P111-251-DSP/ESD

Total No. of Questions – [06] Total No. of Printed Pages:[03]

G.R. No.	

April 2022 / INSEM+ENDSEM

F. Y. M. TECH. (Mechanical Design Engineering)

(SEMESTER – I)

COURSE NAME: Advanced Stress Analysis

COURSE CODE: MEPA11201

(PATTERN 2020)

Time: [3 Hours] [Max. Marks: 60]

(*) Instructions to candidates:

1) **All Questions are compulsory**
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. 07

b Explain Plain stress and Plain strain conditions with suitable examples. 03

Q. 2 A stress function is given as under, 10

$$\phi = \left[C_1 \cdot r^4 + C_2 \cdot r^2 + C_3 + \frac{C_4}{r^2} \right] \cdot \cos 2\theta$$

Where r and θ are polar coordinates. Find out whether this is valid stress function. Also determine the stresses.

Q. 3 A hollow thin walled torsion member is shown in Fig. 01 has uniform wall thickness. Show that walls BC, CD and CF are stress free. 10

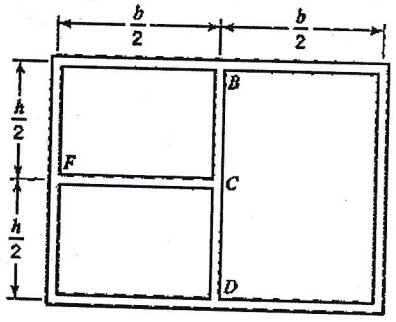


Fig. 01

Q. 4 A hook similar to that shown in Fig. 02 is part of a scarifier used to dig up old road beds before replacing them. Let the tool be made of AISI 4340 steel ($K_{IC} = 59\ MPa\sqrt{m}$) and heat-treated. The dimensions of the tool are as follows: d = 250 mm, 2c = 60 mm, and the width of the rectangular cross section is t = 25 mm. Determine the magnitude of the fracture load P for a crack length of (a) a= 5 mm ($Take\ f_1(\lambda) = 1.22 \quad f_2(\lambda) = 1.02$) (b) a = 10 mm ($Take\ f_1(\lambda) = 1.33 \quad f_2(\lambda) = 1.05$) 10

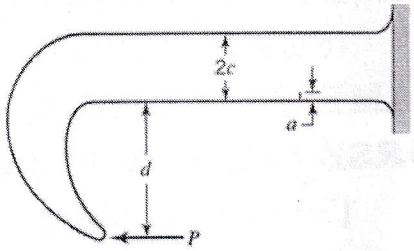


Fig. 02

Q. 5 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, maximum shear stress, maximum octahedral shear stress and distance from plane of contact to the maximum shear stress. 10

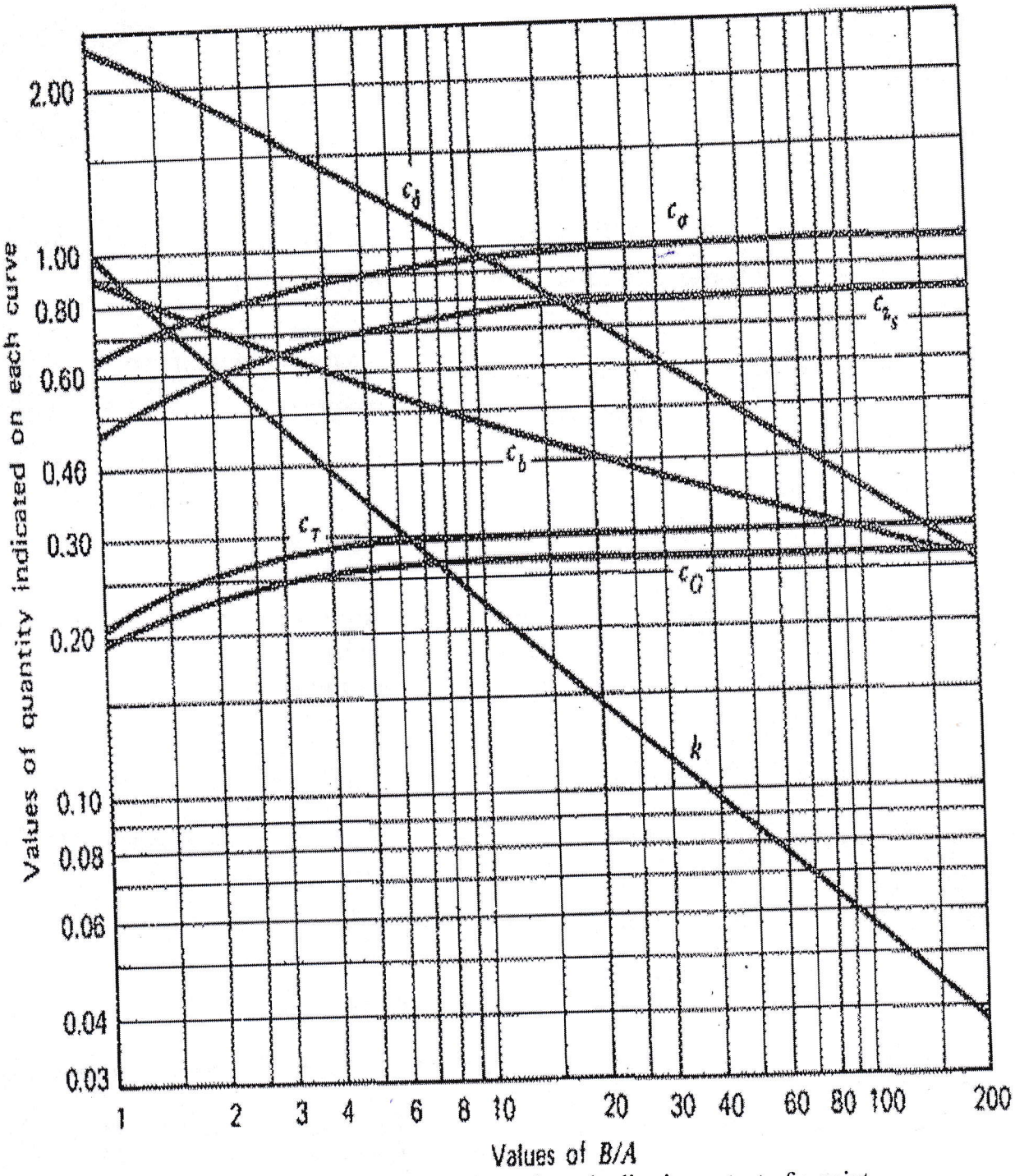
Q. 6 a The strain readings of a rectangular strain gauge rosette are given as: 06

$\varepsilon_A = 85\ X\ 10^{-6}$, $\varepsilon_B = 45\ X\ 10^{-6}$, $\varepsilon_C = 130\ X\ 10^{-6}$

Determine principal stress and maximum shear stress.

Take E = 70 GPa and ν = 0.3

b Write short note on isoclinic fringe analysis 04



Q. 5 Stress and Deflection coefficient of two bodies in contact of a point