12.1.0 VEHICLE TECHNOLOGY

12.1.01 Introduction

This module unit designed to equip the trainees with knowledge, skills and attitudes to acquire Competence in routine vehicle service. After completing this module, the trainee is capable of working in a garage or service station. It targets persons who are interested in gaining basic mechanics skills. The module forms a basis for all other modules to be covered in the course.

12.1.02 General Objectives

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

a) understand the layout and functions of the main vehicle components
b) understand the sealing and locking methods to seal and lock motor vehicle components efficiently
c) carry out routine maintenance on motor vehicles
d) understand the working principle of combustion in spark and compression ignition engines
e) understand workshop /garage layout and operations procedures
f) determine the cost of a vehicle service.

12.1.03 Module Unit Summary and Time Allocation

Vehicle Technology

Code	Sub Module Unit	Content	Time Hrs		
			T	P	Total
12.1.1	Safety	• Safety rules • First aid • Fire classes • Fire extinguishers: • Flammable gases and materials • Safe working procedures. • Factories and workplaces Act	6	12	18
12.1.2	Vehicle Layout	• The major units • Layouts • Types of vehicle drives	14	26	40

		• Engine positions • Types of chassis			
12.1.3	Transmission System	• Types of gear construction • Types of gearboxes • Construction and operation of various types of vehicle gearboxes • Gearbox lubricants • Types of clutch pressure plates • Types of clutch discs • Types of clutches • Construction and operation of various types of clutches • Clutch actuating mechanisms • Types of final drives • Construction and operation of final drive units • Construction and operation of the differential unit • Construction and operation of rear axle • Types of drive shafts • Construction and operation of drive shafts • Types of constant velocity (c.v)joints • Construction and operation of constant velocity joints	14	26	40
12.1.4	Wheels and Tyres	• Function of wheels. • Types of wheels and tyres. • Types of rims • Tread patterns • Tyre pressures • Wheel balancing	10	20	30

		• Tyre and tube repairs			
12.1.5	Steering System	• Function of a steering system • Construction and operation of conventional steering system • Steering system layouts • Steering gearboxes • Power assisted steering • Power steering	8	18	26
12.1.6	Suspension system	• Types of suspension systems • Types of suspension units • Air suspension • Hydraulic suspension • Rubber suspension	14	16	30
12.1.7	Braking System	• Layout of the braking system • Types of brakes • Brake actuating mechanisms • Power brakes • Auxiliary brakes • Types and properties of brake fluids • Anti – lock braking system (ABS) • Anti-jacknifing mechanism	14	26	40
12.1.8	Driving	• Model town board • Road signs • First aid	16	24	40
Total Time			**96**	**168**	**264**

12.1.1 SAFETY

Theory

12.1.1T0 *Specific Objectives*

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

a) observe safety rules
b) apply first aid techniques;
c) categorize classes of fire;
d) use different types of fire extinguishers
e) differentiate flammable materials and gases;
f) observe safe working procedures in the workshop;
g) employ the factories and work places Act in relation to workshop.

12.1.1C Competence

The trainee should have the ability to:

i) Perform first aid drill
ii) Perform fire fighting drill

Content

12.1.1T1 Safety rules
12.1.1T2 First aid
12.1.1T3 Fire classes
  i) Class A,B,C,D and E
12.1.1T4 Fire extinguishers:
  i) water
  ii) carbon dioxide
  iii) foam
  iv) fire blankets
  v) sand
  vi) powder
12.1.1T5 Flammable gases and materials
12.1.1T6 Safe working procedures
12.1.1T7 Factories and workplaces Act.

Practice

12.1.1P0 Specific Objectives

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

a) practice safety rules and regulations in the auto workshop
b) perform first aid and first aid techniques
c) classify different types of fires
d) extinguish different classes of fire using appropriate fire extinguishers

Content

12.1.1P1 Safety rules and regulations
12.1.1P2 First aid and first aid techniques
  i) Shock
  ii) Burns
  iii) Cut and wounds
  iv) Fractures
12.1.1P3 Classes of fire
  i) Class A

ii) Class B
iii) Class C
iv) Class D
v) Class E

12.1.1P4 Fire extinguishers
i) Carbon dioxide
ii) Foam
iii) Water
iv) Fire blankets
v) Sand

Suggested Learning Resources
i) Workshop safety equipment
ii) Manuals
iii) Journals
iv) Charts

12.1.2 VEHICLE LAYOUT

Theory

12.1.2T0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) describe the function of the major vehicle components
b) describe types of vehicle layouts.
c) describe types of vehicle drives.
d) describe types of engine positions.
e) differentiate types of vehicle and body chassis

12.1.2C Competence
The trainee should have the ability to:
i) locate various vehicle parts
ii) design and construct the vehicle chassis

Content

12.1.2T1 The major components
i) Engine
ii) Transmission
iii) Suspension
iv) Braking
v) Steering
vi) Electrical system
i) Body

12.1.2T2 Layouts
i) Conventional
ii) Alternative layout

12.1.2T3 Types of vehicle drives
i) Rear wheel
ii) Front wheel
iii) Four wheel
iv) Six wheel

12.1.2T4 Engine positions
i) Front engine
ii) Central engine
iii) Rear engine

12.1.2T5 Types of chassis
i) Separate
ii) Integral

Practice

12.1.2P0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) locate various types of vehicle units
b) design and construct a vehicle chassis

Content

12.1.2P1 Vehicle units
- i) engine
- ii) transmission
- iii) brakes
- iv) suspension
- v) steering
- vi) auxiliary
- vii) chassis

12.1.2P2 Design project
- i) Vehicle chassis

Suggested Learning Resources
- i) Charts
- ii) Journals
- iii) Vehicle units
- iv) Models
- v) Text books
- vi) Hand tools
- vii) Equipments
- viii) Materials

12.1.3 TRANSMISSION SYSTEM

Theory

12.1.3T0 *Specific Objectives*

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

a) name the various types of gear construction;
b) name the various types of gearboxes;
c) describe the construction and operation of various types of vehicle gear boxes;
d) describe the various types and properties of gearbox lubricants;
e) describe the construction and operation of clutch pressure plates;
f) describe the construction and operation of clutch discs;
g) name the various types of clutches
h) describe the construction and operation of various types of clutches;
i) describe the construction and operation of various types of clutch actuating mechanisms;
j) name the types of final drive units;
k) describe the construction and operation of final drive units;
l) describe the construction and operation of the differential unit;
m) describe the construction and operation of the rear axle
n) name various types of drive shafts;
o) describe the construction and operation of various types of drive shafts;
p) name various types of constant velocity (c.v)joints;
q) describe the

construction and operation of various types of c.v. joints;

Content

12.1.3T1 Types of gear construction
- i) Straight bevel
- ii) Spur
- iii) Helical
- iv) Hypoid
- v) Spiral bevel
- vi) Worm

12.1.3T2 Types of vehicle gearboxes
- i) Manual
- ii) Splitter
- iii) Twin layshaft
- iv) Constant mesh
- v) Synchromesh
- vi) Semi automatic
- vii) Automatic
- viii) Continuously variable transmission (CVT)

12.1.3T3 Construction and operation of various types of vehicle gearboxes
- i) Manual
- ii) Splitter
- iii) Twin layshaft
- iv) Constant mesh
- v) Synchromesh
- vi) Semi automatic
- vii) Automatic
- viii) Continuously variable transmission (CVT)

12.1.3T4 Types and properties of gearbox lubricants

12.1.3T5 Construction and operation of clutch pressure plate
- i) Multi-coil
- ii) diaphragm

12.1.3T6 Construction and operation of clutch disc
- i) flexible hub
- ii) rigid hub

12.1.3T7 Types of clutches
- i) coil spring
- ii) diaphragm spring
- iii) multi-plate
- iv) semi-centrifugal
- v) centrifugal

12.1.3T8 Construction and operation of various types of clutches
- i) coil spring
- ii) diaphragm spring
- iii) multi-plate
- iv) semi-centrifugal
- v) centrifugal

12.1.3T9 Clutch actuating mechanisms
- i) mechanical
- ii) hydraulic

12.1.3T10 Types of final drive units
- i) crown wheel and pinion
- ii) worm and worm wheel

12.1.3T11 Construction and operation of final drive units
- i) crown wheel and pinion
- ii) worm and worm wheel

12.1.3T12 Construction and operation of the differential unit
- i) Planet wheel
- ii) Sun wheel
- iii) Cross pin/spider shaft
- iv) Differential lock

v) Limited slip differential (mechanical, viscous)
vi) Two – speed differential

12.1.3T13 Construction and operation of rear axle
i) Dead and live axle
ii) Axle casing (split, banjo)
iii) Axle shafts
iv) Semi floating
v) ¾ floating
vi) Fully floating
vii) Drive shafts
viii) Double reduction drives

12.1.3T14 Types of drive shafts
i) Front-wheel
ii) Rear-wheel
iii) Rear axle propeller shafts

12.1.3T15 Construction and operation of drive shafts
i) Drive shafts
ii) Half shafts

12.1.3T16 Types of constant velocity joints
i) Double Hooke's
ii) Rzeppa
iii) Weisss
iv) Tracta
v) Tripot

12.1.3T17 Construction and operation of various types of constant velocity joints
i) Double Hooke's
ii) Rzeppa
iii) Weisss
iv) Tracta
v) Tripot

Practice

12.1.3P0 *Specific Objectives*

By the end of the sub module unit, the trainee should be able to:
a) Identify various types of gears
b) service various types of gearboxes
c) Identify and be able to use gearbox lubricants
d) service clutch pressure plates
e) Service clutch discs
f) Service various types of clutches
g) Service various types of clutch actuating mechanisms
h) Service final drive units
i) Service the differential unit
j) Service the rear axle
k) Service various types of drive shafts
l) Service various types of c.v. joints

Content

12.1.3P1 Identify various types of gears
i) Straight bevel
ii) Spur
iii) Helical
iv) Hypoid
v) Spiral bevel
vi) Worm

12.1.3P2 Service gearboxes
i) Manual gearbox

ii) Constant mesh
iii) Synchromesh
iv) Semi automatic gearbox
v) Automatic gearbox
vi) continuously variable transmission (CVT)

12.1.3P3 Identify and use gearbox lubricants

12.1.3P4 Service clutch pressure plates
i) multi-coil
ii) diaphragm

12.1.3P5 Service clutch discs
i) flexible hub
ii) rigid hub

12.1.3P6 Service different types of clutches
i) coil spring
ii) diaphragm spring
iii) multi-plate
iv) semi-centrifugal
v) centrifugal

12.1.3P7 Service different types of clutch actuating mechanisms
i) mechanical
ii) hydraulic

12.1.3P8 Service different types of final drive units
i) crown wheel and pinion
ii) worm and worm wheel

12.1.3P9 Service differential unit
i) Planet wheel
ii) Sun wheel
iii) Cross pin/spider shaft
iv) Differential lock
v) Limited slip differential (mechanical, viscous)
vi) Two – speed differential

12.1.3P10 Service the rear axle Dead and live axle
i) Axle casing (split, banjo)
ii) Axle shafts
iii) Semi floating
iv) ¾ floating
v) Fully floating
vi) Drive shafts
vii) Double reduction drives

12.1.3P11 Service drive shafts
i) Drive shafts
ii) Half shafts

12.1.3P12 Service constant velocity joints
i) Double Hooke's
ii) Rzeppa
iii) Weisss
iv) Tracta
v) Tripot

Suggested Learning Resources
- Models
- Transmission System Unit
- Complete vehicle fitted with final drive differential and rear axle
- Assorted clutches
- Assorted gearboxes
- Rear axles
- Constants velocity joints
- Drive shafts
- Tools
- Equipment
- Job Cards

- Journals
- Manuals
- Charts

12.1.4 WHEELS AND TYRES

Theory

12.1.4T0 *Specific Objectives*

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

a) describe the purpose of wheels in the vehicle
b) identify different types of wheels and tyres
c) describe different types of rims
d) describe the different types of tread patterns made on a tyre
e) explain the importance of tyre inflation pressures
f) describe the importance of tyre rotation

12.1.4C Competence

The trainee should have the ability to:

i) repair tubes, valves and tyres
ii) practice wheel balancing using the correct machines and procedures
iii) use and recommend suitable tyres for various types of vehicles and road conditions

Content

12.1.4T1 Function of wheels.
12.1.4T2 Types of tyres.
i) Tubeless
ii) Tube type
iii) Cross ply
iv) Radial ply
12.1.4T3 Wheel rims
i) Well type
ii) Three piece
iii) Spooked
12.1.4T4 Treads patterns
i) Aquaplaning
12.1.4T5 Inflation pressures
ii) Under inflation
iii) Over inflation
iv) Pressure gauges
v) Pressure valves
12.1.4T6 Importance of tyre rotation

Practice

12.1.5P0 *Specific Objectives*

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

a) identify types of rims and tyres
b) repair tubes and valves
c) carry out wheel balancing
d) select suitable tyre tread patterns for given vehicles and road conditions

Content

12.1.4P1 Types of rims and tyres
i) Tyres
ii) Tubes
iii) Valves
iv) Rims

12.1.4P2 Repair and service wheels
- i) Wheel balancing
- ii) Select tread patterns

12.1.4P3 Wheel balancing

12.1.4P4 Selection of tyre tread patterns for various road types

Suggested Learning Resources
- i) Wheels
- ii) LCD
- iii) Practical work
- iv) Tyres
- v) Tools
- vi) Equipment
- vii) Manuals
- viii) Charts
- ix) Job cards
- x) Journals

12.1.6 STEERING SYSTEM

Theory

12.1.6T0 *Specific objective*
By the end of the sub module unit, the trainee should be able to:
- a) Explain the function of a steering system
- b) Describe the construction and operation of conventional steering system
- c) describe the various steering system layouts
- d) describe the construction and operation of different types of steering gearboxes
- e) describe the construction and operation power assisted steering
- f) describe the construction and operation power steering

12.1.6C Competence
The trainee should have the ability to:
Diagnose steering system faults
Carry out service and repair on different types of steering system

Content

12.1.6T1 Function of a vehicle steering system

12.1.6T2 Conventional steering system
- i) construction
- ii) operation

12.1.6T3 Steering system layouts
- i) conventional
- ii) twin-axle

12.1.6T4 Steering gearboxes
- iii) worm and wheel
- iv) worm and sector
- v) worm and nut
- vi) worm and roller
- vii) recirculating
- viii) worm and
- ix) rack and pinion

12.1.6T5 Power assisted steering system
- i) construction
- ii) operation

12.1.6T6 Power steering

i) construction
ii) operation

Practice

12.1.6P0 *Specific objective*
By the end of the sub module unit, the trainee should be able to:
a) Identify different types of steering systems layouts
b) Diagnose, service and replace different types of steering gearboxes
c) Diagnose, service and replace different types of steering systems

Content

12.1.6P1 Types of steering system layouts
i) conventional
ii) twin-axle

12.1.6P2 Diagnosis and servicing of different types steering gearboxes
i) worm and wheel
ii) worm and sector
iii) worm and nut
iv) worm and roller
v) recirculating
vi) worm and
vii) rack and pinion

12.1.6P2 Diagnose, service and replace different types of steering systems
i) conventional
ii) power assisted
- Leakages
- Over steering
- Under steering

iii) Power
- identify components of a four wheel steering system

Suggested Learning Resources
i) Vehicle fitted with manual steering system
ii) Manuals
iii) Workshop tools and equipment
iv) Manuals
v) Vehicle fitted with power assisted steering system
vi) Vehicle fitted with power steering system

12.1.9 SUSPENSION SYSTEM

Theory

12.1.9T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) Name different types of suspension system
b) describe the construction and operation of different types of suspensions
c) Name different types of suspension units

d) Describe the construction and operation of different types of suspension units
e) Describe the construction and operation of air suspension
f) Describe the construction and operation of hydraulic suspension
g) Describe the construction and operation of rubber suspension

12.1.9C Competence

The trainee should have the ability to service, repair and replace
i) Different types of suspension systems
ii) Different types of suspension units, air suspension, hydraulic suspension and rubber suspension

Content

12.1.9T1 Types of suspension
i) Macpherson strut
ii) Wishbone
iii) Construction
iv) operation

12.1.9T2 Suspension units
i) springs
- Leaf springs
- Coil springs
- Rubber springs

ii) arms
iii) dampers

12.1.9T3 Air suspension
i) Hydra gas
ii) Hydro pneumatic

12.1.9T4 Hydraulic suspension

12.1.9T5 Rubber suspension
i) Hydrolastic

Practice

12.1.9P0 Specific objectives

By the end of the module unit, the trainee should be able to:
a) Identify different types of suspension systems
b) Service, repair and replace different types of suspension
c) Identify different types of suspension units
d) Service, repair and replace different types of suspension units
e) Service, repair and replace air suspension
f) Service, repair and replace hydraulic suspension
g) Service, repair and replace rubber suspension

Content

12.1.9P1 Identify types of suspension systems
i) Macpherson strut
ii) Wishbone

12.1.9P2 Service, repair and replace different types of suspension systems

i) Macpherson strut
ii) Wishbone

12.1.9P3 Service, repair and replace different types of suspension
iii) Air suspension
- Hydra gas
- Hydro pneumatic

iv) Hydraulic suspension
v) Rubber suspension
- Hydrolastic

vi) Leakage
vii) Noise
viii) Body damage
ix) Wear on tyres

Suggested Learning Resources
i) Vehicles fitted with Macpherson strut and wishbone suspensions, sir suspension, rubber suspension and hydraulic suspension
ii) Various types of suspension units
iii) Charts
iv) Workshop manual
v) Workshop tools and equipment

a) describe the layout of a vehicle braking system
b) describe the construction and operation of different types of brakes
c) describe the construction and operation of brake actuating mechanisms
d) describe the construction and operation of auxiliary brakes
e) name types and properties of brake fluids
f) explain the construction and operation of anti – lock braking (ABS) system
g) describe the construction and operation of different types of anti-jacknifing mechanisms

12.1.13 BRAKING SYSTEMS

Theory

12.1.13T0 *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:

12.1.13CCompetence
The trainee should have the ability to:
i) Identify layout of the braking systems
ii) Service different

types of brakes
iii) Service and maintain different brake actuating mechanisms
iv) carryout brake adjustments
v) bleed hydraulic brakes
vi) service and maintain auxiliary braking systems
vii) service the ABS braking system
viii) service anti-jacknifing mechanisms

Content

12.1.13. T1 Layout of the braking system

12.1.13T2 Types of brakes
i) drum
ii) disc
iii) hand brake

12.1.13T3 Brake actuating mechanisms
i) mechanical
ii) hydraulic
iii) pneumatic
iv) air

12.1.13T3 Construction and operation of auxiliary brakes
i) Exhaust brakes
ii) Eddy currents
iii) Hydraulic retarders

12.1.13T4 Power brakes
i) Vacuum assistance
ii) Vacuum assisted servo units
- Indirect acting servos
- Direct acting servos
iii) Hydraulic servo system
- Hydraulic assistance
- Continuous flow system with accumulator
- Air operated power brakes
- Air/hydraulic system
- Truck three-line brake system
- Truck two-line brake system

12.1.13T5 Auxilliary braking system
i) Single cylinder
ii) Tandem (dual) cylinder

12.1.13T6 Brake fluid
i) Types
ii) Properties

12.1.13T7 Anti-lock braking system
i) Anti-lock braking system
ii) requirements
iii) Types of ABS
- electronic
- mechanical
iv) Operating principles of ABS
v) Operation of intrusive electronic ABS
- Wheel speed sensors
- Electronic

control unit
- Modulator assembly
- Layout of intrusive ABS

vi) Traction control system
- Brake application
- Torque control (reducing engine power)

vii) Operation of electronic brake pressure apportioning

viii) Operation of electronic vehicle stability control

Practice

12.1.13P0 *Specific Objectives*

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

a) identify the layout of the vehicle braking system
b) service different types of brakes
c) service different types of brakes
d) service and maintain auxiliary braking systems
e) service the ABS braking system
f) service anti-jacknifing mechanisms

Content

12.1.13P1 Layout of braking systems
i) mechanical brakes
ii) hydraulic brakes

12.1.13P2 Service different types of brakes
i) drum
- Lining the brake shoes
- Adjustment of brakes
- Bleeding of hydraulic brakes

ii) Disc brakes
- Identify parts of the disc brakes
- Service the disc brake parts
- Changing of disc pads
- Changing a worn out disc
- Replacement of rubber boots
- Bleeding the hydraulic system

iii) Handbrake service
- Servicing the handbrakes
- Adjustment of the handbrake

12.1.13P4 Service and maintenance of brake actuating mechanism
i) mechanical
ii) hydraulic
- Service the master cylinder

- Service the wheel cylinders
- bleeding

12.1.13P5 Service and maintenance of power brakes
i) Identify servo units
- Direct
- Indirect

ii) Vacuum assisted brakes
- Service
- Maintenance
- Testing of brakes

iii) Hydraulic servo system
- Service
- Maintenance
- Testing of brakes

12.1.13P6 Identify different types of auxiliary brakes
i) Exhaust brakes
ii) Eddy currents
iii) Hydraulic retarders

12.1.13P7 Service auxiliary brakes

12.1.13P8 Service the anti-lock braking system

Suggested Learning Resources

i) Hand tools
ii) Vehicle with braking system
iii) Hydraulic fluid
iv) Clear pipe
v) Clear bottle
vi) Brake linings
vii) Brake pads
viii) Brake replacement parts
ix) Master cylinders
x) Wheel cylinders
xi) Testing equipment
xii) Speed wheel sensors
xiii) Vehicle air operated brakes
xiv) Servo units
xv) Vehicle with ABS
xvi) Vehicle with auxiliary brakes

12.1.19 DRIVING

12.1.19T0 *Specific Objectives*
By the end of the sub module unit, the trainees should be able to:
a) demonstration appropriate driving skills this model town board
b) enterprise roads signs used in Kenyan roads
c) administer first aid to injuries in the event of an accident

Content

12.1.19T1 Model town board
i) Central island
ii) Round about
iii) Lane drill
iv) Parking
v) Highway code

12.1.19T2 Road signs
i) Regulatory
ii) Hazard

information
iii) Facility

12.1.19T3 First aid
i) Burns
ii) Cuts
iii) Blisters

Practice

12.1.19P0 *Specific Objectives*
By the end of the sub-module unit, the trainees should be able to:
a) take off from rest and move to other gears
b) reverse a vehicle
c) park a vehicle
d) maintain the correct lane while driving

Content

12.1.19P1 Driving from rest
- Gear 1,2,3,4,and 5; hill start

12.1.19P1 Reversing
- 3 point turn

12.1.19P2 Use of driving mirror

12.1.19P3 Parking
i) Angle parking
ii) Flush parking

12.1.19P4 Lane drill
i) Lanes
ii) Roundabout
iii) Junctions

Competence
The trainee should have the ability to:
i) Carry out routine checks.
ii) Read and interpret road signs.
iii) Interpret highway codes.
iv) Start and drive a motor vehicle which observing all the regulations.
v) Drive safely on Kenyan roads
vi) Give first aids to an injured passenger and self

Suggested Learning Resources

i) Model board
ii) Highway code
iii) Vehicle
iv) Road signs
v) Model cars