and micro tribology	Introduction; Difference between nano and macro tribology; Bridging the gap between the scales; Characterization techniques;	3	T1& T2	NT

Evaluation Scheme and Schedule:

Evaluation component	Duration	Weightage	Date/Time/Venue	Evaluation type
Quiz 1	30 min	10 %	Feb	Open /Closed book
Mid-Semester Test	90 min	30 %	March	Open /Closed book
Quiz 2	30 min	10 %	April	Open /Closed book
Comprehensive Examination	120 min	35 %	May	Open /Closed book
Lab (7 experiments)		15 %	May	

Chamber Consultation Hour: To be announced in the class.

Notices concerning the course: All notices concerning this course will be displayed on Mechanical Engineering Department Notice Board/ CMS. Besides this, students are advised to visit regularly CMS (institute's web based course management system) for latest updates

Make-up Policy: Make-up for Mid-semester exam and Comprehensive will be granted for genuine reasons, only when prior-permission is obtained from Instructor-in-charge.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-In-Charge
DE G513