



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2401 : INDUSTRIAL HYDRAULICS
END OF SEMESTER EXAMINATION
SERIES: DECEMBER2016
TIME: 2 HOURS
DATE: Pick DateDec2016

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions.

Question **ONE** is **COMPULSORY**

Attempt any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Mobile phones are not allowed in the examination room.

Question ONE (COMPULSORY: 30 Marks)

- a) State **FIVE** (5) advantages of hydraulic systems over other methods of power transmission. (5 Marks)
- b) i) Outline **THREE** functions of hydraulic system reservoirs.
ii) Explain the principle of operation of the following hydraulic filters.
 - Surface filtration
 - Depth filtration (5 Marks)
- c) Outline two possible causes and remedies for each of the following trouble in hydraulic system:
 - i) Absence of proper speed and torque of the hydraulic motor.
 - ii) Sudden drop of pressure in the accumulator. (5 Marks)

d) A hydraulic system is to be designed for clamping work and to perform drilling operation. The system is to consist of the following components:

- Reservoir
- Pump
- Safety Valve
- Manually operated spring centered three position four way directional control valve
- Throttle check valve
- Hydraulic cylinder

Using two line diagram and hydraulic symbols, design and draw a suitable circuit diagram for the system. (15 Marks)

Question TWO (20 Marks)

- a) i) Mention FOUR (4) major functions of a hydraulic accumulator (2 Marks)
ii) Assisted by diagrams, differentiate between a spring-loaded accumulator and a bag-type accumulator. For any of these accumulators, describe its operations and the limitations. (4 Marks)
- b) i) Differentiate between filters and strainers and name the THREE (3) parts of a Full-flow hydraulic filter and their functions. (4 Marks)
ii) Describe the structure and operation of a proportional flow filter and state when it can be used. (3 Marks)
- c) A 25 cm diameter pipe carries lubrication oil of 0.9 specific gravity at a velocity of 3 m/s. Find the mass flow rate of oil. What will be the oil velocity at another section where diameter is reduced to 20 cm. (4 Marks)
- d) Water under a pressure of 29.43 N/cm² (g) and velocity of 2 m/s is flowing through a 5 cm diameter pipe. Find the total head of water at a section 5 m above datum line. (3 Marks)

Question THREE (20 Marks)

- a) Explain the working principles of the following devices:
- I. Hydraulic Press (3 Marks)
 - II. Hydraulic Lift (3 Marks)
 - III. Hydraulic Intensifier (3 Marks)
- b) A certain machinery is operated with a hydraulic accumulator through a pipe 180 m long and 100 mm diameter. The accumulator has ram 250 mm diameter and 3 m stroke and is loaded with 345 kN weight. It is fed with water from a

three throw pump at 45 rpm. The plunger of the pump has a diameter of 45 mm and stroke of 350 mm; the slip being 3 per cent. If the machinery absorbs 36.8 kW power, calculate the longest period for which it can be operated continuously.

Take friction factor, $f=0.032$.

(11 Marks)

Question FOUR (20 Marks)

- a) Define the following terms used in connection with the flow of a liquid:
- i) Uniform flow (1.5 Marks)
 - ii) Unsteady Flow (1.5 Marks)
 - iii) Mass Flow Rate (1.5 Marks)
 - iv) Mean Velocity (1.5 Marks)
 - v) Steady Flow (1.5 Marks)
 - vi) Discharge (1.5 Marks)
- b) A jet of water is discharged through a nozzle with an effective diameter of 75 mm and a velocity of 22.5 m/s. Calculate the power of the issuing jet. If the nozzle is supplied from a reservoir which is 30 m above it, what is the loss of head in the pipeline and nozzle and the efficiency of power transmission?

(11 Marks)

Question FIVE (20 Marks)

- a) Name two types of hydraulic pump in each of the following categories:
- Non-Positive Displacement
 - Positive Displacement
- With the aid of a sketch, explain the operation of lobe pump. (8 Marks)
- b) State Seven (7) requirements imposed on a hydraulic liquid that make it acceptable to be used in hydraulic systems. (7 Marks)
- c) With the aid of a diagram, state the following:
- i) Interaction of hydraulic and atmospheric pressures
 - ii) Effect of friction on pressure (5 Marks)