071906T4AEN

AGRICULTURAL ENGINEERING LEVEL6

ENG/OS/AGR/CC/04/6

Apply Principles of Fluid Mechanics

November/December 2025

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

Time: 3 HOURS

INSTRUCCANDIDATE

1. This paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** questions in section A and **ANY THREE** (3) questions in section B.
3. Marks for each question are indicated in the brackets.
4. Candidates are provided with a separate answer booklet
5. Do not write on the question paper.

This paper consists of THREE (3) printed pages

Candidate should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

Answer ALL the questions in this section.

1. Fluid is a substance forms continuously when subjected to external shearing force. State FOUR classifications of fluids. (4 marks)
2. Water flows from a pipe with a diameter of 1 m into another pipe with a diameter of 0.5 m. If the velocity in the first pipe is 5 m/s, calculate the velocity in the second pipe. (4 marks)
3. A pipe 200m long, 0.1m diameter carries water at $0.002m^3/s$. calculate the head loss due to friction. (take f =0.02). (4 marks)
4. Losses in pipes are a reduction in the total energy of a fluid as it flows through a piping system. State FOUR minor losses in pipes (4 marks)
5. Non-uniform flow is that type of flow in which the velocity at any given time changes with respect to space. State TWO examples of non-uniform flow (2 marks)
6. Three-dimensional flow is that type of flow in which the velocity is a function of time and three mutually perpendicular directions. List TWO types of three-dimensional flow. (2 marks)
7. Laminar flow is a type of fluid motion. State FOUR characteristics of laminar flow. (4 marks)
8. Pumps are mechanical devices that transfer energy to a fluid to move it from one location to another, often increasing its pressure or elevation. Outline FOUR factors to consider in pump installation (4 marks)
9. The space between two square flat parallel plates is filledil. Each side of the plate is 720 mm. The thickness of the oil film is 15 mm. The upper plate, which moves at 3 m/s requires a force of 120 N to maintain the speed. Determine:
    a) The dynamic viscosity of the oil. (2 marks)
    b) viscosity of oil if the specific gravity of oil is 0.95. (2 marks)
10. The Reynolds number is a dimensionless quantity in fluid dynamics used to predict whether fluid flow patterns will be laminar or turnolds flow depends on several factors. List FOUR factors that influence the Reynolds number. (4 marks)
11. A centrifugal pump is a mechanical device that converts rotational energy from a motor or engine into kinetic ener classify centrifugal pumps. (4 marks)

SECTION B (60 MARKS)

Attempt Any THREE Questions in This Section

12. A centrifugal pump on the principle that when a certain mass of fluid is rotated by an external source, it is thrown away from the central axis of rotation and a centrifugal head is impressed which enables it to rise to a higher level.
    a) Outline THREE efficiencies applicable to centrifugal pump. (6 marks)
    b) With the aid of a sketch describe the working principle of a centrifugal pump (14 marks)

13. Dimensional analysis is a mathematical technique which makes use of the study of the dimensions.
    a) Explain FOUR uses of dimensional analysis. (4 marks)
    b) Using the M-L-T System, perform the Dimension analysis of the following physical quantities
        i. Pressure (2 Marks)
        ii. Force (2 Marks)
        iii. Specific weight (3 Marks)
    c) Prove that Reynolds number $Re = \frac{\rho V d}{\mu}$ is dimensionally homogeneous. (5 marks)
    d) List FOUR limitations of dimensional analysis (4 marks)

14. Viscosity is a measure of a fluid's resistance to flow. It's often described as the thickness of a fluid.
    a) Explain TWO effects of temperature on viscos. (4 marks)
    b) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 litres/sec. through a 1.2m diameter pipe. Tests were conducted on a meter pipe using water at 20°C. If the viscosity water at 20° C is 0.01 poise, find:
        i. Velocity of flow in the model. (7 marks)
        ii. Rate of flow in the model. (3 marks)
    c) A circular disc of diameter D is slowly rotated in a liquid of large viscosity (μ) at a small distance (h) e. Derive an expression of torque (T) necessary to maintain an angular velocity (ω). (6 marks)

15. The reciprocating pump is a positive displacement pump as it sucks and raises the liquid by actually displacing it with a piston/plunger.
    a) aid of a neat sketch explain the operation of a double acting reciprocating pump. (10 marks)
    b) A single-acting reciprocating pump, running at 50 r.p.m. delivers 0.00736 m3/s of water. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 3.5 m and 11.5 m respectively. Determine:
        i. Theoretical discharge, (2 marks)
        ii. Co-efficient of discharge, (2 marks)

iii. Percentage slip of the pump, (2 marks)
iv. Power required to run the pump. (4 marks)