MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

DIPLOMA IN MOTOR VEHICLE ENGINEERING

SET 2101/321 : FLUID MECHANICS

SET 2501/304B: FLUID MECHANICS

SET 2503/304B: FLUID MECHANICS

DATE: 2/8/2016 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

- **Attempt any FOUR questions.**

QUESTION ONE

Methods of dimensional analysis show that the resistance R, of a ship is given by the following expression;

$$R = \varrho V^2 L^2 \phi \left\{ \frac{\varrho LV}{\mu}, \frac{V^2}{Lg} \right\}$$

Where ϱ = Density of water, L = length of the ship, V =Velocity of flow, g = Gravitational acceleration, μ = Dynamic viscosity of water

A ship of the above phenomena has a length of 135m and a wetted area of 2350m^2 when in water. A model of the same has a length of 5m and when towed in fresh water at a velocity of 1.5m/s, experiences a total resistance of 25.55N. The model surface has a skin resistance of 11N/m^2 at a velocity of 3m/s and velocity index of 1.90.When the ship in sea water ofdensity 1025Kg/m^3 andmoving at a velocity of 3m/s has a velocity index of 1.85 and the skinresistance of 45N/m^2.Determine the shaft power required to propel the ship at the corresponding speed with the propeller efficiency of 85%. (20 marks)

QUESTION TWO

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 15cm diameter and 6 meter long and the other of diameter 22.5cm and 16mlong empties water tothe second reservoir. if the difference in the water level in the two reservoir is 6m and thefriction coefficient is 0.04 determine the;

(a) Velocity of water at entry to the second reservoir (16 marks)

(b) Discharge (2 marks)

(c) Power output as water enters the second reservoir (2 marks)

QUESTION THREE

(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.(15marks)

(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 FOUR

(a) Stating the assumptions made, show from basic principles that Frictional head loss h_f of a fluid flowing at a mean velocity, $\bar{v}$ in an Inclined Pipe of length, L and diameter, D is given by;

$$h_f = 4f\frac{L\bar{v}^2}{D2g}$$

Where g is gravitational acceleration and f is the friction coefficient. (14 marks)

(b) A pipe of diameter 5m loaded with oil of specific gravity 0.8 has a sharp entrance, the pipe suddenly contracts to a diameter of 2m and velocity Changes from 12m/s to 30m/s. the contraction coefficient is 0.644 and Neglecting friction loss, calculate the power developed. (6 marks)

QUESTION FIVE

(a) Show that when a fluid flows between two parallel plates at a distance h, and length L, the velocity V, of the flow of an elemental strip at distance y, from the axis of the plates is given by the following expression;

$$V = \frac{P}{2\mu L}\left\{\frac{h^2}{4} - y^2\right\}$$

Where P is the pressure difference between the ends of the plates and μ is the dynamic Viscosity. (15 marks)

(b) Oil of dynamic viscosity 0.687Ns/m is contained in a cylindrical tank of 6m diameter. Leakageoccurs at the circumferential seam which consists of riveted lap joints, when oil pressure is 345KN/m^2.If the plate overlap is100mm and the effective gap between the plates is 0.025mm, determine the rate of leakage when the effective circumferential length of the opening is 40%. (5 marks)