B. E. Third Semester (Civil Engineering) / SoE–2014–15 Examination

Course Code : CV 1201/CV 201 **Course Name : Strength of Materials**

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) All questions carry marks as indicated.

1. (A) Solve any **One** :

(A1) A steel rod of 25 mm diameter passes through a brass tube of 25 mm internal diameter and 35 mm external diameter. The nut on the rod tightened until a stress of 10 MPa is developed in the rod. The temperature of the tube is then raised by 60^0C. What are the final stresses in the rod and the tube ? Take

E_s = 200 GPA and $\alpha_s = 0.0000117/^0C$

E_b = 80 GPA and $\alpha_b = 0.00019/^0C$ 4(CO1,2)

(A2) A steel bar 2 m long, 20 mm wide and 10 mm thick is subjected to an axial load of 20 KN in the direction of its length. Find the change in length, breadth, thickness and volume of a bar. Take $E = 2 \times 10^5$ MPa and m = 4. 4(CO1,2)

(B) Solve any **One** :

(B1) A composite section made up of copper rod 200 mm diameter enclosed in steel tube 160 mm internal diameter and 10 mm thick. Length of assembler is 1000 mm and fastened at both ends. If the temperature of the assembler is raised to 90^0, find stresses developed in each material. $E_S = 2 \times 10^5$ N/mm^2, $\alpha_S = 12 \times 10^{-6}/^0C$, $E_C = 1.05 \times 10^5$ N/mm^2, $\alpha_C = 17.5 \times 10^{-6}/^0C$. 4(CO1,2)

(B2) Steel plate 5 m long, 40 mm wide, and 20 mm thick is subjected to a tensile force of 30 KN in direction of length. Take $\mu = 0.25$, $E = 2 \times 10^5$ N/mm^2. Determine change in dimension and change in volume. 4(CO1,2)

(C) Solve any **One** :

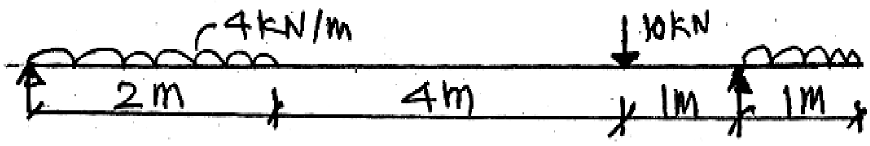
(C1) Draw stress–strain diagram for mild steel rod and show difference limits on it. 2(CO1)

(C2) Define lateral strain and longitudinal strain. 2(CO1)

2. (A) Solve any **One** :

(A1) A beam of span 6 m carries a u.d.l. of 1.5 kN per meter run over the entire span and two point loads of 4 kN and 5 kN at 2 m and 4 m from the left hand support. Find the position and magnitude of maximum B.M. Draw S.F. and B.M. diagram. 4(CO2,3)

(A2) Draw the shear force and bending moment diagrams for the beam shown loaded in fig. Clearly mark the position of the bending moment and determine its value.



4(CO2,3)

(B) Solve any **One** :

(B1) A beam of span 6 m carries a u.d.l of 1.5 kN per meter run over the entire span and two point loads of 4 kN and 5 kN at 2 m and 4 m from the left hand support. Find the position and magnitude of maximum B.M. Draw S.F. and B.M. diagram. 4(CO2,3)

(B2) A cantilever beam of span 2.5 m carries three point loads of 1 kN, 2kN, 3 kN at 1 m, 1.5 m, 2.5 m from the fixed end. Draw S.F.D. and B.M.D. 4(CO2,3)

(C) Solve any **One** :

(C1) Define shear force and bending moment. Also give the sign convention for the same. 2(CO1)

(C2) Define point of contra flexure of a loaded beam. 2(CO1)

3. (A) Solve any **One** :

(A1) A hollow rectangular section 40 mm x 80 mm inside dimension and 10 mm thick is subjected to a shear force of 50 kN. Draw the shear stress variation diagram and find the ratio of maximum shear stress to average shear stress. 4(CO2,3)

(A2) A rectangular beam section 300 mm wide and 500 mm deep is simply supported over a span of 4 m. It carries a full span u.d.l. of 10 kN/m. Find the maximum bending stress induced in the section. Draw the bending stress distribution diagram. 4(CO2,3)

(B) Solve any **One** :

(B1) A circular section of 20 cm diameter is subjected to a shear force of 4 kN when used as a beam. Determine the maximum shear stress induced and draw the shear stress distribution diagram. 4(CO2,3)

(B2) A beam of rectangular c/s 100 mm x 200 mm is subjected to a shear force of 30 kN. Calculate the shear stress across the cross–section at the layer 20 mm away from neutral axis. 4(CO2,3)

(C) Solve any **One** :

(C1) State the assumptions in the theory of simple (pure) bending. 2(CO3)

(C2) What is section modulus ? Write the equation of section modulus for hollow rectangular section and hollow circular section. 2(CO3)

4. (A) Solve any **One** :

(A1) Find the torque that can be applied to a shaft of 100 mm in diameter, if the permissible angle of twist is 2.75^0 in a length of 6 m. Take C = 80 kN/mm². 4(CO3,4)

(A2) A solid shaft is to transmit a torque of 45×10^5 N.mm. If the maximum shearing stress is not to exceed 80 N/mm^2 and angle of twist is not to exceed one degree in 20 diameters length of the shaft, determine the diameter of the shaft. Take C = 0.8×10^5 N/mm^2. 4(CO3,4)

(B) Solve any **One** :

(B1) Determine the diameter of the solid shaft which will transmit 300 KN at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 10 in a shaft length 2 m. Take modulus of rigidity as 1×10^5N/mm^2. 4(CO3,4)

(B2) A steel shaft ABCD having a total length of 2400 mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameter 80 mm and 50 mm respectively, BC is solid and 80 mm diameter. CD is also solid and 70 mm diameter. If the angle of twist is same for each section, determine length of each portion and the total angle of twist. Maximum permissible shear stress is 50 MPa and shear modulus 0.82×10^5 MPa. 4(CO3,4)

(C) Solve any **One** :

(C1) Define Torsional rigidity of shaft. 2(CO4)

(C2) What do mean by strength of the shaft ? 2(CO4)

5. (A) Solve any **One** :

(A1) A simply supported beam of 10 m span carries a uniformly distributed load of 15 kN/m over the entire span, find the slope at the ends. EI = 30,000 KN/m^2. 4(CO2,3)

(A2) A beam length of 10 m is simply supported at its ends and carries two point loads of 100 KN and 60 KN at a distance of 2 m and 5 m respectively from the left support. Calculate the deflections under each load. Find the maximum deflection. Take $I = 18 \times 10^8$ mm^4 and $E = 2 \times 10^5$ N/mm^2. 4(CO2,3,4)

(B) Solve any **One** :

(B1) A cantilever of length 2 m carries an uniformly distributed load of 2.5 KN/m run for a length of 1.25 m from the fixed end, a point load of 1 KN at the free end. Find the deflection at the free end if the section is rectangular 12 cm wide and 24 cm deep and $E = 1 \times 10^4$ N/mm^2. 4(CO2,3,4)

(B2) A cantilever of length 2 m carries a uniformly distributed load 2 KN/m over a length of 1 m from the free end, and a point load of 1 KN at the free end. Find the slope and deflection at the free end if $I = 6.667 \times 10^7$ mm^4 and $E = 2.1 \times 10^5 N/mm^2$. 4(CO2,3,4)

(C) Solve any **One** :

(C1) What are the advantages of Macaulay method over the double integration method, for finding the slope and deflection of beam. 2(CO4)

(C2) What is maximum value of slope and deflection for a simply supported beam subjected to point load at center of beam. 2(CO4)

6. (A) Solve any **One** :

(A1) At a point in a strained material, the principal stresses are 200 N/mm^2 (T) and 60 N/mm^2 (C). Determine the direction and magnitude in a plane inclined at 600 to the axis of major principal stress. What is the maximum intensity of shear stress in the material at the point ? 4(CO2,3,4)

(A2) A closed cylindrical vessel made of steel plates 5 mm thick with plane ends, carries fluid under pressure of 6 N/mm^2. The diameter of cylinder is 35 cm and length is 85 cm. calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in the diameter, length and volume of the cylinder. Take E = 2.1 x 10^5 N/mm^2 and Poisons ratio 0.286. 4(CO2,3,4)

(B) Solve any **One** :

(B1) A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and tensile stress of 47 N/mm^2 on the plane at right angle to the former plane and a tensile stress of 47 N/mm^2 on the plane at right angle to the former. Each of the above stress is accomplanied by a shear stress of 63 N/mm^2.
Find :

(1) The direction and magnitude of each of the principal stress.

(2) Magnitude of greatest shear stress. 4(CO2,3,4)

(B2) A rectangular block of material is subjected to a tensile stress of 210 N/mm^2 on one plane and tensile stress of 28 N/mm^2 on the plane at right angle to the former plane and a tensile stress of 28 N/mm^2 on the plane at right angle to the former. Each of the above stress is accomplanied by a shear stress of 53 N/mm^2.
Find :

(1) The direction and magnitude of each of the principal stress.

(2) Magnitude of greatest shear stress. 4(CO2,3,4)

(C) Solve any **One** :

(C1) Distinguish between thick and thin cylinders. 2(CO4)

(C2) Define Principal planes and Principal stress. 2(CO4)