TAM 554 Midterm Due November 20, 2019
Name_____

Q1(10 points). In an early paper, Drucker (Drucker, D. C. (1949) *Relations of experiments to mathematical theories of plasticity*, Journal of Applied Mechanics, vol. 16, pp. 349–357), Drucker proposed a yield criteria of the following form. $f = J_2^3 - \alpha J_3^2 - k^2 = 0$. Derive a flow rule for this yield criteria.

Q2(25 points). We want to solve the shear stress versus applied shear strain for the simple shear problem. We showed the solution of the problem using the Jaumann Stress rate in class. Please repeat the same problem using (i) Green-Naghdi co-rotational stress rate and (ii) Truesdell Rate. Comment on your results. Which result is most realistic? Discuss?

Q3. (40 points) Read the paper by M. Cherkaoui Try to reproduce his stress-strain curve result for the Hadfield steel case. This is the slip-twin case. Use his constants.

Q4. (25 points) A thick-walled spherical shell having an internal radius a and an external radius b is rendered partially plastic by the application of an internal pressure p. The material of the shell hardens linearly with a constant plastic modulus H. Introducing the assumption of complete incompressibility of the material, and neglecting changes in geometry, show that the pressure necessary for the elastic-plastic boundary to have a radius c is given by:

$$\left(1+\frac{H}{E}\right)p = \frac{2}{3}Y\left\{1-\frac{c^3}{b^3}+\ell n\frac{c^3}{a^3}+\frac{H}{E}\left(\frac{c^3}{a^3}-\frac{c^3}{b^3}\right)\right\}$$

where Y denotes the uniaxial yield stress of the material.