

## 6.1.0 MECHANICAL SCIENCE I

### 6.1.1 Introduction

Mechanical science introduces the trainee to the engineering science applicable to the engineering field. Its aim is to equip the trainee with the basic concepts of engineering science. The instructional approach will emphasize on experiments, industrial attachment and analysis of various engineering concepts.

### 6.1.2 General Objective

By the end the end of the module unit, the trainee should be able to understand the basic concepts of engineering science and design simple engineering structures.

### 6.1.3 Module Unit Summary And Time Allocation

#### Mechanical Science I

Code	Sub-Module Unit	Content	Time (Hrs)		
			Theory	Practice	Total
6.1.01	Forces	<ul style="list-style-type: none"><li>• Definition of terms</li><li>• Resolution of forces</li><li>• Statement of theorems</li><li>• Statement of Bow's notation</li><li>• Determination of resultant equilibrant of forces</li></ul>	10	4	14
6.1.02	Moments	<ul style="list-style-type: none"><li>• Definition of a moment</li><li>• Principle of moments</li><li>• Calculation of moments</li><li>• Definition of couple</li><li>• Determination of magnitude of couple</li><li>• Engineering examples</li></ul>	10	7	17
6.1.03	Friction	<ul style="list-style-type: none"><li>• Nature of friction</li><li>• Types of friction</li><li>• Laws of dry friction</li><li>• Calculation of limiting friction force for a pull / push parallel to the surface</li></ul>	10	6	16

		<ul style="list-style-type: none"> <li>• Calculation of pull/push applied at an angle to the horizontal surface</li> <li>• Advantages and disadvantages of friction</li> <li>• Application of friction in engineering problems</li> </ul>			
6.1.04	Motion	<ul style="list-style-type: none"> <li>• Definitions</li> <li>• Laws of motion</li> <li>• Calculations of velocity, acceleration &amp; distance covered</li> <li>• Using graphs of velocity-time &amp; displacement-time</li> <li>• Relationship between linear and angular motion</li> </ul>	8	5	13
6.1.5	Work Energy And Power	<ul style="list-style-type: none"> <li>• Definitions of terms</li> <li>• Principle of conservation of energy</li> <li>• Calculation on work, energy and power</li> </ul>	4	2	6
<b>Total Time</b>			<b>42</b>	<b>24</b>	<b>66</b>

## 6.1.01 FORCES

### Theory

#### 6.1.01T *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;

- a) define terms related to study of forces
- b) resolve forces into two perpendicular components
- c) state the parallelogram, triangle and polygon of forces theorems
- d) state Bow's notation
- e) determine the resultant/equilibrium of two or more coplanar forces

#### 6.1.01C **Competence**

The trainee should have the ability to:

- i) define forces
- ii) state the following forces theorems
- iii) determine the resultant of coplanar forces
- iv) parallelogram
- v) triangle
- vi) polygon

#### *Content*

#### 6.1.01T1 Definition

- i) force
- ii) scalar quantity

iii) vector quantity

6.1.01T2 Resolution of forces

6.1.01T3 Statement of theorems

i) parallelogram of forces

ii) triangle of forces

iii) polygon of forces

6.1.01T4 Statement of Bow's notation

6.1.01T5 Determination of the resultant equilibrant force of two or more forces

- analytical

- graphical

### Practice

#### 6.1.01P *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:-

- a) verify the parallelogram of forces theorem
- b) verify the triangle of forces theorem
- c) Verify the polygon of forces theorem
- d) Determine the resultant/equilibrant of two or more coplanar forces

6.1.01P1 Parallelogram of forces theorem

6.1.01P2 Triangle of forces theorem

6.1.01P3 Polygon of forces theorem

6.1.01P4 Determination of resultant/equilibrant of forces

*Suggested Teaching/Learning Resources*

- Text books
- Hand outs
- Force Board
- Pulleys
- Clamps
- Weights
- Drawing paper
- Spring

## 6.1.02 MOMENTS

### Theory

- 6.1.02T *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to;
- a) define a moment of a force
  - b) explain the principle of moments
  - c) calculate the moment of a force about an axis (multiple forces)
  - d) define a couple
  - e) determine the magnitude of a couple
  - f) state engineering applications of moments and couples

## 6.1.02C Competence

The trainee should have the ability to:

- i) define moments
- ii) calculate moments
- iii) state the principle of moments
- iv) define couples
- v) state engineering examples on application of moments

### Content

- 6.1.02T1 Definition of a moment  
6.1.02T2 Principle of moments  
6.1.02T3 Calculation of moments
- i) single load on beam
  - ii) multiple loads on beam
  - iii) reaction force
- 6.1.02T4 Definition of couple  
6.1.02T5 Determination of magnitude of couple  
6.1.02T6 Applications of moments and couples
- i) tightening (spanners)
  - ii) beams (for supporting cranes)

### Practice

- 6.1.02P *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to:-
- a) determine the magnitude of the moment of a force about a point

- b) determine the magnitude of a couple
  - c) verify the principle of moments
- 6.1.02P1 Determination of moment
- 6.1.02P2 Determination of a couple
- 6.1.02P3 Verification of principle of moments

*Suggested Teaching/Learning Resources*

- various weight
- Rule
- Spring balance
- Beams of various length

### 6.1.03 FRICTION

#### Theory

- 6.1.03T *Specific Objectives*  
By the end of the sub module unit, the trainee should be able to;
- a) explain the nature of friction
  - b) explain the types of friction
  - c) state the laws of dry friction
  - d) calculate the force to overcome friction on a horizontal plane

- e) calculate the force to overcome friction on an inclined plane
- f) state advantages and disadvantages of friction
- g) state applications of friction in engineering

#### 6.1.03C Competence

The trainee should have the ability to:

- i) state the laws of friction
- ii) calculate coefficient of friction
- iii) explain advantages and disadvantages of friction
- iv) minimize the effects on friction

#### Content

- 6.1.03T1 Nature of friction
- 6.1.03T2 Types of friction
- ruling
  - sliding
  - static
- 6.1.03T3 Laws of dry friction
- 6.1.03T4 Calculation of limiting friction force a pull / push parallel to the surface
- i) pull/push applied at an angle to the horizontal surface

- 6.1.03T5 Calculation of limiting friction on an inclined plane
- i) pull/push parallel to the inclined surface
  - ii) pull/push parallel to the inclined surface
- 6.1.03T6 Advantages and disadvantages of friction
- 6.1.03T7 Application of friction in engineering
- i) brakes
  - ii) coupling

### Practice

- 6.1.03P *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to:-
- a) determine the coefficient of friction for various surfaces
  - b) explain the effect of various lubricants on friction

### Content

- 6.1.03P1 Determination of coefficient of friction
- 6.1.03P2 Effect of lubricants various lubricants on friction

### *Suggested Teaching/Learning Resources*

- Text books
- Hand outs

- Adjustable friction plane
- Pulleys
- Slider
- String

## 6.1.04 MOTION

### Theory

- 6.1.04T *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to;
- a) define terms used in the study of linear motion
  - b) derive equations of motion
  - c) relate linear and angular motion
  - d) solve problems of motion
  - e) state the laws of motion
  - f) state the principle of conservation of momentum
  - g) apply the concept of momentum to solve problems

### 6.1.04C Competence

- The trainee should have the ability to:
- i) define terms related to motion
  - ii) state the law of motion
  - iii) use displacement/time graphs

- iv) use velocity/time graphs
- v) convert angular to linear motion

*Content*

- 6.1.04T1 Definitions
  - i) displacement
  - ii) speed
  - iii) velocity
  - iv) acceleration
- 6.1.04T2 Derivation of equations of motion
- 6.1.04T3 Relation between linear and angular motion
- 6.1.04T4 Solving problems of motion
  - i) linear motion
  - ii) angular motion
  - iii) displacement / time
  - iv) velocity/time
- 6.1.04T 5 Laws of motion
- 6.1.04T6 Principle of conservation of momentum

**Practice**

- 6.1.04P *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to:-
  - a) determine the velocity using distance/time graphs
  - b) determine the velocity using velocity/time graph
  - c) verify the principle of conservation of momentum

*Suggested Teaching/Learning Resources*

- text books
- hand outs
- ticker tape timer
- ticker - timer
- rubber cord
- spring balance

**6.1.05 WORK ENERGY AND POWER**

6.1.05T *Specific Objectives*

- By the end of the sub module unit, the trainee should be able to;
- a) define terms related to work, energy and power
  - b) state the principle of conservation of energy
  - c) calculate problems related to work energy and power

**6.1.05C Competence**

- The trainee should have the ability to:
- i) determine work done
  - ii) determine energy
    - kinetic
    - potential
  - iii) determine power and efficiency

	<i>Content</i>	
6.1.05T1	Definitions of terms	<ul style="list-style-type: none"> <li>b) measure the energy of a body</li> <li>c) determine the power of a moving body</li> <li>d) determine the efficiency of a dynamic body</li> </ul>
	<ul style="list-style-type: none"> <li>i) work</li> <li>ii) energy</li> <li>iii) kinetic energy</li> <li>iv) potential energy</li> <li>v) power</li> </ul>	
6.1.05T2	Principle of conservation of motion	6.1.05P1 Work done of a moving body
6.1.05T3	Calculation on:	6.1.05P2 Energy of moving body
	<ul style="list-style-type: none"> <li>i) work done</li> <li>ii) energy</li> <li>iii) power</li> <li>iv) efficiency</li> </ul>	6.1.05P3 Power of a moving body
		6.1.05P4 Efficiency of a dynamic body

**Practice**

- 6.1.05P *Specific Objectives*  
 By the end of the sub-module unit, the trainee should be able to:-
- a) measure the work done of a moving body

*Suggested Teaching/Learning Resources*

- Text books
- Hand outs
- Force board with pulley
- Weights
- Rules