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Name............................

Reg. No.........................

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2010

ME 04 405—ADVANCED MECHANICS OF SOLIDS

(2004 admissions)

Time : Three Hours

Maximum : 100 Marks

Part A

Answer all *questions.*

I. (a) State Hooke's law.

(b) What is rigid body motion ? Explain how it can be avoided.

(c) Briefly explain about stress concentration factor.

(d) Explain the stress state in slender members.

(e) Define centroid and shear center.

(f) Explain the principle of minimum complementary energy.

(g) Explain about Wrinkler's theory.

(h) When a circular shaft is subjected to torsion show that the shear stress varies linearly from the axis to the surface.

(8 × 5 = 40 marks)

Part B

II. (a) Deduce an expression for the elastic potential energy stored per unit volume in a monotropic material with linear behaviour, as a function of the elements of the stress tensor.

Or

(b) The shearing stress at a point in a loaded structure $\tau_{xy} = 40$ MPa. Also it is known that the principal stresses at this point are $\sigma_1 = 40$ MPa and $\sigma_2 = -60$ MPa. Determine σ_x (compression) and σ_y and indicate the principal and maximum shearing stresses with an appropriate sketch.

Turn over

III. (a) Consider a rectangle plate with sides a and b of thickness "t" as shown in Fig. 1. (i) Determine the stresses σ_x, σ_y and τ_{xy} for the stress function $\phi = c_1 x^3 y$, where c_1 is a constant ; (ii) Draw a sketch showing the boundary stresses on the plate and find the resultant normal and shearing boundary forces on each of the faces.

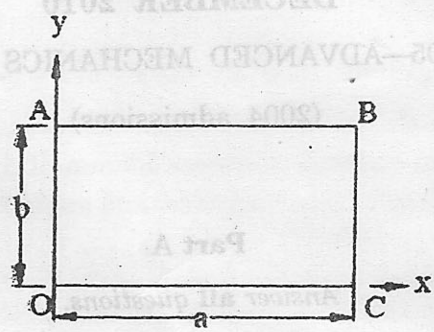

Fig. 1.

Or

(b) The thin cantilever shown in Fig. 2 is subjected to uniform shearing stress τ_0 along its upper surface ($y = +h$) while surfaces $y = -h$ and $x = L$ are free of stress. Determine whether Airy stress function

$$\phi = \frac{1}{4}\tau_0\left(xy - \frac{xy^2}{h} - \frac{xy^3}{h^2} + \frac{Ly^2}{h} + \frac{Ly^3}{h^2}\right)$$

Satisfies the required condition

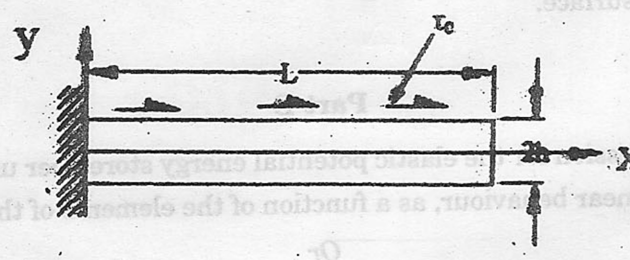

Fig. 2.

IV. (a) Derive an expression for radial stress (σ_r) and tangential stress (σ_θ) for a solid rotating disk of radius r, made with a material of density ρ and Poisson's ratio υ, rotating with an angular velocity ω.

Or

(b) Investigate the following stress function. Determine the loading and boundary conditions that satisfy

$$\phi = -\frac{F}{d^3}\, xy^2 \;(3d - 2y)$$

Applied to the region included in $y = 0$, $y = d$, $x = 0$ on the side x positive.

V. (a) The cross-section of a thin walled aluminium tube is an equilateral triangular section of mean side length 50 mm and wall thickness 3.5 mm. If the tube is subjected to a torque of 40 N.m. what are the maximum shearing stress and angle of twist per unit length ? Take G = 28 GPa.

Or

(b) A thin walled bridge deck having singly symmetric cross-section as shown in the fig.3. Determine the torsional stiffness of the section, T/θ', in (kN m^2/degree), if the shear modulus is constant throughout and of value 70000 N/mm^2.

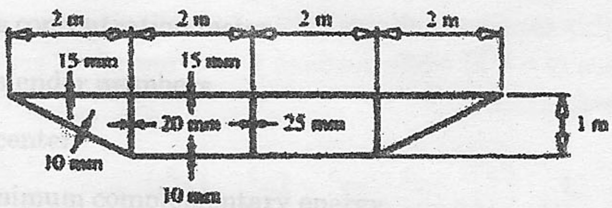

Fig. 3.

(4 × 15 = 60 marks)