

### ME425 Industrial Tribology

| L | T   | P   | Credit | Area    |  | CWS   | PRS | MTE   | ETE   | PRE |
|---|-----|-----|--------|---------|--|-------|-----|-------|-------|-----|
| 3 | 0/1 | 2/0 | 4      | DEC/GEC |  | 15/25 | 25  | 20/25 | 40/50 | -   |

**Course Objective:** To familiarize the students with basics of lubrication, wear & cost of friction. To impart in-depth knowledge of mechanisms of erosive and cavitations wear, hydrostatic lubrication, design of bearing, smart bearing and bearing with IOT.

| Syllabus      |  |  |  |  |  |  | Contact Hours |
|---------------|--|--|--|--|--|--|---------------|
| <b>Unit-1</b> | Introduction: Surface interactions, science of rubbing surface, general consideration of parameters involved, wear rate, modeling and solution of simple problems.   |  |  |  |  |  | <b>6</b>      |
| <b>Unit-2</b> | Material properties influencing interactions: Introduction, elastic properties, plastic deformation properties, relation between the strength and other properties of solids, chemical reactivity of surfaces, absorbed surface layer, Surface energy, relation between surface energy and hardness, Surface Interfacial Energies of Solids under engineering condition.   |  |  |  |  |  | <b>6</b>      |
| <b>Unit-3</b> | Surface Interaction: Size of real contact area and effect of surface energy, size of junction, rheological properties, Wear in tribological joints - classification, calculation methods with allowance for stiffness, wear limits, reliability of joints, simple examples, detail study of manufacturing methods for highly reliable joints. Economic role of wear, measurement, types, and use of radiotracer techniques.  |  |  |  |  |  | <b>8</b>      |
| <b>Unit-4</b> | Adhesive wear: Mechanism, size, shapes of transferred and wear particles, quantitative laws, equilibrium calculation of fragments under different conditions, minimum load for loose particle formation, Quantitative expression for abrasive wear, of hardness and particle size on abrasive wear rate, surface fatigue wear, brittle fracture wear, corrosive wear with types.   |  |  |  |  |  | <b>8</b>      |
| <b>Unit-5</b> | Friction: Introduction, laws, function, properties of uncontaminated metals in air, outgassed metal surface, calculation of flash temperature using surface energy, stick-slip and its prevention.   |  |  |  |  |  | <b>6</b>      |
| <b>Unit-6</b> | Lubrication: Solid film lubrication, boundary lubrication with single and multiple penetration models, properties of lubricants, effectiveness of lubrication-intermediate temperature, behavior of a solid lubrication below melting point; effect of speed, load on lubrication. Lubricants, their properties lubrication technique in vacuum, lubricant coating and its stability. Theory of elastohydrodynamic lubrication film thickness, frictional stress heat flow & temperature, service life of roller bearings. |  |  |  |  |  | <b>8</b>      |
|               | Total  |  |  |  |  |  | <b>42</b>     |

#### Reference Book:

|   |  |
|---|--|
| 1 | Engineering Tribology by Gwidon Stachowiak, Butterworth Heinemann, ISBN-0750673044, 2000.  |
| 2 | Experimental Methods in Tribology by Gwidon Stachowiak, Elsevier, ISBN-0444515895, 2004.   |
| 3 | Engineering Tribology by John Williams, Cambridge University Press, ISBN-0521609887, 2005. |

## Course Outcomes

|     |   |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----|---|--|--|--|--|--|--|--|--|--|--|--|--|--|
| CO1 | The student can identify different areas of Industrial Tribology.                                       |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO2 | Be able to know the surface, properties of surface and related instruments                              |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO3 | Understand the friction, friction theory and behaviour of metals and non-metals                         |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO4 | Understand wear processes, wear theory, behaviour of metals and non-metals and different instruments    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO5 | Be able to understand the lubricants, lubrication and instruments for measuring lubricant's properties. |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO6 | Can find the applications of all the areas in day to day life   |  |  |  |  |  |  |  |  |  |  |  |  |  |

## CO-PO/PSO Matrix

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1 | 3   | 2   | 1   | 1   | 1   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 1    | 3    |
| CO2 | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 3    | 3    | 2    | 2    |
| CO3 | 3   | 3   | 3   | 2   | 2   | 2   | 1   | 1   | 1   | 1    | 1    | 2    | 2    | 1    | 3    |
| CO4 | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 3    | 1    | 2    |
| CO5 | 3   | 3   | 3   | 3   | 3   | 2   | 2   | 1   | 1   | 1    | 1    | 3    | 3    | 2    | 3    |
| CO6 | 3   | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 1   | 1    | 1    | 2    | 3    | 2    | 3    |