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K 4387

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Third Semester

Mechanical Engineering

ME 1202 — FLUID MECHANICS AND MACHINERY

(Regulation 2004)

(Common to B.E. Aeronautical Engineering, Automobile Engineering, Production Engineering and Mechatronics Engineering)

(Common to B.E. (Part-Time) Second Semester – Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by absolute pressure and gauge pressure?
2. Define the term Kinematic Viscosity and give its dimension.
3. What is Dimensionally Homogeneous equation and give an example?
4. State the advantages of Dimensional and model analysis.
5. Define the term Drag and Lift.
6. What is Hydraulic Gradient Line?
7. Define Specific speed of a turbine.
8. How are Hydraulic turbines classified?
9. What are the functions of Air Vessel?
10. What are the advantages of Centrifugal Pump over Reciprocating Pump?

PART B — (5 × 16 = 80 marks)

11. (a) (i) State the effect of temperature and pressure on viscosity. (4)
- (ii) At a depth of 8 km from the surface of ocean, the pressure is stated to be 82 MN/m². Determine the mass density, weight density and specific volume of water at this depth. Take density at the surface $\rho = 1025 \text{ kg/m}^3$ and bulk modulus of elasticity $K = 2350 \text{ MPa}$ for the indicated pressure range. (8)
- (iii) Convert intensity of pressure of 2 MPa into equivalent pressure head of oil of specific gravity 0.8. (4)

Or

- (b) (i) The measuring instruments fitted inside an airplane indicate a pressure $1.032 \times 10^5 \text{ Pa}$, temperature $T_0 = 288^\circ \text{ K}$ and density $\rho_0 = 1.285 \text{ kg/m}^3$ at take off. If a standard temperature lapse rate of 0.0065° K/m is assumed, at what elevation is the plane when a pressure of $0.53 \times 10^5 \text{ Pa}$ is recorded? Neglect variation of acceleration due to gravity with altitude and take airport elevation as 600 m.

A person must breathe a constant mass rate of air to maintain his metabolic processes. If he inhales 20 times per minute at the airport level of 600 m, what would you expect his breathing rate at the calculated altitude of the plane? (8)

- (ii) Explain the term specific gravity, density, compressibility and vapour pressure. (8)

12. (a) (i) Write a brief note on velocity potential function and stream function. (4)
- (ii) In a two dimensional incompressible flow the fluid velocities are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form. Find also the stream function. (8)
- (iii) What are the uses and limitations of flownet? (4)

Or

- (b) (i) State Bernoulli theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli equation and state the assumptions made. (10)
- (ii) State Buckingham II-theorem. What are the criteria for selecting repeating variable in this dimensional analysis? (6)

13. (a) (i) The rate of flow of water through a horizontal pipe is $0.25 \text{ m}^3/\text{sec}$. The diameter of the pipe which is 20 cm is suddenly enlarged to 40 cm . The pressure intensity in the smaller pipe is 11.772 N/cm^2 .
- Determine :
- Loss of head due to sudden enlargement,
- Pressure intensity in larger pipe,
- Power loss due to enlargement. (9)
- (ii) A laminar flow is taking place in a pipe of diameter 20 cm . The maximum velocity is 1.5 m/s . Find the mean velocity and radius at which this occurs. Also calculate the velocity at 4 cm from the wall of pipe. (7)

Or

- (b) (i) A jet plane which weighs 29430 N and has a wing area of 20 m^2 flies at a velocity of 250 km/hr . When the engine delivers 7357.5 kW . 65% of power is used to overcome the drag resistance of the wing. Calculate the coefficient of lift and coefficient of drag for the wing. Take density of air equal to 1.21 kg/m^3 . (8)
- (ii) An oil of sp.gravity 0.7 is flowing through a pipe of diameter 30 cm at the rate of 500 litres/sec . Find the head lost due to friction and power required to maintain the flow for a length of 1000 m . Take $\gamma = 0.29 \text{ stokes}$. (8)
14. (a) (i) A Pelton wheel has a mean bucket speed of $10 \text{ meters per second}$ with a jet of water flowing at the rate of 700 litres/sec under a head of 30 meters . The buckets deflect the jet through an angle of 160° . Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity 0.98 . (8)
- (ii) Obtain an expression for the workdone per second by water on the runner of a Pelton wheel and draw inlet and outlet velocity triangles for a Pelton turbine and indicate the direction of various velocities. (8)

Or

- (b) (i) A Kaplan turbine runner is to be designed to develop 7357.5 kW shaft power. The net available head is 5.50 m . Assume that the speed ratio is 2.09 and flow ratio is 0.68 , and the overall efficiency is 60% . The diameter of the boss is $1/3^{\text{rd}}$ of the diameter of the runner. Determine the diameter of the runner, its speed and its specific speed. (8)
- (ii) Derive an expression for specific speed. What is the significance of specific speed of turbine? (8)

15. (a) (i) Obtain an expression for workdone by impeller of a centrifugal pump on water per second per unit weight of water. (8)
- (ii) Define cavitation. What are the effects of cavitation? Give the necessary precaution against cavitation. (6)
- (iii) Define specific speed of a centrifugal pump. (2)

Or

- (b) (i) Define slip, percentage slip and negative slip of a reciprocating pump. (6)
- (ii) What is priming? Why is it necessary? (4)
- (iii) A single stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 r.p.m and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75%. Find the number of stages and diameter of each impeller of a similar multistage pump to lift 5 m^3 of water per second to a height of 200 meters when rotating at 1500 r.p.m. (6)