Homework 5
CM4650
Spring 2020

Due:
5A: due Wednesday 18March 2020, in class
5B: due Monday 30March 2020 in class

Please do not write on the back side of the pages for your solutions. Please write legibly and large. Thank you.

Part 5A (covered in Exam 2)

1. (10 points) (Material behavior) Text problem 6.6
2. (10 points) (Material behavior) Text problem 6.7
3. (10 points) (Explore CY GNF) Text problem 7.24
   The Carreau-Yasuda GNF model (p231) is given below:

$$\underline{\underline{\tau}}(t) = -\underline{\underline{\dot{\gamma}}}(t)\left[\eta_\infty + (\eta_0 - \eta_\infty)[1 + (\lambda\dot{\gamma})^a]^{\frac{n-1}{a}}\right]$$

   where η_∞, η_0, λ, n and $a=2$ are constant parameters of the model and $\dot{\gamma} = \left|\underline{\underline{\dot{\gamma}}}\right|$ is the magnitude of the rate of deformation tensor.

4. (20 points) Plot the start-up of steady shearing traces for the Carreau-Yasuda Generalized Newtonian Fluid with parameters given in Text problem 7.24. Using software (Excel, MATLAB, equivalent packages), plot traces of $\eta^+(t,\dot{\gamma}_0)$ for the following values of $\dot{\gamma}_0$: $0.01, 0.1, 10, 50s^{-1}$.

Part 5B (not covered in Exam 2; covered in later exam)

5. (20 points) Text 7.15 ($\underline{\underline{\tau}}$ for all GNF)
6. (30 points) Text 7.29 (axial annular flow of a PL GNF). Complete all four parts; note this is a lengthy problem. The answer to part (a) is:

$$\frac{v_z}{V} = \frac{\left(\left(\frac{r}{R}\right)^{1-\frac{1}{n}} - 1\right)}{\left(\kappa^{1-\frac{1}{n}} - 1\right)}$$