



MACHAKOS UNIVERSITY

University examinations 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR
BACHELOR IN CIVIL ENGINEERING

ECV 309: HYDRAULICS II

Date 8/3/2023

time 8:30 – 10:00 AM

INSTRUCTIONS

- *This paper comprises of five questions. Answer **three** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **two** questions*

1. (a) Differentiate between the following terms as applied in hydraulics

- Piezometric head and Dynamic head (3 marks)
- Volumetric efficiency and Hydraulic efficiency (3 marks)
- Reaction Turbine and Impulse Turbine (3 marks)
- Static head and Velocity head (3 marks)
- Coefficient of discharge and Percentage slip (3 marks)

(b) Briefly highlight four working principles of pumps (4 marks)

(c) Highlight four advantages of a centrifugal pump (4 marks)

(d) Discuss four differences between Francis Turbine and Kaplan Turbine

(8 marks)

(e) Calculate the exit blade angle for an impeller of a pump that delivers $1.37\text{m}^3/\text{min}$ at 1350 rpm. The impeller diameter is 460 mm and the breadth at outlet is 13.5 mm. The pressure difference between the inlet and outlet flanges is 350 kN/m^2 ; take manometric efficiency at 70%.
(9marks)

2. (a) Differentiate between closed impeller and open impeller (3 marks)
- (b) The impeller of a centrifugal pump had an external diameter of 350 mm and internal diameter of 100 mm and runs at 1140 rpm. Assuming a constant radial flow through the impeller at 1.5 m/s and that the vanes at exit are set back at an angle 20° , determine:
- (i) Inlet vane angle (4 marks)
- (ii) The angle, absolute velocity of water at exit makes with tangent (4 marks)
- (iii) The work done per N of water (4 marks)
3. (a) Explain two reasons why the actual discharge is always slightly different from the theoretical discharge (4 marks)
- (b) A single acting reciprocating pump operating at 250rpm has a piston diameter of 260mm and stroke of 380 mm. The suction and delivery heads are 6.5 m and 25 m respectively. If the efficiency of both suction and delivery strokes is 80%, determine:
Given: $N = 250\text{ rpm}$, $D = 0.26\text{ m}$, $L = 0.38\text{ m}$, $h_s = 6.5\text{ m}$, $h_d = 25\text{ m}$.
- (i) Theoretical discharge (4.5 marks)
- (ii) Power required by the pump (6 marks)
4. (a) Highlight the difference between Gross head and Net head (3 marks)
- (b) A Pelton wheel having a mean bucket diameter of 1.65m is running at 1350rpm. The net head on the Pelton wheel is 1060m. If the side clearance angle is 16° and the discharge through the nozzle is $0.135\text{ m}^3/\text{s}$, determine:
- (i) Power available at the nozzle (6 marks)
- (ii) Hydraulic efficiency of the turbine (6 marks)

5. (a) Describe the function of a draft tube in Francis turbines (5 marks)
- (b) Describe the three characteristic curves in of centrifugal pumps (15 marks)