

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination: Semester I

Academic Year: 2008

Date: July 27, 2008

Time: 9:00-12:00

Subject: 230-600 Advanced Engineering

Room: A401

Mathematics for Chemical Engineers

ชื่อ.....รหัส.....

อนุญาตให้นำกระดาษ A4 จดด้วยลายมือ(ห้ามสำเนา)และเครื่องคำนวณทุกชนิดเข้าห้องสอบได้

ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริต
และพักการศึกษา 1 ภาคการศึกษา

Question #	Total Score	Score
1	10	
2	10	
3	25	
4	20	
5	35	
Total	100	

ผศ.ดร. ชญานุช แสงวิเชียร

ผู้ออกข้อสอบ

ก่อนลงมือทำ...โปรดตรวจดูว่าข้อสอบมีทั้งหมด 9 หน้า (รวมปก)

1. (10 points) Explain what is the difference between ODE and PDE. Also give illustrations with your answer.

2. (10 points) Write down the Order and Degree for the following Differential Equations

Differential Equation	Order	Degree
$\frac{d^4 y}{dx^4} - k^4 y = 0$		
$\left(\frac{d^3 y}{dx^3}\right)^4 - 6x^2 \left(\frac{dy}{dx}\right)^8 + e^y = \sin xy$		
$k(y'')^2 = [1 + (y')^2]^3$		
$e^x dx + e^y dy = 0$		
$\frac{\partial^2 y}{\partial t^2} = a^2 \frac{\partial^2 y}{\partial x^2}$		

3. (25 points) Solve the following differential equations

(i) $x \frac{dy}{dx} + 3x^4 + 5y = 0; \quad y(1) = 0,$

(15 points)

(ii) $\frac{d^2y}{dx^2} - \frac{4}{x} \frac{dy}{dx} + \frac{6}{x^2} y = 0.$

(10 points)

4. (20 points) Solve the following equations

(i) Find $\Gamma(4.52)$ Using Gamma Function, $\Gamma(x) = \int_0^{\infty} e^{-t} t^{x-1} dt$ (10 points)

Table: Selected Values for Gamma Function ($x \in 1,2$)

x	0	1	2	3	4	5	6	7	8	9
1.0	1.000	.994	.989	.984	.978	.974	.969	.964	.960	.956
1.1	.951	.947	.944	.940	.936	.933	.930	.926	.924	.921
1.2	.918	.916	.913	.911	.909	.906	.904	.903	.901	.899
1.3	.898	.896	.895	.893	.892	.891	.890	.889	.889	.888
1.4	.887	.887	.886	.886	.886	.886	.886	.886	.886	.886
1.5	.886	.887	.887	.888	.888	.889	.890	.891	.891	.892
1.6	.894	.895	.896	.897	.899	.900	.902	.903	.905	.907
1.7	.909	.911	.913	.915	.917	.919	.921	.924	.926	.929
1.8	.931	.934	.937	.940	.943	.946	.949	.952	.955	.958
1.9	.962	.965	.969	.972	.972	.980	.984	.988	.992	.996
2.0	1.00									

(ii) Using Beta Function to find $B(x, y)$ when $x = 5$ and $y = 3$

(10 points)

5. (35 points) Consider the chemical reaction $P + Q \rightarrow X$, where the initial concentration of P and Q are the same $= c_0$. Let $x(t)$ denote the concentration of product X at time t .

For an initial concentration $x(0) = 0$, a model for $x(t)$ could be

$$\frac{dx}{dt} = \beta(c_0 - x)^2, \quad \text{with } x(0) = 0$$

- (a) Is the differential equation linear or nonlinear?
- (b) Solve the initial value problem for $x(t)$.
- (c) What is the behavior as $t \rightarrow \infty$? Does it make sense physically?
- (d) Suppose an experiment is done with initial concentrations $c_0 = 5 \text{ moles/m}^3$. After 100 seconds, a measurement shows the concentration of X is now 1 moles/m^3 . Find the rate of reaction β .