B.E (FULL TIME) DEGREE END SEMESTER EXAMINATION, NOV/DEC - 2011

COMMON TO MECHANICAL ENGINEERING AB & CD BATCH

III SEMESTER - (REGULATION 2009)

23

CE 9211 - FLUID MECHANICS AND MACHINERY

Time: 3 hours **Marks: 100**

Part – A

10 x 2 = 20

Answer ALL questions

1. What is a real fluid? Give examples.
2. Differentiate between atmospheric pressure and vapour pressure.
3. What is boundary layer? Give a sketch of a boundary–layer region over a flat plate.
4. Distinguish between and hydraulic gradient and total energy line.
5. State Buckingham's π-theorem.
6. What is a Mach number? Mention its field of use.
7. Differentiate between impulse and reaction turbines.
8. How the velocity head is converted into pressure head in a centrifugal pump?
9. Define slip of reciprocating pump and under what circumstances does the negative slip will occur?
10. State any two advantages of rotary pumps?

Part - B

5 x 16 = 80

11. The efficiency η of a fan depends on density ρ, viscosity of fluid μ, angular velocity ω, diameter D of the rotor and the discharge Q. Derive an expression for η by dimensional analysis and show that, $\eta = \Phi [\mu/(D^2\omega\rho), Q/(D^2\omega)]$. **(16)**

12. (a) (i) Explain with the neat sketch Surface tension and Capillarity and obtain necessary expressions. **(8)**

    (ii) Explain the types of flow with one practical example for each type. **(8)**

    (OR)

    (b) Derive Euler's equation of motion along a stream line and state its application. **(16)**

13. (a) Derive from basic principle Hagen Poiseuille equation for laminar flow through pipe. **(16)**

    (OR)

    (b) (i) In the boundary layer over the face of the spillway, the velocity distribution is observed to have the following form $u/U = (y/\delta)^{0.22}$. The free stream velocity U at a certain

section is observed to be 30 m/s and a boundary layer thickness of 60 mm is also estimated at the section. The discharge (water of density 1000 kg/m^3) passing over the spillway is 6 m^3/s per m length of the spillway. Calculate displacement and energy thickness **(8)**

(ii) A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of the pipe. **(8)**

14. (a) A centrifugal pump has to discharge 235 liters of water per second against a head of 25m when the impeller rotates at a speed of 1500 rpm. Determine (a) the impeller diameter and (b) the vane angle at the outlet edge of the impeller. Assume that η_{mano} = 0.75; the loss of head in pump in meters due to fluid resistance is $0.03V_1^2$, where V_1 m/s is the absolute velocity of water leaving the impeller, the area of the impeller outlet surface is ($1.2\ D_1^2$) m^2, where D_1 is the impeller diameter in m, and water enters the impeller without whirl. **(16)**

(OR)

(b) An inward flow turbine (reaction type with radial discharge) with an overall efficiency of 80% is required to develop 150 kW. The head is 8 m; peripheral velocity of the wheel is 0.96 $\sqrt{2gH}$; the radial velocity of the flow is 0.36 $\sqrt{2gH}$. The wheel is to make 150 r.p.m, and the hydraulic losses in the turbine are 22 % of the available energy. Determine: (i) the angle of the guide blade at inlet, (ii) the wheel vane angle at inlet, (iii) the diameter of the wheel and (iv) the width of the wheel at inlet. **(16)**

15. (a) (i) Derive an expression for pressure head due to acceleration of the piston of a reciprocating pump, assuming motion of the piston to be S.H.M. **(16)**

(OR)

(b) (i) Distinguish between rotodynamic pump and positive displacement pump with simple sketch **(4)**

(ii) The Indicator diagram of a single acting reciprocating pump gives effective delivery head of 5 m and 23 m with crank at inner and outer dead centers respectively. What is the static delivery head of the reciprocating pump? **(12)**