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Question Paper Code : 10684

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Third Semester

Aeronautical Engineering

CE3391 — FLUID MECHANICS AND MACHINERY

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

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define vacuum pressure on a fluid.
2. Give any two examples for buoyancy force.
3. Write the expression for entry and exit loss in a pipe.
4. List the types of boundary layer thickness?
5. How are the repeating variables selected for dimensional analysis?
6. What are the three types of similarities which must exist between a model and prototype?
7. Find the force per unit area exerted on a fixed vertical plate by a water of jet having velocity 20 m/s?
8. Differentiate between gross head and net head in Pelton wheel turbine.
9. When will a pump be called as a positive displacement type?
10. At what condition, the actual discharge of reciprocating pump is more than its theoretical discharge?

PART B — ($5 \times 13 = 65$ marks)

11. (a) In a vertical pipe conveying oil of specific gravity 0.8, two pressure gauges have been installed at A and B where the diameters are 16 cm and 8 cm respectively. A is 2 meters above B. The pressure gauge readings have shown that the pressure at B is greater than A by 0.981 N/cm^2 . Neglecting all losses, calculate the flow rate. If the gauges at A and B are replaced by a U-tube manometer containing mercury, calculate the difference in level of mercury in the two limbs.

Or

- (b) Define the equation for continuity and Obtain an expression for continuity equation for a three-dimensional flow.
12. (a) A laminar flow is taking place in a pipe of diameter 200 mm. 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 the pipe.

Or

- (b) Derive Darcy-Weisbach equation to find the frictional losses when liquid flows through the pipe clearly stating the assumptions made.
13. (a) Derive an equation using dimensional analysis with suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω , speed of advance V , diameter D , dynamic viscosity μ , mass density ρ , elasticity of the fluid medium which can be denoted by the speed of sound in the medium C .

Or

- (b) A model of a sub-marine of scale $\frac{1}{40}$ is tested in a wind tunnel. Find the speed of air in wind tunnel if the speed of sub-marine in sea water is 15 m/s. Also find the ratio of the resistance between the model and its prototype. Take the values of kinematic viscosities for sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and of air are given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.
14. (a) The following data is given for a Francis turbine. Net head $H = 60 \text{ m}$, Speed $N = 700 \text{ rpm}$, shaft power = 294.3 KW, $\eta_{\text{overall}} = 84\%$, $\eta_{\text{hydraulic}} = 93\%$, flow ratio = 0.20, breadth ratio $n = 0.1$, Outer diameter of runner = $2 \times$ inner diameter of runner. The thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine:

- (i) Guide blade angle
- (ii) Runner vane angles at inlet and outlet
- (iii) Diameters of runner at inlet and outlet
- (iv) Width of wheel at inlet

Or

- (b) Explain the construction and working of Kaplan turbine with a neat sketch. Mention its advantages and limitations.
15. (a) The length and diameter of a suction pipe of a single acting reciprocating pump are 5 m and 10 cm respectively. The pump has a plunger of diameter 15 cm and a stroke length of 35 cm. The centre of the pump is 3 m above the water surface in the pump. The atmospheric pressure head is 10.3 m of water and pump is running at 35 r.p.m. Determine,
- (i) The pressure head due to acceleration at the beginning of the suction stroke.
 - (ii) Pressure head in the cylinder at the beginning and at the end of the stroke.

Or

- (b) What are the main parts of centrifugal pump? Explain the working of centrifugal pump with a neat sketch.

PART C — (1 × 15 = 15 marks)

16. (a) A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference of water level as 20 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is connected in parallel to the last 1200 m length of the existing pipe, find the increase in discharge. Take $f = 0.015$ and neglect minor losses.

Or

- (b) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 r.p.m. The vane angles of the impeller at the inlet and outlet are 20° and 30° respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water.

