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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2026

M.Tech-II Semester (SE)

COURSE CODE (CREDITS): 25M1WCE213 (3) MAX. MARKS: 35

COURSE NAME: THEORY OF PLATES AND SHELLS

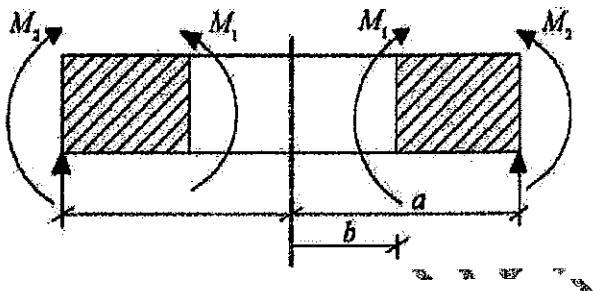
COURSE INSTRUCTORS: DR. SAURAV MAX. TIME: 1 Hour 30 Min

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Use of Non programmable calculator is allowed.

Q.No	Question	CO	Marks
Q1	A long concrete retaining wall is subjected to a plane strain condition. The material properties are: • Modulus of Elasticity, E=30 GPa • Poisson's ratio, ν=0.20 At a point in the wall, the measured strains are: • $\varepsilon_x=500\times10^{-6}$ • $\varepsilon_y=200\times10^{-6}$ • $\gamma_{xy}=300\times10^{-6}$ Using the plane strain stress–strain relationship, determine: i. The normal stress σ_x ii. The normal stress σ_y iii. The shear stress τ_{xy} Also analyze whether the state of stress is predominantly tensile or compressive.	1	5
Q2	A simply supported rectangular plate of dimensions a×b is subjected to a uniformly distributed load of intensity q_0. Using Navier's double trigonometric series method, derive the expression for the maximum central deflection of the plate. You may use the governing differential equation of thin plate bending: $$\nabla^4 w = \frac{q_0}{D}$$ where D is the flexural rigidity of the plate. Further, for a square plate (a=b), show that the approximate maximum deflection considering the first term only is: $$(w)_{max} = \frac{4q_0a^4}{\pi^6 D}$$	2	6
Q3.	A simply supported square plate of side 2.0 m and thickness 120 mm carries a uniformly distributed load of intensity 8 kN/m^2. The plate is made of concrete having: • Modulus of Elasticity, E=25 GPa • Poisson's Ratio, ν = 0.20 Using the first-term approximation, determine: 1. The flexural rigidity D of the plate 2. The maximum central deflection	2	5

	3. The maximum bending moment at the center in the x-direction		
Q4.	**i)** A circular plate having an inner radius b and outer radius a has a circular hole at the centre (Fig. 1) . It is subjected to uniformly distributed bending moments M_1 at the inner boundary and M_2 at the outer boundary. Using the governing differential equation for axisymmetric bending of circular plates, derive the expression for deflection **w(r)**  **Fig. 1** **ii)** A circular plate with a concentric circular hole has: • Outer radius a=500 mm • Inner radius b=200 mm • Uniform bending moment at inner edge M_1=12 kN-m/m • Uniform bending moment at outer edge M_2=8 kN-m/m • Flexural rigidity D=2.5×10^7 N-mm Determine the deflection at radius r=300 mm.	3	7+3
Q5.	The internal and external radii of a thick cylinder are 200 mm and 300 mm respectively. The external pressure on the cylinder is four Newton per square. Find the internal pressure that can be applied if the maximum stress is limited to 15 N/mm^2. Also sketch the distribution of radial operation and stress across the wall section.	4	5
Q6.	For a plate element subjected to bending moments Mx, My, and twisting moment Mxy, the principal bending moments act on planes inclined at an angle α to the x- axis. Starting from the moment transformation equations for a plate element, derive the expression for the inclination of principal planes and show that: $$\tan 2\alpha = \frac{2M_{xy}}{M_x - M_y}$$ Where: • Mx = bending moment per unit length in x-direction • My = bending moment per unit length in y-direction • Mxy = twisting moment per unit length	3	4