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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Third Semester

(Regulation 2004)

Mechanical Engineering

ME 1202 — FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering/ Automobile 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. Differentiate between solids and liquids.

2. Define the following terms :

   (a) Total pressure

   (b) Centre (or) position of pressure.

3. Distinguish between stream line and path line.

4. Write the impulse-momentum equation.

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

6. List any four minor losses in a pipe flow.

7. Define cavitation in a pump.

8. Why priming is necessary in a centrifugal pump?

9. What are the functions of a draft tube?

10. Define specific speed of a turbine.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State and prove Pascal's law. (8)

(ii) What depth of oil, specific gravity 0.8, will produce a pressure of 120 KN/m^2? What would be corresponding depth of water? (8)

Or

(b) (i) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. (8)

(ii) A circular plate 3 m diameter is immersed in water in a such a way that its greatest and least depth below free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. (8)

12. (a) (i) Do the following velocity potential represents possible flow? If so, determine the steam function, $\phi = y + x^2 - y^2$. (8)

(ii) A horizontal venturimeter of specification 200 mm × 100 mm is used to measure the discharge of an oil of specific gravity 0.8. A mercury manometer is used for the purpose. If the discharge is 100 litres per second and the coefficient of discharge of meter is 0.98, find the manometer deflection. (8)

Or

(b) (i) Derive Bernoulli's equation along with assumptions made. (8)

(ii) Determine the stream function, of the velocity components of a two dimensional incompressible fluid flow are given by $u = \frac{1}{3} y^3 + 2x - x^2 y$ and $v = xy^2 - 2y - \frac{1}{3}x^2$. (8)

13. (a) (i) Derive an expression for the velocity distribution for viscous flow through a circular pipe. (8)

(ii) A main pipe divides into two parallel pipes, which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1 m respectively, while the length and diameter of second parallel pipe are 2000 m and 0.8 m respectively.

Find the rate of flow in each parallel pipe, if total flow in the main is 3 m^3/s. The coefficient of friction for each parallel pipe is same and equal to 0.005. (8)

Or

(b) (i) Two pipes of 15 cm and 30 cm diameters are laid in parallel to pass a total discharge of 100 litres per second. Each pipe is 250 m long. Determine discharge through each pipe. Now these pipes are connected in series to connect two tanks 500 m apart, to carry same total discharge. Determine water level difference between the tanks. Neglect minor losses in both cases, $f = 0.02$ f_n both pipes. (8)

(ii) A pipeline carrying oil of specific gravity 0.85, changes in diameter from 350 mm at position 1 to 550 mm diameter to a position 2, which is at 6 m at a higher level. If the pressure at position 1 and 2 are taken as 20 N/cm^2 and 15 N/cm^2 respectively and discharge through the pipe is 0.2 m^3/s. Determine the loss of head. (8)

14. (a) (i) Explain the operation of a centrifugal pump with the help of a neat sketch. Write short notes on different types of casing used in centrifugal pumps. (8)

(ii) Define specific speed of a centrifugal pump. Derive expression for the same in terms of head 'H', discharge 'Q' and speed 'N'. (8)

Or

(b) A centrifugal pump, in which water enters radially, delivers water to a head of 165 m. The impeller has a diameter of 360 mm and width 180 mm at inlet and the corresponding dimensions at the outlet are 720 mm and 90 mm respectively. Its rotational speed is 1200 rpm. The blades are curved backward at 30° to the tangent at exit and the discharge is 0.389 m^3/s. Determine,

(i) Theoretical head developed

(ii) Manometric efficiency

(iii) Pressure rise across the impeller assuming losses equal to 12% of velocity head at exit.

(iv) Pressure rise and the loss of head in the volute casing.

(v) The vane angle at inlet and

(vi) Power required to drive the pump assuming an overall efficiency of 70%. What would be the corresponding mechanical efficiency?

15\. (a) (i) Draw a neat sketch of Kaplan turbine, name the parts and briefly explain the working. (8)

(ii) A Pelton turbine having 1.6 m bucket diameter develops a power of 3600 KW at 400 rpm, under a net head of 275 m. If the overall efficiency is 88%, and the coefficient of velocity is 0.97, find : speed ratio, discharge, diameter of the nozzle and specific speed. (8)

Or

(b) (i) A Pelton wheel supplied water from reservoir under a gross head of 112 m and the friction losses in the pen stock amounts to 20 m of head. The water from pen stock is discharged through a single nozzle of diameter of 100 mm at the rate of 0.30 m^3/s. Mechanical losses due to friction amounts to 4.3 KW of power and shaft power available is 208 KW. Determine : velocity of jet ; water power at inlet to runner ; power loss in nozzles ; power lost in runner due to hydraulic resistance. (8)

(ii) Show that the overall efficiency of a hydraulic turbine is the product of volumetric, hydraulic and mechanical efficiencies. (8)
