Reg. No. : | | | | | | | | | | | |

R 3450

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Third Semester

(Regulation 2004)

Aeronautical Engineering

ME 1202 — FLUID MECHANICS AND MACHINERY

(Common to Automobile Engineering/Mechanical Engineering/Mechatronics Engineering/Production 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. How does the dynamic viscosity of (a) liquids and (b) gases vary with temperature?

2. What is the difference between gauge pressure and absolute pressure?

3. Define stream line. What do stream lines indicate?

4. Write the Bernoulli's equation in terms of head. Explain each terms.

5. What is the physical significance of Reynold's number?

6. Define the terms : Drag and Lift.

7. Differentiate between the turbines and pumps.

8. Define specific speed.

9. What do you mean by manometric efficiency and mechanical efficiency of a centrifugal pump?

10. Define slip of a reciprocating pump.

PART B — (5 × 16 = 80 marks)

11. (a) (i) When a pressure of 20.7 MN/m^2 is applied to 100 litres of a liquid its volume decreases by one litre. Find the bulk modulus of the liquid and identify this liquid. (6)

(ii) State and prove Pascal's law. (10)

Or

(b) (i) The barometric pressure at sea level is 760 mm of mercury while that on a mountain top is 735 mm. If the density of air is assumed constant at 1.2 kg/m^3, what is the elevation of the mountain top? (8)

(ii) Calculate the capillary effect in millimetres in a glass tube of 4 mm diameter, when immersed in (1) water and (2) mercury. The temperature of the liquid is 20°C and the values of surface tension of water and mercury at 20°C in contact with air are 0.0735 N/m and 0.51 N/m respectively. The contact angle for water $\theta = 0$ and for mercury $\theta = 130°$. Take specific weight of water at 20°C as equal to 9790 N/m^3. (8)

12. (a) (i) Obtain an expression for continuity equation in Cartesian coordinates. (8)

(ii) The two dimensional stream function for a flow is $\psi = 9 + 6x - 4y + 7xy$. Find the velocity potential. (8)

Or

(b) (i) State if the flow represented by

$$u = 3x + 4y \text{ and}$$
$$v = 2x - 3y$$

is rotational or irrotational. Find the potential function, if the flow is irrotational and vorticity, if it is rotational. (8)

(ii) A 300 mm × 150 mm venturimeter is provided in a vertical pipe line carrying oil of relative density 0.9, the flow being upwards. The differential U tube mercury manometer shows a gauge deflection of 250 mm, calculate the discharge of oil, if the coefficient of meter is 0.98. (8)

13. (a) Obtain an expression for Hagen-Poiseuille flow. Deduce the condition of maximum velocity. (16)

Or

(b) A flat plate 1.5 m × 1.5 m moves at 50 km/h in a stationary air of density 1.15 kg/m^3. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine (i) the lift force (ii) the drag force (iii) the resultant force and (iv) the power required to set the plate in motion. (16)

14. (a) Obtain an expression for the workdone per second by water on the runner of a Pelton wheel. Hence derive an expression for maximum efficiency of the Pelton wheel giving the relationship between the jet speed and bucket speed. (16)

Or

(b) (i) A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm. The net head on the Pelton wheel is 700 m. If the side clearance angle is 15° and discharge through nozzle is 0.1 m^3/s, find (1) power available at the nozzle and (2) hydraulic efficiency of the turbine. Take $C_v = 1$. (8)

(ii) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90% determine, specific speed of the machine, power generated and type of turbine. (8)

15. (a) (i) A centrifugal pump delivers water against a net head of 14.5 metres and a design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump if manometric efficiency is 95%. (8)

(ii) A single acting reciprocating pump running at 50 rpm, delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine the theoretical discharge of the pump, coefficient of discharge and slip and the percentage slip of the pump. (8)

Or

(b) (i) Explain the working principles of vane pump and gear pump with neat sketches. (8)

(ii) A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 120 cm and the flow area is 0.4 m^2. The angles made by absolute and relative velocity at inlet are 20° and 60° respectively, with the tangential velocity. Determine, the volume flow rate, the power developed and the hydraulic efficiency. (8)
