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BTECH
(SEM V) THEORY EXAMINATION 2024-25
STRENGTH OF MATERIAL

TIME: 3 HRS

M.MARKS: 100

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 10 = 20

Q no.	Question	CO	Level
a.	Draw Mohr's circle for pure shear stress.	1	K 3
b.	Write all three relations for elastic constants.	1	K 2
c.	What is the importance of section modulus of beam?	2	K 3
d.	Draw bending stress distribution in a square beam.	2	K 3
e.	Write the applications of laminated springs.	3	K 3
f.	Define 'stiffness of spring'.	3	K 3
g.	What are the advantages of wire winding on thin cylinder?	4	K 3
h.	What is 'Shrinkage allowance' in compound cylinders?	4	K 3
i.	What is the governing relation to find the shear stress in beams?	5	K 4
j.	In a beam of I section, which part will carry the maximum shear stress?	5	K 4

SECTION B

2. Attempt any three of the following:

10 x 3 = 30

a.	<p>The state of stress in two-dimensionally stressed body at a point is as shown in fig. below. Determine the principal planes, principal stresses, maximum shear stress and their planes.</p>	1	K 3
b.	Derive the relation of torsional equation of shaft.	2	K 3
c.	A close-coiled helical spring has a coil diameter to wire diameter ratio of 6. The spring deflects 4 cm under a load of 500 N, and the maximum shear stress is not to exceed 30 kN/cm ² . Find diameter and length of wire required. Modulus of rigidity of wire material is equal to 80 GN/m ² .	3	K 3
d.	Deduce the general equations for circumferential and radial stresses developed in thick cylinders. What are the assumptions made?	4	K 3
e.	A crane hook having a trapezoidal horizontal cross section is 50 mm wide inside and 30 mm wide outside. Thickness of the section is 60 mm. The crane hook carries a vertical load of 20 kN whose line of action is 50 mm from the inside edge of the section. The center of curvature is 60 mm from the inside edge. Determine the maximum tensile and compressive stresses in the section.	5	K 4



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SECTION C

3. Attempt any one part of the following: 10 x 1 = 10

a.	The temperature of a steel ring is raised through 150°C in order to fit it on a wooden wheel of 1.2 m diameter. Find the original diameter of the steel ring and also the stresses developed in the ring, when it cools back to normal temperature. Take $E_s = 2 \times 10^5 \text{ N/mm}^2$ and $\alpha_s = 12 \times 10^{-6}/^\circ\text{C}$.	1	K 2
b.	Discuss in detail the stresses on inclined plane subjected to biaxial loading combined with shear.	1	K 3

4. Attempt any one part of the following: 10 x 1 = 10

a.	A cantilever consists of a steel tube having an outside diameter of 100 mm, an inside diameter of 75mm and a length of 2.4m. Find the total UDL if the maximum stress due to bending is 75 N/mm ² .	2	K 3
b.	A hollow shaft with a length of 1.8 m is loaded by a torque of 6 kNm. Determine the external and internal diameters of the shaft, if the angle of twist is not to exceed 2° and the shear stress is not to exceed 7kN/cm ² . The modulus of rigidity of steel is 8 MN/cm ² .	2	K 3

5. Attempt any one part of the following: 10 x 1 = 10

a.	Discuss the kernel/core of rectangular column with eccentricity of load in both x and y direction.	3	K 3
b.	A 4-m long fixed –end hollow cast-iron column supports an axial load of 1 MN. The external diameter of the column is 200 mm. Determine the thickness of the column by using Rankine formula taking a constant of 1/6400 and working stress as 78 MN/m ² .	3	K 3

6. Attempt any one part of the following: 10 x 1 = 10

a.	A boiler of 1.6 m diameter is made of 20 mm thick steel plates. Determine the permissible steam pressure in the boiler if the efficiency of the longitudinal joint of the boiler is 80% and maximum tensile stress in the steel plates is not to exceed 80 MPa. What will be the circumferential stress in the solid plate section at this pressure? Also calculate the longitudinal stress in the plate section through the rivets of the circumferential joint if the efficiency of the joint is 70%.	4	K 3
b.	Find the thickness of the cylinder of a hydraulic ram of 50-mm internal diameter to withstand an internal pressure of 30 MPa. The allowable tensile stress is limited to 45 MPa and the allowable shear stress to 40 MPa.	4	K 3

7. Attempt any one part of the following: 10 x 1 = 10

a.	Prove that moment of inertia about any set of rectangular axes is constant.	5	K 4
b.	With the help of Winkler batch theory, derive the value of factor h^2 for: (i) Rectangular section (ii) Circular section	5	K 4