TEVETA

Technical Education Vocational and Entrepreneurship Training Authority

DIPLOMA IN BIOMEDICAL ENGINEERING

LEVEL 6 YEAR II EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY - AUGUST 2026

SUBJECT: PNEUMATICS AND HYDRAULICS

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

INSTRUCTIONS TO CANDIDATE **PASS MARK: 50**

1. **Write your Examination number and National Registration Card (NRC) number on the answer booklet provided. Ensure you append your signature in the space provided on the answer booklet.**
2. **Write the ANSWER SCRIPT SERIAL NUMBER on the examination register and on the entry slip.**
3. **This paper has TWO (2) Sections.**
   - **Answer ALL questions in section A.**
   - **Answer FIVE (5) questions in Section B. Question one (1) is compulsory then answer any four (4) questions from the remaining six (6) questions.**
4. **Diagrams may be used where necessary to clarify your answer.**
5. **Cell phones and programmable calculators are not allowed in the examination room.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A: MULTIPLE CHOICE QUESTIONS **TOTAL MARKS: 20**

ANSWER ALL QUESTIONS BY CHOOSING THE BEST OPTION

1. Which fluid is used in pneumatic systems?
   A. Water
   B. Hydraulic oil
   C. Compressed air
   D. Steam

2. Which law forms the basis of hydraulic systems?
   A. Boyle's Law
   B. Pascal's Law
   C. Charles' Law
   D. Bernoulli's Principle

3. In pneumatics, the FRL unit stands for:
   A. Filter, Regulator, Lubricator
   B. Flow, Regulator, Level
   C. Filter, Relay, Lubricator
   D. Flow, Restrictor, Lubricator

4. Hydraulic systems use liquids because they are:
   A. Compressible
   B. Incompressible
   C. Volatile
   D. Reactive

5. Which component converts fluid power into mechanical motion?
   A. Valve
   B. Actuator
   C. Compressor
   D. Reservoir

6. The main function of a hydraulic pump is to:
   A. Store fluid
   B. Convert mechanical energy to fluid flow
   C. Control pressure
   D. Filter oil

7. Which of the following is not an advantage of pneumatics?
   A. Clean operation
   B. High power density
   C. Safety
   D. Simple maintenance

8. The pressure in a hydraulic system is measured in:
   A. Newtons
   B. Joules
   C. Pascals
   D. Litres

9. A non-return valve allows air to flow:
   A. In both directions
   B. In one direction only
   C. At variable pressure
   D. Through multiple ports

10. Which device converts mechanical energy into compressed air?
   A. Compressor
   B. Pump
   C. Cylinder
   D. Valve

11. Hydraulic oil must have:
   A. High compressibility
   B. Low viscosity
   C. Good lubricating properties
   D. High volatility

12. The speed of a pneumatic actuator is controlled by:
   A. Pressure control valve
   B. Flow control valve
   C. Directional valve
   D. Relief valve

13. Which component stores hydraulic fluid?
   A. Reservoir
   B. Pump
   C. Cylinder
   D. Filter

14. In pneumatics, air is usually compressed to:
   A. 1–2 bar
   B. 6–10 bar
   C. 20–30 bar
   D. 100 bar

15. Which of the following is a disadvantage of hydraulic systems?
   A. High power output
   B. Oil leakage
   C. Smooth control
   D. Compact design

16. The function of a pressure relief valve is to:
   A. Increase pressure
   B. Maintain constant flow
   C. Prevent overpressure
   D. Stop air leakage

17. Which type of compressor uses pistons to compress air?
    A. Rotary screw
    B. Centrifugal
    C. Reciprocating
    D. Vane

18. Hydraulic systems are preferred over pneumatics when:
    A. High speed is required
    B. High force is required
    C. Clean operation is needed
    D. Lightweight design is desired

19. The main difference between pneumatic and hydraulic actuators is:
    A. Type of valve used
    B. Working fluid
    C. Pressure gauge
    D. Reservoir size

20. Which property of hydraulic oil ensures smooth flow at varying temperatures?
    A. Density
    B. Viscosity
    C. Compressibility
    D. Conductivity

SECTION B

THERE ARE SEVEN (7) QUESTIONS IN THIS SECTION, ANSWER FIVE (5) QUESTIONS. QUESTION ONE (1) IS COMPULSORY.

QUESTION 1 (Compulsory)

Draw a schematic circuit of:

a) Single acting cylinder. [5 marks]
b) Double acting cylinder. [5 marks]
c) Double acting cylinder with double ended piston rod. [5 marks]
d) Double acting cylinder with non- adjustable cushioning in one direction. [5 marks]

[TOTAL: 20 MARKS]

QUESTION 2

Explain the purpose of the following in a pneumatics system.

a) Air filter [3 marks]
b) Actuator [3 marks]
c) Air lubricator [3 marks]
d) Pressure gauge [3 marks]
e) Silencer [3 marks]

[TOTAL: 15 MARKS]

QUESTION 3

a) Describe **five (5)** factors influencing the selection of hydraulic oil for biomedical engineering applications. [15 marks]

[TOTAL: 15 MARKS]

QUESTION 4

a) State the role of pressure control valves in maintaining system safety and efficiency. [2 marks]
b) Compare the functions of flow control valves and directional control valves in pneumatic circuits. [4 marks]
c) Draw the symbols for the following types of valves.
   i) Check valve. [3 marks]
   ii) Spring loaded check valve [3 marks]
   iii) Shuttle valve [3 marks]

[TOTAL: 15 MARKS]

QUESTION 5

a) State **two (2)** types of actuators. [2 marks]
b) Explain the function of actuators. [4 marks]
c) Explain three (3) major differences between the air motor and an electric motor. [9 marks]

[TOTAL: 15 MARKS]

QUESTION 6

a) State **five (5)** hydraulic components that form the basic hydraulic system. [5 marks]

b) Explain **five (5)** common causes of failure in hydraulic system. [10 marks]

[TOTAL: 15 MARKS]

QUESTION 7

a) Describe **five (5)** types of control valve that you. [15 marks]

[TOTAL: 15 MARKS]