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B.E / B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATION, APRIL/MAY 2012

MECHANICAL ENGINEERING BRANCH

68

THIRD SEMESTER

CE 291 - FLUID MECHANICS AND MACHINERY

(REGULATIONS 2004)

Time: 3 hr **Marks: 100**

Answer ALL questions

Part – A (10 x 2 = 20 Marks)

1. Why the change in temperature affects viscosity in fluids?
2. What is fluid continuum?
3. Write the expressions for three boundary layer thickness
4. What is Moody Diagram and its use in pipe flow?
5. List the different types of physical model laws
6. Write the primary dimensions in dimensional analysis
7. Define specific speed for pumps and turbines
8. What is significance of draft tube in turbine?
9. What is indicator diagram used in reciprocating pumps
10. In what aspect the rotary pumps are superior the than rotodynamic machines

Part – B (5 x 16 = 80)

11. (i) Derive the expression for capillarity and surface tension of a fluid? **(8)**

(ii) A cylindrical shaft of 90 mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal diameter. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 0.2 Ns/m^2, determine the power required to overcome viscous resistance when the shaft is rotated at a speed of 240 rpm. **(8)**

12. (a) (i) A compound pipe made of 320 mm diameter for 120 m length, 450 mm diameter for 100 m length and 250 mm diameter for 80 m length. Determine the equivalent length of a pipe of diameter 125 mm whose friction coefficient is 0.0075. Assume the friction coefficient as 0.005, 0.01 and 0.006 for 120 m, 100 m and 80 m pipes respectively. Neglect all minor losses. **(10)**

(ii) The water is flowing through a taper pipe of length 50 m having diameters 40 cm at the upper end and 20 cm at the lower end, at the rate of 0.060 m^3/s. The flow in the pipe is in downward direction with a slope of 1 in 40. Find the pressure at the lower end if the pressure at the upper end is 24.525 N/cm^2. Neglect head loss due to friction. **(6)**

(OR)

(b) (i) Derive an expression for Euler's equation of motion and obtain Bernoulli's equation for a steady streamline flow. **(12)**

(ii) State the assumptions and limitations of Bernoulli's theorem. **(4)**

13. (a) A shallow river is 1500 m wide and the maximum depth of flow in it is 5 m. It carries a discharge of 3000 m^3/s, the velocity of flow being 1.5 m/s. The model of river is constructed to the horizontal scale of 1:800 and the vertical scale of 1:40. If Manning's 'n' for the bed material in the river is 0.025, find the value of 'n' for the bed material of the model. Check whether the flow in the model is turbulent. The hydraulic mean depth may be assumed to be equal to mean depth of flow. **(16)**

(OR)

(b) (i) A simply supported beam of diameter D, length L, and modulus of elasticity E is subjected to a fluid flow of velocity V, density ρ, and viscosity μ. Its center deflection is assumed to be a function of all these variables. Write this proposed function in dimensionless form and derive the relation using Buckingham pi theorem. **(10)**

(ii) State all the guidelines for selecting repeating variable in Buckingham pi theorem. **(6)**

14. (a) Design a Francis turbine runner with the following data: Net head H = 68 m; speed N =750 rpm; output power P=330kW; hydraulic efficiency 94%; overall efficiency 85%; flow ratio 0.15; breath ratio n=0.1; inner diameter of runner is 0.5 times outer diameter. Also assume 6% circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout and flow is radial at exit. **(16)**

(OR)

(b) A three stage centrifugal pump has impeller of 40 cm in diameter and 2.5 cm wide at outlet. The vanes are curved back at the outlet at 30° and reduce the circumferential are by 15%. The manometric efficiency is 85% and overall efficiency is 75%. Determine the head generated by the pump when running at 12000 rpm and discharging 0.06 m^3/s. Also find shaft horse power. **(16)**

15. (a) If a single acting reciprocating pump having diameter of plunger 150 mm and stroke length 225 mm, has for the suction side d_s=75 mm, l_s=6 m, H_s=3m and for the delivery side d_d =75 mm, l_d=60 m, H_d= 27 m. Find the maximum possible speed at which separation of water could be avoided. Hence find the maximum theoretical discharge at this speed. **(16)**

(OR)

(b) (i) What is an air vessel? Describe the function of air vessel for reciprocating pump. **(6)**

(ii) Show that the maximum inertia head in a reciprocating pump is given by $H_a = \frac{l}{g}\frac{A}{a}\omega^2 r$, where 'A' is area of the cylinder, 'a' is area of the pipe, 'r' is radius of the crank, 'ω'is angular velocity. **(10)**