KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF CIVIL ENGINEERING

ECV 309: HYDRAULICS II

DATE: THURSDAY 19TH APRIL 2012   TIME: 8.00 A.M. – 10.00 A.M.

INSTRUCTIONS:

(a)   This paper contains FIVE (5) questions.

(b)   You are required to answer THREE (3) questions only.

(c)   Question ONE is compulsory.

(d)   Attempt any other TWO questions.

(e)   Question ONE carries 30 marks and the others carry 20 marks each. Answer Question One and ANY TWO questions

Question One

a) With the aid of a sketch explain the construction and working of a pelton wheel turbine. (6 marks)

b) A pelton wheel develops 2500 kW under a head of 180metres, and with an overall efficiency of 85 per cent. Find the diameter of the nozzle, if the coefficient of velocity for the nozzle is 0.98. (8 marks)

c) A turbine is to operate under a head of 30 m at 250 rpm the discharge is 12m³/s. If the overall efficiency is 92 per cent, determine:

   i.   Power generated

   ii. Specific speed of the turbine

   iii. Type of turbine (7 marks)

d) A centrifugal pump is required to lift water to a total head of 55metres at the rate of 65 litres per second. Find the power required for the pump, if its overall efficiency is 75 per cent. (4 marks)

e) Describe five advantages of floating breakwaters coastal structures over other forms of coastal structures. (5 marks)

Question Two

a. Describe any five differences between an impulse turbine and a reaction turbine. (5 marks)

b. Give the range of specific speed values of the Kaplan, Francis turbines and pelton wheels. What factors decide whether Kaplan, Francis or Pelton wheel type turbine would be used in a hydroelectric project? (6 marks)

c. A pelton wheel, having semi-circular buckets and working under a head of 210 metres is running at 800 rpm. The discharge through the nozzle is 750 litres per second and diameter of the wheel is 600 mm. Find

   i.   Power available at the nozzle

   ii. Velocity of the jet

   iii. Hydraulic efficiency of the wheel, if coefficient of velocity is 0.98. (9 marks)

Question Three

a.   In a hydroelectric scheme, the distance between high level reservoirs at the top of mountains and turbine is 1.4 km and difference of their levels is 450 m. the water is brought in 4 penstocks each of diameter of 0.8 m connected to a nozzle of 250 mm diameter at the end. Taking coefficient of velocity as 0.98, Find:

i.   Velocity of the jet

ii.   Discharge through each jet

iii.   Power of each jet

iv.   Total power available at the reservoir, taking the value of Darcy's coefficient of friction as 0.008.   (10 marks)

b.   Describe any six advantages of centrifugal pump over reciprocating pump.   (6 marks)

c.   A pump lifts water from a large tank at a rate of 30 litres per second, if the input power is 10 kW and the pump is operating at an efficiency of 40 per cent, find the head developed across the pump.   (4 marks)

Question Four

a.   Describe the principle and working of a reciprocating pump.   (5 marks)

b.   A single-acting reciprocating pump has a plunger of diameter 400 mm and stroke of 250 mm. if the speed of the pump is 65 rpm and it delivers 30 litres per second of water. Determine:

i.   Theoretical discharge

ii.   Coefficient of discharge

iii.   Percentage slip of the pump and.   (7 marks)

c.   A centrifugal pump delivers 150 litres of water per second against a head of 90 metres at 950 rpm find the specific speed of the pump. What type of impeller would you select for the pump?   (4 marks)

d.   Describe three disturbing forces which generate waves on coastal water surfaces.
                                                                            (4 marks)

Question Five

a. A multi-stage centrifugal pump is required to lift 9 cubic meters per minute from a mine, the total head including friction being 75 metres. If the speed of the pump is 1200 rpm, find the least number of stages, if the specific speed per stage is not less than 60 rpm.

(6 marks)

b. Describe the effects of cavitation and the necessary precaution against it.

(6 marks)

c. The total power generated in a hydraulic station is 18,000 kW under a head of 16 m. while the turbine runs with a speed of 192 rpm. Find the minimum number of turbine of the same size required in case of:

i. Francis' turbines with maximum speed of 210 rpm and

ii. Kaplan turbines with maximum speed of 300 rpm.

iii. Comment why there is difference in the number of turbines in (i) and (ii) above. (8 marks)