

## Homework Assignment 3

### Problem 1

Derive the associated flow rule for a viscoplastic solid with rate-dependent with yield criterion given by

$$\sqrt{J_2} = k + \eta (2\dot{\epsilon}_{ij}\dot{\epsilon}_{ij})^{\frac{1}{2m}}$$

### Problem 2

A work-hardening plastic solid is assumed to obey the Mises-like yield criterion with isotropic hardening, that is,  $f(\boldsymbol{\sigma}, \boldsymbol{\Lambda}) = \sqrt{J_2} - k(\epsilon^p)$  and an associated flow rule. Show that

$$\dot{\epsilon}_{ij}^p = \frac{\sqrt{3}S_{ij} (S_{kl}\dot{S}_{kl})}{4k^2k'(\epsilon^p)}$$

### Problem 3

We typically draw yield surfaces in the  $\Pi$ -plane view, i.e. looking down the  $\sigma_I = \sigma_{II} = \sigma_{III}$  line; however, we can also take a meridional “side” view by projecting the three dimensional yield surface onto a 2 dimensional plane. Perform this projection and plot both the von Mises and Tresca yield surfaces with an ordinate axis that corresponds to the  $\sigma_{II} - \sigma_{III}$  plane and an abscissa that corresponds to the  $\sigma_I - \sigma_{III}$  plane. Label the points that cross the axes with values that correspond to a yield stress  $Y$ .