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320412 (20)

BE (4th Semester)

Examination, April-May, 2021

Branch : Civil

FLUID MECHANICS - II

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : All questions carry equal marks. Attempt any two questions from (b), (c) & (d).

Unit-I

Q. 1. (a) What is free turbulence ? 2

(b) The velocity of flow in a rough 10 cm diameter pipe is found to increase 10% as a pitot tube is moved from a point 1.5 cm from the wall to a point 3.0 cm from the wall. Estimate the relative roughness $\frac{r_0}{\epsilon}$ and friction factor f for the pipe. **7**

(c) Explain in brief Colebrook-White equation. **7**

(d) A 25 cm diameter C.I. pipe (ϵ_o = 0.15 mm) conveys water (ν = 1×10^{-6} m^2/sec) with a hydraulic gradient of 0.025. Estimate the discharge in the pipe and the power required to pump this rate over 100 m of pipeline. **7**

Unit-II

Q. 2. (a) What do you understand by boundary layer thickness ? 2

(b) Find out the displacement and momentum thicknesses for given velocity profiles :

$$\frac{u}{U} = 2\eta - \eta^2$$

where $\eta = \left(\frac{y}{\delta}\right)$ 7

(c) Discuss in brief the drag force on sphere. 7

(d) A flat plate 2 m long and 1.5 m wide is towed at 30 km/h in water. The drag and lift coefficient are found to be 0.20 and 0.60 respectively. Calculate : 7

(i) the resultant force on the plate and

(ii) the power required to keep the plate in motion.

Unit-III

Q. 3. (a) What is specific energy ? 2

(b) Water flows at a velocity of 1 m/sec and a depth of 2.0 m in an open channel of rectangular cross-section 3.0 m wide. At a certain section the width is reduced to 1.80 m and the bed is raised by 0.65 m. Will the upstream depth be affected ? If so to what extent ? 7

(c) Prove that for gradually varied flow equation : 7

$$\frac{dy}{dx} = \frac{S_o - S_e}{1 - F^2}$$

(d) A hydraulic jump occurs in a rectangular channel and the depths of flow before and after jump are 0.5 m and 3.0 m. Calculate : 7

(i) Critical depth

(ii) Power lost/width of channel

Unit-IV

Q. 4. (a) What is water hammer ? 2

(b) The water is flowing with a velocity of 1.5 m/sec in a pipe of length 2500 m and of diameter 500 mm. At the end of the pipe, a valve is provided. Find the rise in pressure if the valve is closed in 25 seconds. Take the value of C = 1460 m/sec. 7

(c) Explain in brief Buckingham's π theorem for dimensional analysis. 7

(d) A pipe of diameter 1.5 m is required to transport an oil of sp. gr. 0.90 and viscosity 3×10^{-2} poise at the rate of 3000 litre/s. Tests were conducted on a 15 cm diameter

pipe using water at 20°C. Find the velocity and rate of flow in the model. Viscosity of water at 20°C = 0.01 poise. 7

Unit-V

Q. 5. (a) What is turbine ? 2

(b) What do you understand by the characteristic curves of turbine ? Name the important types of characteristic curves. 7

(c) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 cumec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 metres. 7

(d) Explain in brief the classification of pumps. 7