AMSC/CMSC 660 Quiz 9 , Fall 2008

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, other electronic devices, communication with others, scratchpaper, etc.

Name _____

1. Consider the DAE from Chapter 21 for modeling the spread of an infection:

$$\begin{aligned} \frac{dI(t)}{dt} &= \tau I(t)S(t) - I(t)/k \\ \frac{dS(t)}{dt} &= -\tau I(t)S(t)\,, \\ 1 &= I(t) + S(t) + R(t). \end{aligned}$$

We are given values for τ and for $I(0)$, $S(0)$, and $R(0)$.

(a) (7) Write this system in the form $\boldsymbol{M}\boldsymbol{y}' = \boldsymbol{f}(t, \boldsymbol{y})$, where $\boldsymbol{M}$ is a 3×3 matrix.

(b) (3) If $\boldsymbol{M}$ is nonsingular, then `ode23s` should be used to solve this problem. Otherwise, `ode15s` should be used. Which of these two algorithms would you choose?

2. (10) Let

$$u'' = \cos(t)u'(t) + \sin(t)u(t),$$

with $u(0) = 0$ and $u(1) = 1$. Let $h = 1/8$ and write a set of finite difference equations that approximate the solution to this problem at $t = jh$, $j = 0, \ldots, 8$.