
B.E. (Full Time) DEGREE END SEMESTER EXAMINATION, APR / MAY 2013

COMMON TO INDUSTRIAL, MANUFACTURING AND MINING ENGINEERING

FOURTH SEMESTER - (REGULATION 2008)

CE 9211 - FLUID MECHANICS AND MACHINERY

Time: 3 hours **Max. Marks: 100**

Answer ALL questions

Part – A **10 x 2 = 20 Marks**

1. Sketch the variation of shear stress with velocity gradient.
2. Calculate the compressibility of a liquid compressed in a cylinder has a volume of 0.0113 m^3 at 6.87×10^6 N/m^2 and a volume of 0.0112 m^3 at 13.73×10^6 N/m^2 pressure.
3. Distinguish between laminar flow and turbulent flow.
4. What do you understand by boundary layer?
5. Write the application of Mach number and Froude number.
6. Enlist the applications of dimensional analysis in fluid mechanics with suitable example.
7. Define specific speed of a pump and write the necessary equation.
8. How variation of suction head affects the discharge in a centrifugal pump?
9. What is net positive suction head (NPSH) in pump?
10. In a reciprocating pump the negative slip occurs, when there is long suction pipe and short delivery pipe. State how?

Part - B **5 x 16 = 80 Marks**

11. (i) A double acting reciprocating pump running at 60 rpm is discharging 1.5 m^3 of water per minute. The pump has a stroke length of 400 mm. The diameter of the piston is 250 mm. The delivery and suction heads are 20 m and 5 m respectively. Find the power required to drive the pump and slip of the pump. (8)

(ii) Draw the indicator diagram considering the effect of acceleration and friction in suction and delivery pipe. Also write the expression of work done by the reciprocating pump based on the indicator diagram. (8)

12.(a) (i) Derive Euler's equation of motion along a stream line and obtain Bernoulli's equation by its integration. (12)

(ii) Calculate the capillary effect in mm in a glass tube of 3 mm in diameter when immersed in (i) water (ii) Mercury. The surface tension of water and mercury in contact with air are 0.0736 N/m and 0.51 N/m respectively. (4)

(OR)

(b) (i) A reducer bend having an outlet diameter of 15 cm discharges freely. The bend connected to a pipe of 20 cm diameter has a deflection of 60^0 and lies in a horizontal plane. Determine the magnitude and direction of force on the anchor block supporting the pipe when a discharge of 0.3 m^3/s passes through the pipe. (16)

13.(a) Derive Hagen Poiseuille equation for laminar flow through a pipe line and explain with suitable diagram. (16)

(OR)

(b) (i) Two pipes 1 and 2, each of 10 cm diameter branch off from a point A in a pipeline and rejoin at B. Pipe 1 is 400 m long and pipe 2 is 600 m long. The total head at A is 30 m. A frictionless short pipe of 8 cm diameter is fitted at B and the flow is discharged through it. Assuming friction factor as 0.02 for both the pipes, find the total discharge and division of discharge in pipes 1 and 2. (12)

(ii) A compound piping system consists of 1800 m of 0.5 m dia, 1200 m of 0.4 m dia and 600 m of 0.3 m dia new cast iron pipes connected in series. Convert the system to an equivalent length of 0.40 m pipe. (4)

14.(a) (i) The variables controlling the motion of a floating vessel through water are the drag force F, speed V, length L, acceleration due to gravity ***g***, fluid density ρ, and viscosity μ. Derive an expression for F by dimensional analysis and show that,

$F = \rho V^2 L^2 \Phi (\sqrt{g} L / V ,\ \mu / \rho V L)$ (12)

(ii) Write the guidelines for selecting repeating variables. (4)

(OR)

(b) (i) The pressure drop in a flow meter in which oil flows at an upstream velocity of 0.9 m/s is to be estimated by model studies. A 1:6 scale model is used with water. If the pressure drop in the model is 450 Pa, what will be the pressure drop in prototype? If the prototype discharges 200 lit/s, what is the model discharge? Assume density of fluid in model and prototype as 998 kg/m^3 and 900 kg/m^3, viscosity of fluid in model and prototype as 0.001 Pa.s and 0.104 Pa.s. (12)

(ii) A model boat, 1/100 size of its prototype has 0.12 N of resistance when simulating a speed of 5 m/s of the prototype. Water is the fluid in both cases. What is the corresponding resistance in the prototype? (4)

15. (a) (i) A centrifugal pump has to discharge 225 lit/s against a head of 25 m when the impeller rotates at a speed of 1500 rpm. Determine (a) the impeller diameter (b) the vane angles at the outlet edge of the impeller. Assume that manometric efficiency as 0.75, the loss of head in pump in metres due to fluid resistance is 0.03 V_1^2,, where V_1 is

the absolute velocity of water leaving the impeller in m/s, the area of the impeller outlet surface is $1.2D_1^2$ m^2, where D_1 is the impeller diameter at outlet in m and water enters the impeller without whirl/loss. (12)

(ii) Explain priming and cavitation in centrifugal pump. (4)

(OR)

(b) (i) Design an inward flow reaction turbine runner with the following data: Net head H=68 m; speed N=750 rpm; output power P= 330 kW; η_h=94%; η_o=85%; flow ratio ψ=0.15; breadth ratio (B/D) n=0.1; inner diameter of runner is 0.5 times outer diameter. Also assume 6% of 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. (12)

(ii) What is draft tube? Explain its function in reaction turbine. (4)