(b) What is ideal plastic solid ? Mention all the postulates of yielding in perfectly plastic materials. 8

4. (a) Show that the general yield condition in plasticity can be put in the form

$$f\left(J_2^1, J_3^1\right)=0$$

where J_2^1 and J_3^1 are the invariats of the deviatoric part of the stress. 8

(b) Deduce stress invariants for deviatoric and spherical parts of stress. 8

5. A rectangular beam is bent by terminal couple of moment M. If the transverse section of the beam occupies the region defined by $|x|<\frac{b}{2}, |y|<\frac{h}{2}$ where h is the depth and b is the width of the beam, prove that full plastic state is not physically realizable by the application of a finite moment. 16

6. 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

$$p=\frac{\sigma_0}{\sqrt{3}}\log\left(1+\frac{b_0^2-a_0^2}{a_2}\right)$$ 16

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Ex./M.Sc./M/B1.12/37/2019

MASTER OF SCIENCE EXAMINATION, 2019

(2nd Year, 1st Semester)

MATHEMATICS

Coupled Field f Solid Mechanics & Plasticity - I

Unit - 3.5(B 1.12)

Time : Two hours Full Marks : 50

All symbols have their usual meanings.

Answer ***Question No. 1*** and any ***three*** from the rest.

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 the change in the intermediate principal stress does not affect Tresca's yield condition but changes the Mises' yield condition. 8

3. (a) Show that in plasticity stress-strain relations are given by

$$\sigma_{ij}^{/}=2G\,e_{ij}^{/} \text{ and } \sigma_{ij}^{//}=3k\,e_{ij}^{//}$$

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