MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

MED-PR 208: FLUID MECHANICS II

DATE:30/5/2017 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) State and briefly illustrate the application of the principle of dimensional homogeneity. (10 marks)

b) Calculate the loss of head and power required to maintain flow in a horizontal circular pipe of 40mm diameter and 750m long when water of dynamic viscosity 0.00114Ns/m^2 flows through it at a rate of 4 litres per minute. (10 marks)

c) i. Show from basic principles that for a steady fluid flow under laminar condition, the pressure gradient equals the shear gradient.

ii. Name three areas in engineering where lamina flow occurs (10 marks)

QUESTION TWO (20 MARKS)

a) The variables controlling the motion of a floating vessel through water are the drag force (R),the speed (V),the length (L),the density (ϱ),the dynamic viscosity (μ) and the gravitational acceleration (g).Using Buckingham's pie – theorem, show that the drag is given by the expression;

$$R = \varrho V^2 L^2 \phi \left\{ \frac{\varrho VL}{\mu} \quad \frac{V}{\sqrt{Lg}} \right\}$$

(15 marks)

b) A model of the above phenomena is depends only on Froude number only, the scale ratio is 1/25 and its drag at a speed of 6m/s is1.8N, determine the drag of the prototype at the corresponding speed. (5 marks)

QUESTION THREE (20 MARKS)

a) Show that the loss of head, H_L when a pipe undergoes a sudden increase in diameter is given by;

$$H_L = \frac{(v_1 - v_2)^2}{2g}$$

Where v_1 and v_2 are velocities at sections while g is the gravitational acceleration. (10 marks)

b) Two reservoirs are connected by a horizontal pipeline consisting of two pipes joined together. The entrance and exit are sharp and the change in section is sudden. One of the pipe is 125mm diameter and 8 meter long and the other of diameter 200mm and 18m long empties water to the second reservoir. If the difference in the water level in the two reservoir is 7m and the friction coefficient is 0.01 determine the;

i. Velocity of water at entry to the second reservoir

ii. Power output as water enters the second reservoir (10 marks)

QUESTION FOUR (20 MARKS)

a) Show from basic principles that the loss of head,h_f in a pipe due to friction under laminar flow is given by;

$$h_f = \frac{32\mu\bar{v}l}{\omega D^2}.$$

Where μ=coefficient of dynamic viscosity, $\bar{v}$=mean velocity of flow,

D = diameter of pipe, l = length of pipe and ω=specific weight of fluid. (15 marks)

b) A pump is designed to pump fluid in a pipe of 650mm diameter and 850m long, at a rate of 200litres/minute. The oil dynamic viscosity is 0.8Nm/s and specific gravity 0.9.If the pipe is inclined upwards at 1 in 80,assuming laminar conditions determine the;

i. Pressure difference required at the inlet and exit in order to maintain flow.

ii. Pump power if the efficiency is 85%. (5 marks)

QUESTION FIVE (20 MARKS)

a) i. With reference to pumps define the term cavitation and explain any two of its effects and causes.

ii. State three main reasons why air vessels are fitted in reciprocating pumps

(5 marks)

b) A double - acting reciprocating pump of 200mm diameter by 300mm stroke draws water from a source 5m below and delivers to a height 50m above its level. Both suction and delivery pipes are 100mm diameter and their respective lengths are 6m and 7m.The pump piston has simple harmonic motion and makes 40 double stokes per minute. The air vessel on the suction side is 2m away from the cylinder, while that on the delivery side is 5m away. The friction coefficient for the pipe is 0.04 Determine the pressure difference between the two sides of the piston when the crank position is 45^0 from the inner – dead – centre. (15 marks)