Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

Level : B.E.
Year : II

Course : MEEG 202
Semester : II

Exam Roll No. :

Time: 30 mins

F. M. : 20

Registration No. :

Date SEP 04 2017

SECTION "A"

[20Q × 1 = 20 marks]

Choose the most appropriate answer and **mark [X]**.

1. The stress at which the extension of the material takes place more quickly as compared to the increase in load, is called
   [ ] elastic limit [ ] yield point [ ] ultimate point [ ] breaking point

2. Compression members always tend to buckle in the direction of the
   [ ] axis of load
   [ ] perpendicular to the axis of load
   [ ] minimum cross section
   [ ] least radius of gyration

3. The bending moment in the centre of a simply supported beam carrying a uniformly distributed load of w per unit length is
   [ ] zero [ ] $wl^2/2$ [ ] $wl^2/4$ [ ] $wl^2/8$

4. A beam of uniform strength has
   [ ] same cross-section throughout the beam
   [ ] same bending stress at every section
   [ ] same bending moment at every section
   [ ] same shear stress at every section

5. The extremities of any diameter on Mohr's circle represent
   [ ] principal stresses
   [ ] normal stresses on planes at 45^0
   [ ] shear stresses on planes at 45^0
   [ ] normal and shear stresses on a plane

6. For any part of a beam subjected to uniformly distributed load, Shear force diagram is
   [ ] horizontal straight line
   [ ] vertical straight line
   [ ] line inclined to x-axis
   [ ] parabolic

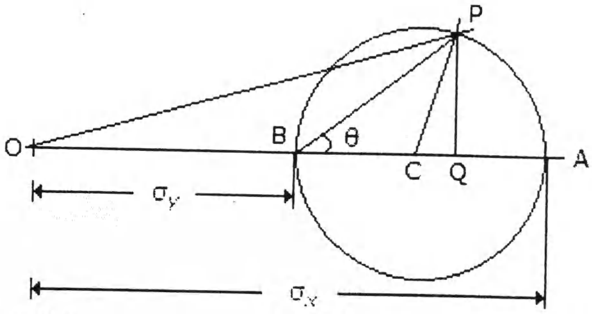
7. When the shear force diagram is a parabolic curve between two points, it indicates that there is a
   [ ] point load at the two points
   [ ] no loading between the two points
   [ ] uniformly distributed load between the two points
   [ ] uniformly varying load between the two points

8. When a bar of length l, width b and thickness t is subjected to a pull of P, its
   [ ] length, width and thickness increases
   [ ] length, width and thickness decreases
   [ ] length increases, width and thickness decreases
   [ ] length decreases, width and thickness increases

9. A column with maximum equivalent length has

[ ] both ends hinged
[ ] both ends fixed
[ ] one end fixed and the other end hinged
[ ] one end fixed and the other end free

10. The given Figure shows the Mohr's circle of stress for two unequal and like principal stresses (σ_x and σ_y) acting at a body across two mutually perpendicular planes. The resultant stress is given by



[ ] OC
[ ] OP
[ ] OQ
[ ] PQ

11. In Mohr's circle, the centre of circle from Y-axis is taken as

[ ] $\frac{\sigma_x - \sigma_y}{2}$
[ ] $\frac{\sigma_x + \sigma_y}{2}$
[ ] $\frac{\sigma_x - \sigma_y}{2} + \tau$
[ ] $\frac{\sigma_x + \sigma_y}{2} + \tau$

13. When there is a sudden increase or decrease in shear force diagram between any two points, it indicates that there is a

[ ] point load at the two points
[ ] no loading between the two points
[ ] uniformly distributed load between the two points
[ ] uniformly varying load between the two points

14. Which of the following is the correct torsion equation?

[ ] $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$
[ ] $\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{l}$
[ ] $\frac{M}{R} = \frac{T}{J} = \frac{C\theta}{l}$
[ ] $\frac{T}{l} = \frac{\tau}{J} = \frac{R}{C\theta}$

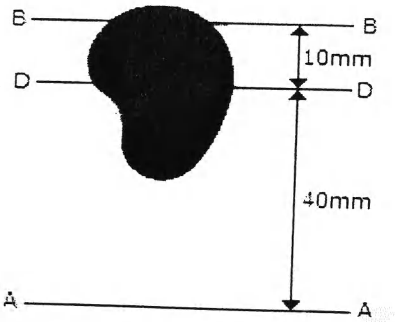
15. The polar modulus for a hollow shaft of outer diameter (D) and inner diameter (d)

[ ] $\frac{\pi}{4}\left(\frac{D^2 - d^2}{D}\right)$
[ ] $\frac{\pi}{16}\left(\frac{D^3 - d^3}{D}\right)$
[ ] $\frac{\pi}{16}\left(\frac{D^4 - d^4}{D}\right)$
[ ] $\frac{\pi}{32}\left(\frac{D^4 - d^4}{D}\right)$

16. A shaft of diameter D is subjected to a twisting moment (T) and a bending moment (M). If the maximum bending stress is equal to maximum shear stress developed, then M is equal to

[ ] $T/2$
[ ] T
[ ] $2T$
[ ] $4T$

17. The irregular area has a moment of inertia about the AA axis of 35 (10^6) mm^4. If the total area is 12.0 (10^3) mm^2, determine the moment of inertia if the area about the BB axis. The DD axis passes through the centroid C of the area.



[ ] $I_{BB} = 5.00(10^6)\ mm^4$
[ ] $I_{BB} = 16.80(10^6)\ mm^4$
[ ] $I_{BB} = 17.00(10^6)\ mm^4$
[ ] $I_{BB} = 55.4(10^6)\ mm^4$

18. Moment of inertia is the
[ ] second moment of force
[ ] second moment of mass
[ ] second moment of area
[ ] all of these

19. In a simply supported beam, bending moment at the end
[ ] is always zero if it does not carry couple at the end
[ ] is zero, if the beam has uniformly distributed load only
[ ] is zero, if the beam has concentrated loads only
[ ] may or may not be zero

20. A beam of uniform strength has
[ ] same cross section through the beam
[ ] same bending moment at every section
[ ] same bending stress at every section
[ ] same shear stress at every section

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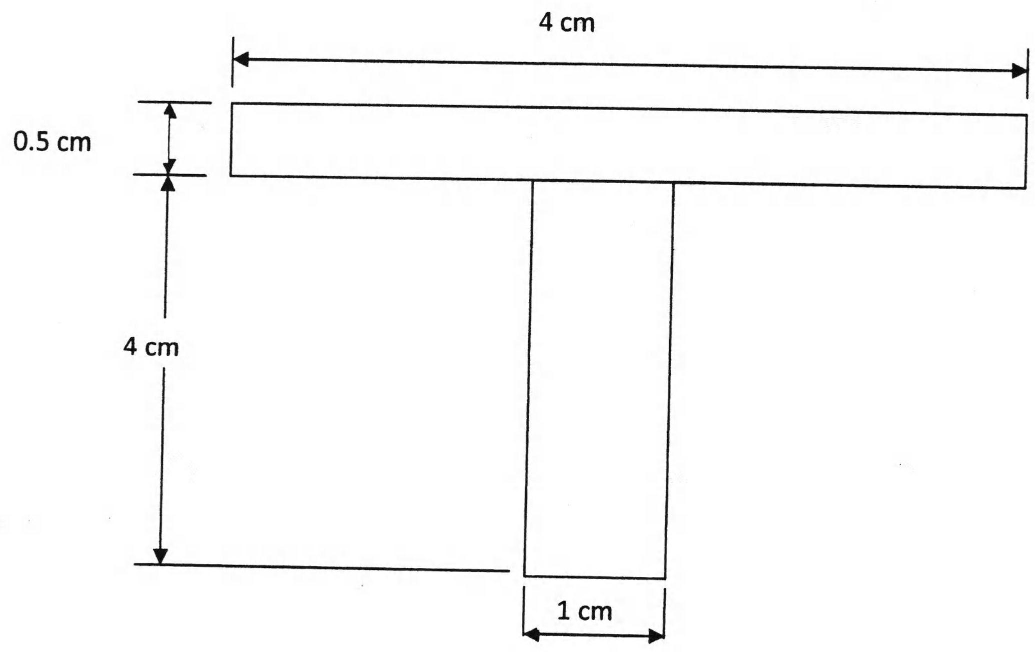
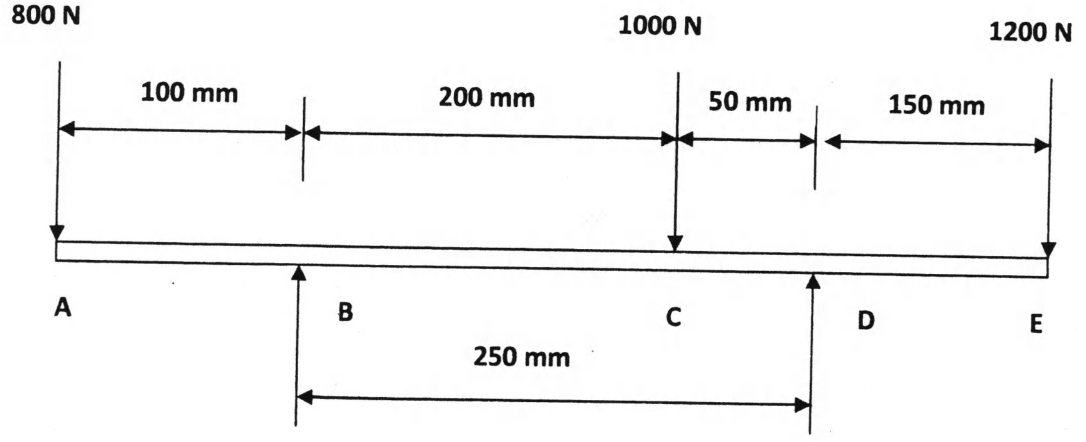
Attempt ***ALL*** question. Assume suitable data if necessary.

SECTION "B"

1. State and prove theorem of parallel axis. [3]
2. Compute the moment of inertia of the tee shape in Figure with respect to the centroidal axis. [6]



3. Compute the reaction forces at points B and D of overhanging beam in Figure below. Also, Draw its complete Shearing force and bending moment diagrams. [6]



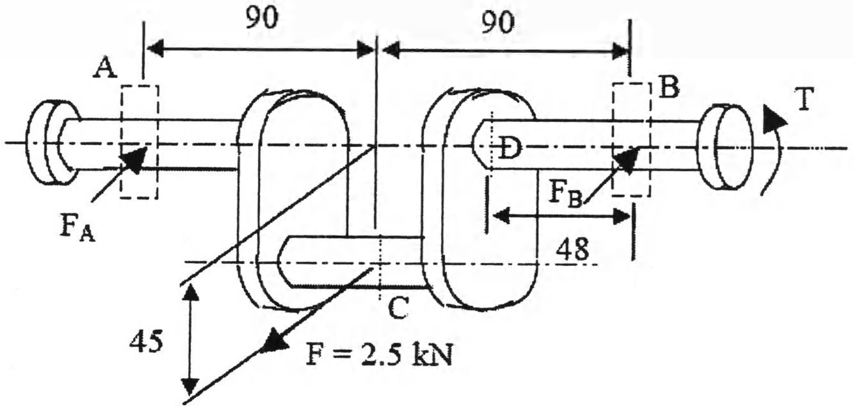
4. A steel bar is placed between two copper bars, each having the same area and length as steel bar at 20 ^{0}C. At this stage, they are rigidly connected together at both the ends. When the temperature is raised to 320 ^{0}C, the length of the bars increases by 1.5 mm. Determine the original length and final stresses in the bars.
Assume E for Steel = 220 GN/m^2, E for Copper = 110 GN/m^2, α for Steel = 0.000012 per ^{0}C, α for copper = 0.0000175 per ^{0}C. [6]

5. A beam AB of span 8 meters is simply supported at the ends. It carries a uniformly distributed of 30 kN/m over its entire length and a concentrated load of 60 kN at 3 meters from the support A. Determine the maximum deflection in the beam and the location where the deflection occurs. Assume E = 200 x 10^6 kN/m^2 and I = 80 x 10^{-4} m^4. [6]

6. Derive torsion equation for hollow circular shaft. [4]

7. A Solid cylindrical shaft is to transmit 300 kW at 100 rpm.
i. if the shear stress is not to exceed 80 MN / m^2, find its diameter.
ii. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 of the external diameter? The length, the material and maximum shear stress being the same. [4]

8. The steel crankshaft is loaded statically as shown in Figure. The steady force is counter balanced by a twisting torque T and by reactions at A and B. The yield strength of the material is 420 MPa. If the factor of safety according to maximum shear stress theory is to be 2.0, what should be the minimum diameter of the crankshaft? (Note: In practice such problems are dealt with dynamic considerations. Here it is taken as a static example.) At point C, there is normal stress in axial direction due to bending (max. moment). At point D, both axial stress due to bending and shear stress due to torsion exist. [8]



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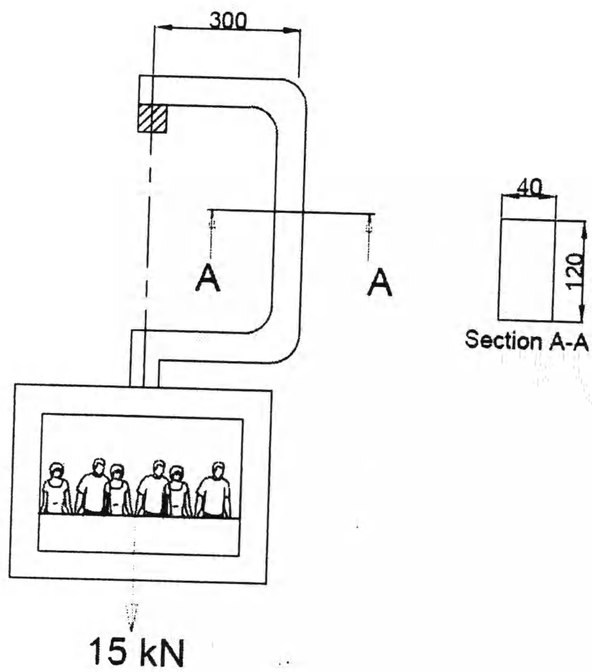
9. The schematic diagram of a lift is shown in the Figure below with the dimension of the arm and cross section. Determine the maximum normal stress developed in the section A-A. Also calculate maximum principal stress and maximum shear stress at the point of maximum stress. Construct Mohr circle and solve. All dimensions are in mm. [8]



10. A Slender pin ended aluminum column 1.8 m long and of circular cross section is to have an outside diameter of 50 mm. Calculate the necessary internal diameter to prevent failure by buckling if the actual load applied is 13.6 kN and the critical load applied is twice the actual load. Take E for aluminum as 70 GN/m^2. [4]