Total No. of Questions – [09] - Total No. of Printed Pages: 04

G.R. No.	

Paper Code - P119-151 (ESE)

DECEMBER 2019 / ENDSEM

F. Y. M. TECH. (Mechanical Design Engineering) (SEMESTER - I)

COURSE NAME: Advanced Stress Analysis

COURSE CODE: MEPA11181

(PATTERN 2018:R1)

Time: [3 Hour] [Max. Marks: 50]

(*) Instructions to candidates:

1) **Answer Q.1, Q.2, Q.3, Q.4 OR Q.5, Q.6 OR Q.7, Q.8 OR Q.9**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q. 1 a The strain distribution in a thin plate has the form $\begin{bmatrix} ax^3 & axy^2 \\ axy^2 & ayx^2 \end{bmatrix}$ where 'a' is constant. Show that whether this strain field is a valid solution of an elasticity problem. Body forces are neglected. 03

OR

Q. 1 b The stress distribution in hollow cylinder subjected to uniform pressure on the inner and outer surface can be represented by stress function, $\emptyset = [A \log r + B r^2 \log r + C r^2 + D]$ Where A, B, C and D are constants. Prove that it is a valid stress function. 03

Q. 2 a Draw neat diagram of plane polariscope. 03

OR

Q. 2 b Explain rectangular strain gauge rosette. 03

Q. 3 a Write short note on volume fraction. 02

OR

Q. 3 b Discuss in detail application of composite material in mechanical engineering 02

Q. 4 A hard steel ball (E = 200 GPa, υ = 0.29) of diameter 50 mm is pressed against a thick aluminum plate (E = 72 GPa, υ = 0.33 and yield stress = 450 MPa). Determine the magnitude of load P required to initiate yield in the aluminum plate according to the maximum octahedral shear stress criterion of failure($\tau_{oct(max)} = \frac{\sqrt{2}}{3} Y$), maximum shear stress and distance from plane of contact to the maximum shear stress. 14

OR

Q. 5 A fatigue testing machine tool is used to determine fatigue life under rolling contact consist of a steel toroid (body 2) and steel cylinder 14

$R_1 = 32\ mm$, $R_1' = \infty$, $R_2 = 32\ mm$, $R_2' = 20\ mm$,

For steel E = 200 GPa, $\upsilon = 0.29$

1. Determine an expression for maximum compressive stress in terms of load 'P'.
2. Fatigue testing machine indicates that fatigue failure occurs at approximately 10^9 cycles with σ_{max} = -2758 MPa. Determine the applied load, maximum shear stress, maximum octahedral shear stress and distance from plane of contact to the maximum shear stress.

Q. 6 A tubular section showm in **Fig. 01** subjected to a torque of 113 kN-m. Determine the shear stress developed in the walls of the section. 14

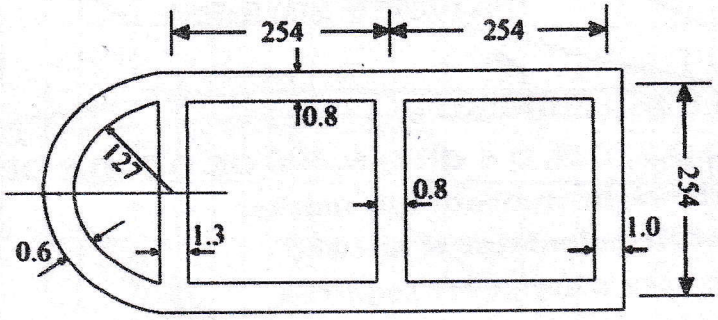


Fig. 01

OR

Q. 7 Find the maximum shear stress and unit angle of twist of the steel bar having the cross section shown in **Fig 02** when subjected to a torque at its ends of 600 N m. Take G = 77.5 GPa. 14

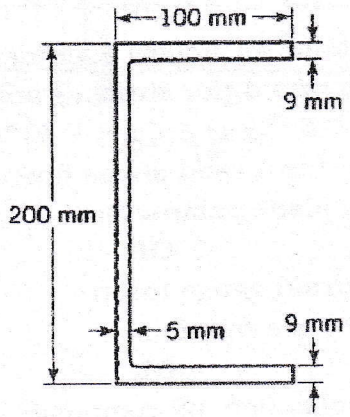


Fig 02

Q.8 a. A 4-mm-thick plate of steel is formed into the cross section shown in **Fig. 03**. Locate the shear center for the cross section. 14

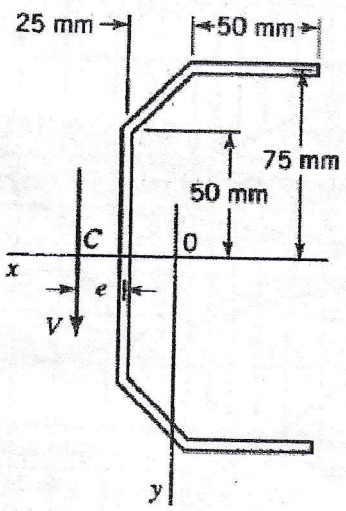


Fig.03

OR

Q. 9 A 2.50-mm-thick plate of steel is formed into the cross section shown in **Fig. 04**. Locate the shear center for the cross section. 14

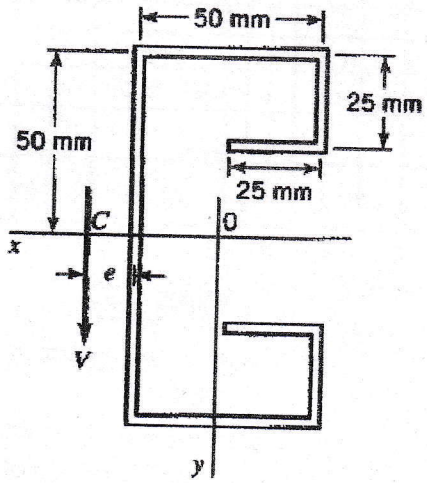
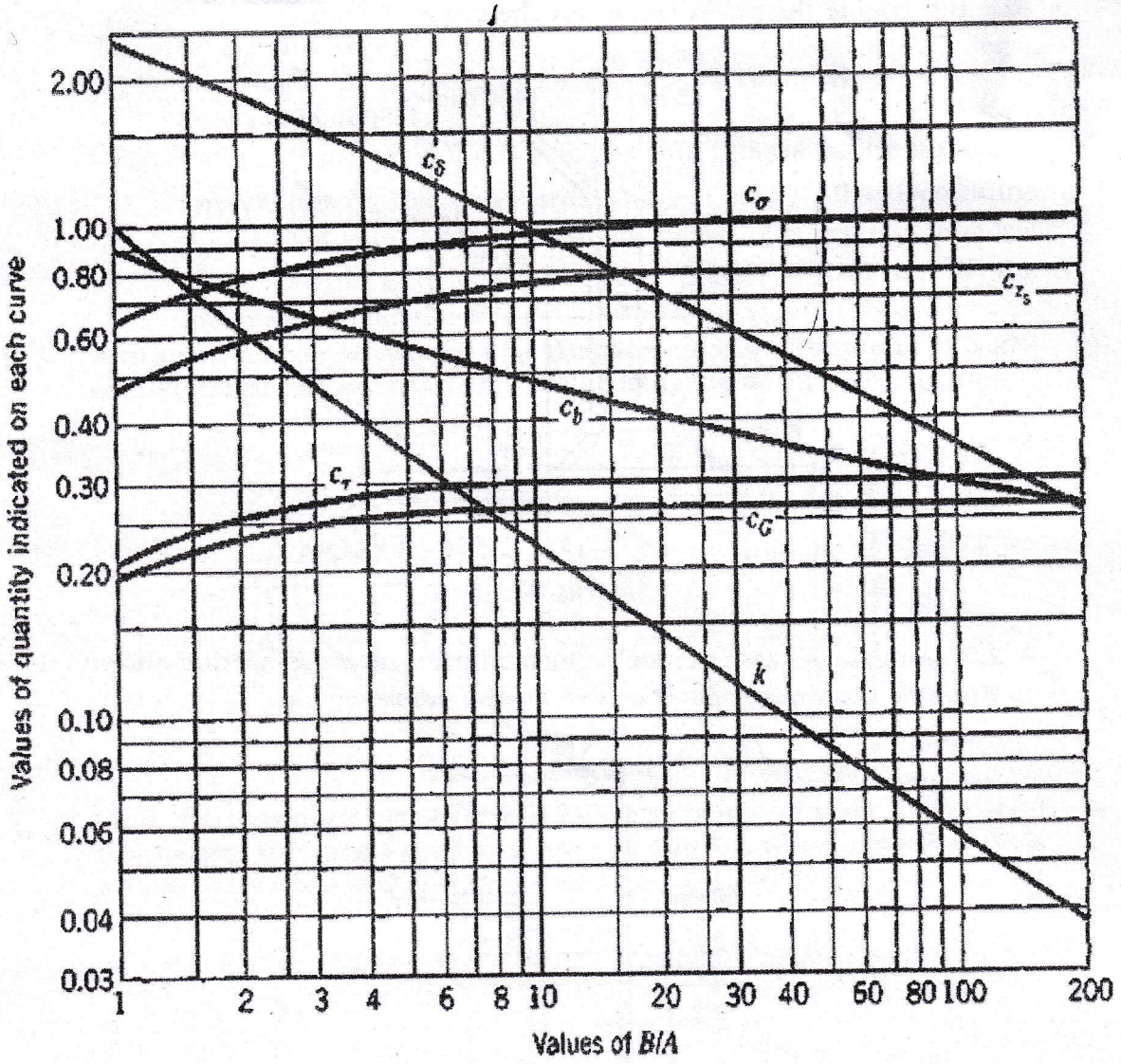


Fig. 04


2.00
1.00
0.80
0.60
0.40
0.30
0.20
0.10
0.08
0.06
0.04
0.03
1
2
3
4
6
8
10
20
30
40
60
80
100
200
Values of quantity indicated on each curve
Values of B/A
c_S
c_σ
c_{r_s}
c_b
c_r
c_G
k