Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination/ ~~Re-Examination~~

~~January/February~~ - 2025

3/1/25

Max. Marks: 100 Duration: 3 Hours

F.Y. M.Tech Sem I

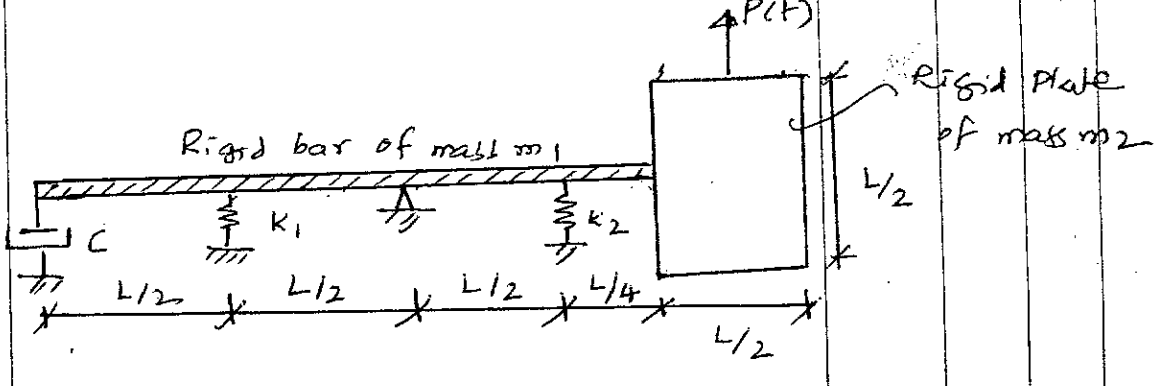
Class: M.Tech. Semester: I Program: Civil Engineering

Name of the Course: Structural Dynamics Course Code : PC- MST 101

Instructions:

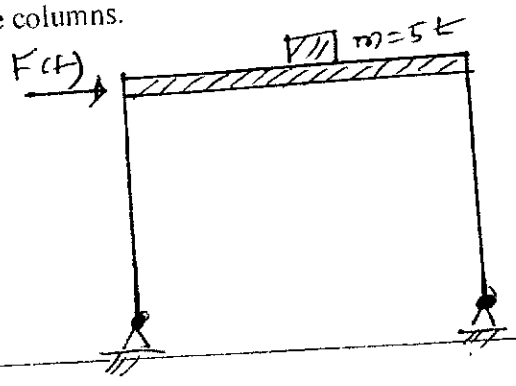
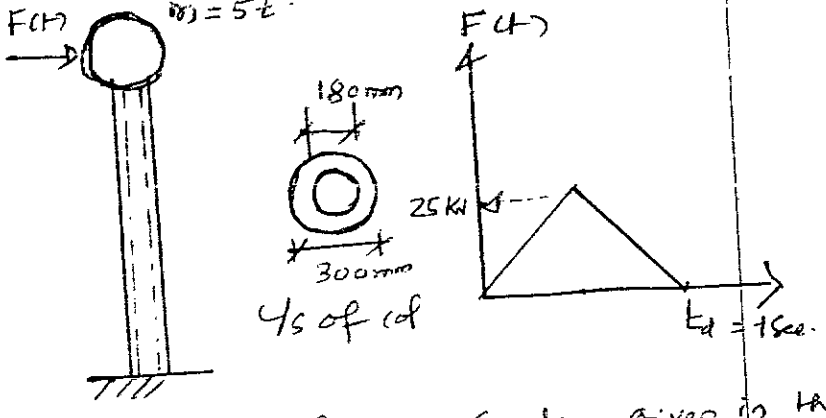
- Answer any five questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

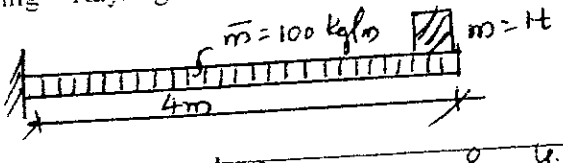
Question No		Points	CO	BL	Module No.
Q1 (a)	What is normal mode? Explain briefly characteristics of normal mode.	3	3	4	5
Q1(b)	For the rigid body system shown in figure: (a) Formulate the equation of motion (b) Determine the natural frequency and damping ratio (c) Calculate the maximum response $u_0(x)$	12	2	3	4



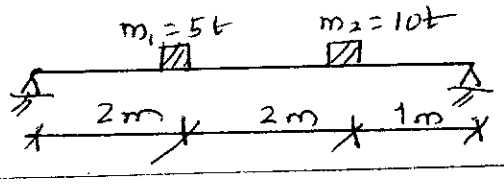
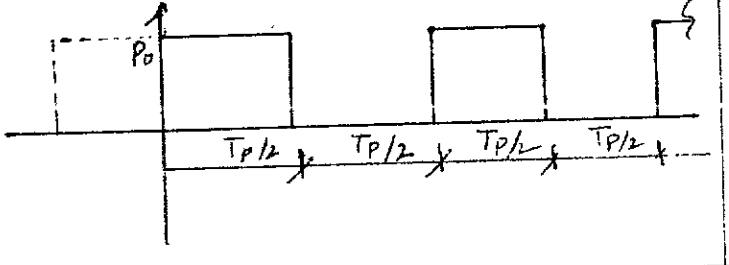
$m_1 = 1000$ Kg $m_2 = 500$ kg $K_1 = 1000$ kN/m

$K_2 = 500$ kN/m. $C = 1$ kN-m/sec. $L = 2$m.

Q1(c)	A rigid steel frame shown in figure is subject to harmonic load with amplitude of load 200KN and frequency 1.5 times the frequency of structure. Assuming the ratio as 2%, determine the maximum displacement at girder level and bending moment in the columns. 	5	2	3	2
Q2 (a)	A hallow circular cantilever column shown in figure is subjected to a triangular pulse type load as shown in figure. Calculate the maximum horizontal displacement maximum bending moment in column. The response spectra for this dynamic load are also shown in the figure.  Note Use Response Spectra given in the end.	7	2	3	2
Q2(b)	Derive the expression for Transmissibility Ratio and briefly explain how vibration isolation can be achieved.	7	2	3	2
Q2(c)	An air-conditioning unit weighing 5 KN is supported at the mid-span of the simply supported beam of span 6m. The motor in the air conditioning unit excite the vertical component of the force on the beam of ampliiude 270 N at the speed of 300 rpm.(Harmonic load) Neglecting the weight of the beam and assuming 5% damping, determine the amplitude of steady state deflection of the beam at mid-span and the force transmitted to the supports. E= $2x10^5$ N/mm^2, I= $2x10^8$ mm^4.	6	2	3	2

Q3	A three storey single bay frame has storey height of **4 m.** The columns on ground and first story are **250 mm** wide **X 600 mm** deep while at 2nd story the size a column is **250 mm x 450 mm** & beams are very stiff. The mass on 1st and 2nd floor is **30 t.** while on 3rd floor it is **25t. E = 20000 Mpa**. Calculate natural frequencies & mode shapes	**20**	**3**	**4**	
Q4(a)	State and prove orthogonality principle. Also state the significance of orthogonality principle in dynamic analysis	**5**	**3**	**3**	**5**
Q4 (b)	A three storey frame with free vibration characteristics as given below is subjected to a harmonic force with amplitude 100 KN and at frequency of 20 rad/sec. at the 3nd floor level , 75 KN amplitude with same frequency at 2nd floor and 50K amplitude with same frequency at 1st floor. Calculate maximum displacements of each storey. Take damping ratio =5%.	**15**	**2**	**4**	**6**
Q 5(a)	For the beam shown in figure calculate the fundamental frequency using Rayleigh's Method.  $E = 2\times10^5\ N/mm^2$ $I = 2\times10^8\ mm^4$	**8**	**4**	**3**	**7**
Q 5(b)	A simply supported beam of 8m span, 300 mm wide 600 mm deep carries a suddenly applied force of 200 KN at quarter span from left support.. Calculate the maximum displacement and bending moment responses under the load and shear force at left support. E= 2×10^4 Mpa. and density of material = 2500 kg/m^3. Take contribution from the four lowest contributing modes	**12**	**4**	**4**	**7**

Story No.	Mass No.	Mass (t)	ω rad/sec	Mode shapes		
				Φ_{i1}	Φ_{i2}	Φ_{i3}
1	1	30	15.73	0.399	0.747	1.0
2	2	30	49.85	1.0	0.727	-0.471
3	3	25	77.82	-0.908	1.0	-0.192

Q6(a)	For the simply supported beam shown in figure, calculate the natural frequencies and mode shapes. 	10	3	4	5
Q6(b)	If the beam referred in Q6 (a) above, a suddenly applied constant load of 100 KN under second mass m_2, calculated the maximum reposes under each mass.	10	3	3	6
Q 7(a)	Starting from first principal, derive the expression for natural frequency and mode shape for a simply supported beam with uniformly distributed mass.	10	4	2	7
Q 7(b)	Represent the periodic load shown in figure in terms of Fourier Series and determine the response of damped SDOF system subjected above periodic load. 	10	5	3	3

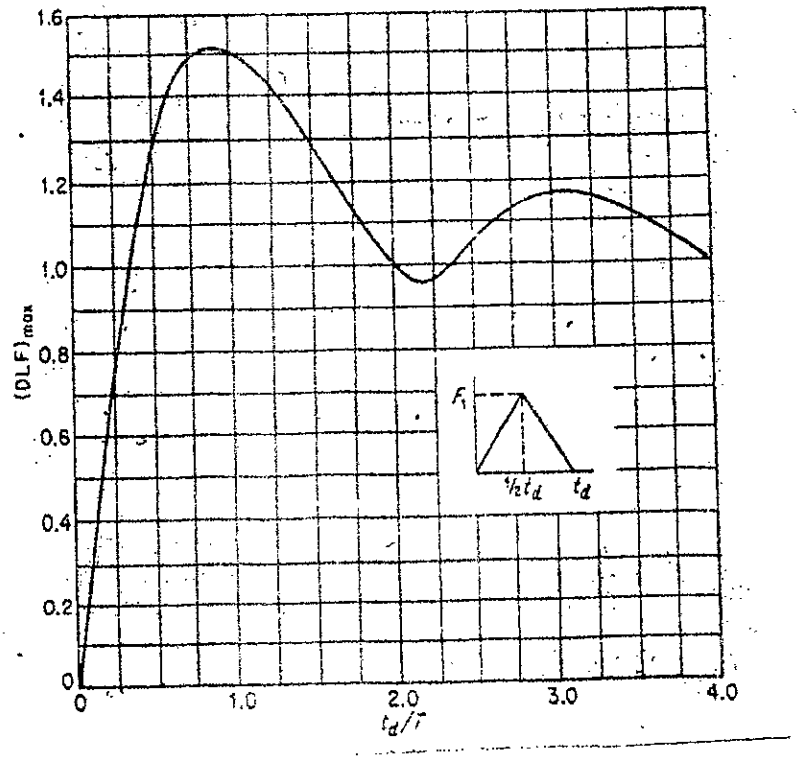


Fig for Q.NO. 2(a)

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END SEM/~~RE-EXAM~~ EXAMINATION JAN/~~FEB~~ 2025

Program: M. Tech Civil – Structures **Duration: 3 Hrs** 6/1/25

Course Code: PC-MTSE102 **Maximum Points: 100**

Course Name: Advanced Theory of Structures **Semester: I**

Notes:

1. Attempt any 5 questions
2. Answer to each new question to be started on a fresh page.
3. Figures in brackets on the right-hand side indicate full marks.
4. Assume Suitable data if necessary and state it clearly.

Q. No.	Questions	Points	CO	BL	Module No.
1	A. From the first principle, derive the stiffness matrix for the member of the space frame.	10	2	3	1
	B. Generate the expressions for shear force, bending moment and twisting moment at any point in the ring beam of radius 'R', resting on six equally spaced supports, subjected to uniformly distributed load 'w'.	10	3	3	5
2	A. From the first principle, derive the formulae for deflection, rotations, bending moment and shear force at any point for a semi-infinite beam resting on elastic supports subjected to point load at its end.	10	4	3	7
	B. Using the above formulae, plot the variation of the deflection, shear force and bending moment for a semi-infinite beam of size 1000 mm in width and 600 mm in depth subjected to a point load of 500 kN acting at its end. Assume modulus of elasticity of the beam material as 25 GPa and soil stiffness as 2500 kN/m/m length of the beam.	10	4	4	7
3	A. Explain the difference between straight and curved beams.	05	3	3	6
	B. A circular ring of a steel chain is made up of 32 mm diameter rod with a mean radius of 100 mm. The ring is subjected to a tensile force of 200 kN. Determine maximum stresses developed in the ring. Also plot the variation of stresses across the section at the critical sections. Assume E = 200 GPa and G = 80 GPa.	15	3	4	6
4	Determine the forces developed in the rigid jointed plane frame shown in figure 1 using flexibility matrix approach. Also plot the variation of bending moment.	20	1	4	4

END SEM/~~RE-EXAM~~ EXAMINATION JAN/~~FEB~~ 2025

5	Determine the forces developed in the pin jointed plane frame shown in figure 2 using stiffness matrix approach.	20	2	4	3
6	A. Determine the forces developed in the rigid beam shown in figure 3 using stiffness matrix approach. Also plot the variation of bending moment and the deflected shape of the beam. Note that support B settles down by 20 mm and EI = 25000 kN-m^2.	15	2	4	3
	B. Explain the procedure for analysis of indeterminate structure subjected to temperature change using stiffness matrix approach	05	2	3	2
7	Determine the forces developed in the rigid jointed plane frame shown in figure 4 using stiffness matrix approach. Also plot the variation of bending moment and deflected shape.	20	2	4	3

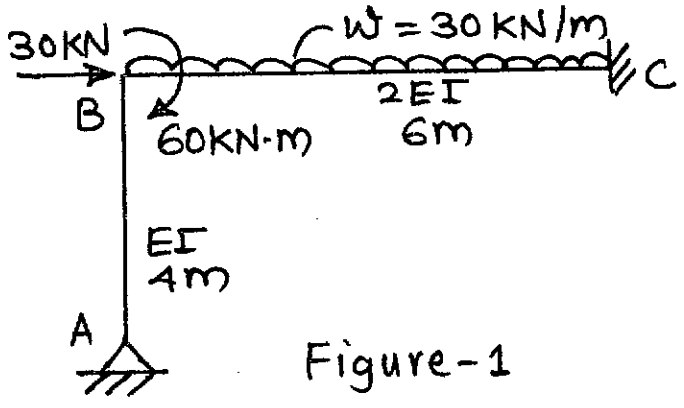

Figure-1

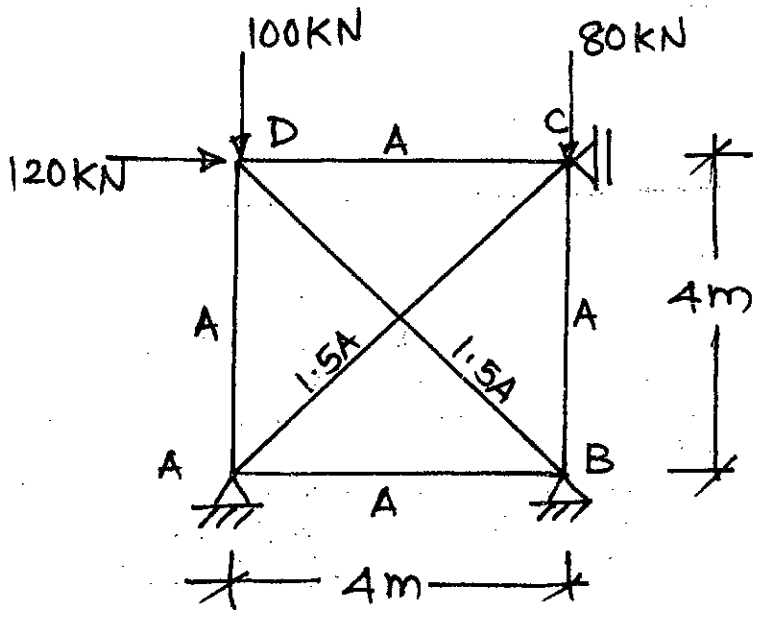

Figure-2

END SEM/~~RE-EXAM~~ EXAMINATION JAN/~~FEB~~ 2025

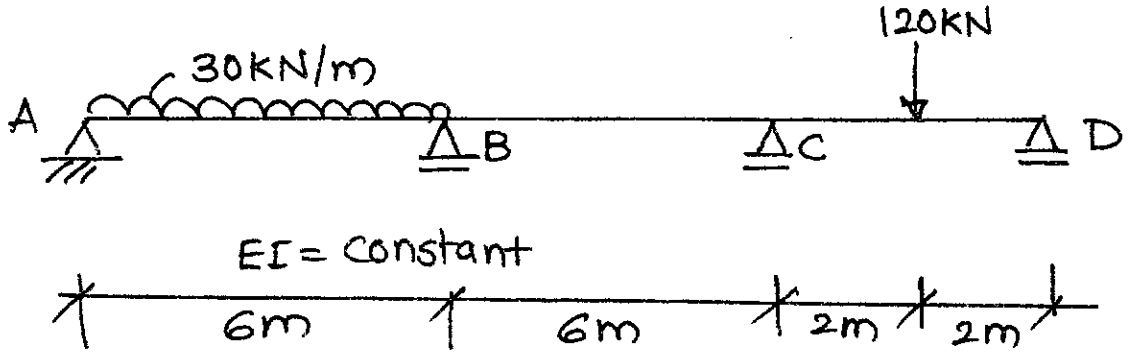

Figure - 3

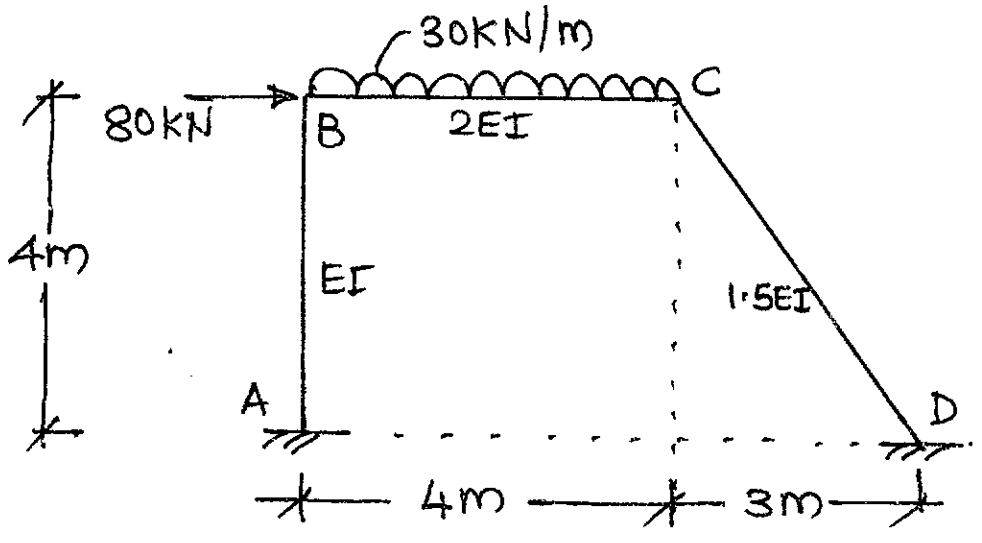

Figure - 4.

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End Semester/Re-Examination- January/February 2025

10/1/25

Program: M.Tech. (Structural Engineering) Sem I **Duration: 3 Hours**

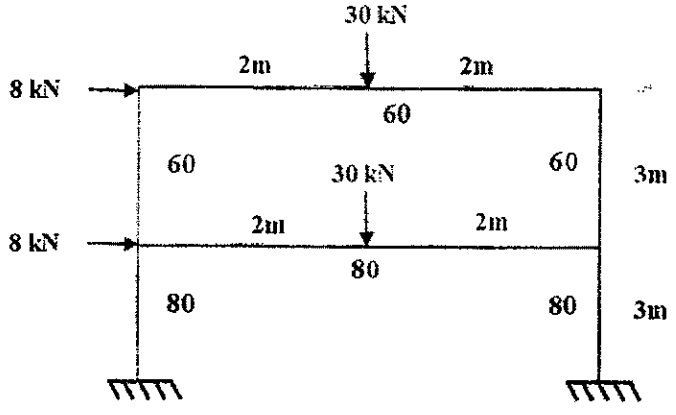
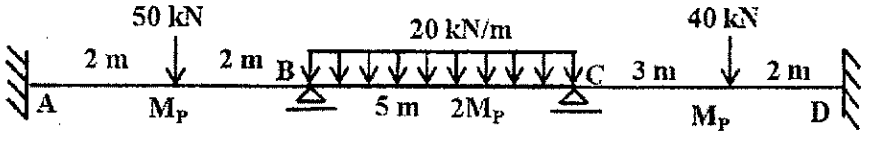
Course Code: PE-MTSE121 **Maximum Points: 100**

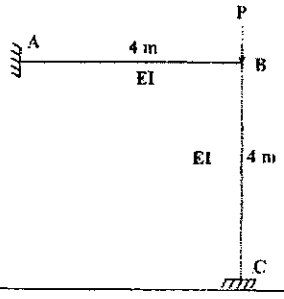
Course Name: Program Elective-II: Non Linear Analysis **Semester: I**

Instructions:

- Attempt any FIVE questions out of SEVEN questions.
- **Answers to all sub questions should be grouped together.**
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

Q.No	Questions	Points	CO	BL	Module No
Q1(a)	**What are the assumptions made in the plastic theory of bending?**	(05)	1	1,2	1
Q1(b)	**Write a note on the factors affecting the lateral buckling of a beam.**	(05)	4	1,2	7
Q1(c)	**Write a note on different methods of buckling analysis of a column.**	(05)	3	2	4
Q1(d)	**Explain St. Venant's torque and Torsion-bending torque.**	(05)	4	2	6
Q2(a)	**A steel beam of rectangular section 100 mm wide and 200 mm deep is simply supported over a span of 4 m. If the beam carries a uniformly distributed load of 30 kN / m length on the entire span, find the depth of the elastic core and the moment resisted by the elastic core at the mid-span. The yield stress of steel 250 N/mm^2.**	(10)	1	3,4	1
Q2(b)	**Find the shape factor of an unsymmetrical I section with following details:** **Top flange width = 200 mm & thickness = 20 mm** **Bottom flange width = 300 mm & thickness = 30 mm** **Depth of web = 200 mm and thickness of web = 20 mm**	(10)	1	3,4	1

Q3	**For the frame shown in figure below, find the collapse load factor. Loads shown in the figure are working loads and the plastic moment capacity of each member in kN-m is also shown in the figure.**	(20)	1	3,4	2
					
Q4(a)	**A continuous beam is subjected to working loads as shown in figure below. If M_P = 75 kN-m, calculate the (true) load factor for the beam.**	(10)	1	3,4	1
					
Q4(b)	**With derivation of the expression, write a note on the effect of shear force on plastic moment capacity of a flexural member of rectangular cross section.**	(10)	2	1,2, 3	3
Q5(a)	**A simply supported column of length L is under the action of a compressive load P. Find the critical load by finite difference method if the flexural rigidity of the member varies uniformly from EI at either end to 2EI at the center.**	(10)	3	3,4	4
Q5(b)	**For the column given in Q5(a) above, find the critical load by energy method.**	(10)	3	3,4	4

Q6(a)	**Determine the critical load for the frame shown in figure.**	(15)	3	3,4	5
					
Q6(b)	**Explain the modes of buckling in case of a channel section symmetrical about X-axis.**	(05)	4	2	6
Q7(a)	**A steel beam of rectangular cross section 50 mmx 200 mm and span 5m, is subjected to end moments M at its both the ends. Find the value of M at which it buckles laterally. $E=2x10^5$ N/mm^2 , $G=0.769x10^5$ N/mm^2**	(06)	4	1,2	7
Q7(b)	**Derive the governing differential equation for the torsional buckling of column with symmetrical cross- section.**	(14)	4	1,2, 3	6

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END SEMESTER/~~RE EXAMINATION~~ JANUARY/ ~~FEBRUARY~~ 2025

Program: M. TECH (STRUCTURES) Term I 13/1/25 **Duration: 3 HR**

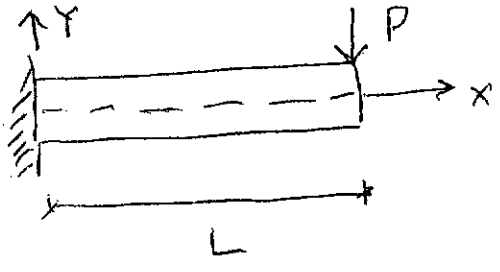
Course Code: PE-MTSE131 **Maximum Points: 100**

Course Name: Advanced solid Mechanics **Semester: I**

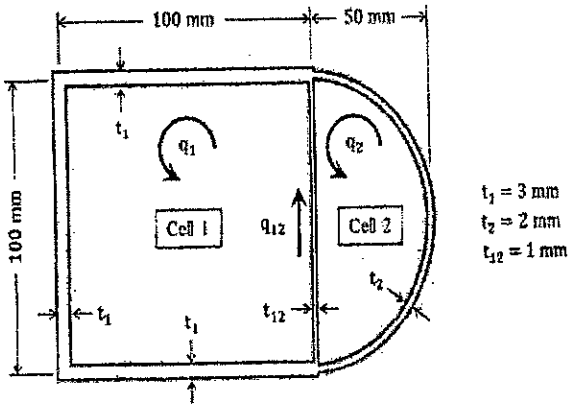
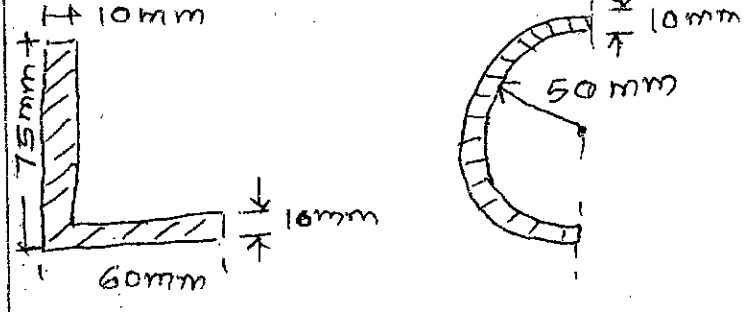
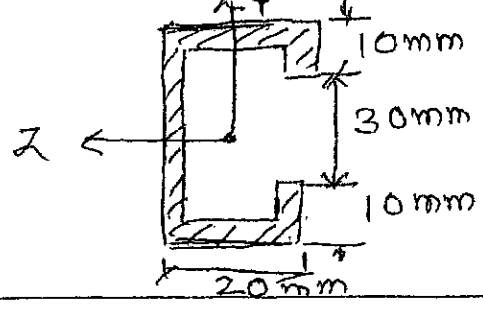
Notes: Solve any 5 questions.

Q.No.	Questions	Points	CO	BL	Module
1 (a)	The state of stress in Mpa at a point is given by $\begin{bmatrix} 12 & -10 & 08 \\ -10 & 08 & 04 \\ 08 & 04 & 15 \end{bmatrix}$ MPa If the element is rotated by 45° about the Z axis in the anticlockwise direction, Determine the new **strain tensor** at this point. Take E = 2 x 10^5 N/ mm^2 , Poisson's ratio = 0.28.	10	1	3	1
1(b)	A thin-walled tube is fabricated of a brittle material having ultimate tensile and compressive strengths σt = 300 MPa and σc = 700 MPa. The radius and thickness of the tube are r = 100 mm and t = 5 mm. Calculate the limiting torque that can be applied without causing failure by fracture. Apply (a) the Tresca theory and (b) the Von-Mises theory.	10	3	3	7
2(a)	Using the stress function $\Phi = Axy + Bx^2 + Cx^2y + By^3 + Exy^3 + Fx^2y^3 + Gy^5$ Obtain the stress field for simply supported beam of length L subjected to point load of magnitude 2 P at mid span cross section dimension of beam is 2c depth and b width (consider X axis @ centre of beam & Y axis @ midspan)	12	2	3	3

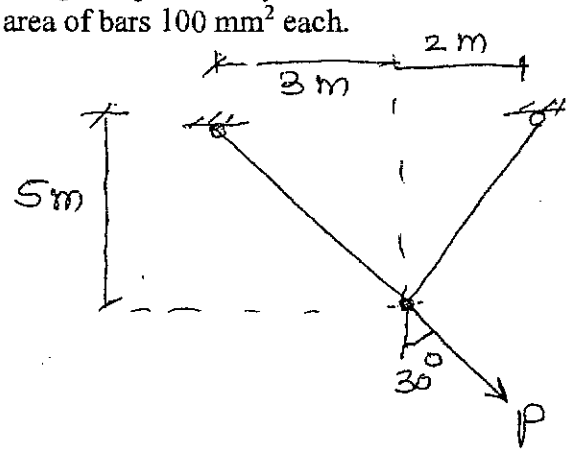
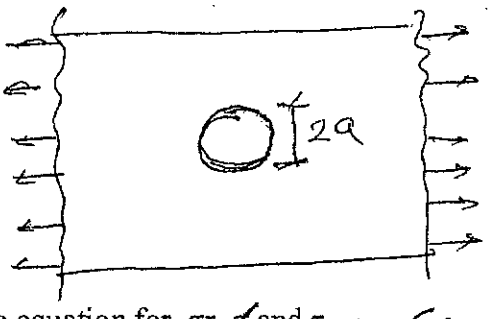
END SEMESTER/~~RE-EXAMINATION~~ JANUARY/ ~~FEBRUARY~~ 2025

2(b)	A body with a plane stress field has material properties E= 200 GPa and υ=0.3and has following displacement field, $u(x, y) = 28x^2 - 10x^3y + 18y^3$ mm $v(x, y) = = 10x^3 + 20xy^3 + 6y^2$ mm Where, x and y are in meters. Determine stresses and rotation of the body at x= 0.080 m and y= 0.025 met Check if the displacement field is compatible.	08	1	3	4
3	The stress field at a point with respect to X, Y, Z coordinate system is given by the array in MPa as $\begin{bmatrix} 40 & 18 & 22 \\ 18 & -12 & -15 \\ 22 & -15 & 14 \end{bmatrix}$ MPa Calculate principal stresses and direction cosine associated with maximum value of stress	20	1	3	1
4(a)	Prove that to convert a plane strain solution to a plane stress solution you substitute $\frac{1+2\nu}{(1+\nu)^2}E$ & $\frac{\nu}{1+\nu}$ For E and ν respectively.	08	1	3	2
4(b)	For the beam shown determine the displacement field due to bending only. Consider the cross section of beam to be rectangular and thin so that deflections are not functions of z. The stiffness of the beam is EIz and poisson's ratio υ. 	12	2	3	1

END SEMESTER/~~RE EXAMINATION~~ JANUARY/ ~~FEBRUARY~~ 2025

5 (a)	 For a thin walled multi cell member subjected to torque $T=5 \times 10^5$ N-m , the material properties are E= 70 GPa and Poisson's ratio = 0.33. Calculate **a) shear flow in walls b) maximum shear stress** **c) angle of twist per unit length**	14	2	3	5
5 (b)	Each of the section shown is transmitting torque of 200 N-m. Estimate the maximum shear stress in each section and angle of twist per unit length 	06	3	3	5
6(a)	Determine the location of shear centre "e" for the cross section shown from first principle. All dimensions are in mm and thickness of walls is 4 mm. 	10	3	3	6

END SEMESTER~~RE EXAMINATION~~ JANUARY/ ~~FEBRUARY~~ 2025

6 (b)	For the given cable arrangement calculate deflection of point B in vertical and horizontal direction for given load using complementary theorem. E= 2x 10^5 N/ mm^2 and area of bars 100 mm^2 each. 	10	3	3	7
7	For plate loaded in tension by force per unit area σ , is having circular hole at centre. Outer diameter of the plate is very large compared to diameter of hole 2a. Use Airy's stress approach with polar coordinates  Derive equation for σr, ~~σ~~ and $\tau_{r\theta}$, σ_θ	20	2	3	4