

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

D 4704

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Annual Pattern — First Year

Electrical and Electronics Engineering

CE IXII — SOLID AND FLUID MECHANICS

(Common to EEE, Electronics and Instrumentation Engineering/
Instrumentation and Control Engineering)

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define perfect truss and redundant truss.
2. Given modulus of elasticity 200 GPa and Poisson's ratio 0.3, what is the modulus of rigidity?
3. Define pure bending and point of contra flexure.
4. A hollow shaft of outer radius 10 cm and inner radius 4 cm is subjected to twisting moment. What is the shear stress at the inner radius if the maximum shear stress developed is 50 N/mm²?
5. Find the kinematic viscosity of an oil having density 981 kg/m³. The shear stress at a point is 0.25 N/m² and velocity gradient at that point is 0.2 per second.
6. State Buckingham's π theorem.

7. Water is flowing through a pipe of diameter 200 mm with a velocity of 3 m/s. Find head lost due to friction for a length of 5 m if the coefficient of friction is given by $0.002 + 0.9 / \text{Re}^{0.3}$ where Re. is the Reynolds number and kinematic viscosity is $0.01 \times 10^{-4} \text{ m}^2/\text{s}$.
8. Define boundary layer thickness.
9. Define turbines and pumps.
10. Define suction head and delivery head.

PART B — (5 × 16 = 80 marks)

11. (a) Compute the member forces for the plane truss shown in Fig. 1.

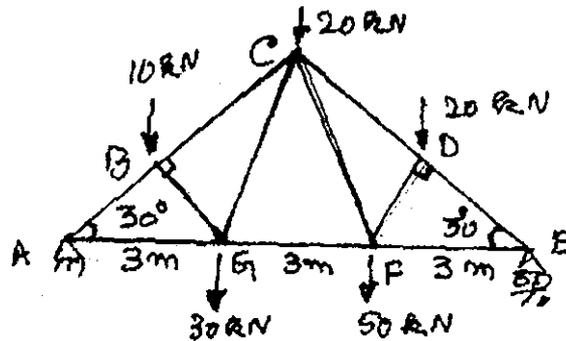


Fig. 1

Or

- (b) (i) Derive the expression for the principal stresses for a biaxial stress field comprising of σ_{xx} , σ_{yy} and τ_{xy} . (8)
- (ii) For the state of stress shown in Fig. 2 compute the direction of principal stresses, principal stresses and maximum shear stress. (8)

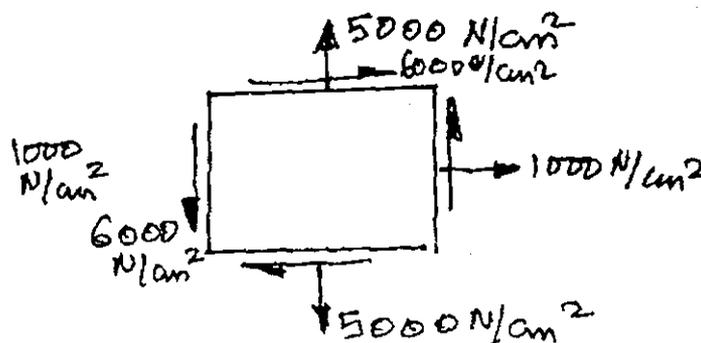


Fig. 2

12. (a) (i) Derive bending formula used for the analysis of beam. (6)
- (ii) A cantilever beam of length 3 m is subjected to load W at the free end. The cross section of the beam is a T-section. The width of the flange is 10 cm and thickness is 1.5 cm. The web height is 15 cm and thickness is 1.5 cm. What is the maximum value of load W so that the bending stress in the section is limited to 50 N/mm^2 ? (10)

Or

- (b) (i) A solid shaft 5 m long is subjected to a torque so that the maximum shear stress developed is 80 MPa and the twist of the shaft is 4° . Given $G = 85 \text{ GPa}$ find the diameter and the torque developed in the shaft. If it is running at 100 rpm what is the power transmitted? (8)
- (ii) A close coiled helical spring is having stiffness of 200 N/cm and shear stress is limited to 8000 N/cm^2 under a load of 500 N. The diameter of the coil is ten times the diameter of wire. $G = 85 \text{ GPa}$. Compute the wire diameter, coil diameter and number of turns. Also find the deflection of the spring. (8)
13. (a) (i) A hydraulic press shown in Fig. 3 has a ram of 30 cm diameter and plunger of 4.5 cm diameter. Find the weight lifted by hydraulic press when the force applied in the plunger is 500 N. If the weight to be lifted is 30 kN what is the force required at the plunger. (6)

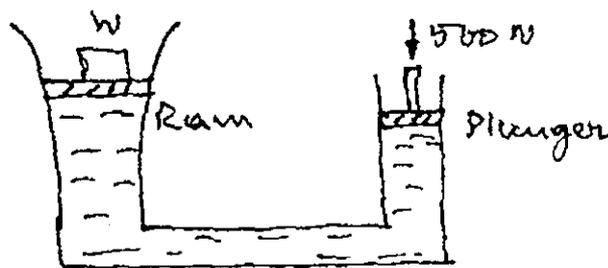


Fig. 3

- (ii) Explain how the manometers are classified. (4)

- (iii) A U-tube manometer is used to measure pressure of water in a pipe line which is in excess of atmospheric pressure as shown in Fig. 4. Determine the pressure of water in the pipe line. Density of water is 1000 kg/m^3 and specific gravity of mercury is 13.6. (6)

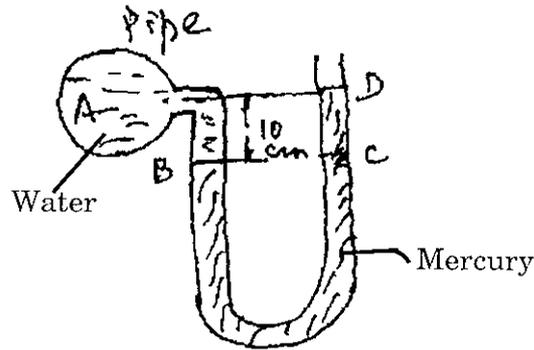


Fig. 4

Or

- (b) (i) A pipe line carrying oil of specific gravity 0.87 changes in diameter from 200 mm at a position A to 500 mm diameter at position B which is 4 m above the level of A. If the pressures at A and B are 10 N/cm^2 and 6 N/cm^2 respectively and the discharge is 200 litres/s determine the loss of head and the direction of the flow. (8)
- (ii) The pressure difference Δp in a pipe of diameter D and length L due to viscous flow depends on the velocity V , viscosity μ and density ρ . Using Buckingham's π theorem obtain the expression for Δp . (8)
14. (a) (i) At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient raises by 10 mm. Estimate the rate of flow. (8)
- (ii) An oil of viscosity 0.1 N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. The rate of flow through pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. (8)

Or

- (b) (i) An oil of viscosity $0.02 \text{ N}\cdot\text{s}/\text{m}^2$ is flowing between two stationary parallel plates 1 m wide and at 10 mm apart. The velocity midway between the plates is 2 m/s . Compute the pressure gradient along the flow, average velocity and the discharge of oil. (8)
- (ii) A main pipe line divides into two parallel pipes as shown in Fig. 5. The length and diameter of first parallel pipe are 2000 m and 1 m respectively while the length and diameter of second parallel pipe are 2000 m and 0.8 m respectively. Find the rate of flow in each parallel pipes if the total flow in the main is $3 \text{ m}^3/\text{s}$. The coefficient of friction for each parallel pipe is same and equal to 0.005 . (8)

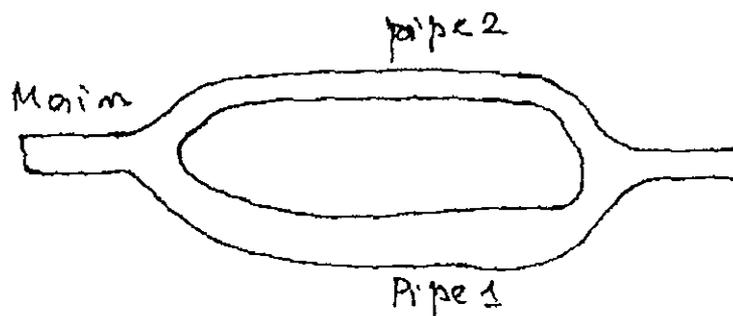


Fig. 5

15. (a) (i) Briefly describe the classification of turbines. (8)
- (ii) A Pelton wheel is to be designed for the following data : Shaft power is 11772 kW . Head 380 m . Speed 750 rpm . Overall efficiency 86% . Jet diameter is not to exceed one sixth of the wheel diameter. Determine the wheel diameter, the number of jets required and the jet diameter. Speed ratio is 0.45 and coefficient of velocity is 0.985 . (8)

Or

- (b) (i) Describe the main parts of centrifugal pump. (8)
- (ii) A centrifugal pump having outer diameter equal to two times the inner diameter and running 1000 rpm works against total head of 40 m. The velocity of flow through the impeller is constant and is equal to 2.5 m/s. The vanes set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm determine the vane angle at inlet, work done by impeller on water per second and the manometric efficiency. (8)
-