



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 309: HYDRAULICS II

DATE: 1/12/2020

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Differentiate between the following terms as applied in hydraulics
- i) Theoretical Discharge and Actual Discharge (3 marks)
 - ii) Mechanical efficiency and Volumetric efficiency (3 marks)
 - iii) Reaction Turbine and Impulse Turbine (3 marks)
- b) Briefly highlight the working mechanism of a double action-reciprocating pump (4 marks)
- c) Describe four advantages of a centrifugal pump (4 marks)
- d) Discuss Four the differences between Francis Turbine and Kaplan Turbine (4 marks)
- e) Calculate the exit blade angle for an impeller of a pump that delivers $1.27 \text{ m}^3/\text{min}$ at 1250 rpm. The impeller diameter is 360 mm and the breadth at outlet is 12.5 mm. The pressure difference between the inlet and outlet flanges is 250 kN/m^2 , take manometric efficiency at 73%. (9 marks)

QUESTION TWO (20 MARKS)

- a) Differentiate between closed impeller and semi-open impeller (3 marks)
- b) The impeller of a centrifugal pump had an external diameter of 450 mm and internal diameter of 150 mm and runs at 1245 rpm. Assuming a constant radial flow through the impeller at 2.5 m/s and that the vanes at exit are set back at an angle 20° , determine:
- i) Inlet vane angle (6 marks)
 - ii) The angle, absolute velocity of water at exit makes with tangent (6 marks)
 - iii) The work done per N of water (5 marks)

QUESTION THREE (20 MARKS)

- a) Describe Three reasons why the actual discharge is always slightly different from the theoretical discharge (3 marks)
- b) A single acting reciprocating pump operating at 145rpm has a piston diameter of 230mm and stroke of 350 mm. The suction and delivery heads are 4.5 m and 20.5 m respectively. If the efficiency of both suction and delivery strokes is 80%, determine the power required by the pump. (8 marks)
- i. Theoretical discharge (4 marks)
- ii. Power required by the pump (5 marks)

QUESTION FOUR (20 MARKS)

- a) Highlight the difference between Gross head and Net head (4 marks)
- b) A pelton wheel having a mean bucket diameter of 1.45m is running at 1250rpm. The net head on the Pelton wheel is 870m. If the side clearance angle is 17° and the discharge through the nozzle is $0.14 \text{ m}^3/\text{s}$, determine:
- i. Power available at the nozzle (8 marks)
- ii. Hydraulic efficiency of the turbine (8 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the function of a draft tube in Francis turbines (7 marks)
- b) In a Francis turbine the supply head is 13 m and flow rate is $0.28 \text{ m}^3/\text{s}$, outer diameter is half the inner diameter 12 m. The velocity of flow is $0.15 (2gH)^{0.5}$. The inner vanes are radial at inlet and runner rotates at 300 rpm. The hydraulic efficiency is 80%. Determine guide vane angle and runner vane angle at exit for radial discharge. (13 marks)