



# 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

#### FIRST SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

#### SUPPLEMENTARY EXAM

#### FLUID MECHANICS 11

DATE: 1/8/2016

TIME: 8.30-10.30 AM

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#### **INSTRUCTIONS:**

*This paper consists of two sections. Section A is compulsory, and then answer any other two questions from section B*

#### **SECTION A**

1. a) The friction factor for 25cm diameter pipe carrying water is 0.03. if the shear stress in water at 5cm from the pipe centre is  $13.734 \text{ N/m}^2$ , calculate the flow rate  
(7 marks)
- b) What size of pipe would be required to carry 176.58 M of oils  $s=0.90$ ,  $v=0.002 \text{ m}^2(\text{sec})$  per second through a 300m long horizontal pipe? The loss of head in pipe is 7m of oil.  
(10 marks)
- c) A crude oil ( $s=0.90$ ) flows through a horizontal pipe 100mm in diameter and 10m long and 1000kg of oil is collected in 5 minutes. If the pressure difference at the two ends is  $14.715 \text{ KN/M}^2$ , calculate the viscosity of the oil.  
(13 marks)

#### **SECTION B**

2. a) list three conditions of lamina flow. (3 marks)

- b) The thrust on a 100mm diameter shaft is taken by a collar formed by stepping down the shaft diameter at one end to 50mm. This end is fitted into a bearing pad. If the thickness for the oils  $\mu = 1.5$  (poise) between the annular surface of the collar and the bearing pad is 0.5mm, calculate the power absorbed by the collar bearing. The shaft is rotating at 600 r.p.m. (10 marks)
3. a) Draw the diagram of a centrifugal pump and explain how it works. (10 marks)
- b) Water is raised to a height of 20m above the pump level by a simple acting reciprocating pump having a bore of 15cm and a stroke of 30cm. If the pump has a speed of 60 r.p.m., find the theoretical power and the theoretical discharge. If the efficiency of the pump is 70%, calculate the actual power. If the pump's actual discharge is 0.0052 cumecs, find the percentage slip. (10 marks)
4. a) Derive an equation for the work done on the impeller pump (10 marks)
- b) A centrifugal pump with radial in flow delivers 0.08 cumecs of water against a total head of 40m. If the outer diameter of the impeller is 30 cm and its width at the outer peripheral is 1.25cm, find the blade angles at exit. The speed of the pump is 1500 r.p.m. and its manometric efficiency is 80%. (10 marks)
5. a) Derive an expression for the loss of head due to friction in a pipeline in terms of the velocity head, assuming that the frictional resistance per unit area of pipe wall is proportional to the square of the mean velocity of flow. (10 marks)
- b) What minimum diameter of pipe is necessary to carry 0.25 kg/sec of air with a maximum velocity of 6m per second? The air is at a temperature of  $27^{\circ}\text{C}$  and an absolute pressure of 196.2 kN/m<sup>2</sup>.  $R = 28.7 \text{ J/kgK}$ . (10 marks)