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320452(20)

BE (4th Semester)
Examination, April-May, 2018

(New Scheme)

Fluid Mechanics-II

Time Allowed : 3 hours | *Maximum Marks :* 80
Minimum Pass Marks : 28

Note : (*i*) Part (*a*) is compulsory. Attempt any two parts from (*b*), (*c*) and (*d*) of each question.

(*ii*) The figures in the right-hand margin indicate marks.

1. (*a*) Explain the concept of equivalent pipe. [2]

(*b*) Two pipes of diameter D and d of equal length l are considered. If the pipes are arranged in parallel, the loss of head for either pipe when a total quantity of water flows through them is h. If the pipes are arranged in series and the same quantity Q flows through them, the loss of head is H. If $d=0.5D$, find the percentage of total flow through each pipe when placed in parallel and the ratio of H to h. Neglect minor losses and assume friction coefficient to be constant. [7]

(*c*) Derive velocity distribution equation for turbulent flow in terms of mean velocity for smooth and rough pipes. [7]

(*d*) Explain the work of L.F. Moody by Moody's diagram and compare it with Nikuradse's plot related to turbulent flow in pipes. [7]

2. (*a*) Explain the term Friction Drag clearly. [2]

(*b*) Air flows over a flat plate 1 m long at a velocity of 6 m/s. Determine (*i*) the boundary layer thickness at the end of plate, (*ii*) shear stress at the middle of the plate and (*iii*) total drag per unit length on the sides of plate. Take $\rho = 1.226$ kg/m^3 and $\nu = 0.15$ stokes of air. [7]

(*c*) A kite weighing 12.26 N has an effective area of 0.9 m^2. The tension in the kite string is 32.37 N when the string makes an angle of 45° with the horizontal. For a wind of 32 km/hour, what are the coefficient of lift and drag if the kite assumes an angle of 8° with the horizontal? Take specific weight of air as 11.801 kg/m^3. [7]

(*d*) Write short notes on : [7]

(*i*) Magnus effect

(*ii*) Laminar sublayer

(*iii*) Boundary layer thickness

3. (*a*) The two alternate depths in a 4.0 m wide rectangular channel are 3.86 m and 1.0 m respectively. Find the discharge in the channel in m^3/s. [2]

(*b*) A rectangular channel is 4.0 m wide and carries a discharge of 20 m^3/s at a depth of 2.0 m. At a certain section it is proposed to build a hump. Calculate the water surface elevation at the upstream of the hump and over the hump if the hump height is 0.20 m (assume no loss of energy at the hump). [7]

(*c*) Describe the basic differential equation of gradually varied flow. Write down any two specific differential equations of gradually varied flow. [7]

(*d*) For a hydraulic jump taking place in a horizontal frictionless rectangular channel the energy loss relative to the critical depth y_c, can be expressed as

$$\left(\frac{E_L}{y_c}\right)^3 = \frac{(\eta-1)^9}{32(\eta+1)\eta^4}$$

where $\eta = y_2/y_1$ = sequence depth ratio. Prove [7]

4. (*a*) What is 'scale effect'? What are the reasons for the development of scale effect? [2]

(*b*) Explain the application of dynamic similarity to model investigation of partially submerged objects. [7]

(*c*) What is the maximum permissible velocity in a cast iron pipeline 100 mm diameter and 15 mm thick, which can be suddenly stopped by a valve at the outlet end of the pipe without letting the rise of pressure in

the pipe to be exceed 1.545×10^3 kN/m^2? Take E for cast iron as 123.606×10^9 N/m^2 and K for water as 206.01×10^7 N/m^2. [7]

(*d*) By the dimensional analysis obtain an expression for the drag force R on a partially submerged body moving with a relative velocity v in a fluid; the other variables being the linear dimension l, height of surface roughness K, fluid density ρ and gravitational acceleration g. [7]

5. (*a*) Define specific speed with its significance. [2]

(*b*) Show that the pressure at inlet of draft tube of a reaction turbine is below atmospheric pressure. [7]

(*c*) The head at the base of the nozzle of a Pelton wheel is 650 m. The outlet vane angle of the buckets is 15°. The relative velocity at outlet is reduced by 15% due to friction along the vanes. If the discharge at outlet is without whirl, find the ratio of the bucket speed to the jet speed. If the jet diameter is 100 mm while the wheel diameter is 1.2 m, find the speed of the turbine in rpm, the force exerted by the jet on the wheel, the power developed and the hydraulic efficiency. Take $C_v = 0.97$. [7]

(*d*) Write short notes on : [7]

(*i*) Component parts of a centrifugal pump

(*ii*) Different efficiencies of a centrifugal pump

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