TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2401: INDUSTRIAL HYDRAULICS

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MARCH 2014

TIME: 2 HOURS

INSTRUCTIONS:

- This paper consists of **FIVE** questions.
- Answer any **THREE** questions. All questions carry **EQUA**L marks.
- All symbols have their usual meaning unless specified otherwise. Use clear and neat sketches.

This paper consists of Three printed pages

QUESTION 1 (Compulsory)

a) Illustrate the operation of the following types of cylinders as used in hydraulic systems:
   i) Double rod cylinder
   ii) Single acting cylinder with spring.
   With the aid of a sketch, explain the construction of a Tie-Rod cylinder. **(10 marks)**

b) i) Differentiate a Relief valve from a sequence valve in pressure control valve.
   ii) Outline the **FOUR** variables upon which the flow of hydraulic fluid depends on in a Throttle valve. **(10 marks)**

QUESTION 2

a) i) Outline any **FOUR** desirable properties of a hydraulic fluid.
ii) Explain the cause of sludge in a hydraulic fluid and its effects on a hydraulic system. **(11 marks)**

b) I) List **FOUR** factors considered when selecting a hydraulic pump for a particular application
II) With the aid of sketches explain the construction and operation of following hydraulic pumps:
i) Internal gear pump
ii) Balanced vane pump **(9 marks)**

QUESTION 3

a) Define the following terms in connection with the flow of a liquid:
i) Uniform flow **(2 marks)**
ii) Steady flow **(2 marks)**
iii) Unsteady flow **(2 marks)**
iv) Mean velocity **(2 marks)**
v) Discharge **(2 marks)**
vi) Mass flow rate **(2 marks)**

b) A hydraulic hose with internal diameter of 0.025m is carrying oil with kinematic viscosity 5.0×10^{-5} m^2/s at a flow rate of $0.00126 m^3/s$. Calculate the Reynolds number and determine if the flow is laminar or turbulent. **(5 marks)**

c) $10 m^3/h$ of water flows through a pipe of 100mm inside diameter. The pipe is later reduced to an inside dimension of 80mm. calculate the flow velocity in each section of the pipe. **(3 marks)**

QUESTION 4

a) i) State the Pascal's law as applied to hydraulics.
ii) Explain **FOUR** functions of a hydraulic fluid in a hydraulic system. **(5 marks)**

b) I) Name **TWO** types of hydraulic pump in each of the following categories:
i) Non positive displacement
ii) Positive displacement

II) With the aid of a sketch, explain the operation of a lobe pump. **(7 marks)**

c) A pipeline connecting two reservoirs having a difference of level of 6m is 720m long, and rises to a height of 3m above the upper reservoir at a distance of 240m from the entrance before falling to the lower reservoir. If the pipe is 1.2m in diameter and the frictional coefficient f= 0.01, what will be the discharge and the pressure at the highest point of the pipeline. **(8 marks)**

QUESTION 5

a) I) Outline **THREE** functions of hydraulic system reservoirs.
II) Explain the principle of operation of the following hydraulic filters

i) Surface filtration
ii) Depth filtration **(5 marks)**

b) A hydraulic system is to be designed for clamping work and to perform drilling operation. The system is to consist of the following components:
i) Reservoir
ii) Pump
iii) Relief valve
iv) Manually operated spring centered three position four way directional control valve.
v) Two sequence valves
vi) Two double acting actuators.

Using two line diagram and hydraulic symbols design, draw a suitable circuit diagram for the system. **(10 marks)**

c) Outline **TWO** possible causes and the 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)**