



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 309: HYDRAULICS II

DATE:

TIME:

INSTRUCTIONS:

- This paper comprises of FIVE questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Differentiate between the following terms:
- Turbine and Pump (3 marks)
 - Hydraulic efficiency and volumetric efficiency of turbine (3 marks)
 - Closed impeller and semi-open impeller (3 marks)
 - Axial flow and radial flow (3 marks)
- b) Briefly highlight the working mechanism of a centrifugal pump (3 marks)
- c) Discuss Four differences between Francis Turbine and Kaplan Turbine. (4 marks)
- d) Impeller of a centrifugal pump has an external diameter of 460 mm and internal diameter of 220 mm and it runs at 1460 r.p.m. Assuming a constant radial flow through the impeller at 2.5 m/s and the vanes at exit are set back at an angle 25° , determine:
- Inlet vane angle (3 marks)
 - The angle, absolute velocity of water makes with the tangent (4 marks)
 - Work done per N of water (4 marks)

QUESTION TWO (20 MARKS)

- a) Discuss the two essential functions of casing in centrifugal pumps (8 marks)
- b) A centrifugal pump is to discharge $0.125 \text{ m}^3/\text{s}$ at a speed of 1550 r.p.m against a head of 30 m. The impeller diameter is 300 mm, its width at outlet is 60 mm and manometric efficiency is 80%. Determine the vane angle at the outer periphery of the impeller. (12 marks)

QUESTION THREE (20 MARKS)

- a) Describe function of indicator diagram in reciprocating pump (6 marks)
- b) A single-acting reciprocating pump has a stroke length of 160 mm, suction pipe is 8 m long and the ratio of suction pipe diameter to the piston diameter is $3/4$. The water level in the sump is 2.5 m below the axis of the pump cylinder and the pipe connecting the sump and pump cylinder is 75 mm in diameter. If the crank is running at 80 r.p.m., determine the pressure head on the piston at the beginning, middle and end of the suction stroke. Take friction co-efficient, $f = 0.01$. (14 marks)

QUESTION FOUR (20 MARKS)

- a) Define the term runaway speed used in turbines (3 marks)
- The maximum speed, governor being disengaged, at which a turbine would run when there is no external load but operating under design head and discharge. All the rotating parts including the rotor of alternator should be designed for the centrifugal stresses caused by this maximum speed.
- b) A single jet Pelton wheel runs at 290 r.p.m under a head of 490 m. The jet diameter is 195 mm, its deflection inside the bucket is 162° and its relative velocity is reduced by 13% due to friction. Determine:
- Take mechanical losses 3%, coefficient of velocity 0.98, speed ratio 0.46.
- (i) Water power (5 marks)
- (ii) Resultant force on the bucket (6 marks)
- (iii) Overall efficiency (6 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the two function of draft tubes in reaction turbines (6 marks)
- b) For an inward flow turbine the head on the/ turbine is 32m. Internal and external diameters are 0.72 and 1.44m. The flow velocity of flow through the runner is 3m/s. Guide blade angle is 10° and the runner vanes are rigid at the inlet. If the discharge at outlet is radial, determine:
- i) Speed of the turbine (4 marks)
 - ii) Vane angle at outlet of the runner (6 marks)
 - iii) Hydraulic efficiency (4 marks)