

6. (a) Prove how draft tube reduces the pressure below atmosphere at the outlet of the turbine. (07)
- (b) Define metacentric height. Explain analytical method to determine metacentric height of a ship model. (08)
7. (a) Discuss how piston acceleration and friction affect the ideal indicator diagram of a single acting reciprocating pump. (07)
- (b) A centrifugal pump is to discharge $0.118 \text{ m}^3/\text{s}$ at a speed of 1450 rpm against a head of 25 m (manometric head). The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. (08)

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B.Tech. ME/AE/MAE IIIrd SEMESTER**Fluid Mechanics and Fluid Machines****(PCC-ME-205/PCC-AE-205/PCC-MAE-205)**

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.
2. Answer any four questions from Part-B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.
4. Assume suitable value for missing data.

PART - A

1. (a) Define specific weight and specific gravity. (1.5)
- (b) State Pascal's law and hydrodynamic law. (1.5)
- (c) What is the difference between Couette and Poiseuille flow? (1.5)
- (d) List three characteristics of boundary layer. (1.5)

- (e) Define Similitude. (1.5)
- (f) What are various forces present in a physical phenomenon related to fluid mechanics? (1.5)
- (g) Draw velocity triangle for a Francis Turbine. (1.5)
- (h) State *three* differences between impulse and reaction turbine. (1.5)
- (i) Define cavitation. (1.5)
- (j) Define manometric head and manometric efficiency. (1.5)

PART - B

2. (a) Derive general form of continuity equation. (07)
- (b) A pipe 200 m long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end, and carries 100 lit/sec of oil (sp. Gravity 0.8). If pressure gauge at higher end read 60 kN/m², determine :
- (i) Velocities at the two ends.
- (ii) Pressure at the lower end.
- Neglect all losses. (08)

3. (a) Derive Darcy Weisbach equation. (07)
- (b) A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drop per meter length of pipe is 20 kN/m². Determine (i) The mass flow rate in kg/min (ii) Shear stress at the pipe wall (iii) The Reynold number of the flow. (08)

4. The discharge Q of a centrifugal pump depends upon the mass density of fluid (ρ), the speed of the pump (N), the diameter of the impeller (D), the manometric head (H) and the viscosity of the fluid (μ). Show that

$$Q = ND^3 f(gH/N^2D^2, \mu/\rho ND^2). \quad (15)$$

5. A single jet Pelton wheel runs at 300 rpm under a head of 510 m. The jet diameter is 200 mm, its deflection inside the bucket is 165° and its relative velocity is reduced by 15% due to friction. Determine:
- (i) Water Power.
- (ii) Resultant force on the bucket.
- (iii) Overall efficiency.

Take coefficient of velocity = 0.98 and speed ratio = 0.46. (15)