Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57150

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Mechanical Engineering

CE 6306 – STRENGTH OF MATERIALS

(Common to MecHatronics Engineering, Industrial Engineering and Management, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich), Material Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A ($10 \times 2 = 20$ Marks)

1. Define principal planes.

2. Obtain the relation between E and K.

3. Discuss the fixed and hinged support.

4. What are the advantages of flitched beams ?

5. Draw and discuss the shafts in series and parallel.

6. List out the stresses induced in the helical and carriage springs.

7. How the deflection and slope is calculated for the cantilever beam by conjugate beam method ?

8. State the Maxwell's reciprocal theorem.

9. Differentiate between thin and thick cylinders.

10. Describe the Lame's theorem.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) A steel bar 20mm in diameter, 2m long is subjected to an axial pull of 50 kN. If $E = 2 \times 10^5$ N/mm^2 and m = 3. Calculate the change in the (1) length, (2) diameter and (3) volume. (8)

(ii) A mild steel bar 20mm in diameter and 40 cm long is encased in a brass tube whose external diameter is 30mm and internal diameter is 25mm. The composite bar is heated through 80 °C. Calculate the stresses induced in each metal. α for steel = 11.2×10^{-6}; α for brass = 16.5×10^{-6} per °C. E for steel = 2×10^5 N/mm^2 and E for brass = 1×10^5 N/mm^2. (8)

OR

(b) (i) Two steel rods and one copper rod, each of 20 mm diameter, together support a load of 20kN as shown in Fig. Q. 11 (b) (i). Find the stresses in the rods. Take E for steel = 210kN/mm^2 and E for copper = 110 kN/mm^2. (8)

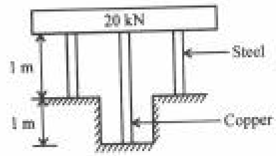

Fig. Q. 11 (b) (i)

(ii) Direct stresses of 140N/mm^2 tensile and 100N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 160 N/mm^2 (8)

(1) What must be the magnitude of the shear stresses on the two planes ?

(2) What will be the maximum shear stress at the point ?

12. (a) Draw SFD and BMD and indicates the salient features of beam loaded Fig. Q. 12. (a) **(16)**

Fig. Q. 12. (a)

OR

(b) (i) Find the dimensions of a timber joist, span 4 m to carry a brick wall 230 mm thick and 3m high if the unit weight of brickwork is 20 kN/m^3. Permissible bending stress in timber is 10 N/mm^2. The depth of the joist is twice the width. **(8)**

(ii) A flitched beam shown in Fig. Q. 12. (b) (ii) is used as a load carrying member. Find the moment of resistance of the combined section and bending stress in steel, if $E_s = 2 \times 10^5$ N/mm^2, $E_w = 1.25 \times 10^5$ N/mm^2. **(8)**

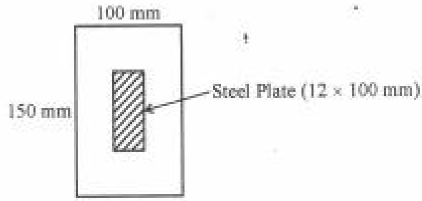

Fig. Q. 12. (b) (ii)

13. (a) A solid circular shaft 200mm 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 maximum shear stress is to be the same as that of a solid shaft. Also find the percentage savings in mass. **(16)**

OR

(b) (i) A closely coiled helical spring made from round steel rod is required to carry a load of 1000 Newton for a stress of 400 MN/m^2, the spring stiffness being 20 N/mm. The diameter of the helix is 100mm and G for the material is 80 GN/m^2. Calculate (1) the diameter of the wire and (2) the number of turns required for the spring. **(8)**

(ii) A spiral spring is made of 10 mm diameter wire has 20 close coils, each 100 mm mean diameter. Find the axial load the spring will carry if the stress is not to exceed 200 N/mm^2. Also determine the extension of the spring. Take $G = 0.8 \times 10^5 N/mm^2$. **(8)**

14. (a) A simply supported beam subjected to uniformly distributed load of w kN/m for the entire span. Calculate the maximum deflection by double integration method. **(16)**

OR

(b) A simply supported beam AB of span 5m carries a point of 40 kN at its centre. The value of moment of inertia for the left half is 2×10^8 mm^4 and for the right half portion is 4×10^8 mm^4. Find the slopes at the two supports and deflection under the load. Take $E = 200$ GN/m^2. **(16)**

15. (a) (i) A cylindrical vessel is 2 m diameter and 5 m long is closed at ends by rigid plates. It is subjected to an internal pressure of 4 N/mm^2. If the maximum principal stress is not to exceed 210 N/mm^2, find the thickness of the shell. Assume $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3. Find the changes in diameter, length and volume of the shell. **(12)**

(ii) A spherical shell of 1.50 m internal diameter and 12 mm shell thickness is subjected to pressure of 2 N/mm^2. Determine the stress induced in the material of the shell. **(4)**

OR

(b) (i) A spherical shell of internal diameter 1.2 m and of thickness 12 mm is subjected to an internal pressure of 4 N/mm^2. Determine the increase in diameter and increase in volume. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.33$. **(8)**

(ii) A steel cylinder of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking the diameter at the junction is 250 mm and radial pressure at the common junction is 40 N/mm^2. Find the original difference in radii at the junction.

Take $E = 2 \times 10^5$ N/mm^2. **(8)**

(ii) A spiral spring is made of 10 mm diameter wire has 20 close coils, each 100 mm mean diameter. Find the axial load the spring will carry if the stress is not to exceed 200 N/mm^2. Also determine the extension of the spring. Take $G = 0.8 \times 10^5 N/mm^2$. **(8)**

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OR

(b) A simply supported beam AB of span 5m carries a point of 40 kN at its centre. The value of moment of inertia for the left half is 2×10^8 mm^4 and for the right half portion is 4×10^8 mm^4. Find the slopes at the two supports and deflection under the load. Take $E = 200$ GN/m^2. **(16)**

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(ii) A steel cylinder of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking the diameter at the junction is 250 mm and radial pressure at the common junction is 40 N/mm^2. Find the original difference in radii at the junction.

Take $E = 2 \times 10^5$ N/mm^2. **(8)**

Reg. No. :

Question Paper Code : 27099

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Mechanical Engineering

CE 6306 — STRENGTH OF MATERIALS

(Common to Mechatronics Engineering, Industrial Engineering and Management, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich) Material Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulations 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Differentiate Elasticity and Elastic Limit.

2. What is principle of super position?

3. Write the assumption in the theory of simple bending?

4. What are the types of beams?

5. The shearing stress is a solid shaft is not to exceed 40 N/mm^2 when the torque transmitted is 20000 N-m. Determine the minimum diameter of the shaft.

6. What are the various types of springs?

7. What are the methods of determining slope and deflection at a section in a loaded beam?

8. What is the equation used in the case of double integration method?

9. State the expression for maximum shear stress in a cylindrical shell.

10. Define — hoop stress and longitudinal stress.

PART B — (5 × 16 = 80 marks)

11. (a) A metallic bar 300 mm × 100 mm × 40 mm is subjected to a force of 50 kN (tensile), 6 kN (tensile) and 4 kN (tensile) along x, y and z directions respectively. Determine the change in the volume of the block. Take $E = 2 \times 10^5$ N / mm² and Poisson's ratio = 0.25.

Or

(b) A steel rod of 3 cm diameter is enclosed centrally in a hollow copper tube of external diameter 5 cm and internal diameter of 4 cm as shown in Fig-1. The composite bar is then subjected to axial pull of 45000 N. If the length of each bar is equal to 15 cm, determine: (i) The stresses in the rod and tube, and (ii) Load carried by each bar. Take E for steel = 2.1×10^5 N/mm² and for copper = 1.1×10^5 N/mm².

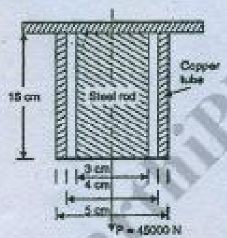

Fig. 1

12. (a) Draw the shear force and B.M diagrams for a simply supported beam of length 8 m and carrying a uniformly distributed load of 10 kN/m for a distance of 4m as shown in fig-2.

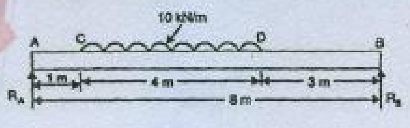

Fig. 2

Or

(b) A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E = 2 \times 10^5$ N/mm².

13. (a) A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/ mm^2.

Or

(b) A closely coiled helical spring of mean diameter 20 cm is made of 3 cm diameter rod and has 16 turns. A weight of 3 kN is dropped on this spring. Find the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 18 cm. Take $C = 8 \times 10^4$ N/mm^2.

14. (a) A beam 6m long, simply supported at its ends, is carrying a point load of 50 kN at its centre. The moment of inertia of the beam is given as equal to 78×10^6 mm^4. If E for the material of the beam = 2.1×10^5 N/mm^2, calculate : (i) deflection at the centre of the beam and (ii) slope at the supports.

Or

(b) A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 respectively from the left support as shown Fig-3.

Using Macaulay's method find:

(i) deflection under each load,

(ii) maximum deflection, and

(iii) the point at which maximum deflection occurs,

Given $E = 2 \times 10^5$ N/mm^2 and $I = 85 \times 10^6$ mm^4.

Fig. 3

15. (a) A boiler is subjected to an internal steam pressure of 2N/mm^2. The thickness of boiler plate is 2.6 cm and permissible tensile stress is 120 N/mm^2. Find the maximum diameter, when efficiency of longitudinal joint is 90% and that of circumference point is 40%.

Or

(b) Calculate: (i) the change in diameter, (ii) change in length and (iii) change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5 m long when subjected to internal pressure of 3 N/mm^2. Take the value of $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio, $\mu = 0.3$.

Question Paper Code : 80197

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Mechanical Engineering

CE 6306 — STRENGTH OF MATERIALS

(Common to Mechatronics Engineering, Industrial Engineering and Management, Agriculture Engineering, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich), Materials Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

1. Define Young's Modulus.
2. What do you mean by principal planes and principal stresses?
3. Draw the shear force diagram and bending moment diagram for the cantilever beam carries uniformly varying load of zero intensity at the free end and w kN/m at the fixed end.
4. List out the assumptions used to derive the simple bending equation.
5. Define torsional rigidity.
6. What is a spring? Name the two important types of springs.
7. List out the methods available to find the deflection of a beam.
8. State Maxwell's reciprocal theorem.
9. Name the stresses develop in the cylinder.
10. Define radial pressure in thin cylinder.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A compound tube consists of a steel tube 140 mm internal diameter and 160 mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The two tubes are of same length. The compound tube carries an axial compression load of 900 kN. Find the stresses and the load carried by each tube and the amount of its shortens. Length of each tube is 140 mm. Take E for steel as 2×10^5 N/mm^2 and for brass 1×10^5 N/mm^2. (10)

(ii) Two members are connected to carry a tensile force of 80 kN by a lap joint with two number of 20 mm diameter bolt. Find the shear stress induced in the bolt. (3)

Or

(b) (i) A point in a strained material is subjected to the stress as shown in fig. Q.11(b)(i). Locate the principle plane and find the principle stresses. (7)

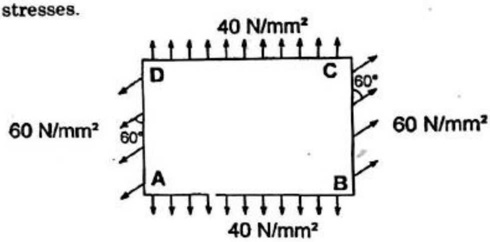

Fig. Q. 11(b)(i)

(ii) A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at the end by rigid plates of negligible thickness. The nuts are tightened lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take E for steel as 2×10^5 N/mm² and copper as 1×10^5 N/mm² and α for steel and copper as 12×10^{-6} per °C and 18×10^{-6} per °C. (6)

12. (a) (i) A simply supported beam AB of length 5 m carries point loads of 8 kN, 10 kN and 15 kN at 1.50 m, 2.50, and 4.0 m respectively from left hand support. Draw shear force diagram and bending moment diagram. (8)

(ii) A cantilever beam AB of length 2 m carries a uniformly distributed load of 12 kN/m over entire length. Find the shear stress and bending stress, if the size of the beam is 230 mm × 300 mm. (5)

Or

(b) (i) Construct the SFD and BMD for the beam shown in fig. Q. 12(b)(i). (6)

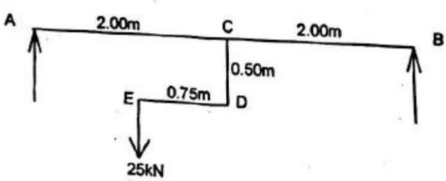

Fig. Q. 12(b)(i)

(ii) Two members are connected to carry a tensile force of 80 kN by a lap joint with two number of 20 mm diameter bolt. Find the shear stress induced in the bolt. (3)

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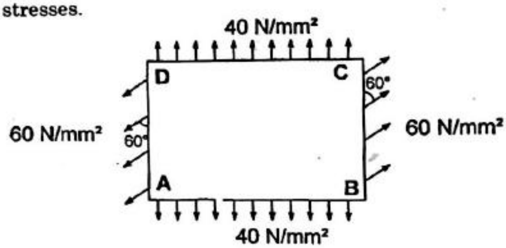

Fig. Q. 11(b)(i)

(ii) A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at the end by rigid plates of negligible thickness. The nuts are tightened lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take E for steel as 2×10^5 N/mm² and copper as 1×10^5 N/mm² and α for steel and copper as 12×10^{-6} per °C and 18×10^{-6} per °C. (6)

12. (a) (i) A simply supported beam AB of length 5 m carries point loads of 8 kN, 10 kN and 15 kN at 1.50 m, 2.50, and 4.0 m respectively from left hand support. Draw shear force diagram and bending moment diagram. (8)

(ii) A cantilever beam AB of length 2 m carries a uniformly distributed load of 12 kN/m over entire length. Find the shear stress and bending stress, if the size of the beam is 230 mm × 300 mm. (5)

Or

(b) (i) Construct the SFD and BMD for the beam shown in fig. Q. 12(b)(i). (6)

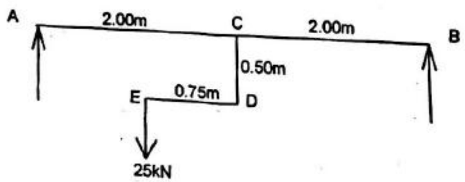

Fig. Q. 12(b)(i)

(ii) Two timber joist are connected by a steel plate, are used as beam as shown in fig. Q. 12(b)(ii). Find the load W if, the permissible stresses in steel and timber are 165 N/mm² and 8.5 N/mm² respectively. (7)

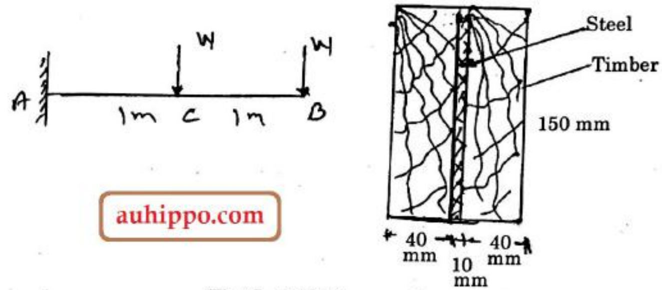

Fig. Q. 12(b)(ii) Cross section

13. (a) (i) A solid shaft has to transmit the Power 105 kW at 2000 r.p.m. The maximum torque transmitted in each revaluation exceeds the mean by 36%. Find the suitable diameter of the shaft, if the shear stress is not to exceed 75 N/mm² and maximum angle of twist is 1.5° in a length of 3.30 m and $G = 0.80 \times 10^5$ N/mm². (8)

(ii) A laminated spring carries a central load of 5200 N and it is made of 'n' number of plates, 80 mm wide. 7 mm thick and length 500 mm. Find the numbers of plates, if the maximum deflection is 10 mm. Let $E = 2.0 \times 10^5$ N/mm². (5)

Or

(b) (i) A stepped solid circular shaft is built in at its ends and subject to an externally applied torque T at the shoulder as shown in fig. Q.13(b)(i). Determine the angle of rotation θ of the shoulder section when T is applied. (7)

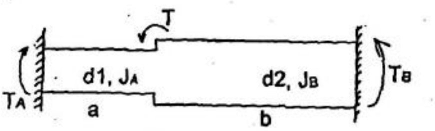

Fig. Q.13(b)(i)

(ii) A closed coiled helical spring is to be made out of 5 mm diameter wire 2 m long so that it deflects by 20 mm under an axial load of 50 N. Determine the mean diameter of the coil. Take $C = 8.1 \times 10^4$ N/mm². (6)

14. (a) Cantilever of length l carrying uniformly distributed load w kN per unit run over whole length. Derive the formula to find the slope and deflection at the free end by double integration method. Calculate the deflection if, w = 20 kN /m, l = 2.30 m and EI = 12000 kN m². (13)

Or

(b) (i) Derive the formula to find the deflection of a simply supported beam with point load W at the centre by moment area method. (8)

(ii) A simply supported beam of span 5.80 m carries a central point load of 37.50 kN, find the maximum slope and deflection, let EI = 40000 kN m². Use conjugate beam method. (5)

15. (a) Calculate Change in diameter, Change in length and Change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5 m long when subjected to internal pressure of 3 N/mm². Take the value of $E = 2 \times 10^5$ N/mm² and Poisson's ratio = 0.30. (13)

Or

(b) Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to with stand an internal pressure of 25 MN/m², if maximum permissible shear stress is 125 MN/m². (13)

PART C — (1 × 15 = 15 marks)

16. (a) The intensity of resultant stress on a plane AB (Fig.Q.16(a)) at appoint in a materials under stress is 8 N/mm² and it is inclined at 30° to the normal to that plane. The normal component of stress on another plane BC at right angles to plane AB is 6 N/mm². Determine the following :

(i) The resultant stress on the plane BC

(ii) The principal stresses and their directions

(iii) The maximum shear stresses. (15)

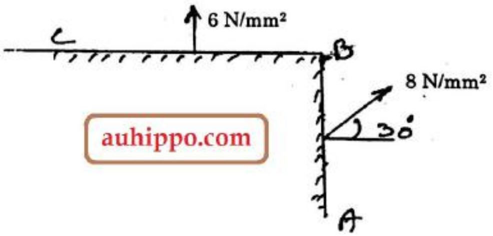

Fig. Q. 16(a)

Or

(b) A water tank vertical wall is stiffened by vertical beam, and the height of the tank is 8 m. The beams are spaced at 1.5 m centre to centre. If the water reaches the top of the tank, calculate the maximum bending moment on a vertical beam. Sketch the shear force and bending moment diagrams. Unit weight weight of water = 9.8 kN/m³. (15)

Question Paper Code : 71551

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third Semester

Mechanical Engineering

CE 6306 — STRENGTH OF MATERIALS

(Common to Mechatronics Engineering, Industrial Engineering and Management, Agriculture Engineering, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich), Materials Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Derive a relation for change in length of a bar hanging freely under its own weight.

2. What does the radius of Mohr's circle refer to?

3. Draw shear force diagram for a simply supported beam of length 4 m carrying a central point load of 4 kN.

4. Prove that the shear stress distribution over a rectangular section due to shear force is parabolic.

5. Draw shear stress distribution of a circular section due to torque.

6. What is meant by spring constant?

7. Write down the equation for the maximum deflection of a cantilever beam carrying a central point load 'W'.

8. Draw conjugate beam for a double side over hanging beam.

9. How does a thin cylinder fail due to internal fluid pressure?

10. State Lame's equations.

PART B — (5 × 13 = 65 marks)

11. (a) The bar shown in fig.Q.11(a) is subjected to a tensile load of 160 kN. If the stress in middle portion is limited to 150 N/mm², determine the diameter of the middle portion. Find also the length of the middle portion if the total elongation of the bar is to be 0.2 mm. Young's modulus is 2.1×10^5 N/mm².

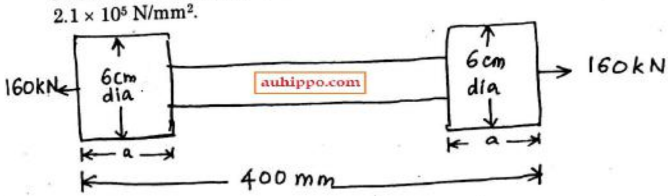

fig.Q.11(a)

Or

(b) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate :

(i) Young's modulus

(ii) Poisson's ratio and

(iii) Bulk modulus.

12. (a) Draw shear force diagram and bending moment diagram for the beam given in fig.Q.12(a)

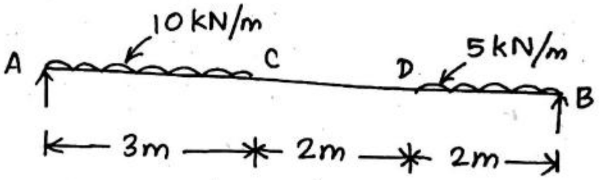

fig.Q.12(a)

Or

(b) A beam of square section is used as a beam with one diagonal horizontal. The beam is subjected to a shear force F, at a section. Find the maximum shear in the cross section of the beam and draw shear stress distribution diagram for the section.

13. (a) A hollow shaft, having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting in the same power at the same speed. Calculate percentage saving in material, if the material to be is also the same.

Or

(b) Derive a relation for deflection of a closely coiled helical spring subjected to an axial compressive load 'W'.

14. (a) Determine the deflection at its mid point and maximum deflection for the beam given in fig.Q.14(a). Use Macaulay's method.
$E = 2 \times 10^5$ N/mm², $I = 4.3 \times 10^8$ mm⁴.

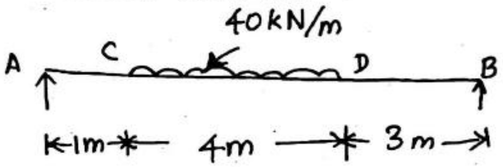

fig.Q.14(a)

Or

(b) Determine the slope at the two supports and deflection under the loads. Use conjugate beam method. $E = 200\,GN/m^2$, I for right half is $2 \times 10^8\,mm^4$, I for left half is $1 \times 10^8\,mm^4$ the beam is given in fig.Q.14(b).

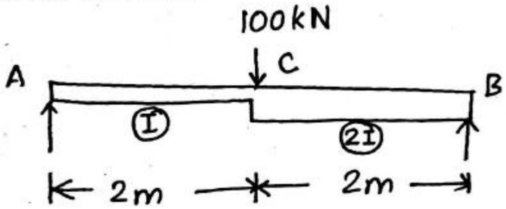

fig.Q.14(b)

15. (a) Derive a relation for change in volume of a thin cylinder subjected to internal fluid pressure.

Or

(b) Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of $8\,N/mm^2$. Also sketch the radial pressure distribution and hoop stress distribution across the section.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Draw stress strain curve for mild steel and explain the salient points on it. (7)

(ii) Derive a relation for change in length of a circular bar with uniformly varying diameter, subjected to an axial tensile load 'W'. (8)

Or

(b) A water main of 500 mm internal diameter and 20 mm thick is full. The water main is of cast iron and is supported at two points 10 m apart. Find the maximum stress in the metal. The cast iron and water weigh $72000\ N/m^3$ and $10000\ N/m^3$ respectively.

Question Paper Code : 77058

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Mechanical Engineering

CE 6306 — STRENGTH OF MATERIALS

(Common to Mechatronics Engineering, Industrial Engineering and Management, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich) Material Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What do you mean by thermal stresses?

2. Draw the Mohr's circle for the state of pure shear in a strained body and mark all salient points in it.

3. Define :
   (a) Shearing force and
   (b) Bending moment.

4. What is neutral axis of a beam section? How do you locate it when a beam is under simple bending?

5. What is meant by torsional stiffness?

6. What are the uses of helical springs?

7. What are the advantages of Macaulay's method over other methods for the calculation of slope and deflection?

8. In a cantilever beam, the measured deflection at free end was 8 mm when a concentrated load of 12 kN was applied at its mid-span. What will be the deflection at mid-span when the same beam carries a concentrated load of 7 kN at the free end?

9. Distinguish between thin and thick shells.

10. State the assumptions made in Lame'e theorem for thick cylinder analysis.

PART B — (5 × 16 = 80 marks)

11. (a) A steel rod of diameter 32 mm and length 500 mm is placed inside an aluminium tube of internal diameter 35 mm and external diameter 45 mm which is 1 mm longer than the steel rod. A load of 300 kN is placed on the assembly through the rigid collar. Find the stress induced in steel rod and aluminium tube. Take the modulus of elasticity of steel as 200 GPa and that of aluminium as 80 GPa.

Or

(b) At a point in a strained material the resultant intensity of stress across a vertical plane is 100 MPa tensile inclined at 35° clockwise to its normal. The normal component of intensity of stress across the horizontal plane is 50 MPa compressive. Determine graphically using Mohr's circle method :

(i) The position of principal planes and stresses across them and

(ii) The normal and tangential stress across a plane which is 60° clockwise to the vertical plane.

12. (a) An overhanging beam ABC of length 7 m is simply supported at A and B over a span of 5 m and the portion BC overhangs by 2 m. Draw the shearing force and bending moment diagrams and determine the point of contra-flexure if it is subjected to uniformly distributed loads of 3 kN/m over the portion AB and a concentrated load of 8 kN at C.

Or

(b) Three beams have the same length, the same allowable stress and the same bending moment. The cross-section of the beams are a square, a rectangle with depth twice the width and a circle. Find the ratios of weights of the circular and the rectangular beams with respect to the square beam.

13. (a) A brass tube of external diameter 80 mm and internal diameter 50 mm is closely fitted to a steel rod of 50 mm diameter to form a composite shaft. If a torque of 10 kNm is to be resisted by this shaft, find the maximum stresses developed in each material and the angle of twist in 2 m length. Take modulus of rigidity of brass and steel as 40×10^3 N/mm² and 80×10^3 N/mm² respectively.

(b) A close-coiled helical spring is to have a stiffness of 900 N/m in compression, with a maximum load of 45 N and a maximum shearing stress of 120 N/mm^2. The solid length of the spring (i.e., coils touching) is 45 mm. Find :

(i) The wire diameter,

(ii) The mean coil radius, and

(iii) The number of coils. Take modulus of rigidity of the material of the spring as 0.4×10^5 N/mm^2.

14. (a) A horizontal beam of uniform section and 7 m long is simply supported at its ends. The beam is subjected to a uniformly distributed load of 6 kN/m over a length of 3 m from the left end and a concentrated load of 12 kN at 5 m from the left end. Find the maximum deflection in the beam using Macaulay's method.

Or

(b) A cantilever of span 4 m carries a uniformly distributed load of 4 kN/m over a length of 2 m from the fixed end and a concentrated load of 10 kN at the free end. Determine the slope and deflection of the cantilever at the free end using conjugate beam method. Assume El is uniform throughout.

15. (a) A thin cylindrical shell, 2.5 m long has 700 mm internal diameter and 8 mm thickness. if the shell is subjected to an internal pressure of 1 MPa, find

(i) The hoop and longitudinal stresses developed

(ii) Maximum shear stress induced and

(iii) The changes in diameter length and volume. Take modulus of elasticity of the wall material as 200 GPa and Poisson's ratio as 0.3.

Or

(b) A thick cylinder with external diameter 320 mm and internal diameter 160 mm is subjected to an internal pressure of 8 N/mm^2. Draw the variation of radial and hoop stresses in the cylinder wall. Also determine the maximum shear stress in the cylinder wall.