

## I YEAR M. TECH (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T6D

TRIBOLOGY

Credits 4

Lecture: 4 periods/week

Internal assessment: 40 marks

Tutorial: - -

Semester end examination: 60 marks

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### COURSE OBJECTIVES:

- Illustrate nature of surfaces and know the selection of lubricating system for different types of bearings in various environmental conditions
- Understand the principles of design of Hydrostatic and Hydro Dynamic bearings and Classify the mechanical seals
- Assess and monitor rolling element bearings and analysis of failure of tribological components

### COURSE OUTCOMES:

Upon successful completion of this course, the student should be able to:

1. Monitor the nature of surfaces and select proper lubrication system to reduce friction
2. Analyze and design hydro dynamic bearings
3. Analyze and design hydro static bearings and plan proper sealing
4. Select the rolling element bearing for the given conditions and analyze failure of tribological components

**Pre Requisites:** Design of machine Members

### UNIT-I

#### INTRODUCTION:

Nature of surfaces and contact-Surface topography-friction and wear mechanisms and effect of lubricants- methods of fluid film formation.

#### LUBRICATION:

Choice of lubricants, types of oil, Grease and solid lubricants- additives- lubrication systems and their selection – selection of pump, filters, piping design- oil changing and oil conservation.

### UNIT-II

#### HYDRODYNAMIC BEARINGS:

Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number- performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings;

Raimondi and Boyd solution for hydrodynamic thrust bearings- fixed tilting pads, single and multiple pad bearings-optimum condition with largest minimum film thickness.

### **UNIT-III**

#### **HYDROSTATIC BEARINGS:**

Thrust bearings – pad coefficients- restriction- optimum film thickness journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

#### **SEALS:**

Different type-mechanical seals, lip seals, packed glands, soft piston seals, Mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves – selection of mechanical seals.

### **UNIT-IV**

#### **SELECTION OF ROLLING ELEMENT BEARINGS:**

Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load- bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

#### **FAILURE OF TRIBOLOGICAL COMPONENTS:**

Failure analysis of plain bearings, rolling bearings, gears and seals, adhesive wear, abrasive wear, corrosion wear, surface fatigue, wear analysis using soap and Ferrography.

## **Learning Resources**

### **Text books:**

1. Hydrostatic and Hybrid bearing design by Rowe W.W.& O. Dionoghue, Butterworths & Co. Publishers Ltd, 1983.
2. Mechanical Fault diagnosis and condition monitoring by Collacott R.A, Chapman and Hall, London 1977.
3. Fundamentals of fluid film lubricant by Bernard J. Hamrock, Mc Graw-Hill Co, 1994.

### **References:**

1. Tribology hand Book by Neale MJ Neumann Butter worths, 1975.
2. Standard hand book of lubrication engineers by Connor and Boyd JJO, ASLE, Mc Graw Hill Book & Co.,1968
3. Design of Machine Elements, (3<sup>ed</sup> Edition) by V.B. Bhandari, Tata McGraw Hill Publishers, New Delhi, 2010.

### **Data Book to be allowed in Examination:**

1. Design data hand book (4<sup>th</sup> Edition), by K Mahadevan & K Balaveera Reddy, CBS Publishers, 2013.
2. Design Data Hand Book by (1<sup>st</sup> Edition) by S. Md. Jalaluddin, , Anuradha Publications, Chennai, 2009.