TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)

ECE 2312: HYDRAULICS II

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Pocket Calculator*

This paper consists of **FIVE** questions. Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
Use neat, large and well labeled diagrams where required
This paper consists of **TWO** printed pages

Question One

a) List the classification characteristics of centrifugal pumps **(4 marks)**

b) Show that for a centrifugal pump running at a speed N rpm and delivering a discharge $Q m^3/sec$, if the speed is changed to N_1 rpm the new discharge Q_1 will be given by the relationship $Q_1 = QN_1/N$
   (7 marks)

c) Distinguish between the specific speed of a pump and that of a turbine **(2 marks)**

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d) Derive the Lagrange celerity equation for the propagation of small waves in rectangular channels
(17 marks)

Question Two

A Pelton wheel running at 480r.p.m and operating under an available head of 420m is required to develop 4800kW. There are two equal jets and the bucket deflection angle is 165o. The overall efficiency is 85 percent when the water is discharged from the wheel in a direction parallel to the axis of rotation. The co-efficient of velocity of nozzle = 0.97 and blade speed ratio = 0.46. The relative velocity of water at exit from the bucket is 0.86 times the relative velocity at inlet. Calculate:

   a) Cross-sectional area of each jet
   b) Bucket pit h circle diameter, and;
   c) Hydraulic efficiency of the turbine   **(20 marks)**

Question Three

In a inward flow reaction turbine the head on the turbine is 32m. The external and internal diameters are 1.44m and 0.72m. The velocity of flow through the runner is constant and equal to 3m/s. The guide blade angles is $10°$ and the runner vanes are rigid at inlet. If the discharge at outlet is radial, determine:

a) The speed of the turbine
b) The vane angle at outlet of the runner, and
c) Hydraulic efficiency   **(20 marks)**

Question Four

A Pelton wheel nozzle, for which C_v = 0.97, is 400m below the water surface of a lake. The jet diameter is

$$h_f = \frac{fLV^2}{D \, x \, 2 \, g}$$

80mm, the pipe diameter is 0.6m, its length is 4km and f = 0.0.032 in the formula   . The buckets deflect the jet through 165o and they run at 0.48 times the jet speed, bucket friction reducing the relative velocity at outlet by 15 percent of the relative velocity at inlet. Mechanical efficiency = 90%. Determine:

a) The flow rate, and
b) The shaft power developed by the turbine   **(20 marks)**

Question Five

A centrifugal pump lifts water under a static head of 36m of water of which 4m is suction lift. Suction and delivery pipes are both 150mm in diameter. The head loss in suction pipe is 1.8m and in delivery pipe 7m. The impeller is 380mm in diameter and 25mm wide at mouth and revolves at 1,200rpm. Its exit blade angle is 35o. If the manometric efficiency of the pump is 82%, determine:

a) The discharge through the pump
b) The pressure at the suction and delivery branches of the pump   **(20 marks)**