MASTER OF SCIENCE EXAMINATION, 2017

(2nd Year, 1st Semester)

MATHEMATICS

Unit - 3.5 (B-1.12)

(Coupled fields of Solid Mechanics and Plasticity)

Full Marks : 50 Time : Two Hours

The figures in the margin indicate full marks.

All symbols have their usual meanings.

Answer Q. No. 1 and any *three* from the rest of the questions.

1. Define deviatoric and spherical stresses. 2

2. (a) Define yield criteria in plasticity. Show that Von Mises' yield criterion can be put in the form

$$(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2=2\sigma_0^2$$ 8

(b) Show that experimental results on combined tension and torsion show Mises' yield criterion is more accurate. 8

3. Define stress space and π-plane. Give geometrical interpretation of yield criteria due to Tresca and Von Mises. 16

[*Turn over*]

4. (a) What is ideal plasticity ? Write basic postulates of ideal plasticity and deduce the yield criterion for ideal plastic solid. 8

(b) Show that in plasticity stress-strain relations are given by

$$\sigma'_{ij} = 2G\, e'_{ij} \quad \text{and} \quad \sigma''_{ij} = 3K\, e''_{ij}$$

where $K = \lambda + \frac{2}{3}G$. 8

5. Show that for unrestricted plastic flow in a circular tube under internal pressure p_0 and initial radii a_0 and b_0 the pressure at any point within the tube is given by

$$p = \frac{\sigma_0}{\sqrt{3}} \log\left(1 + \frac{b_0^2 - a_0^2}{a^2}\right). \qquad 16$$

6. A rectangular beam is bent by terminal couple of moment M. If the transverse section of the beam occupies the region defined by

$$-\frac{b}{2} < x < \frac{b}{2}, \quad -\frac{h}{2} < y < \frac{h}{2}$$

[*Turn over*]

where h is the depth and b is the width of the beam, prove that moment required to produce plastic zone upto $-\eta < y < \eta$ is $b\sigma_0\left(\frac{h^2}{4} - \frac{\eta^2}{3}\right)$ where σ_0 is the yeild stress according to Tresca.

Prove that full plastic state is not physically realizable by the application of a finite moment. 16