

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Second Semester

U07CE204: FLUID AND SOLID MECHANICS

(Common to Electrical and Electronics Engineering & Electronics and Instrumentation Branches)

Time: Three hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

- Newton's law of viscosity is given by the relation

A. $\tau = \mu^2 \frac{du}{dy}$ B. $\tau = \sqrt{\mu} \frac{du}{dy}$ C. $\tau = \mu \frac{du}{dy}$ D. $\tau = (\mu)^{3/4} \frac{du}{dy}$
- The capillary rise of water in the glass tube is given by

A. $h = \frac{2\sigma}{wd}$ B. $h = \frac{3\sigma}{wd}$ C. $h = \frac{4\sigma}{wd}$ D. $h = \frac{6\sigma}{wd}$
- Bernoulli's equation mathematically written as

A. $\frac{p}{w} + \frac{v}{2g} + z = \text{Constant}$ B. $\frac{p}{w^2} + \frac{v^2}{2g} + z = \text{Constant}$

C. $\frac{p^2}{w} + \frac{v^2}{2g} + z = \text{Constant}$ D. $\frac{p}{w} + \frac{v^2}{2g} + z = \text{Constant}$
- Loss head at entrance of to a pipe is given by

A. $0.5 \frac{v^2}{2g}$ B. $\frac{v}{g}$ C. $\frac{v^2}{2g}$ D. $\frac{v^3}{2g}$
- The Specific speed of a turbine is expressed as

A. $\frac{N\sqrt{p}}{H}$ B. $\frac{N\sqrt{p}}{H^2}$ C. $\frac{N\sqrt{p}}{H^{3/4}}$ D. $\frac{N\sqrt{p}}{H^{5/4}}$
- The ratio of lateral strain to linear strain is known as

A. Modulus of elasticity B. Modulus of Rigidity

C. Poisson's ratio D. Elastic limit
- Relation between E(modulus of elasticity), K(Bulk modulus) and C(modulus of rigidity) is given by

A. $E = \frac{9KC}{3K+C}$ B. $E = \frac{3K+C}{6KC}$ C. $E = \frac{6KC}{K+3C}$ D. $E = \frac{3KC}{3K+C}$
- In case of circular section the section modulus is given as

A. $\frac{\pi d^2}{16}$ B. $\frac{\pi d^3}{16}$ C. $\frac{\pi d^3}{32}$ D. $\frac{\pi d^4}{64}$
- Two springs of stiffness k_1 and k_2 respectively are connected in series, the stiffness of the composite spring (k) will be given by

A. $k = k_1 + k_2$ B. $k = k_1 * k_2$ C. $k = \frac{k_1 k_2}{k_1 + k_2}$ D. $k = \frac{k_1 + k_2}{k_1 k_2}$
- The perfect frame should satisfy the relation

A. $m = 2j - 3$ B. $m = 2j - 4$ C. $m = 3j - 2$ D. $m = 3j - 3$

PART B (10 x 2 = 20 Marks)

11. A fluid of one cubic meter volume weighs 9810 N. Calculate its mass density. 23. (b)
12. Distinguish between Ideal fluid and Real Fluid
13. Define Centre of Pressure.
14. What is the advantage of orifice meter over venturimeter?
15. Classify the turbines according to the head and quantity of water available.
16. State Hooke's law.
17. A rod of 2 m long and 15 mm diameter is subjected to an axial load of 25 kN. Find the elongation of the rod. Assume the modulus of elasticity of the material of the rod as $1 \times 10^5 \text{ N/mm}^2$.
18. What are principle planes?
19. What are the advantages of providing leaf springs? 24. (a) (i)
20. Define "Perfect frames".

PART C (5 x 14 = 70 Marks)

21. (a) (i) A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a liquid. Determine the viscosity of the fluid, if a torque of 20 Nm is required to rotate the inner cylinder at 1200 rpm. (7)
 - (ii) A differential manometer connected at two points A and B in a pipe containing an oil of specific gravity of 0.9, shows a difference in mercury levels as 150mm. Find the difference in pressures at the two points. (7)
- (OR)**
- (b) (i) If the equations of a velocity distribution over a plate is given by $u = 2y - y^2$, in which 'u' is the velocity in m/s at a distance 'y', measured in metre above the plates, what is the velocity gradient at the boundary at 7.5cm and 15cm from it?. Also determine the shear stress at these points if absolute viscosity, $\mu = 8.6$ poise. (8) 25. (a) (i)
 - (ii) Calculate the pressure in N/m due to a column of 0.3 m of water, 0.3 m of oil of specific gravity 0.9 and also 0.3 m of mercury of specific gravity 13.6. (6) (ii)
22. (a) (i) A horizontal venturimeter with inlet and throat diameter 300mm and 100mm respectively is used to measure the flow of water. The pressure intensity at inlet is 130 KN/m^2 while the vacuum pressure head at throat is 350 mm of mercury. Assuming that 3 percent head lost between the inlet and throat. Find the value of coefficient of discharge for the venturimeter and also determine the rate of flow. (7)
 - (ii) Derive Darcy Weisbach equation for head loss due to friction in flow through pipe. (7)

(OR)

23. (b) (i) A vertical venturimeter carries a liquid of relative density 0.8 and has inlet and throat diameters of 150mm and 75mm respectively. The pressure connection at the throat is 150mm above the inlet. If the actual rate of flow is 40 litres/sec and $C_d=0.96$, Calculate the pressure difference between inlet and throat in N/m^2 . (7)

(ii) Water is flowing through a pipe 300mm in diameter at a velocity of 5 m/sec. The pressures at two points in the flow are 245.3 KN/m^2 and 196.2 KN/m^2 respectively. The datum heads at A and B are 12 m and 14m. Determine the direction of flow and loss of head between A and B. (7)

24. (a) (i) Design a Pelton Turbine to develop a Power of 100KW under a head of 60m while running at 200 rpm. Assume speed ratio as 0.45, coefficient of velocity as 0.98 and overall efficiency as 0.85. (7)

(ii) A single acting reciprocating pump has a cylinder of 0.25 m diameter. The stroke length is 0.35 m. Speed of the crank is 60 rpm. It delivers $0.017 \text{ m}^3/\text{sec}$. Find the theoretical discharge, coefficient of discharge, the slip and percentage of slip. (7)

(OR)

(b) (i) At a certain point in a strained material, the direct stresses on the two planes at right angles to each other are 40 N/mm^2 (along horizontal direction) and 20 N/mm^2 (along the vertical direction). They are accompanied by a shear stress are 20 N/mm^2 . Compute the principle stresses and any one of the principle plane. (7)

(ii) Write down the step by step procedure of the tension co-efficient method to analyses a perfect, determinate plane truss. (7)

25. (a) (i) A simply supported beam of 4 m effective span carries the concentrated loads of 2KN, 4KN and 2KN at distances 1,2 and 3m respectively from the left support. Calculate shearing force and bending moment. Draw SFD and BMD. (7)

(ii) A solid circular shaft 200 mm in diameter is to be replaced by a hollow shaft. The ratio of external diameter to internal diameter being 5:3, determine the size of the hollow shaft if the maximum shear stress is to be the same as that of solid shaft. Also find the percentage economy in mass. (7)

(OR)

- (b) (i) Draw the shear force and bending moment diagram for the simply supported beam shown in Fig. Q 24. (b)(i), for the given loading (7)

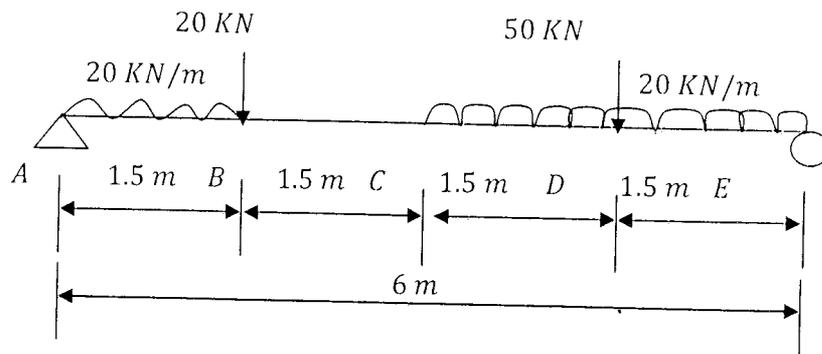


Fig. Q 24. (b) (i)

- (b) (ii) A symmetrical section 200mm deep has moment of Inertia of $2.26 \times 10^{-5} m^4$ about its neutral axis. Determine the longest span over which, when simply supported, the beam would carry a uniformly load of 4 kN/m run without the stress due to bending exceeding $125 \times 10^6 N/m^2$. (7)
25. (a) (i) A solid steel has to transmit 75 KW at 200 rpm. Taking the allowable shear stress as $70 \times 10^6 N/m^2$. Determine suitable diameter for the shaft, if the maximum torque transmitted on each revolution exceeds the mean by 30%. (7)
- (ii) A close-coiled helical spring is made out of 10 mm diameter steel rod. The coil consists of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of 200 N. Find the maximum shear stress induced in the section of rod, if Modulus of Rigidity, $C = 80 \times 10^9 N/m^2$. Also determine deflection in the spring? (7)

(OR)

- (b) (i) A hollow shaft of diameter ratio $3/8$ is required to transmit 600 KW at 110 rpm, the maximum torque being 20% greater than mean. Calculate the maximum external diameter if
- (1) Shear stress not exceed by $63 \times 10^6 N/m^2$.
 - (2) Twist in a length of 3m not to exceed 1.4 degree. Take Modulus of Rigidity, $C = 84 \times 10^9 N/m^2$. (7)
- (ii) A weight of 200 N is dropped on to a helical spring made of 15 mm wire closely coiled to a mean diameter of 120 mm with 20 coils. Determine the height of drop if the instantaneous compression is 80 mm. Take Modulus of Rigidity, $C = 84 \times 10^9 N/m^2$. (7)
