



# MACHAKOS UNIVERSITY

University Examination 2018/2019

**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:**

**TIME:**

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**INSTRUCTIONS:** Attempt 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  $16^\circ$  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  $20^\circ$ , 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) 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:
    - i) Theoretical discharge (3 marks)
    - ii) Co-efficient of discharge (3 marks)
    - iii) Percentage slip of the pump (3 marks)
    - iv) 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  $15^\circ$  and the relative velocity of the water leaving the buckets 0.85 of the inlet, determine:
    - i) Discharge (4 marks)
    - ii) Diameter of the jet (4 marks)
    - iii) 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:
    - i) Volumetric flow rate (4 marks)
    - ii) Diameter of the jet (4 marks)
    - iii) Wheel diameter (4 marks)