THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY
MECHANICAL & ROBOTICS ENGINEERING (DMRE 5)
INSTRUMENTATION & CONTROL ENGINEERING (DICE 5)

EME 2308: PNEUMATIC & HYDRAULICS

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: OCTOBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*

This paper consists of **FIVE** questions. Answer question **ONE (COMPULSORY)** and any other **TWO** questions

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

This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question 1

a) State **FIVE** advantages of Hydraulic power area pneumatic power (5 marks)

b) Explain the formation
   i. Turbulence
   ii. Eddies (4 marks)

c) Calculate the absolute pressure of a 76cm head of mercury given its relative density as 936 and the atmosphere pressure as 101.3KN (5 marks)

d) Sketch a simple oil barometer showing an atmosphere pressure of $78.4N/m^2$ given the relative density of oil is 0.8 (take $g = 9.81m/s^2$) (3 marks)

e) State the **FIVE** basic components that make up a hydraulic or pneumatic circuit (5 marks)

f) Explain the following:
   i. Viscosity
   ii. Streamline flow
   iii. Hydrostatics
   iv. Fluid (4 marks)

g) From basic principles, derive the Bernoulli's equation (4 marks)

SECTION B (Answer *any TWO questions from this section - 20 marks each*)

Question 2

a) Water flows at a rate of 9000kg/min between an inlet of 0.9m diameter and an outlet of 0.45m diameter. The inlet is 1.3m vertically above outlet. Given the density of water as $1000kg/m^3$. Calculate the pressure difference between the Inlet and the Outlet. (10 marks)

b) Design and sketch a pneumatic circuit for a car wash consisting of the following components
   i. Non Return value
   ii. Pressure relief value
   iii. Compressor
   iv. Filter
   v. Pressure regulator
   vi. Pressure gauge
   vii. Globe value
   viii. Reservoir (10 marks)

Question 3

$$\frac{p}{\rho g} = \frac{V^2}{2}$$

a) From the conservation of energy principle, show that;

Where p – static pressure
ρ
- Density
G = gravitational acceleration
V = Velocity (7 marks)

b) An oxifice of 50mm diameter is at the base of a tank filled with oil upto 6m depth and at a vertical height of 30m from the ground. If the relative density of the oil is 0.8 and the pressure loss is a head of 3.6m.
Calculate
i. The volumetric and the mass flow rates of discharge of the oil through the orifice
ii. The power the oil develops as it hits the ground
iii. The power loss in KW. (13 marks)

Question 4

a) Design and sketch a hydraulic circuit for a hydraulic powered conveyor system having the following components

i. Filter
ii. Reservoir
iii. Pressure relief value
iv. Pressure regulator
v. Pressure gauge.
vi. 3 position, 4 way directional control value
vii. 5 Double acting cylinder
viii. Pump (12 marks)

b) The inlet and outlet pressure of a fluid flowing in a horizontal pipe are 126KN/m2 and 140KN/m2 respectively. The pipe tapers from 100m diameter at the inlet to 150mm diameter at the outlet. If the fluid has a relative density of 0.8, calculate the mass and volumetric flow rate at the outlet. (8 marks)

Question 5

a) The jet of a fluid from a 10mm diameter orifice falls a vertical distance of 33cm and a horizontal distance of 1.5m away from a tank filled with oil up to a depth of 7.8m. If the mass flow rate is 13.6kg/min and the relative density of the oil is 0.76, calculate:
i. The co-efficient of discharge
ii. The co-efficient of velocity
iii. The co-efficient of contraction
iv. The power of the jet (12 marks)

b) Explain the working principle and sketch the graphic symbol for the following components.
i. Strainer/filter
ii. Pressure relief value
iii. Pressure regulator
iv. Double acting cylinder (8 marks)