# B. E. Third Semester (Civil Engineering) / SoE–2018 Examination

**Course Code : CV 2201** **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 round steel bar 20 mm diameter and 300 mm long is placed concentrically within a brass tube which has an outside diameter of 30 mm and an inside diameter of 22.5 mm, the length of the tube exceeds that of the bar by 0.2 mm. Rigid plates are placed on the ends of the tube through which an axial compressive force applied to the compound bar. Determine the compressive stresses in the bar and the tube due to a force of 50 KN. Take Esteel = 210 Gpa, Ebrass = 100 Gpa. ($100 \times 10^3 N/mm^2$) Esteel = $210 \times 10^3$ $N/mm^2$. 4(CO1,2)

(A2) A hollow cylindrical drum of 600 mm internal has thickness of 40 mm. The length of the cylinder is 3m. It is closed with plates at ends and is subjected to an internal air pressure of 3 Mpa. Determine the increase in volume of the drum. Take $E = 2 \times 10^5$ Mpa, $\mu = 0.3$. 4(CO,1,2)

(B) Solve any **One** :

(B1) Draw stress strain curve for tension test on a M.S. specimen and mark the significant point on it. 4(CO1,2)

(B2) Derive the relation between Young's modulus and Modulus of Rigidity. 4(CO1,2)

(C) Solve any **One** :

(C1) Define bulk modulus. 2(CO1)

(C2) State the relationship between Modulus of Elasticity and Modulus of Rigidity and Modulus of Elasticity and Bulk Modulus. 2(CO1)

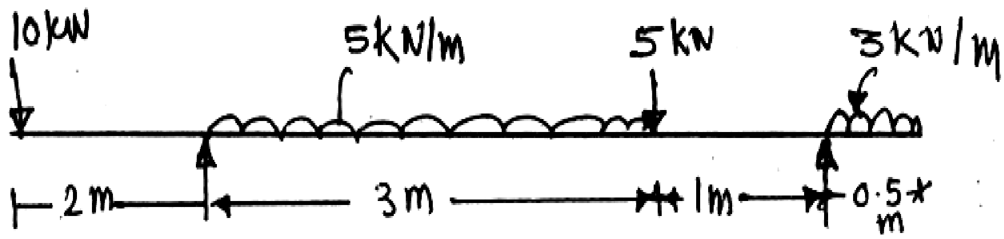
2. (A) Solve any **One** :

(A1) Write any four standard cases for different type of loading for shear force and bending moment for simply supported beam and cantilever beam. 4(CO2,3)

(A2) A beam of span 8 m carries a u.d.l. of 3 kN per meter run upto mid 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)

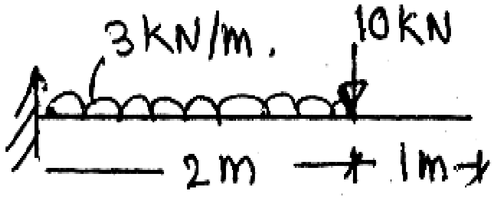
(B) Solve any **One** :

(B1) Draw the shear force and bending moment diagrams for the overhang beam shown loaded in fig. Clearly mark the position of the bending moment and determine its value.




4(CO2,3)

(B2) Draw the shear force and bending moment diagrams for the cantilever beam shown loaded in fig. Clearly mark the position of the bending moment and determine its value.




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 simply supported beam of span 4 m has a rectangular section of 100 mm x 200 mm. Find the Uniformly distributed load it can carry, if the maximum bending and shear stresses are not to exceed 10 $N/mm^2$ and 0.6 $N/mm^2$ respectively. 4(CO2,3)

(A2) A beam of Channel section 500 mm deep and 190 mm wide has flanges 25 mm thick and web 15 mm thick. It carries a shear force of 450 kN at a section. Draw the stress distribution diagram showing the values at salient points. 4(CO2,3)

(B) Solve any **One** :

(B1) The unsymmetrical I section has following dimensions :

Top flange 80 mm x 20 mm

Bottom flange– 160 mm x 20 mm

Web – 200 mm x 20 mm

Draw the stress distribution diagram showing the values at salient points if it carries a shear force of 40 kN at a section. 4(CO2,3)

(B2) A simply supported beam of span 4 m has a rectangular section of 100 mm x 200 mm. Find the Uniformly distributed load it can carry, if the maximum bending and shear stresses are not to exceed 10 $N/mm^2$ and 0.6 $N/mm^2$ respectively. 4(CO2,3)

(C) Solve any **One** :

(C1) Draw the shear stress distribution diagram for the following sections indicating salient points. Hollow Rectangular section. 2(CO3)

(C2) Draw the shear stress distribution diagram for the following sections indicating salient points. un–Symmetrical I section. 2(CO3)

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

(A1) Calculate the maximum intensity of stress induced and the angle of twist in degrees for a length of 10 m for a solid shaft of 100 mm diameter transmitting 112.5 kW at 150 r.p.m. Take C = 84 GN/m². 4(CO3,4)

(A2) A Hallow shaft of diameter ratio 5/8 is subjected to torque of 100 N–m. The shear stress in shaft must not exceed 160 MPa and twist in a length 3.5 m is not exceed $1^0$. Calculate the minimum external diameter of shaft.
Take C = 0.8 x $10^5$ N/mm². 4(CO3,4)

(B) Solve any **One** :

(B1) A steel shaft is to transmit 22.5 kW at 200 rpm. If the shear stress in the material must not exceed 80 Mpa and angle of twist is not to exceed $1^0$ per meter length, determine the diameter of the shaft. Take C = 80 GN/m².

(i) If the shaft is solid.

(ii) If the shaft is hollow with diameter ratio 0.6.
4(CO3,4)

(B2) A solid steel shaft is to transmit 1000 kW at 100 rpm. If the shear stress in the material must not exceed 80 Mpa and the maximum torque is likely to exceed the mean torque by 25% find the required diameter. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose diameter ratio is 0.6, the length, material and the maximum shear stress being same. 4(CO3,4)

(C) Solve any **One** :

(C1) What is meant by composite shaft ? 2(CO4)

(C2) Define torsional rigidity of the solid circular shaft. 2(CO4)

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

(A1) A uniform beam AB of span 6 m is simply supported at its ends A and B. The beam carries a udl of 30 KN/m over the whole span and a concentrated load of 40 KN placed at a distance 2 m from left support A. A clockwise moment of KNm is also applied at end B. Obtain the equation to the elastic line. Find deflection of beam at the point where the concentrated load is placed. 4(CO2,3,4)

(A2) A beam ABCDEF is supported at A and E. EF is overhang. AB = 3m, BC = 3m, DE = 4m, EF = 2m. The beam carries a point load of 40 KN at B, a clockwise moment of 10 KN–m at C, a point load of 35 KN at D, a udl of 10 KN–m over DE and a udl of 15 KN/m over EF. Using Macaulay's method calculates the deflection at free end and under moment in terms of EI. 4(CO2,3,4)

(B) Solve any **One** :

(B1) 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(CO2,3,4)

(B2) 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)

(C) Solve any **One** :

(C1) What are the advantage 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 $100 N/mm^2$ (T) and 160 $N/mm^2$(C). Determine the direction and magnitude in a plane inclined at $60^0$ 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 masonry dam is 8 m high, the maximum depth of water impounded being 7.5 m. The top width of dam is 1.5 m. The weight of masonry is 20 $kN/m^3$ while the weight of water is 10 $kN/m^3$ Find the minimum width of section at base for no tension. The coefficient of friction between masonry to masonry is 0.6. The water face of the dam is vertical. 4(CO2,3,4)

(B) Solve any **One** :

(B1) Two planes AB and BC which are at right angles carry shear, stress of intensity 5 $N/mm^2$ while these planes also carry a tensile stress of 70 $N/mm^2$ and a compressive stress of 35 $N/mm^2$ resp. Determine the principal plane and principal stresses. Also determine the maximum shear stress and the plane on which it acts. 4(CO2,3,4)

(B2) 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 accompanied 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)

(C) Solve any **One** :

(C1) What is the principal plane and principal stresses. 2(CO4)

(C2) What is the angle between principal plane and a plane carrying maximum shear ? What is the angle of obliquity ? 2(CO4)