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B. E / B. Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS Nov/Dec 2013
MECHANICAL ENGINEERING
THIRD SEMESTER
**CE 253 / CE 291 / CE 9211 FLUID MECHANICS AND MACHINERY**
(REGULATION 2004 / 2008)

TIME: 3 hr Max Mark: 100

Answer ALL questions

PART – A (10 x 2 = 20 MARKS)

1. Calculate the capillary rise /fall in mm in a glass tube of 4 mm diameter when immersed in a container of water. Surface tension of water is 0.0735 N/m and the wetting angle with glass is 0°.
2. Write the moment of momentum equation and state its applications.
3. Define boundary layer
4. What is meant by 'pipes in series' and 'pipes in parallel'?
5. Write the dimensions for Momentum and power
6. List the criteria used in selecting the repeating variables in Buckingham's Pi theorem.
7. How mechanical efficiency of a turbine is different from its volumetric efficiency?
8. Differentiate volute and vortex casing of a centrifugal pump with a diagram.
9. What is meant by head separation in reciprocating pump?
10. Why is it that the speed of the reciprocating pump without air vessel is not high?

PART – B (5 x 16 = 80 Marks)

11. a.i If the velocity profile of a fluid over a plate is a parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/sec. Calculate the velocity gradients and shear stresses at a distance of 0,10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise. (8)

    a.ii A 45 degree reducing bend is connected in a pipe line, the diameters at the inlet and the outlet of the bend being 500 mm and 200 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 9 N/cm$^2$ and rate of flow of water is 500 lps. (8)

12. a.i The friction factor for turbulent flow through rough pipes can be determined by Karman-Prandtl equation, $(1/\sqrt{f}) = 2\log_{10}(R_o/k) + 1.74$ ,where f is friction factor, $R_o$ is pipe radius and k average roughness. Two reservoirs with a surface level difference of 20 metres are to be connected by 1 metre diameter pipe 6 km long. What will be the discharge when a cast iron pipe of roughness k = 0.3 mm is used? What will be the percentage increase in the discharge if the cast iron is replaced by a steel pipe of roughness k=0.1 mm? Neglect all losses. (16)

OR

12. b.i Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow. (16)

13. a.i Explain the different types of hydraulic similarities that must exist between a prototype and its model. (6)

a.ii The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Using Rayleigh's method express η in terms of dimensionless parameters. (10)

OR

13. b.i A small sphere of density $\rho_s$ and diameter D settles at a terminal velocity V in a liquid of density $\rho_f$ and dynamic viscosity μ. Gravity g is known to be a parameter. Express the functional relationships between these variables in a dimensionless form. (10)

b ii What is meant by dimensionless numbers, derive any four of them. (6)

14. a. i An inward flow reaction turbine has external and internal diameter as 0.9m and 0.45m. The turbine is running at 200rpm and width of turbine at inlet is 20 cm. The velocity of flow through the runner is constant and is equal to 1.8m/s. The guide blade angle is 10 degree to the tangent of the wheel and discharge at outlet is radial. Draw inlet and outlet velocity triangle and find absolute velocity at inlet, whirl velocity at inlet, Relative velocity at inlet, runner blade angle and weight of water flowing through the runner per second (16)

OR

14. b. i Explain the functions of various components of Pelton turbine with neat sketches (6)

b. ii Derive an expression for minimum speed for starting a centrifugal pump (10)

15. a. i Determine the maximum speed at which a double acting reciprocating pump can be operated under the following conditions (a) no air vessel on the suction side (b) very large air vessel on the suction side close to the pump. The suction lift is 4m, length of suction pipe 6.5 m, diameter of suction pipe 100 mm, diameter of piston 150mm and length of stroke is 0.45m. Assume SHM, separation would occur at 2.6 m of water absolute. Take Darcy's f =0.024. (16)

OR

15. b.i Derive an expression for the acceleration head in a single acting reciprocating pump and how it is shown in the indicator diagram (16)