# GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

***(Autonomous)***

**(Civil Engineering Department)**

## II B.Tech I Semester Mid- II Examinations

## SOLID MECHANICS I

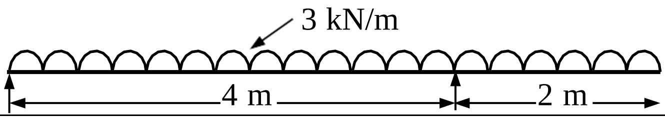
**Course Code: GR20A2011**

**Time: 40 Minutes** **Max Marks: 20**

**SUBJECTIVE**

**(Answer any Two questions)**

**Time: 30 Minutes** **2 * 5 = 10 Marks**

| | | | | |
|---|---|---|---|---|
| **1** | Draw the shear force and bending moment diagram for the overhanging beam carrying uniformlydistributed load of 3 KN/m over the entire length as shown in Figure. Also locate the point of contraflexure.<br><br> | **[5]** | **CO3** | **BL4** |
| **2** | a) Prove that bending stress at any section of beam is directly proportional to the distance from neutral layer.<br>b) The shear force acting on a section of a beam is 50 kN. The section of the beam is of T shaped of dimensions 100mm x 100mm x 20mm. The flange thickness and web thickness are 20 mm. Find the shear stress at the neutral axis and the junction of web and flange (I = 3.14 X $10^6$ $mm^4$) | **[5]** | **CO4** | **BL3** |
| **3** | a) Explain briefly different methods to find slope and deflection and mention their merits and demerits<br>b) A simply supported beam of length L carries uniformly distributed load of w over the entire length. Ifthe modulus of elasticity is E, find the slope at the supports and maximum deflection. | **[5]** | **CO5** | **BL3** |

**OBJECTIVE**

# SOLID MECHANICS I

**Course Code: GR20A2011**

**Multiple Choice Questions (MCQs)**

**(Answer ALL questions. All questions carry equal marks)**

**Time: 10 Minutes** **10 *1 = 10 Marks**

1. The shear stress at a fiber in a section of beam is given by ( )
   a) $\tau$=(FxAy/Ib) b) $\tau$=(FxAy/Id) c) $\tau$=(FxAx/Ib) d) None of the above
2. The shear stress is maximum at the NA for a circular section is given by ( )
   a) $\tau_{max}=(3/4)\tau_{avg}$ b) $\tau_{max}=(2/3)\tau_{avg}$ c) $\tau_{max}=(4/3)\tau_{avg}$ d) $\tau_{max}=(3/2)\tau_{avg}$
3. For maximum deflection, slope dy/dx is ( )
   a) 1 b)0 c)05 d)2
4. The deflection at the center of simply supported beam carrying point load at center is given by ( )
   a) $y_c=(wl^2/584EI$ b) $y_c=(wl^2/384EI)$ c) $y_c=(wl^2/48EI)$ d) None of the above
5. The slope dy/dx of a cantilever beam when a point load at free end is given by ( )
   a) Wl^2 / 2EI b) Wl^2 / 3EI c) Wl^2/4EI d) Wl^2/6EI
6. The deflection by moment area method is given by ( )
   a) A/EI b) Ax /EI c) x/EI d) None of the above
7. The shear stress for a triangular section is maximum at a height of ( )
   a) h/2 b) h/3 from top c) h/3 from bottom d) 2h/3 from top
8. Bending moment at Point of Contra flexure is given by ( )
   a) 1 b) 0 c) negative d) depends on load
9. Bending moment at the free end of cantilever beam is given by ( )
   a) 1 b) 0 c) negative d) depends on load
10. Which method is more suitable when multiple loads are acting ( )
    a) Double Integration b) Moment Area Theorem c) Macaulay's method d) all of the above

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## SOLID MECHANICS I

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**Time: 40 Minutes** **Max Marks: 20**

**SUBJECTIVE**

**(Answer any Two questions)**

**Time: 30 Minutes** **2 * 5 = 10 Marks**

| | | | | |
|---|---|---|---|---|
| **1** | a) A steel tube 50m external diameter and 3mm thick encloses centrally a solid copper bar of 35mm diameter. The bar and tube are rigidly connected at the ends at a temperature of 20 $^{o}$c. Find the stress in each material when heated to 170$^{o}$c. Consider E of steel=2x$10^5$ N/mm$^2$, E of copper =1x$10^5$ N/mm$^2$ coefficient of expansion is 1.7X$10^{-5}$ per $^{o}$c. | **[5]** | **CO1** | **BL2** |
| **2** | The principal stresses at a point in a bar are 260N/mm$^2$ (tensile) and 100 N/mm$^2$ (compressive). Determine the resultant stresses in magnitude and direction on a plane inclined at 50$^{o}$ to the axis of major principal stress. Also determine the maximum intensity of shear stress in the material at the point. | **[5]** | **CO2** | **BL2** |
| **3** | (a) Draw the Shear Force diagram and bending moment diagram for cantilever beam carrying point load 50KN at the free end.<br>(b) Draw the Shear Force diagram and bending moment diagram for simply supported beam carrying uniformly distributed load over the entire span. | **[5]** | **CO3** | **BL3** |

**OBJECTIVE**

# SOLID MECHANICS I

**Course Code: GR20A2011**

**Multiple Choice Questions (MCQs)**

**(Answer ALL questions. All questions carry equal marks)**

**Time: 10 Minutes** **10 *1 = 10 Marks**

| | | |
|---|---|---|
| **1** | Which of the following materials is more elastic?<br>A) Rubber B) Glass C) Steel D) Wood | **[ ]** |
| **2** | Shape of true stress-strain curve for a material depends on<br>A) Stress B) Strain rate C) Temperature D) A,B,C | **[ ]** |
| **3** | Strain in a direction at right angle to the direction of applied force is ..<br>A) Lateral strain B) Shear strain C) Volumetric strain D) None | **[ ]** |
| **4** | If linear expansion of copper is more than that of steel then ……& …… type of stresses will develop in steel and copper.<br>A) Compressive & Tensile B) Tensile & Compressive<br>C) Shear and Tensile D) Shear & Compressive | **[ ]** |
| **5** | Relationship between modulus of rigidity and bulk modulus is given by<br>A) E= 2K (1+μ) B) E= 2K (1-2μ) C) E= 3K(1+2μ) D) E= 3K(1-2μ) | **[ ]** |
| **6** | Principal strain theory is proposed by<br>A) Haigh B) Rankine C) Guest D) Venant | **[ ]** |
| **7** | The shear stress acting on principal plane is<br>A) One B) Zero C) Maximum D) Minimum | **[ ]** |
| **8** | The maximum shear stress by Mohr's circle method is equal to …………<br>A) Diameter B) Radius C) not defined D) Normal stress | **[ ]** |
| **9** | A beam with one end fixed and another end free is<br>A) Cantilever B) Simply supported C) Fixed D) Continuous | **[ ]** |
| **10** | Number of unknown reactions for roller support is<br>A) One B) Two C) Three D) Zero | **[ ]** |

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## II B.Tech I Semester Regular Examinations, February/March 2022

## SOLID MECHANICS - I
**(Civil Engineering)**

**Time: 3 hours** **Max Marks: 70**

**Instructions:**

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

### PART – A
**(Answer ALL questions. All questions carry equal marks)**

**10 * 2 = 20 Marks**

| | | |
|---|---|---|
| **1. a.** | Define Youngs Modulus and Factor of Safety? | **[BL1][CO1][2]** |
| **b.** | Define Strain Energy and Resilience? | **[BL1][CO1][2]** |
| **c.** | Briefly describe Mohr's Circle of stresses? | **[BL2][CO2][2]** |
| **d.** | What is state of simple shear? | **[BL1][CO2][2]** |
| **e.** | Draw S.F.D. and B.M.D. for simply supported beam with a point load at its centre. | **[BL3][CO3][2]** |
| **f.** | Describe the relation between shear force and bending moment? | **[BL2][CO3][2]** |
| **g.** | Write the bending equation and mention the units of the terms? | **[BL1][CO4][2]** |
| **h.** | Define Neutral stress and Section Modulus? | **[BL1][CO4][2]** |
| **i.** | What is double integration method? | **[BL1][CO5][2]** |
| **j.** | What are the advantages of moment area method? | **[BL1][CO5][2]** |

### PART – B
**(Answer ALL questions. All questions carry equal marks)**

**5 * 10 = 50 Marks**

**2.** **(a)** A copper rod 36 mm in diameter is encased and rigidly attached at the end of a steel tube which is 50 mm external diameter, thickness of metal being 5 mm. The composite section is then subjected to an axial pull of 100 kN. Find the stresses induced in each metal and extension on the length of 1.5m. **[6] [BL2][CO1]**

Take

$Es = 2 \times 10^5$ N/mm$^2$ and $Ec = 1.1 \times 10^5$ N/mm$^2$.

**(b)** Draw the stress-strain diagram of mild steel and indicate salient points. **[4][BL3][CO1]**

**OR**

**3.** The following data pertains to a tension test conducted in a laboratory. **[10]** **[BL4][CO1]**

Diameter of the specimen = 15 mm

Length of the specimen = 200 mm

Extension under a load of 10 kN = 0.035 mm

Load at yield point = 110 kN

Maximum load = 190 kN

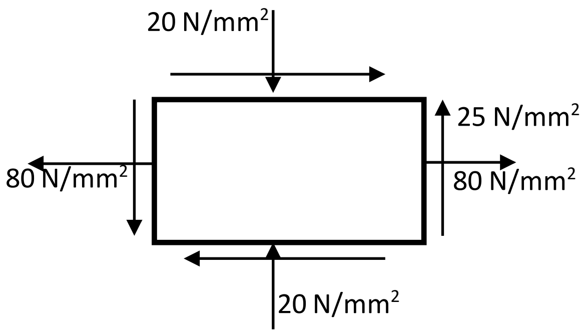
Length of specimen after failure = 255 mm

Neck diameter = 12.25 mm

Determine: (i) Young's Modulus (ii) Yield stress (iii) Ultimate stress

(iv) Percentage elongation (v) Percentage reduction in area (vi) Safe stress using a factor of safety of 1.5.

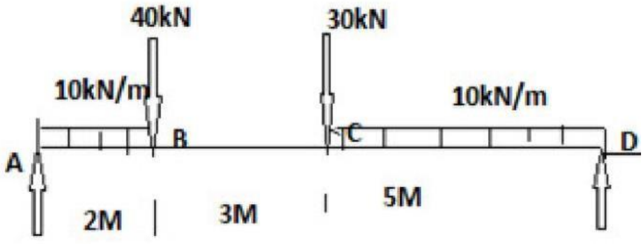
**4.** A plane element in the body is subjected to the stresses as shown in the figure. Determine the principle stresses and their directions as well as the maximum shear stresses and the directions on which they occur. Sketch the stresses on properly oriented planes. Solve analytically or graphically. **[10]** **[BL4][CO2]**




**OR**

**5.** What are various theories of failure. Explain Maximum principle stress and Maximum shear stress theories? **[10]** **[BL2][CO2]**

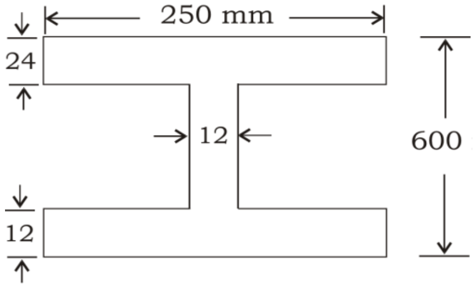
**6.** Draw SF and BM diagrams for the beam loaded as shown in figure. All loads are in kN and length are in metre **[10]** **[BL4][CO3]**




**OR**

**7.** A simply supported beam AB of span 10 m carries a U.D.L. of 20 N per metre over the entire span. It has also two point loads of 20 N and 60 N at 3 m and 8 m respectively from the LH support. Draw the B.M. and S.F. diagrams and calculate the B.M. at significant points. **[10] [BL4][CO3]**

**8.** A beam of I-section as shown in figure (All dimensions are in mm). The beam is simply supported over span of 10 m and carriers a udl of 50 kN/m km run over the entire span. Calculate the maximum stress produced due to bending. **[10] [BL3][CO4]**



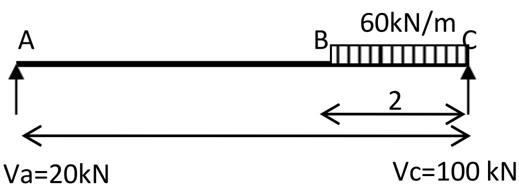

**OR**

**9.** **(a)** A T beam of span 5 m has a flange 125 mm x 12.5 mm and web 187.5 mm x 8 mm. If the maximum permissible stress is 150 MPa , find the maximum udl the beam can carry. **[6] [BL3][CO4]**
**(b)** Derive simple bending equation. **[4][BL3][CO4]**

**10.** **(a)** A cantilever beam of length 3 m carries UDL of 2 kN/m over a length of 1.5 m from fixed end and a point load of 1 kN at free end. If the section is 80 mm × 120 mm deep, calculate the deflection at free end. Take E = 2 x$10^5$N / $mm^2$. **[6] [BL4][CO5]**
**(b)** Explain about different methods used to find slope and deflection of beams. **[4] [BL4][CO5]**

**OR**

**11.** A simply supported steel beam AC of span 6 m carrying a uniformly distributed load of 60 kN/m on the part BC. The beam is having $I_{xx}$ = 9821.6 $cm^4$. Determine (i) The slopes at A and B, (ii) Deflection at C, (iii) Maximum deflection Take E = 200 kN/$mm^2$. Use Macaulay's method. **[10] [BL4][CO5]**

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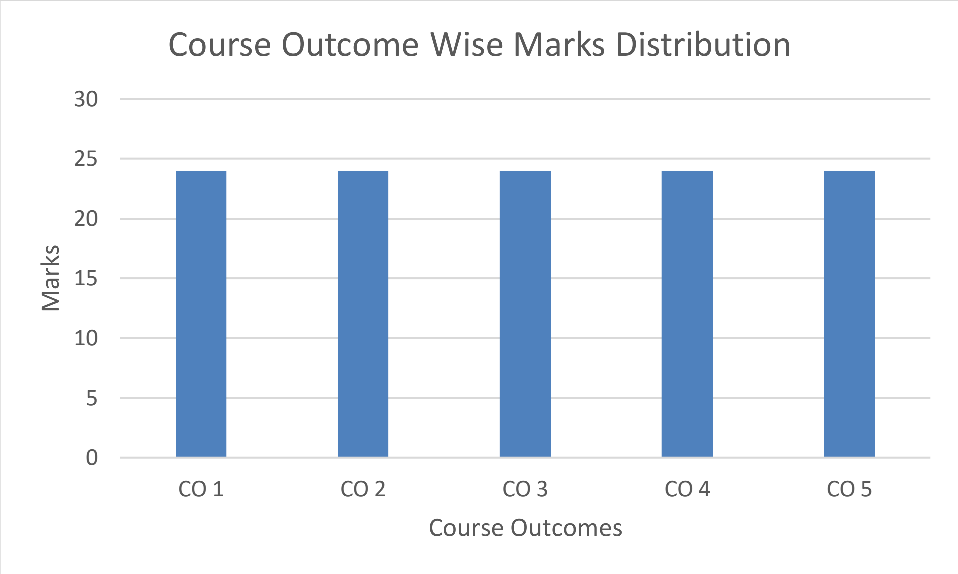
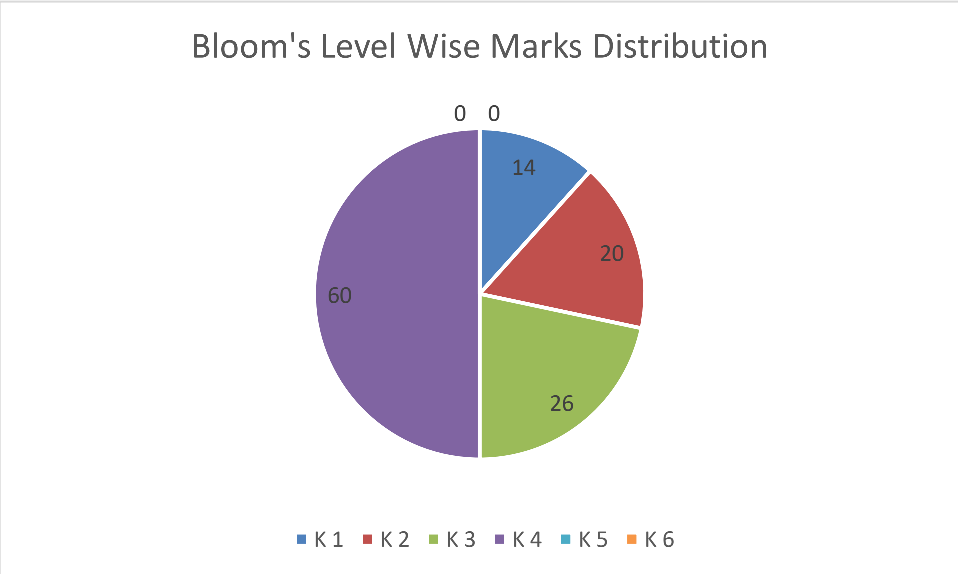

Course Outcome Wise Marks Distribution
30
25
20
15
10
5
0
Marks
CO 1
CO 2
CO 3
CO 4
CO 5
Course Outcomes


Bloom's Level Wise Marks Distribution
0
0
14
20
26
60
K 1
K 2
K 3
K 4
K 5
K 6