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Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, August 2018
(2013 Scheme)
13.404 : FLUID MECHANICS – II (C)

Time : 3 Hours Max. Marks : 100

***Note** : Assume **suitable** data **if necessary**.*

PART – A

I. Answer **all** questions. **Each** question carries **4** marks.

a) Derive the expression for the most economic trapezoidal channel section.

b) Obtain an expression for integrating the equation of uniformly varied flow, by step method.

c) Briefly explain the phenomenon 'separation' and its effects.

d) What are the methods for dimensional analysis ? Describe the Rayleigh's method for dimensional analysis.

e) Distinguish between reaction turbines and impulse turbines.

PART – B

Answer **any one full** question from **each** Module. **Each full** question carries **20** marks.

Module – I

II. a) A sewer pipe line is to be laid at a slope of 1 in 8000 to carry a maximum discharge of 750 litres/s, when the depth of water is 75% of the vertical diameter. Find the diameter of this pipe if the value of Manning's N = 0.025. **10**

b) The discharge of water through a rectangular channel of width 6 m, is 18 m^3/s when the depth of flow of water is 2 m. Calculate the specific energy of the flowing water, critical depth, critical velocity and value of minimum specific energy. **10**

OR

III. a) A discharge of 40 m^3/s flows in a trapezoidal channel with bottom width 4.0 m and side slopes 2 horizontal to 1 vertical. If the normal depth at bottom slope of 0.0016 is 2.0 m, determine the values of Manning's and Chezy's constants. Is the flow subcritical or supercritical ? **8**

b) Explain the three typical cases for the location of the exact position of the hydraulic jump in a channel, with neat sketches. **12**

Module – II

IV. a) A 10 m wide, rectangular, concrete-lined channel (Manning's N = 0.013) has a bottom slope of 0.01 and a constant-level reservoir at the upstream end. The reservoir water level is 6.0 m above the channel bottom at entrance. Assuming the entrance losses and the approach velocity in the reservoir to be negligible, determine the channel discharge and qualitatively sketch the water surface profile. Assume the bottom slope is critical. **15**

b) What is surge in an open channel ? Explain positive surge due to sudden increase of flow and get the expression for the celerity of the wave. **5**

OR

V. a) The value of Chezy's C for a wide rectangular channel carrying a discharge of 5.30 m^3/s per m width is 60. If the channel slope abruptly changes from 0.0009 to 0.0049 determine the lengths of surface profiles using step method. Make computation up to y/y_o equal to 0.990 and 1.001 respectively. **12**

b) The depth and velocity of flow in a rectangular channel are 1.0 m and 1.75 m/s respectively. If the rate of inflow at the upstream is doubled, what will be the height and the absolute velocity of the resulting surge ? **8**

Module – III

VI. a) Air with kinematic viscosity $\upsilon = 1.44 \times 10^{-1}$ stokes, flows over a 0.60 m long and 1.0 m wide flat plate at a velocity of 0.80 m/s. Determine (i) the boundary layer thickness at the end of plates (ii) shear stress at 0.30 m from the leading edge and (iii) total drag force on both sides of the plate. Take $\rho = 1.208$ kg/m^3. **10**

b) The power P required to drive the pump depends on the impeller diameter D, the angular velocity ω, the discharge Q and the mass density of the flied ρ. Derive expression for P by dimensional analysis. **10**

OR

VII. A smooth plate of length 5 m and width 2 m is moving with a velocity of 4 m/s in stationery air of density 1.25 kg/m^3 and kinematic viscosity 1.5×10^{-5} m^2/s. Determine the thickness of the boundary layer at the trailing edge of the smooth plate. Find the total drug force on one side of the plate assuming that the boundary layer is turbulent from the very beginning. **20**

Module – IV

VIII. a) A jet of water having a velocity of 60 m/s impinges without shock on a series of vanes moving at 30 m/s. The direction of motion of vanes is inclined at 20° to that of jet. The angle between the inlet and outlet relative velocities is 120° and the ratio between these velocities is 0.9. Find (i) the angle θ at the entry edge of the vane and (ii) the work done by the vane N.m/N of water supplied by the jet. **10**

b) The single acting reciprocating pump running at 50 rpm delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length is 400 mm. Determine :

i) The theoretical discharge of the pump.

ii) Coefficient of discharge and

iii) Slip and the percentage of slip of the pump. **10**

OR

IX. a) With a neat sketch, explain the components and working of a Kaplan turbine. **10**

b) Find the rise in pressure in the impeller of a centrifugal pump through which water is flowing at the rate of 15 litre/s. The internal and external diameters of the impeller are 20 cm and 40 cm respectively. The width of impeller at inlet and outlet are 1.6 cm and 0.8 cm. The pump is running at 1200 rpm. Water enters the impeller radially at inlet and impeller vane angle at outlet is 30°. Neglect losses through the impeller. **10**