MECH 307 Numerical Methods for Mechanical Engineering
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Homework #6

FORMAT of the file to be submitted:

1. All the m-files should be named as pr1.m, pr2.m and so.
2. The results (figure, table, or individual result such as x = 2.653, …, and any comment) should be placed in a WORD file named as yourlastname_HW_04.doc
3. All the m-files should be inserted at the end of the WORD file using COURIER 9 font.
4. The WORD file and all the m-files should ZIPPED together, and the file should be named as yourlastname_HW_06.zip or (yourlastname_HW_06.rar).
5. Place the file to the following folder:
   F:\COURSES\UGRADS\MECH\MECH307\HOMEWORK\...

Problem 1 O.D.E.: $\dfrac{dy}{dt} = 5 - 0.4\,t - t\,e^{-0.10\,t}$

I.C.: $y(0) = 10$

- Plot y versus t until y becomes negative.
- y_{max} = ______________ m at t = _______________ s.
- y = 0 at t = _______________ s.

Problem 2 O.D.E.: $\dfrac{dy}{dt} = 5 - c\,t - t\,e^{-0.10\,t}$

I.C.: $y(0) = 10$

- Plot y_{max} versus c, which is a parameter in $0.4 \le c \le 5$.
- y_{max} = 15 m when c = __________ (with a +/- 0.1 error in it).

Problem 3

A mass-spring-damper system satisfies the following ODE and initial conditions:

O.D.E.: $$m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx = 0$$

I.C.: $x(0) = 0.5$ and $dx/dt(0) = 0$

The parameters of the problem are given below:

m = 10 kg,
c = 5 kg.s,
k = 40 N/m.

Calculate and plot the displacement of the mass, *x(t)* in $0 \le t \le 20$.
Use a time step of 0.001 s.

Find the first four peaks of the vibration:

$x_{peak,1}$ = _______0.5_______ m at t = ________0.00________ s.

$x_{peak,2}$ = ________________ m at t = ____________________ s.

$x_{peak,3}$ = ________________ m at t = ____________________ s.

$x_{peak,4}$ = ________________ m at t = ____________________ s.

Then, calculate the period of the vibration:

$t_{peak,2} - t_{peak,1}$ = _____________

$t_{peak,3} - t_{peak,2}$ = _____________

$t_{peak,4} - t_{peak,3}$ = _____________

What is the amplitude ratios:

$x_{peak,1} / x_{peak,2}$ = _____________

$x_{peak,2} / x_{peak,3}$ = _____________

$x_{peak,3} / x_{peak,4}$ = _____________

Problem 4 O.D.E.: $\frac{dy}{dt} = \frac{30\,e^{-0.10\,t}}{1+\sqrt{y}} - t\,e^{-0.25t}$

I.C.: $y(0) = 100$

What is the limit? That means, y approaches to ______________________ as time goes to infinity.

Problem 5 O.D.E.: $\frac{dy}{dt} = \frac{c\,e^{-0.1\,t}}{1+\sqrt{y}} - t\,e^{-0.25t}$

I.C.: $y(0) = 100$

It was given that y(10) = 120.
Estimate the value of c = ________________ with a tolerance of +/- 0.1.
Plot y versus t for that particular value of c.

Problem 6 O.D.E.: $\frac{d^3y}{dt^3} = -0.5y - 0.3t$

I.C.: $y(0) = 10$

$dy/dt\,(0) = 100$

$d^2y/dt^2\,(0) = 0$

- Plot y versus t in $0 \le t \le 5$.
- ymax = ____________ m at t = _______________ s.