KATHMANDU UNIVERSITY
End Semester Examination [C]
January, 2019

Marks scored:

Level : B.E.
Year : II
Course : MEEG 202
Semester: II

Exam Roll No. :
Time: 30 mins.
F. M. : 20

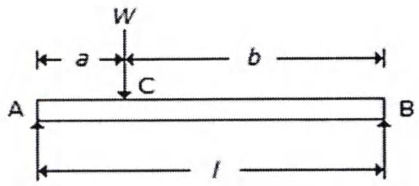
Registration No.:
Date : JAN 0 4 2019

SECTION "A"
[20 Q × 1 = 20 marks]

Cross [×] mark the most appropriate answer.

1. A steel bar of 15 mm is heated from 15 ^{0}C to 40 ^{0}C and it is free to expand. The bar will induce
   [ ] no stress
   [ ] shear stress
   [ ] compressive stress
   [ ] tensile stress

2. For a beam as shown in the below Figure, when the load *W* is applied in the center of the beam, the maximum deflection is,

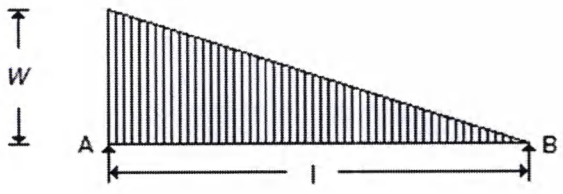


   [ ] $Wl^3/48EI$
   [ ] $5Wl^3/38EI$
   [ ] $Wl^3/192EI$
   [ ] $Wl^3/384EI$

3. The energy stored in a body when strained within elastic limit is known as
   [ ] resilience
   [ ] proof resilience
   [ ] strain energy
   [ ] impact energy

4. When shear force at a point is zero, then bending moment is _____ at that point.
   [ ] zero
   [ ] minimum
   [ ] maximum
   [ ] infinity

5. The maximum bending moment for the beam shown in the below lies at a distance of _____from B.



   [ ] 1/2
   [ ] 1/3
   [ ] $1/\sqrt{2}$
   [ ] $1/\sqrt{3}$

6. A principle plane is a plane of
[ ] only normal stress [ ] only bending stress
[ ] only shear stress [ ] both normal and shear stress

7. In a body loaded under plane stress conditions, what is the number of independent stress components?
[ ] 2 [ ] 1 [ ] 6 [ ] 3

8. A material has Poisson's ratio of 0.5. If uniform pressure of 300 GPa is applied to that material, what will be the volumetric strain of it?
[ ] 0.5 [ ] 0.25 [ ] 0.75 [ ] 0

9. A circular hole of radius r is cut out from a circular disc of radius 2r in such a way that the diameter of the hole is the radius of the disc. The centre of the gravity of the section lies at _____
[ ] centre of a disc [ ] centre of a hole
[ ] somewhere in a disc [ ] somewhere in a hole

10. Moment of inertia of any section about an axis passing through its C.G. is
[ ] maximum [ ] minimum
[ ] depends on dimension of section [ ] depends on shape of section

11. The point of contra flexure is a point where
[ ] shear force changes sign [ ] B.M. changes sign
[ ] shear force is maximum [ ] B.M. is maximum

12. Circular bar is subjected to an axial and shear force. The difference between two principle stresses is 120 MPa. Based on MSS what will be the factor of safety if elastic limit of the bar is 300 MPa?
[ ] 5 [ ] 2 [ ] 2.5 [ ] 3

13. Which of the following is the elastic curve equation for shear force?
[ ] $S = EI\,(dy/dx)$ [ ] $EI\,(d^2y/dx^2)$ [ ] $EI\,(d^3y/dx^3)$ [ ] $EI\,(d^4y/dx^4)$

14. Calculate the deflection if the slope is 0.0225 radians. Take the distance of centre of gravity of bending moment to free end as 2 meters.
[ ] 45 mm [ ] 35 mm [ ] 28 mm [ ] 49 mm

15. For the same material, length and given torque a hollow shaft weighs_____ a solid shaft.
[ ] less than [ ] more than
[ ] equal to [ ] depends on other factors

16. Which of the following is not an assumption in derivation of torsion equation?
[ ] circular shaft remains circular after twisting
[ ] material of the shaft is isotropic
[ ] section of the shaft is unchanged after twisting
[ ] angle of twist is proportional to radius

17. In Euler's theory, long column fail due to _____
[ ] crushing [ ] buckling [ ] compression [ ] tension

18. If the effective length of the column is twice the actual length then the column is _____
[ ] fixed at both ends
[ ] fixed at one end and hinged at the other end
[ ] fixed at one end and free at the other end
[ ] hinged at both ends

19. When the bending moment is parabolic curve between two points it indicates that there is
[ ] no loading between two points [ ] point loads between the two points
[ ] U.D.L. between the two points [ ] UVL between the two points

20. The lengthcoefficient of thermal expansion and Young's modulus of bar A are twice of bar B. if the temperature of both bars is increased by the same amount while preventing any expansion, then the ratio of stress developed in bar A to that in bar B will be
[ ] 2 [ ] 4 [ ] 8 [ ] 16

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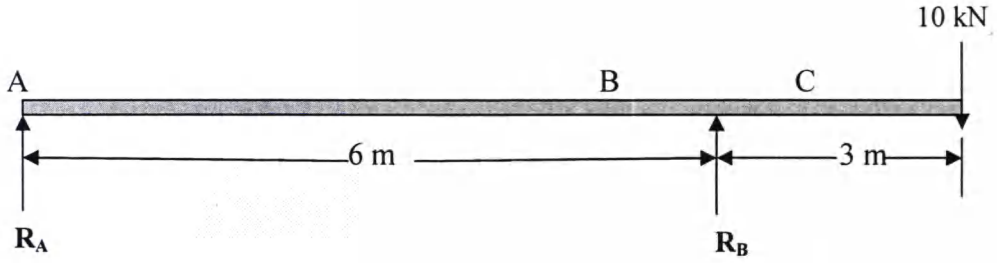
SECTION "B"

Attempt *ALL* questions. Assume any missing values (only if needed)

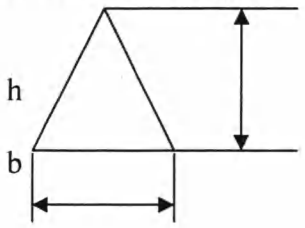
1. An elemental cube is subjected to tensile stress of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and determine the magnitude and direction of principal stresses and also the greatest shear stress. [8]

2. A column of timber section 15 cm × 20 cm is 6 m long both ends being fixed. If the Young's modulus for timber = 17.5 kN/mm^2, determine safe load for the column if FOS = 3. [6]

3. An overhanging beam ABC is loaded as shown in figure find the slopes over each support and at the right end. Find also the maximum upward deflection between the supports and the deflection at the right end. Take E= 2×10^5 N/mm^2 and I = 5×10^8 mm^4 [8]



4. A triangular section ABC is as shown in the Figure. [8]



Derive an expression for the Moment of Inertia of the section

5. A composite bar made up of aluminum bar and steel bar is firmly held between two rigid supports. Length and CSA for aluminum are 100 mm and 1000 mm^2 and that for steel are 150 mm and 1500 mm^2. An axial load of 200 kN is applied at B (junction of aluminum and steel) at 320 K. Find the stresses in each material when the temperature is 370 K. Take E for aluminum and steel as 70 GPa and 210 GPa respectively. Take α for aluminum and steel as 24×10^{-6}/K and 12×10^{-6} /K respectively. [7]

6. An aluminum alloy yields in uniaxial tension at the stress Y=330 MN/m^2. If this material is subjected to the following state of stress, will it yield according to, [5]

   a. Von Mises Theory
   b. MSS Theory

$\sigma_x = 138$ MN/m^2 $\sigma_y = -69$ MN/m^2 and $\tau_{xy} = 138$ MN/m^2

7. Two shafts of the same material and same lengths are subjected to the same torque. If the first shaft is of solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outer diameter? If maximum shear stress developed in each shaft is the same, compare the weights of the shafts. [5]

8. An overhanging beam as shown in Figure is carrying a UDL of 4.5 kN/m throughout its length. Draw the shear force and bending moment diagrams and find the point of contra flexure, if any. [8]