ME 4853 Applied Tribology Laboratory (Elective)

Catalog Description: ME 4853 Applied Tribology Laboratory (2-3-3)

Prerequisites: COE 3001 Mechanics of Deformable Bodies

Introduction to science and technology of interacting surfaces, to cover contact mechanics, adhesion, friction, lubrication and wear, and to include hands-on experience in tribological test methods

Textbook: Ian Hutchings, Philip Shipway, *Tribology: Friction and Wear of Engineering Materials* (2nd ed.), Butterworth-Heinemann, 2017

References: Ernest Rabinowicz, *Friction and Wear of Materials* (2nd ed.), John Willey & Sons, 1995

Horst Czichos, *Tribology: a System Approach to the Science and Technology of Friction, Lubrication and Wear*, Elsevier, 1978

Friction and Wear Testing: Source Book of Selected References from ASTM Standards and ASM Handbooks, ASM International, 1997

Topics covered:

1. Introduction: tribology in a machine's life cycle and its economic impact.
2. Surfaces: roughness, residual stresses, surface energy.
3. Contact: types, real contact, contact mechanics, adhesion.
4. Friction: laws, types and components, energy dissipation, effects of different parameters.
5. Lubrication: types, functions, regimes.
6. Wear: oxidative, abrasive, adhesive, surface fatigue, fretting, erosion.
7. Methods: problem diagnostics, experimental means, reduction of friction and wear as a means of energy conservation and increase in mechanical components' lifetime.

Course outcomes:

Outcome 1: To learn the principles underlying the interaction between surfaces in relative motion.

1.1. Students will be exposed to the multidisciplinary nature of tribology setting problems at the interface between physics, chemistry, material science and mechanics.

1.2. Students will demonstrate general understanding of contact mechanics, adhesion, friction, lubrication and wear.

Outcome 2: To practice basic experimental methods and techniques used to characterize surfaces, their interactions and damage mechanisms.

2.1. Students will become familiar with and operate standard and custom-built tribological characterization tools and experimental test rigs.

2.2. Students will appreciate the non-deterministic stochastic nature of surface phenomena and practice statistical analysis to describe them.

2.3. Students will perform tribological measurements and tests, process and analyze the obtained data and practice scientific writing by describing their findings in technical reports.

Outcome 3: To become acquainted with the problems of friction-related energy loss, wear-related reduction in service life, and possible increase in reliability of mechanical components and systems.

3.1. Students will become aware of the need and promise of tribologically correct design and running of mechanical systems.

3.2. Students will be able to explain changes in technical condition during the service life of mechanical components.

3.3. Students will become familiar with the methods used for finding and studying the tribological failure causes of mechanical systems.

Correlation between Course Outcomes and Student Outcomes:

ME 4853											
	Mechanical Engineering Student Outcome										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X				X					X	X
Course Outcome 1.2	X				X			X		X	X
Course Outcome 2.1	X	X			X						X
Course Outcome 2.2	X	X			X		X				X
Course Outcome 2.3	X	X			X		X				X
Course Outcome 3.1	X		X		X			X			X
Course Outcome 3.2	X	X			X			X			X
Course Outcome 3.3	X	X			X			X			X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Michael Varenberg