MAJOR EXAM
APPLIED PLASTICITY
(AML833)

Date: 03/05/2009 | **Max Marks: 100**
Time: 10:30-12:30am | **Max Time: 02Hrs**

Q.1 **(a)** Derive Henky's and Geiringer's compatibility equations, and write the main differences between the two. **(10)**

(b) Using slip lines, determine the stress and velocity distribution in a semi infinite body indented by a frictionless flat rigid punch. Write assumptions made. **(10)**

Q.2 **(a)** State and prove upper bound theorem and derive its simple formula in plane strain. **(10)**

(b) Determine the upper bound to the extrusion force in symmetrical wedge- shaped die. **(10)**

Q.3. **(a)** Explain the sand heap analogy. Determine the torque required to make a rectangular shaft of perfectly plastic material fully plastic, using sand heap analogy. **(10)**

(b) For the case of internal pressure loading in a hollow sphere,

$$P_{crit} = (2/3)\left((\beta^3-1) / \beta^3 \right)$$

Determine pressure required to cause plastic zone to reach a radius $\mathbf{r_c}$. **(10)**

Q.4. **(a)** For a beam of rectangular cross-section, derive expressions for moment and shear stress distribution using a nonlinear stress-strain relation :

$$\sigma = E\,e + F\,e^n \qquad \textbf{(10)}$$

(b) Using the concept of plastic hinges, determine the collapse load for a given portal frame loaded as shown, given the horizontal beam takes a moment **1.5** times the moment taken by vertical beams. **Q=2P and b/a = 3** **(10)**

Q.5. **(a)** Derive expressions for equivalent stress and equivalent strain and using these quantities derive Prandtl-Reuss equations for a perfectly plastic material **(10)**

(b) Given that σ_0 is the yield stress in simple tension. Derive the expression for yield stress in pure shear for Tresca and Von-Mises criteria. Also calculate the radius of yield locus for Von-Mises yield criteria in Haigh-Westergaard stress space. **(10)**

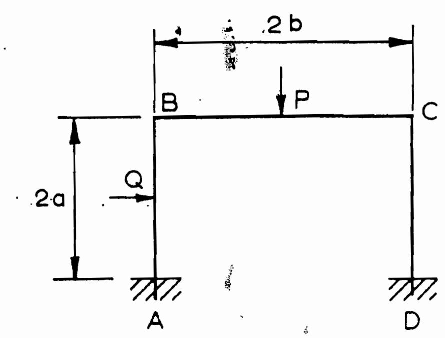

Figure for Question 4 (b)