PAPER ID-421706

Roll No: | | | | | | | | | | | | | |

# BTECH
## (SEM IV) THEORY EXAMINATION 2021-22
## INTRODUCTION TO SOLID MECHANICS

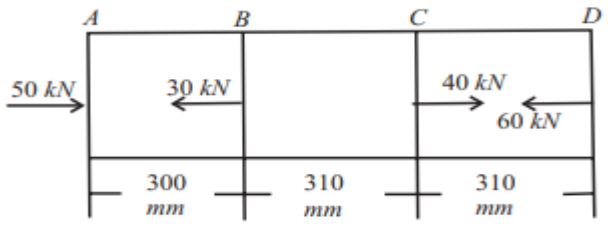
***Time: 3 Hours*** ***Total Marks: 100***

**Notes:**

- *Attempt all Sections and Assume any missing data.*
- *Appropriate marks are allotted to each question, answer accordingly.*

| **SECTION-A** | Attempt **All** of the following Questions in brief | Marks **(10X2=20)** | |
|---|---|---|---|
| Q1(a) | Define stress and strain | | 1 |
| Q1(b) | State Hook's law | | 1 |
| Q1(c) | Define point of contraflexure or point of inflexion. | | 2 |
| Q1(d) | Explain Shear force and bending Moment | | 2 |
| Q1(e) | What is section modulus (Z)? What is the value of Bending moment in terms of section modulus? | | 3 |
| Q1(f) | Define Torsional Rigidity | | 3 |
| Q1(g) | What are the different methods of finding slope and deflection of cantilever | | 4 |
| Q1(h) | What do you understand by the term "Buckling" of columns | | 4 |
| Q1(i) | Write the relation between hoop stress and longitudinal stress for thin cylinder | | 5 |
| Q1(j) | What is the difference between thin and thick cylinder | | 5 |

| **SECTION-B** | Attempt **ANY THREE** of the following Questions | Marks **(3X10=30)** | |
|---|---|---|---|
| Q2(a) | Explain the stress-strain diagram for a ductile material under tension. A load of 5KN is to be raised with the help of a steel wire. Find the diameter of steel wire, if the maximum stress is not to exceed 100 $MN/m^2$ | | 1 |
| Q2(b) | Derive the relation between shear force, bending moment and loading | | 2 |
| Q2(c) | A simply supported rectangular beam with symmetrical section 200mm in depth has moment of inertia of $2.26 \times 10^{-5}$ $m^4$ about its neutral axis. Determine the longest span over which the beam would carry a uniformly distributed load of 4KN/m run such that the stress due to bending does not exceed 125 $MN/m^2$ | | 3 |
| Q2(d) | A hollow cylindrical column, with both ends hinged, is 6 m long, and has an outer diameter of 120 mm and an inner diameter of 80 mm. Calculate the crippling load by Euler's and Rankine's formulae. E = 80,000 $N/mm^2$ and $\sigma_c$ = 550 $N/mm^2$. The Rankine constant = 1/1600 | | 4 |
| Q2(e) | Derive the expression for hoop stress and longitudinal stress in case of thin cylinder | | 5 |

| **SECTION-C** | Attempt **ANY ONE** following Question | Marks **(1X10=10)** | |
|---|---|---|---|
| Q3(a) | The state of stress at a point in a loaded component principal stress is found to be as given below: $\sigma_x$ =50 $GN/m^2$; $\sigma_y$ =150 $GN/m^2$; $\tau_{xy}$ =100 $GN/m^2$; Determine the principal stresses and maximum shearing stress. Find the orientations of the principal planes. | | 1 |
| Q3(b) | A steel bar is subjected to loads as shown in fig. Determine the change in length of the bar ABCD of 18 cm diameter. E = 180 $kN/mm^2$   | | 1 |

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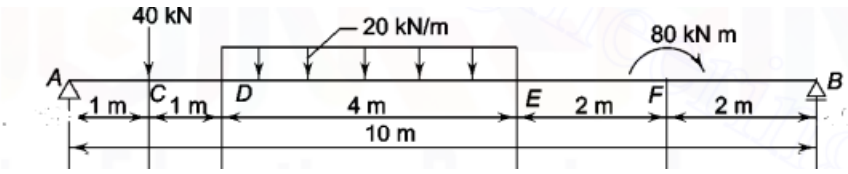
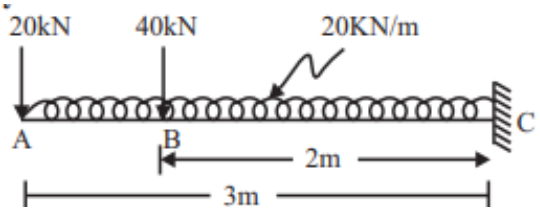
| **SECTION-C** | Attempt **ANY ONE** following Question | Marks **(1X10=10)** | |
|---|---|---|---|
| Q4(a) | Draw the SF and BM diagrams for the loaded beam   | | 2 |
| Q4(b) | Draw the SF and BM diagrams for the loaded beam   | | 2 |

| **SECTION-C** | Attempt **ANY ONE** following Question | Marks **(1X10=10)** | |
|---|---|---|---|
| Q5(a) | Derive the Torsional equation $T/J = \pi/R = G\theta/L$. Write the assumption made in deriving the torsional formulas? | | 3 |
| Q5(b) | The cross section of a beam is a T section of overall depth 140 mm, width of flange 200mm, thickness of flange 40mm and thickness of web 20mm.Draw the shear stress distribution diagram if it carries a shear force of 60 kN. | | 3 |

| **SECTION-C** | Attempt **ANY ONE** following Question | Marks **(1X10=10)** | |
|---|---|---|---|
| Q6(a) | Derive the differential equation for the elastic curve. A cantilever beam is subjected to a concentrated load W at the free end, it is required to determine the maximum deflection of the beam | | 4 |
| Q6(b) | Derive Euler critical buckling load for columns with both the ends hinged. A steel rod 5 m long and of 40 mm diameter is used as a column, with on end fixed and the other free. Determine the crippling load by Euler's formula. Take E as 200 GPa | | 4 |

| **SECTION-C** | Attempt **ANY ONE** following Question | Marks **(1X10=10)** | |
|---|---|---|---|
| Q7(a) | Write down the assumption in Lame's theory and also derive Lame's equation for circumferential stress and radial stress for thick cylinder | | 5 |
| Q7(b) | A composite spring has two close coiled helical springs connected in series, each spring has 12 coils at a mean diameter of 25 mm. Find the diameter of the wire in one of the springs if the diameter of the wire in the other spring is 2.5 mm and stiffness of the composite spring is 700 N/m. Estimate the greatest load that can be carried by the composite spring for a maximum shearing stress of 180MPa. Take G= 80 GPa | | 5 |