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**Question Paper Code : 90321**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third/Fourth Semester

Aeronautical Engineering

CE 8394 – FLUID MECHANICS AND MACHINERY

(Common to: Aerospace Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Safety and Fire Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Compare steady and uniform flow.
2. If 6 $m^3$ of oil weighs 47 kN, find its specific weight and density.
3. What is loss of head in a pipe flow?
4. Differentiate hydraulic gradient line and energy gradient line.
5. State Buckingham's $\pi$ theorem.
6. List down the limitations of dimensional analysis.
7. How can the slip of a reciprocating pump be negative?
8. Why are centrifugal pumps used sometimes in series and sometimes in parallel?
9. What is the significance of the specific speed in the turbine?
10. A hydraulic reaction turbine working under a head of 16 m develops 640 kW of power. What is unit of power of the turbine?

PART B — (5 × 13 = 65 marks)

11. (a) (i) State and prove Bernoulli's equation and also write assumptions involved in deriving it. (8)

(ii) Write short on Newton's law of viscosity. (5)

Or

(b) Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter, the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. (13)

12. (a) With the help of a neat sketch, explain the development of boundary layer along a long thin flat plate, illustrating variations in boundary layer thickness. (13)

Or

(b) Two pipes are connected in parallel between two reservoirs that have difference in levels of 3.5 m. The length, the diameter, and friction factor are 2400 m, 1.2 m, and 0.026 for the first pipe and 2400 m, 1 m, and 0.019 for the second pipe. Calculate the total discharge between the two reservoirs. (13)



13. (a) The discharge Q through an orifice depends on the pressure P, the density of fluid $\rho$ and the diameter of the orifice d. Determine a general formula for the discharge. (13)

Or

(b) (i) The resistance to motion R of a hydrofoil depends upon the characteristic length l, the velocity v, the density $\rho$ and the acceleration of gravity g. It may be shown that Ne = f(Fr) where $Ne = R/(\rho v^2 l^2)$ and $Fr = v/(gl)^{1/2}$ In order to predict the resistance of a hydrofoil, a model is made to a scale of 1/20. The actual hydrofoil must move at 0.8 m/s over water. Calculate the velocity of the model that gives dynamic similarity on the same water. (8)

(ii) Write short notes on Reynolds number. (5)

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14. (a) A centrifugal pump is to discharge 0.118 $m^3$ at a speed of 1450 rpm against a head of 25 m. The diameter and width of the impeller at outlet are 250 mm and 50 mm respectively. If the manometric efficiency is 75%, determine the vane angle at the outlet. (13)

Or

(b) Draw indicator diagrams of a reciprocating pump showing the effect of acceleration and friction head on suction and delivery pipes. (13)

15. (a) A pelton turbine is required to develop 9000 KW when working under a head of 300 m the impeller may rotate at 500 rpm. Assuming a jet ratio of 10 and an overall efficiency of 85% calculate (13)

(i) Quantity of water required.

(ii) Diameter of the wheel

(iii) Number of jets

Or

(b) Draw and explain performance characteristic curves of Kaplan turbine. (13)

PART C — (1 × 15 = 15 marks)



16. (a) It is required to deliver 0.048 $m^3$/second of water to a height of 24 m through a 150 mm diameter and 120 m long pipe and coefficient of friction, f = 0.01 by a centrifugal pump. If the overall percentage of pump is 75, find power required to drive the pump. (15)

Or

(b) For the siphon system shown in Figure, if the fluid is water, calculate

(i) flow velocity at A

(ii) the volume flow at A

(iii) the pressure at B. (15)