

Name _____



Prince of Songkla University
Faculty of Engineering

Midterm Test

Semester 1/2010

7 August 2010

9:00-12:00

215-613 Mathematical Methods in Engineering

Room A401

Direction:

1. All types of calculators, document and books are permitted.
2. There are totally 5 problems. Solve all of them.

Total 80 points

Problem #	Full Score	Your mark
1	10	
2	10	
3	20	
4	20	
5	20	
Total	80	

Perapong Tekasakul
Instructor

215-613
Mathematical Methods in Engineering

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1. Describe if the following differential equations are *ordinary* or *partial*, *linear* or *non-linear*, *homogeneous* or *nonhomogeneous*, and give the *order* of the differential equations as well. (10 points)

(a) $y \frac{d^2 y}{dx^2} + \left(\frac{dy}{dx} \right)^{1/4} - y^3 = 0$

(b) $x^2 \frac{dy}{dx} + 2y^2 - 3 = 0$

(c) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 1$

(d) $x^2 \frac{d^4 y}{dx^4} - 3 \frac{d^2 y}{dx^2} - y = 0$

(e) $\frac{d^3 u}{dy^3} - y^{1.5} \frac{d^2 u}{dy^2} = u$

#	Order	ODE or PDE	Linear or nonlinear	Homogeneous or nonhomogeneous
(a)				
(b)				
(c)				
(d)				
(e)				

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2. Before the final game of the 2010 World Cup between Spain and the Netherlands, David Villa was asked by his teammate, Xabi Alonso, if he could answer the following Math question:

“The ODE, $2xy^3 dx = -3x^2 y^2 dy$ has a solution or not? If yes, what is it?”

If you are asked by Villa to help him solve this problem, what will you do? (10 points)

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3. One day when you were walking in the Suntisook market, you got a phone call from your younger brother who was a first-year student of Dr. Prapong's math class. He was assigned a homework in which he didn't know how to solve. He wanted your help because you passed this course last year with an "A" grade. His homework would be due the next day and he wanted your help immediately. The homework was

Solve the initial value problem

$$y'' + 2y' + y = 20e^{-x}$$

$$y(0) = 2$$

$$y'(0) = 1$$

How would you do to help your brother solve the problem? (20 points)

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4. After you talked with you brother, your girlfriend who was in the same class called you to help her solve two problems

$$1. (1-x^2)y'' - 2xy' + 12y = 0$$

$$y(1) = 2$$

$$2. x^2y'' + xy' + (x^2 - 1)y = 0$$

$$y(0) = 0$$

$$y'(0) = 5$$

How would you do to help your girlfriend solve the problem? (20 points)

Hint: $J_1'(x) = \frac{1}{2}[J_0(x) - J_2(x)]$, $J_0(0) = 1$, $J_1(0) = 0$, $J_2(0) = 0$ and $Y_0(0) = \infty$.

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5. Before you finish your shopping, another student in the same class asked you to help him solve the following problem

The mass-spring-damper system is subjected to an external force and motion of the mass is described by

$$y'' + 4y' + 3y = u(t) - u(t - 10)$$

$$y(0) = 0$$

$$y'(0) = 0$$

Determine the response $y(t)$.

How would you do to help this student solve the problem? (20 points)

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After you finished talking with your friend, you turned your mobile phone off and went shopping happily. Nobody could call and ask you any more questions. Thanks god! You should have turned it off after the first question. Anyway, good luck with the problems you have been asked to solve and enjoy!!!