



MACHAKOS UNIVERSITY

University Examination 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 309: HYDRAULICS II

DATE: 24/3/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS: Answer questions **ONE** and any other **TWO** questions

1. a) Define the following terms as applied in hydraulics
 - i) Suction pipe (2 marks)
 - ii) Mechanical efficiency (2 marks)
 - iii) Turbine (2 marks)
 - iv) Static head (2 marks)
 - v) Specific speed (2 marks)
 - vi) Pump Priming (2 marks)
 - vii) Coefficient of discharge (2 marks)
- b) Briefly highlight the working mechanism of a single action-reciprocating pump (4 marks)
- c) Describe losses of centrifugal pump (4 marks)
- d) Discuss the differences between Francis Turbine and Kaplan Turbine (8 marks)
- e) A Pelton wheel having a mean bucket diameter of 1.45 m is running at 1450 rpm. The net head on the pelton when is 865 m. If the side clearance angle is 16° and discharge through the nozzle is $0.145 \text{ m}^3/\text{s}$, determine, power available at the nozzle and hydraulic efficiency of the turbine. (10 marks)
2. 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:
- Inlet vane angle (4 marks)
 - The angle, absolute velocity of water at exit makes with tangent (4 marks)
 - The work done per N of water (4 marks)
3. a) Differentiate between Co-efficient of discharge and slip percentage of reciprocating pumps (3 marks)
- b) A single acting reciprocating pump, running at 45 rpm delivers $0.00636 \text{ m}^3/\text{s}$ of water. The diameter of the piston is 180 mm and stroke length 280 mm. The suction and delivery heads are 3.0 m and 11.0 m respectively. Determine:
- Theoretical discharge (3 marks)
 - Co-efficient of discharge (3 marks)
 - Percentage slip of the pump (3 marks)
 - Power required to run the pump (3 marks)
4. a) Highlight the difference between Impulse turbine and Reaction turbine (3 marks)
- b) A single jet pelton turbine is required to drive a generator to develop 15000 kW. The available head at the nozzle is 850 m. Assuming electric generation efficiency 94 percent, Pelton wheel efficiency 86 percent, co-efficient of velocity for nozzle 0.95, mean bucket velocity 0.46 of jet velocity, outlet angle of the bucket 15° and the relative velocity of the water leaving the buckets 0.85 of the inlet, determine:
- Discharge (4 marks)
 - Diameter of the jet (4 marks)
 - Force exerted by the jet on the bucket (4 marks)
5. a) Differentiate between compressor and Turbine (3 marks)
- (b) A Pelton wheel develops 67.5 kW under a head of 60 m of water. It rotates at 400 rev/min. The diameter of penstock is 200 mm. The ratio of bucket speed to jet velocity is 0.46 and overall efficiency of the installation is 83%. Calculate:
- Volumetric flow rate (4 marks)
 - Diameter of the jet (4 marks)
 - Wheel diameter (4 marks)