



<b>Programme</b>	<b>Matriculation to HND in Electrical and Electronic Engineering and Mechanical Engineering</b>
<b>Course Title</b>	<b>Fundamentals of Mechanical Systems</b>
<b>Guided Learning Hours</b>	<b>48</b>

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## Aims

This unit aims to give learners knowledge of the components and systems commonly used in lubrication systems, transmissions and plant equipment

## Learning Outcomes

On completing this course successfully learners will be able to:

1. Explain the uses of lubricants and lubrication systems
2. Explain the uses and applications of a range of engineering components
3. Describe the use and operation of various mechanical power transmission systems
4. Describe the use and operation of various plant equipment and systems

## Indicative Content

### 1. Explain the uses of lubricants and lubrication systems

*Lubricants:* State the reasons for lubricating bearings (reduction of frictional resistance, reduction of wear, heat dissipation, prevention of corrosion, prevention of contamination); Discuss the various types of lubricants and their uses (mineral, vegetable and synthetic oils and greases, graphite, compressed gases, cutting fluids), Explain the meaning of the following terms as it relates to lubricants (viscosity, flash point, pour point, emulsification); Explain the need for additives (anti-oxidants, de-foamers, graphite, pressure)

*Lubrication systems:* Describe with the aid of diagrams the operation of various types of lubrication systems (gravity feed, forced feed, ring, splash lubrication, capillary action, grease cups and nipples, grease packing); Explain the need for planned lubrication procedures and how maintenance of these systems are undertaken (replenishment and renewal of lubricants, safe storage and handling);

## **2. Explain the uses and applications of a range of engineering components**

*Bearings:* Classification of bearings (rolling element or sliding element); Describe various types of rolling element bearings (Ball: radial, angular contact, self-aligning, axial thrust; Roller: Cylinder, taper, needle); Describe various types of sliding element bearings (plain journal, tilting wedge thrust, machine guide-ways); Describe how to assemble rolling element bearings.

*Gaskets and seals:* Identify various types of gaskets and seals (rotary lip seals, mechanical seals, piston rings); Describe their procedure for assembly and maintenance; State their uses.

*Locating and fastening devices:* Identify various types of fastening devices stating their applications (metric bolts, studs and set screws, self-tapping screws, counter-sunk); Describe various nut locking devices (positive, frictional); Identify locating and driving devices (dowel pin, cotter pin and keys); Describe their procedure for assembly.

## **3. Describe the use and operation of various mechanical power transmission systems**

*Cams and followers:* Describe with the aid of sketches the operation of the following types of cams and followers (radial plate cams, cylindrical cams, face cams, knife-edge followers, flat plate followers, roller followers).

*Belt and Chain drives:* Describe with the aid of sketches the operation of the following types of belt and chain drives (Belt: flat, V-section, synchronous, tensioning device; Chain: roller, Morse rocker-joint).

*Gear drives:* Describe with the aid of sketches the operation of the following types of gear drives (spur, helical, herring bone, bevel, spiral bevel, hypoid, and worm).

*Clutches:* Describe with the aid of sketches the operation of the following types of clutches (dog, flat plate, conical).

*Couplings:* Describe with the aid of sketches the operation of the following types of couplings such as sections (solid, hollow), Flanged, splined, angled (Hooke's joint, constant velocity).

## **4. Describe the use and operation of various plant equipment and systems**

*Steam Plant:* Describe the function of each elements in a steam generating plant (feed pump, economizer, evaporator, superheater, air fan, air preheater, chimney/stack); Describe the operation of a fire tube and water tube boiler; state all statutory safety requirements for a boiler; explain various methods of providing an air supply to a boiler (mechanical, balanced and induced draught); Explain the purpose of water treatment and describe common impurities found in water; Explain the different types of condensers; Explain the function and operation of a steam turbine; Explain various methods by which steam pipelines are supported.

*Instrumentation and control:* Explain terms used in measuring systems (calibration, accuracy, error); Identify instruments used to measure the following process variables and explain how they operate (temperature, flow, pressure, level and frequency).

*Refrigeration system:* Explain the basic principles of operation for a vapor compression and absorption refrigeration system; List the general requirements for a refrigerant (non-corrosive, non- explosive, non-flammable, large latent heat of vaporization, environmentally friendly).

## **Learning Outcomes**

Candidates will be able to:

### **1. Explain the uses of lubricants and lubrication systems**

- 1.1 State the reasons for lubricating bearings.
- 1.2 Discuss various types of lubricants and their uses.
- 1.3 Sketch and describe the operation and maintenance of various types of lubrication systems.
- 1.4 Define the following properties of lubricants: viscosity, flash point, pour point and emulsification.
- 1.5 Explain the need for adding additives to lubricants and give examples of their application.
- 1.6 Explain the need for planned lubrication procedures and how maintenance of these systems is undertaken such as replenishment and renewal, safe storage and handling.

### **2. Explain the uses of lubricants and lubrication systems**

- 2.1 Distinguish between a rolling element and sliding element bearing and explain the fundamental differences which exist between each type.
- 2.2 Sketch and describe various types of rolling element bearings such as ball and rollers and give examples of their application.
- 2.3 Sketch and describe various types of sliding element bearings such as plain journal, tilting wedge thrust and machine guide-ways giving examples of their application.
- 2.4 Explain the proper assembly procedure for rolling element bearings
- 2.5 Sketch and describe various types of gaskets and seals
- 2.6 Explain their assemble procedures
- 2.7 Sketch and describe various types of fastening devices such as bolts, studs and nuts and screws.
- 2.8 Sketch and describe at least (2) types of positive and frictional nut locking devices

- 2.9 Explain the procedure for assembly of various types of locating and driving devices such as dowel pins, cotter pins and keys and keyways.

**3. Describe the use and operation of various mechanical power transmission systems**

- 3.1 Describe with the aid of sketches the operation of various types of cams and followers.  
3.2 Describe with the aid of sketches the operation of various types of belt and chain drives  
3.3 Describe with the aid of sketches the operation of various types of gear drives  
3.4 Describe with the aid of sketches the operation of various types of clutches.  
3.5 Describe with the aid of sketches the operation of various types of couplings.

**4. Describe the use and operation of various plant equipment and systems**

- 4.1 Describe the function of each element in a steam generating plant.  
4.2 Describe the operation of a fire tube and water tube boiler.  
4.3 Explain various methods of providing draught to a boiler such as mechanical, balanced and induced.  
4.4 Explain the purpose of water treatment and describe the common impurities found in water and how they are removed.  
4.5 Explain with the aid of sketches various methods of supporting steam pipelines.  
4.6 Explain the operation of different types of condensers.  
4.7 Identify the instruments used to measure various process variables such as temperature, flow, pressure, level and frequency and explain how they operate.  
4.8 Explain the basic principles of operation of a vapor compression and absorption refrigeration system.  
4.9 List the general requirements for a refrigerant.

**Outline Learning Plan:**

The outline learning plan has been included in this unit as guidance. It demonstrates one way of planning the delivery and assessment of this unit.

<b>Topic and suggested assignments/Activities</b>	<b>Hours</b>
Tutor led introduction to unit and programme of learning.	0.8
Tutor led discussion explaining the importance of lubricating moving surface which are in contact. Emphasis is placed regarding lubrication of bearings and the benefits which can be achieved. The properties and types of lubricants are also discussed.	3.0

Learners are asked to conduct independent research regarding the various types of lubricants and their properties noting the actual values for viscosity, pour point, flash point etc. Their findings will be discussed at the beginning of the next class.	2.6
Tutor led discussion involving the operation and maintenance of various types of lubrication systems such as splash, ring and chain, gravity and forced circulation. Learners are asked to conduct independent research into the various types of lubrication systems. They are to select a named machine (e.g. lathe, combustion engine) and examine the type of systems used. They must then submit a report based on their research. .	2.6
Tutor led discussion explaining the need for a planned lubrication maintenance programme.	2.6
Tutor led discussion explain in how bearings are classified and describing the various types of rolling element bearings, how they operate, their advantages and disadvantages.	2.6
Tutor led discussion, describing the various types of sliding element bearings. Pictures and videos will be utilized to reinforce the design and operation of this classification of bearings.	2.6
Tutor led discussion, explaining the function and application of various types of gaskets and seals. The proper procedure for the assembly and maintenance of seals and bearings are also explored.	2.6
Tutor led discussion involving nut locking, locating and driving devices. Learners research and sketch at least (3) types of positive and friction nut locking devices prior to the lecture session	2.6
Tutor led discussion involving the operation and typical application of various types of cams and followers.	2.6
Tutor led discussion involving the operation and typical application of various types of belt and chain drives.	2.6
Tutor led discussion involving the operation and typical application of various types of clutches.	2.6
Tutor led discussion involving the operation and typical application of various types of couplings.	2.6
Tutor led discussion involving the function of various elements found in a steam generating plant. Various types of boilers and the statutory requirements for a boiler are also discussed.	2.6
Tutor led discussion involving the various methods by which air is supplied to a boiler (Mechanical, balanced and induced draft)	2.6
Tutor led discussion explaining the purpose of water treatment and describing common impurities found in water. Various method used in the treatment of water are also discussed such as water softening, and de-aeration.	2.6
Tutor led discussion explaining the operation of condensers, steam turbines and methods of supporting pipes	2.6
Tutor led discussion identifying the various instruments used to measure various process variables such as pressure, temperature, flow, water level and frequency. The operation of each instrument is also examined.	2.6
Tutor led discussion explaining the basic principles of operation of various types of refrigeration systems. Properties of refrigerants are also discussed.	2.6
<b>TOTAL LEARNING CONTACT HOURS</b>	<b>48</b>

### Assessment Details

Methods of Assessment	Mid-term Examination	End of Term Examination
Grading Mode	Numeric	Numeric
Weighting %	40	60
Pass Mark%	50 overall	
Outline Details	Two hour unseen closed book examination. (5) structured questions	Three hour unseen closed book examination. (8) structured questions

### Outline Learning Plan:

The outline learning plan has been included in this unit as guidance. It demonstrates one way of planning the delivery and assessment of this unit.

### Essential Learning Resources:

Learners will be given access to a wide range of publications relating to Electric machines from our library facility as well as access to the online EBSCO database. In addition Learners will access to our well-equipped electrical and electronics laboratory for practical training relating to this unit.

### Textbooks and Manuals

1. Neale M J – Lubrication and Reliability Handbook (Newnes, 2000)  
ISBN 0750651547