KUMARAGURU
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B.E DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Third Semester

AUTOMOBILE ENGINEERING

U18AUI3202**:** Strength of Materials

COURSE OUTCOMES

CO1: Estimate the strength of various structural elements subjected to different loading conditions.
CO2: Analyse the different types of beams.
CO3: Determining the slope and deflection of beams
CO4: Analyse the shafts and columns with different edge conditions by using different theories
CO5: Interpret the concepts and theories to design pressure vessels.
CO6: Examine the mechanical properties of materials

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1. Match the Euler's formula for different conditions   CO5 [K2]

List I	List II
A. Both ends fixed	i. $P_E = \dfrac{\pi^2\, EI}{(L)^2}$
B. Both ends hinged	ii. $P_E = \dfrac{\pi^2\, EI}{(0.7L)^2}$
C. One end fixed, other end free	iii. $P_E = \dfrac{\pi^2\, EI}{(0.5L)^2}$
D. One end fixed, other end hinged	iv. $P_E = \dfrac{\pi^2\, EI}{(2L)^2}$

|	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	iv	ii

2. The short columns fail due to   CO5 [K2]

a)	Buckling alone	b)	Crushing alone	
c)	Both Buckling and Crushing	d)	Crippling alone	

3. Which of the following method is used to determine the slope and deflection at a point?   CO3 [K_2]

a)	Arithmetic increase method	b)	Mathematical curve setting
c)	Macaulay's method	d)	Lacey's method

4. _____ is angular shift at any point of the beam between no load condition and   CO3 [K_2]
loaded beam

a)	Deflection	b)	Bending moment
c)	Slope	d)	Shear force

5. Assertion (A): In a solid shaft the shear stress is maximum at the center   CO4 [K_2]

Reason (R): The shear stress is proportional to the radius of the shaft

a)	Both A and R are Individually true and R is the correct explanation of A	b)	Both A and R are Individually true but R is not the correct explanation of A
c)	A is true but R is false	d)	A is false but R is true

6. The number of points of contraflexure in a simple supported beam carrying uniformly   CO2 [K_2]
distributed load, is

a)	0	b)	1
c)	2	d)	3

7. In cantilever beams, the slope is _____ at fixed end.   CO3 [K_2]

a)	Maximum	b)	Zero
c)	Minimum	d)	Uniform

8. Find the elongation of an steel rod of 100 mm length when it is subjected to a tensile strain of   CO1 [K_3]
0.005?

a)	0.2 mm	b)	0.3 mm
c)	0.5 mm	d)	0.01 mm

9. A vertical column has two moments of inertia (i.e. I_{xx} and I_{yy}). The column will tend to   CO3 [K_3]
buckle in the direction of the

a)	axis of load	b)	perpendicular to the axis of load
c)	maximum moment of inertia	d)	minimum moment of inertia

10. The maximum stress produced in a bar of tapering section is at   CO1 [K_2]

a)	smaller end	b)	larger end
c)	middle	d)	After mid section

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11.	Differentiate between Tensile and Compressive stress.	CO1 [K$_2$]
12.	Draw the shear force diagram for a cantilever beam of length L with a point load at the free end	CO2 [K$_3$]
13.	Calculate factor of safety of a given structure if the permissible stress of the material is 600 N/m^2 and the ultimate stress of the material is 1800 N/m^2.	CO1 [K$_3$]
14.	State the theory of simple bending	CO2 [K$_2$]
15.	Distinguish between column, strut and beam.	CO2 [K$_2$]
16.	The shearing stress in a solid shaft is 55 N/mm^2, the torque transmitted is 32000 N m. Determine the minimum diameter of the shaft.	CO4 [K$_3$]
17.	Why hollow circular shafts are preferred when compared to solid circular shafts?	CO4 [K$_4$]
18.	Summarize the causes of a column failure	CO5 [K$_2$]
19.	What are the types of stresses setup in the thin cylinders?	CO5 [K$_2$]
20.	The maximum torque that a hollow circular shaft can transmit is 58900 N m. The inner and outer diameter is 100 mm and 200 mm. Calculate the maximum shear stress.	CO4 [K$_3$]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
### (Answer not more than 350 words)

21. a) An Axial Pull of 50000 N is acting on a bar consisting of the following   7   CO1 [K$_3$]
dimensions,

Section 1 = 7 cm diameter, 18 cm length

Section 2 = 5 cm diameter, 20 cm length

Section 3 = 3 cm diameter, 21 cm length

The young's modulus = 2.1 x 10^5 N/mm^2,

Determine (i) Stresses in each section, (ii) Total extension of the bar.
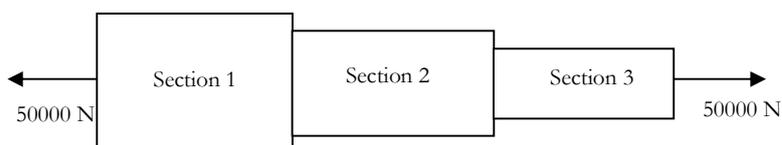
    b)   A composite bar made of aluminum and steel is connected as shown below, there   7   CO1 [K$_3$]

is no buckling sideways, calculate magnitude of force P which will cause the total length of the member to decrease by 0.25 mm.

Modulus of Elasticity for Steel = 2.1 x 10^5 N/mm^2 and for aluminum 7 x 10^4 N/mm^2.
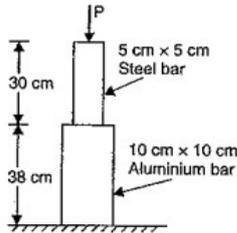
22. a) A body is subjected to stresses in two mutually perpendicular directions, the stresses are 120 N/mm^2 (tensile) and 80 N/mm^2 (compressive) and as shear stress of 55 N/mm^2. Find the normal, tangential stresses on a plane inclined at 30º to the minor stress and the resultant stress and its direction. Use both Analytical and Graphical method.   14   CO1   [K$_3$]

23. a) A simply supported beam of length 10 m carries point loads of 4 kN, 10 kN and 7 kN at a distance of 1.5 m, 2.5 m and 4 m respectively from the left end. Draw the Shear force and Bending moment diagrams for the supported beam.   14   CO2   [K$_3$]

24. a) A beam AB of length 8 m is simply supported at its ends and carries two-point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs. Take E = 2 x 10^5 N/mm^2 and I = 85 X10^6 mm^4.   14   CO3   [K$_3$]

25. a) Two Shafts are connected end to end by means of a flanged coupling in which there are 16 bolts, the pitch circle diameter being 30 cm. the maximum shear stress is limited to 60 N/mm^2 in the shafts and 30 N/mm^2 in the bolts. If one shaft is solid of 6 cm diameter and the other is hollow of 11 cm external diameter, calculate the internal diameter of the hollow shaft and the bolt diameter so that both shafts and coupling are all equally strong in torsion.   14   CO4   [K$_3$]

26. a) A 4.5 m long column has a hollow circular cross section of 200 mm outer diameter thickness of 20 mm, one of the ends of the column is fixed at both the ends. Taking factor of safety as 4, calculate the slenderness ration and critical loads using (i) Rankine's formula, take yield stress = 550 N/mm^2 and a = 1/1600 for pinned ends. (ii) Euler's formula, Young's modulus for cast iron = 8 x 10^4 N/mm^2 7   CO5 [K$_3$]

   b) A pipe of 500 mm internal diameter and 100 mm thickness carries a fluid at a pressure of a 80 MPa. Calculate the maximum and minimum intensities of circumferential stress.   7   CO5 [K$_3$]

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