Prince of Songkla University
Faculty of Engineering

Midterm Test
28 February 2016
215-274 Numerical Methods for Mechanical Engineering

Semester 2/2015
09:00-12:00
Room: Robot Head

Name _____ ID _____

Direction:
1. All types of calculator and dictionary are permitted.
2. There are totally 5 problems.
3. One sheet of hand-written A4 paper is allowed. No photocopy!!

Perapong Tekasakul
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Instructors

Problem	**Full score**	**Your mark**
1	10	
2	10	
3	10	
4	10	
5	10	
Total		

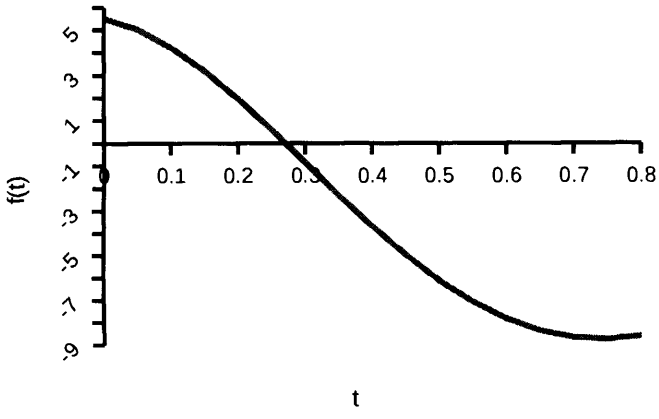
1. Determine the smallest positive real root of

$$f(t) = 9e^{-0.7t}\cos(4t) - 3.5$$

(a) Using the Newton-Raphson method. Employ initial guess of 0.3 and a stopping criterion of 0.01%.

(b) Using the secant method. Employ initial guesses of 0.2 and 0.4 and a stopping criterion of 0.01%.

(10 points)



2. Solve the following system of equation using Gauss Elimination

$$2x_1 - 6x_2 - x_3 = -38$$
$$-3x_1 - x_2 + 7x_3 = -34$$
$$-8x_1 + x_2 - 2x_3 = -20$$

Substitute your results into original equations to prove your answers. (10 points)

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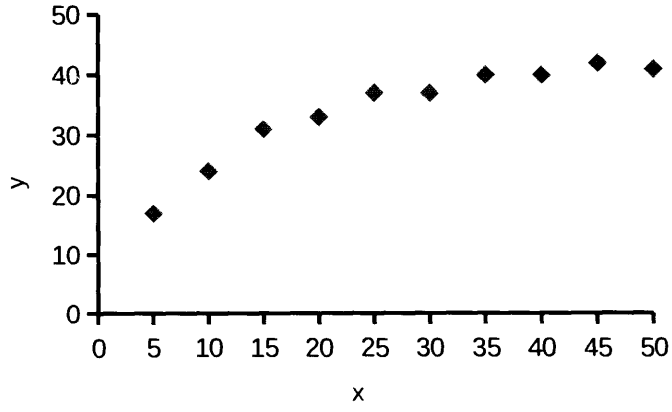
3. Consider the following set of data:

x	y
5	17
10	24
15	31
20	33
25	37
30	37
35	40
40	40
45	42
50	41



Use a second-order polynomial to fit the data. (10 points)

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4. Given the data

x	0	1	2.5	3	4.5	5	6
$f(x)$	2	5.4375	7.3516	7.5625	8.4453	9.1875	12

Calculate $f(3.5)$ using Newton's interpolating polynomials of order 1 through 5. (10 points)

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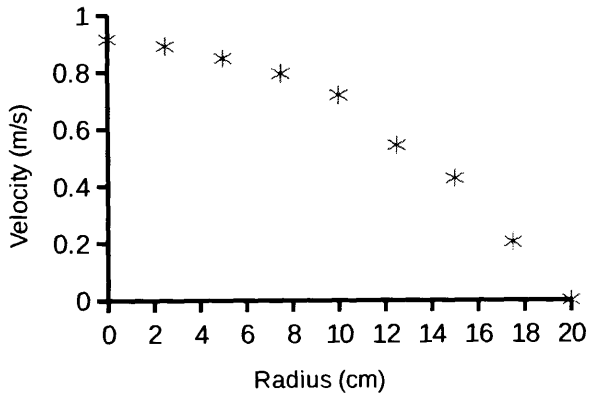
5

5.1 Given the data below, find the volume flow rate using the relationship

$$Q = \int_0^R 2\pi r v dr$$

where r is the radial axis of pipe, R is the radius of the pipe, and v is the velocity. (5 points)

Radius (cm)	0.0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
Velocity (m/s)	0.914	0.890	0.847	0.795	0.719	0.543	0.427	0.204	0



Use multiple Simpson's 1/3 rule to integrate.

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5.2 Estimate the acceleration at each time for the following data. Use finite-difference approximations that are second-order correct. (5 points)

t (s)	1	2	3	4	5	6	7	8	9	10
v (m/s)	10	12	11	14	17	16	12	14	14	10