# 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 $m^3/s$, 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:

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 $m^3/s$ 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° 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)