7.1.0   APPLIED SCIENCE

7.1.01   INTRODUCTION
The module unit is intended to equip the trainee with the knowledge, skills and attitudes to enable him/her apply engineering science relevant to automotive technology

7.1.02   GENERAL OBJECTIVES

By the end of the module unit, the trainee should be able to:
a) apply relevant principles of applied science in solving engineering problems
b) carry out experiments to verify scientific principles
c) demonstrate correct skills in data collection, analysis and interpretation

7.1.03   MODULE UNIT SUMMARY AND TIME ALLOCATION

APPLIED SCIENCE

Code	Sub-Module Unit	Content	Time Hrs		
			Theory	pract	Total
7.1.1	Foundations of Chemistry	• Properties of matter • Properties and effects of acids and bases • Properties and uses of Salts • Atomic structure • Chemical bonding	4	6	10
7.1.2	Light and Sound	• Laws of reflection and refraction of light • Refraction of light through	2	4	6

		various media • Refractive indices of various media • Location of images formed by mirrors and lenses • Power magnification and magnification power of instruments • Principle of operation of optical instruments • Polarization of light and its applications • Propagation and properties of sound • Sound levels			
7.1.3	Gases	• Gas laws • Ideal gas equation • Simple problems on gases • Use of gas laws in automotive technology	2	6	8
7.1.4	Heat	• Temperature and temperature scales and conversions	2	4	6

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		• Types of thermometers • Forms of heat transfer • Determine heat capacities and latent heat • Terms used in calorimetry • Methods of determining quantity of heat • Graphs of change of state • Applications of heat capacity and latent heat			
7.1.5	Density and Pressure	• Terms used for solids, liquids and gases. • Determination of densities • Archimedes principle, law of flotation and buoyancy • Calculation of density from relative density • Problems involving Archimedes and law of flotation • Pressure and types of pressure	2	6	8

		• Pressure in solids, liquids and gases • Calculation of pressure • Methods and instruments of measuring pressure • Practical applications of pressure			
7.1.6	Work, Energy, Power and Machines	• Definitions of terms and units • Forms, sources and types of energy • Law of conservation of energy • Problems involving work, energy and power • Calculations of potential energy (PE) and Kinetic Energy (KE) and the law of conservation of energy • Simple machines • Applications of simple machines • Calculations of Mechanical Advantage	4	6	10

		(MA), Velocity Ratio (VR) and efficiency • Determination of the law of the machine • Problems involving practical application s of simple machines			
7.1.7	Electro-Statics	• Definition of electrostatics • Types of charge and methods of charging objects • Sources of electrostatic charges • Basic law of charge • Capacitors and capacitance	2	4	6
7.1.8	Electro-Magnetic Radiation	•Definition of terms •Properties of electromagneti c waves •Methods of producing and detecting radiations •Cathode Ray Oscilloscope (CRO)	2	2	4
7.1.9	Machines	• Definitions	4	4	8

			24	42	66
		• Problems on simple machines • Problems on levers • Laws of machine			
Total Time			**24**	**42**	**66**

7.1.1 FOUNDATIONS OF CHEMISTRY

Theory

7.1.1T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) state the properties of matter.
b) explain the properties and effects of acids and bases
c) explain the properties and uses of salts
d) explain atomic structure of elements
e) explain chemical bonding of elements

7.1.3C *Competence*
The trainee should have the ability to:

i. State the properties of matter.
ii. explain the properties and effects of acids and bases
iii. explain the properties and uses of salts
iv. explain atomic structure of elements
v. explain chemical bonding of elements

Content

7.1.1T1 Properties of matter
i) Elements
ii) Compounds
iii) Mixtures
iv) Polarization
v) Ionization energies

7.1.1T2 Properties and effects of acids and bases:
i) Type of Indicators
ii) pH
iii) Oxides
iv) Hydroxides

7.1.1T3 Properties and uses of Salts

i) Solubility
ii) Conductivity
iii) Effect of heat
iv) Preparation:
v) Neutralization
vi) Precipitation

7.1.1T4. Atomic structure of elements
   i) Structure of an atom
   ii) Electric configuration
   iii) Atomic Spectra
   iv) Bohr Theory
   v) Spectral Series
   vi) Atomic number
   vii) Periodicity

7.1.1T5 Chemical Bonding of Elements
   i) Types of bonding
   ii) Hydrogen
   iii) Covalent
   iv) Metallic
   v) Co-ordinate
   vi) Van der Waal
   vii) Simple Molecules
   viii) Mole concept
   ix) Chemical equations
   x) Thermo chemical equations
   xi) Acid /base equations
   xii) Redox equations

xiii) Bonding in carbon compounds
xiv) Covalent bonding formation
xv) Hybridization.

Practice

7.1.1P0 *Specific objectives*

By the end of the sub-module unit, the trainee should be able to:
a) Identify and test acids and bases
b) Perform neutralization experiments
c) Prepare salts

Content
7.1.1P1 Acids and bases
7.1.1P2 Neutralization
7.1.1P3 Salts

7.1.2 **LIGHT AND SOUND**

Theory

7.1.2T0 *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:
a) state and explain laws of reflection and refraction of light

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b) explain refraction of light through various media
c) determine refractive indices of various media
d) locate images formed by mirrors and lenses
e) determine power magnification of lenses and magnification power of instruments
f) explain the principle of operation of optical instruments
g) explain polarization of light and its applications
h) explain propagation of sound and its properties.
i) explain sound levels, their measurement, effects and application to noise and noise pollution.

7.1.3C   *Competence*
The trainee should have the ability to perform various experiments involving light and sound

Content
7.1.2T1   Laws of reflection and refraction of light

7.1.2T2   Refraction of light through various media
 i) triangular prisms
 ii) rectangular prisms
 iii) fluids
 iv) convex and concave
 v) prisms.

7.1.2T3   Refractive indices of various media liquids
    -solids (glass)
    -gases (air)

7.1.2T4   Locating images formed by mirrors and lenses
 i) plane mirrors
 ii) curved mirrors
 iii) lenses convex
 iv) concave

7.1.2T5   Power magnification of a lens and the magnification power of instruments
 i) lenses
 ii) microscopes
 iii) projectors
 iv) binoculars
 v) periscopes
 vi) telescope

7.1.2T6   Principle of operation of optical instruments
 i) lens formula
 ii) images formed by lenses and mirrors

iii) power magnification
and magnification
power of lenses
iv) microscopes
v) telescopes
vi) projectors
vii) periscopes
viii) binoculars

7.1.2T7   Polarization of light
and its applications
production
i) glare reduction
ii) photo elasticity
iii) Application of
polarizes light
iv) Projecting images
v) Projecting light
vi) Safety in use of
vii) polarized light

7.1.2T8   Propagation and
properties
of sound
i) media
ii) air
iii) solids
iv) liquids
v) properties
vi) refraction
vii) diffraction
viii) absorption
ix) interference

7.1.2T9   Sound levels
i) measurement
ii) sound intensity
iii) sound pressure
levels
iv) effects
v) media effects
vi) noise potin
vii) noise reduction

viii) mufflers
ix) dampers
x) acoustics
xi) ship whistle

Practice

7.1.2P0   Specific objectives
By the end of the sub-
module unit, the
trainee should be able
to:
a) perform an
experiment to
calculate the
velocity of sound
b) perform experiments
to measure sound
levels.

Content

7.1.2P1   Velocity of sound
Echo method

7.1.2P2   Sound levels

7.1.3   **GASES**

Theory

7.1.3T0   *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

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d) state examples where gases are used in automotive engineering

7.1.3C *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.

Content
7.1.3T1 Gas laws
-Boyles law
-Charles law
-Gas equation
7.1.3T2 Simple problems on:
-Boyles law
-Charles law
-Gas equation
7.1.3T3 Engineering examples
-Engines
-Air compressors

Suggested Learning Resources
- Textbooks
- Handouts

7.1.4 **HEAT**

Theory

7.1.4T0 *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:
a) explain various temperature scales and conventions
b) explain various types of thermometers
c) explain forms of heat transfer
d) solve problems involving heat capacities, specific heat capacities and latent heat
e) define terms used in calorimetry
f) explain methods of determining heat capacities and latent heat
g) plot and interpret graphs of change of state
h) explain applications of heat capacity and latent heat

7.1.4C Competence
The trainee should have the ability to perform various experiments involving heat.

Content

7.1.4T1   Temperature scales
          and conversions
   i) Absolute scale
   ii) Celsius scale
   iii) Fahrenheit scale
   iv) Kelvin scale
   v) Temperature scales
      conversions

7.1.4T2   Types of
          thermometers
   -   Mercury in glass
   -   Pyrometers
   -   Constant volume
       gas

7.1.4T3   Forms of heat transfer:
          Conduction
   i)   Convection
   ii) Radiation
   iii) Black body
        radiation
   iv) Ultraviolet (u.v.)
        and infrared (i.r.)
        Radiation
   v)   Transmission
   vi) Absorption
   vii) Reflection

7.1.4T4   Calculations for
          quantity of
          heat
   -   Heat capacity
   -   Specific heat
       capacity
   -   Latent heat

7.1.4T5   Terms used in
          calorimetry
   i) Heat
   ii) Specific heat
       capacity

   iii) Heat capacity
   iv)   Latent heat of:
   v)   Fusion
   vi)   Vaporization/
   vii) condensation
   viii) Sublimation

7.1.4T6   Methods of
          determining heat
          capacities and latent
          heat
             -Mixture method
             -Electrical method

7.1.4T7   Change of state graphs

7.1.4T8   Applications of heat
          capacity and latent
          heat
             -Refrigeration
             -Heat exchangers

          Practice

7.1.4P0   *Specific Objectives*
          By the end of the
          sub-module unit, the
          trainee should be able
          to perform
          experiments
          involving heat
          transfer, heat
          capacities, specific
          heat capacities and
          latent heat

          Content

7.1.4P1   Heat transfer
          experiments:
          Heat transfer
          Heat capacity
          Specific heat capacity
          Latent heat

7.1.5 DENSITY AND PRESSURE

Theory

7.1.5T0   *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:
a) explain the terms density, relative density and specific gravity
b) determine densities of solids, liquids and gases
c) explain Archimedes principle, law of flotation and buoyancy
d) apply Archimedes principle and law of flotation to solve problems
e) calculate density from relative density
f) explain various types of pressure.
g) explain pressure in solids, liquids and gases
h) perform calculations involving pressure.
i) explain instruments of measuring pressure
j) explain practical applications of pressure.

7.1.5C   *Competence*
The trainee should have the ability to perform various experiments involving Archimedes principle, law of flotation and buoyancy

Content

7.1.5T1   Terms used for solids, liquids and gases
- Density
- Relative density
- Specific gravity

7.1.5T2   Determination of densities:
- Solids
- Liquids
- Gases

7.1.5T3   Archimedes Principle, Law of Floatation and Buoyancy

7.1.5T4   Calculation of density from relative density

7.1.5T5   Application of Archimedes Principle and Law of Flotation to solve problems

7.1.5T6   Pressure and types of pressure:
      -Gauge pressure
      -Absolute pressure
      -Atmospheric pressure

7.1.5T7   Pressure in:
  i) Solids
  ii) Liquids
  iii) variation with depth/
  iv) density (Pascal's Law)
  v) Transmission
  vi) Forces acting on body
  vii) in a fluid
  viii) Velocity head
  ix) Gases

7.1.5T8   Calculations involving pressure:
  i) Conversions.
  ii) Pascal's Law
  iii) Pressure measurements

7.1.5T9   Instruments for measuring pressure:
      -Barometer
      -Manometer

7.1.5T10 Practical applications of pressure
  i) Vacuum pump
  ii) Hydrometer
  iii) Hydraulic pump
  iv) Controlled Pitch
  v) Propeller(CPP)

7.1.6   **WORK, ENERGY, POWER AND MACHINES**

Theory

7.1.6T0   *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) define work, energy and power
b) explain energy
c) state the law of conservation of energy
d) solve problems involving work energy and power
e) perform calculation on potential energy, kinetic energy and Law conservation of energy
f) define terms as used in simple machines.
g) explain practical applications of simple machines
h) perform calculations on mechanical advantage, velocity ratio and
i) efficiency
j) determine the law of the machine

using graphical and
k) analytical methods
l) solve problems involving practical applications of simple machines

7.1.6C *Competence*
The trainee should have the ability to apply the knowledge of work, energy and power in solving problems related to simple machine

Content
7.1.6T1 Definitions
-Work
-Power
-Energy
7.1.6T2 Forms, sources and types of energy
7.1.6T3 The law of conservation of energy
7.1.6T4 Work, energy and power problems
i) Input
ii) Output
iii) Uniform velocity
iv) Variable velocity
7.1.6T5 Calculations of different forms of energy
i) Potential Energy (PE)
ii) Kinetic Energy (KE)
iii) (linear and rotating

iv) bodies)
v) law of conservation of
vi) energy
7.1.6T6 Terms used in simple machine Mechanical Advantage (MA) Velocity Ratio (VR) Efficiency
7.1.6T7 Practical applications of simple machines
-Pulleys
-Levers
-Inclined planes
7.1.6T8 Calculations involving:
-MA
-VR
-Efficiency
7.1.6T9 Determination of the law of the machine
- Graphical method
- Analytical method
7.1.6T10 Problems involving practical applications of simple machines
-Pulleys
-Levers
-Inclined planes

Practice

7.1.6P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to perform experiments to verify the law of machines

using graphical and
analytical methods

Content
7.1.6P1   Determination and
verification of the law
of the machine
   -Graphical method
   -Analytical
   method

7.1.7   **ELECTROSTATICS**

Theory

7.1.7T0   *Specific Objectives*
By the end of the sub-
module unit, the trainee
should be able to:
a) define electrostatics
b) explain methods of
   charging of objects
c) explain the sources
   of electrostatic
   charges
d) explain the basic law
   of charge.
e) explain the principle
   of capacitors and
   capacitance

7.1.7C   *Competence*
The trainee should have
the ability to perform
various experiments
involving electrostatics.

Content
7.1.7T1   Definition of
electrostatics

7.1.7T2   Methods of charging
objects
7.1.7T3   Sources of
electrostatic charge
   i) Ebony
   ii) Glass rod
   iii) Silk
   iv) Fur
   v) Plastics
7.1.7T4   Basic Law of charge
7.1.7T5   Capacitors and
capacitance
  i) Storage of electrical
   charge
  ii) Relationship
   between
iii) voltage and charge
  iv) Capacitor
   connection
  v) Charging and
  vi) discharging of a
 vii) capacitor
viii) Energy stored in a
  ix) Capacitor
  x) Types of capacitors
   and their applications

7.1.8   **ELECTROMAGNETIC
RADIATION**

Theory

7.1.8T0   *Specific Objectives*
By the end of this
unit, the trainee
should be able to:
a)   explain the
   electromagnetic
   spectrum

b) explain the properties of electromagnetic waves
c) explain methods of producing and detecting electromagnetic radiation
d) explain the operations and working of a Cathode Ray oscilloscope

7.1.8C *Competence*
The trainee should have the ability to:
i) prepare and work safely with chemicals
ii) use the periodic table of elements
iii) verify applied science principles and apply them to ship systems use common optical instruments
iv) track and identify weather patterns
v) carry out tests on metals and alloys

Content
7.1.8T1 The electromagnetic spectrum Electromagnetic radiation

7.1.8T2 Properties of electromagnetic waves
7.1.8T3 Methods of producing and detecting electromagnetic radiations:
  - X-rays
  - Gamma rays
  - Cathode rays
7.1.8T4 The Cathode Ray Oscilloscope (C.R.O.)

7.1.9 **MACHINES**

Theory

7.1.9T0 *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

7.1.9C *Competence*
The trainee should have the ability to:
j) solve problem on machines related to mechanical advantage
iii) Velocity ratio Efficiency

iv) solve problems using the machine

Content

7.1.9T1   Definitions
- Mechanical advantage
- Velocity ratio
- Efficiency

7.1.9T2   Problems related to machines
- Mechanical advantage
- Velocity ratio
- Efficiency

7.1.9T3   Law of the machines
 i) Wheel and axle\Screw jack
 ii) Pulleys
 iii) Belt and chain drives
 iv) Gears
 v) On mechanical advantage, velocity ratio, and efficiency

7.1.9T4   Solution of problems using laws of machine
- Load-effort graphs
- Solution of problem using the law of the machine

Suggested Learning Resources
- Text books
- Hand outs