8.1.0 MECHANICAL SCIENCE

8.1.0.1 Introduction

Mechanical science introduces the trainee to the science applicable to the engineering field. Its aim is to equip the trainee with the basic concepts of engineering science. It is covered in the first stage of the course.

The instructional approach will emphasize on experiments, industrial visits and analysis of various engineering concepts.

8.1.02 General Objectives:

By the end of these module units, the trainee should be able to:

a) understand the basic concepts of engineering science
b) design simple engineering structures.

8.1.03 Module Unit Summary and Time Allocation

Mechanical Science

Code	Sub Module Unit	Content	Time Hrs		
			T	P	Total
8.1.1	Forces	• Definition • Resolution of forces • Statement and application of theorems	6	2	8
8.1.2	Moments	• Definition of a moment • Principle of moments • Calculation of moments and reaction on beams • Couples • Engineering examples	4	4	8

8.1.3	Friction	• Nature of friction • Laws of dry friction • Calculation of limiting friction force for a pull / push parallel to the surface • Calculation of pull/push applied at an angle to the horizontal surface • Definition of angle of friction • Calculation of coefficient of friction • Advantages and disadvantages of friction	4	4	8
8.1.4	Motion	• Definitions • Laws of motion • Calculations of velocity, acceleration & distance covered • Using graphs of velocity-time & displacement-time • Relationship between linear and angular motion	6	2	8
8.1.5	Work Energy and Power	• Definitions of terms • Calculation on work, energy and power	4	4	8
8.1.6	Machines	• Definitions • Problems on simple machines • Problems on levers • Laws of machine	4	2	8
8.1.7	Gases	• Gas laws • Engineering examples • Simple problems	4	2	6
8.1.8	Heat	• Definition of heat	4	2	6

		• Simple thermometer • Heat capacity • Definition of the latent heats • Solve simple problems on heat			
8.1.9	Density	• Definitions • Simple measurements of density • Archimedes principles • Simple calculations	2	4	4
8.1.10	Pressure	• Simple calculations on pressure • Simple barometer • Applications of atmospheric pressure	2	2	4
Total Time			**40**	**28**	**66**

8.1.1 FORCES

8.1.1T0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) define a force
b) resolve forces into two perpendicular components
c) state the parallelogram, triangle and polygon of forces theorems
d) determine then resultant/equilibrant of two or more coplanar forces

8.1.1C Competence
The trainee should have the ability to:
i) Define forces
ii) State the following forces theorems
iii) Parallelogram
- Triangle
- Polygon
iv) Determine the resultant of coplanar forces

Content
8.1.1T1 Definition
i) Force
ii) Scalar quantity
iii) Vector quantity
8.1.1T2 Resolution of forces
8.1.1T3 Statement and application of theorems
i) Parallelogram of forces
ii) Triangle of forces
iii) Polygon of forces
iv) State the Bow's notation
8.1.1T4 Determination of the resultant force of two or more forces

Suggested Learning Resources
- Text books
- Hand outs

8.1.2 MOMENTS

8.1.2T0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) define a moment of a force
b) calculate the moment of a force about an axis (multiple forces)
c) define a couple
d) state engineering examples where moments area couples are applied

8.1.2C 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

8.1.2T1 Definition of a moment

8.1.2T2 Calculation of moment

i) Principle of moments
ii) Calculation of moments and reaction on beams
iii) Single load on beam
iv) Multiple loads on beam

8.1.2T3 Couples

i) Definition
ii) Calculation on couples

8.1.2T4 Engineering examples

i) Tightening (spanners)
ii) Beams (for supporting cranes)

8.1.3 FRICTION

8.1.3T0 *Specific Objectives*

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

a) explain the nature of friction
b) state the laws of dry friction
c) calculate the force to overcome friction on a horizontal plane
d) calculate the force to overcome friction on an inclined plane
e) state advantages and disadvantages of friction

8.1.3 Competence

The trainee should have the ability to:

i) State the laws of friction
ii) Calculate the limiting friction
iii) Calculate forces applied at an angle to the horizontal plane
iv) Calculate Coefficient of friction
v) Explain advantages and disadvantages of friction

Content

8.1.3T1 Nature of friction

8.1.3T2 Laws of dry friction

8.1.3T3 Calculation of force to overcome friction on a horizontal plane

8.1.3T4 Calculation of force to overcome friction on an inclined plane

i) Definition of angle of friction
ii) Calculation of coefficient of

friction

8.1.3T5 Advantages and disadvantages of friction

Suggested Learning Resources

- Text books
- Hand outs

8.1.4 MOTION

8.1.4T0 *Specific Objectives*

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

a) Define terms used in the study of motion
b) state the laws of motion
c) calculate problems related to related to motion

8.1.4C Competence

The trainee should have the ability to:

i) define terms related to motion
ii) State the law of motion
iii) Perform calculations on motion
iv) Use Displacement/time graphs
v) Use Velocity/time graphs
vi) Convert angular to linear motion

Suggested Learning Resources

- Text books
- Hand outs

Content

8.1.4T1 Definitions

i) Displacement
ii) Speed
iii) Velocity
iv) Acceleration

8.1.4T2 Laws of motion

8.1.4T3 Calculations of

i) Linear motion
ii) Angular motion
iii) Using graphs of
iv) displacement / time
v) Velocity/time
vi) Relationship between linear and angular

Suggested Learning Resources

- Text books
- Hand outs

8.1.5 WORK ENERGY AND POWER

8.1.5T0 *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) calculate

problems related to work energy and power

8.1.5C *Competence*

The trainee should have the ability to calculate:

i) Work done
ii) Energy either kinetic or potential
iii) Power and efficiency

Content

8.1.5T1 Definitions of terms

i) Work
ii) Energy
iii) Kinetic energy
iv) Potential energy
v) Power

8.1.5T2 Calculation on

i) Work done
ii) Energy
iii) Power
iv) Efficiency
v) Uniform velocity
vi) Variable velocity

8.1.6 MACHINES

8.1.6T0 Specific Objectives

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

a) define related terms
b) calculate problems related to machines
c) determine the law of the machine
d) solve problems using the law of machine

8.1.6C Competence

The trainee should have the ability to:

i) Define terms
ii) Mechanical advantage
iii) Velocity ratio
iv) Efficiency
v) Solve problem on machines related to
vi) Mechanical advantage
vii) Velocity ratio
viii) Efficiency
ix) Determine the law of the machine
x) Solve problems using the machine

Content

8.1.6T1 Definitions

i) Mechanical advantage
ii) Velocity ratio
iii) Efficiency

8.1.6T2 Problems on levers on:

i) Mechanical advantage
ii) Velocity ratio
iii) Efficiency

8.1.6T3 Problems on simple machines

i) Wheel and axle\Screw jack
ii) Pulleys
iii) Belt and chain drives
iv) Gears
v) On mechanical advantage,

velocity ratio, and efficiency

8.1.6T4 Problems on Laws of machine
i) Load-effort graphs
ii) Solution of problem using the law of the machine

Suggested Learning Resources
i) Text books
ii) Hand outs

8.1.7 GASES

8.1.7T0 Specific Objectives
By the end of the sub module unit, the trainee should be able to:
a) state the gas laws
b) establish the ideal gas equation
c) calculate the simple problems on gases
d) state engineering examples where gases are used

Content
8.1.7T1 Gas laws
i) Boyles law
ii) Charles law
8.1.7T2 Gas equation
8.1.7T3 Simple problems on:
i) Boyles law
ii) Charles law
iii) Gas equation
8.1.7T4 Engineering examples
i) Engines
ii) Air compressors

8.1.7C Competence
The trainee should have the ability to:
i) State the gas laws
ii) Apply the gas laws to solve simple gas problems
iii) State engineering examples where gases are used.

Suggested Learning Resources
- Textbooks
- Handouts

8.1.8 HEAT

8.1.8T0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) define heat
b) describe the working of a simple thermometer
c) explain the application of thermal expansion
d) describe methods of heat transfer
e) explain the specific heat capaci

8.1.8C Competence
The trainee should have the ability to:
i) Define heat
ii) Explain the working principle

of a thermometer
iii) Define heat capacity
iv) Define the latent heats
v) Solve simple problems on heat

Content

8.1.8T1 Definition of heat
8.1.8T2 Simple thermometer
8.1.8T3 Heat capacity
8.1.8T4 Definition of the latent heats
8.1.8T5 Solve simple problems on heat

Suggested Learning Resources

i) Textbooks
ii) Handouts

8.1.9 DENSITY

8.1.9T0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) define density and relative density
b) state Archimedes principle
c) solve simple problems on density and relative density

8.1.9C *Competence*
The trainee should have the ability to:
- Solve simple problems on density

Suggested Learning Resources
- Textbooks
- Handouts

Content

8.1.9T1 Definitions
i) Density
ii) Relative density
iii) Simple measurements of density
8.1.9T2 Archimedes principles
8.1.9T3 Simple calculations

8.1.10 PRESSURE

8.1.10T0 Specific Objectives
By the end of the sub module unit, the trainee should be able to:
a) define pressure
b) describe a simple barometer
c) explain the application of atmospheric and liquid pressure
d) explain the use of hydrometers

8.1.10C *Competence*
The trainee should have the ability to:
i) Define pressure
ii) Describe a simple

barometer
iii) Solve simple problems on pressure
iv) Explain the use of hydrometers

Content

8.1.10T1 Definition of pressure
8.1.10T2 Simple barometer
8.1.10T3 Applications of atmospheric pressure
i) Vacuum pump
ii) Hydraulic pump
iii) Simple calculations on pressure
8.1.10T4 Use of hydrometers

Suggested Learning Resources

- Textbooks
- Handouts