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Question Paper Code : 20264

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to : Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)

(Regulations 2013)

(Also Common to : PTCE 6451 — Fluid Mechanics and Machinery – for B.E. (Part-Time) — Second Semester – Mechanical Engineering – Regulations – 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A clean tube of diameter 2.5 mm is immersed in a liquid with a coefficient of surface tension as 0.4 N/m. The angle of contact of the liquid with the glass can be assumed to be 135 degree. The density of liquid is 13600 kg/m^3. What would be the level of the liquid in the tube relative to the free surface of the liquid inside the tube?
2. State Bernoulli's theorem
3. What is meant by TEL and HGL?
4. List the minor losses in the pipe flow.
5. Differentiate Dynamic and Kinematic similarities.
6. State Buckingham's π theorem
7. List the components of the centrifugal pump.
8. Under which condition negative slip occurs.
9. Draw the velocity triangle for Pelton Wheel turbine.
10. What is the function of a draft tube?

PART B — (5 × 13 = 65 marks)

11. (a) The velocity distribution of flow over a plate is parabolic with vertex 30 cm from the plate, where the velocity is 180 cm/s. If the viscosity of the fluid is 0.9 Ns/m² find the velocity gradients and shear stresses at a distances of 0, 15 cm and 30 cm from the plate.

Or

(b) Derive the continuity equation in cartesian coordinates.

12. (a) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow.

Or

(b) Derive an expression for the major loss in pipe flows.

13. (a) Show by Rayleigh method of dimensional analysis that the resistance R to the motion of a sphere of diameter D moving with uniform velocity V through a fluid having density ρ and viscosity μ may be $R = (\rho D^2 V^2)\phi\left(\frac{\mu}{\rho VD}\right)$. Also show that the above expression reduces to $R = k\mu V D$ when the motion is through viscous fluid at low velocity, where k is a dimensionless constant.

Or

(b) The performance of a spillway of a power project is to be studied by means of a model constructed to a scale of 1:9 neglecting the viscous and surface tension effect, determine the rate of flow in the model for a prototype discharge of 1000 m³/s and the dissipation of energy in the prototype hydraulic jump, if the jump in the model studies dissipates 294.2W.

14. (a) Derive an expression for the pressure head due to acceleration of the piston of a reciprocating pump, assuming motion of the piston to be simple harmonic.

Or

(b) A centrifugal pump has an impeller 0.5 m outer diameter and when running at 600 rpm discharges water at the rate of 8000 *lpm* against a head of 8.5 m. The water enters the impeller without whirl and shock. The inner diameter is 0.25 m, and the vanes are set back at outlet at an angle of 45° and the area of flow which is constant from inlet to outlet of the impeller is 0.6 m². Determine the manometric efficiency of the pump, the vane angle at inlet and the least speed at which the pump commences the work.

15. (a) Compare and contrast the components, velocity traingles and working between an impulse turbine and reaction turbine.

Or

(b) Draw and discuss the performance characteristic curves of turbines.

PART C — (1 × 15 = 15 marks)

16. (a) A pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at a rate of 750 lps under a head of 35 m. If the buckets deflect the jet through an angle of 160 degrees, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction in the bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 80%.

Or

(b) Determine the efficiency of Kaplan turbine developing 3000 kW under a net head of 5 m. It is provided with a draft tube with its inlet diameter 3 m set 1.6 m above the tail race. A vacuum gauge connected to the draft tube indicates a reading of 5 m of water. Assume a draft tube efficiency as 78%.

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