



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018**

COURSE NAME : ORDINARY DIFFERENTIAL EQUATIONS
COURSE CODE : BWC 10603
PROGRAMME CODE : BWC
EXAMINATION DATE : JUNE/JULY 2018
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Solve the following differential equations and initial value problem.

(i) $\frac{dy}{dx} = \frac{5x + 4y}{8y^3 - 4x}$.

(ii) $\frac{dy}{dx} + 2(x+1)y^2 = 0$ with $y(0) = -\frac{1}{8}$.

(12 marks)

(b) A cake is removed from an oven at 100°C and left to cool at room temperature, which is 24°C. After 30 minutes the temperature of the cake is 60°C. Determine the time taken to reach 40°C?

(8 marks)

Q2 (a) Find the general solution of the following differential equations.

(i) $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 6 + 5\sin x$.

(ii) $\frac{d^2y}{dx^2} - 10\frac{dy}{dx} + 25y = 6e^{5x}$.

(12 marks)

(b) A body with mass 250 g is attached to the end of a spring that is stretched 25 cm by a force of 9 N. At time $t = 0$ the body is pulled 1 m to the right, stretching the spring, and set in motion with an initial velocity of 5 m/s to the left. Obtain

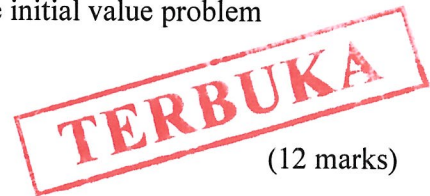
(i) $x(t)$ in the form of $C \cos(\omega_0 t - \alpha)$.

(ii) the amplitude and period of motion of the body.

(8 marks)

Q3 (a) Find a power series expansion for the solution of the initial value problem

$$\frac{dy}{dx} = x + y \quad \text{with} \quad y(0) = 1.$$



(12 marks)

(b) A series solution of a certain differential equation is given by

$$y(x) = c_0 \sum_{n=0}^{\infty} \frac{n+1}{3^n} x^n.$$

Find its radius of convergence. What does it mean by a statement “The series is converged.”?

(8 marks)

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Q4 For **Q4** please refer to **Table Q4**.

- (a) Calculate the Laplace transform of the function below by using the definition of the Laplace transform.

$$f(t) = t^2$$

(8 marks)

- (b) Use Laplace transform to solve the initial value problem

$$x'' - 6x' + 8x = 2 \quad \text{with} \quad x(0) = x'(0) = 0.$$

(12 marks)

Q5 Apply the eigenvalue method to obtain solutions for a given system of first order differential equations with initial values below.

$$y_1' = 2y_1 - 5y_2.$$

$$y_2' = 4y_1 - 2y_2.$$

$$y_1(0) = 2.$$

$$y_2(0) = 3.$$

(20 marks)

– END OF QUESTIONS –

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Table Q4: Laplace Transform

Definition $\mathcal{L}\{f(t)\} = \int_0^{\infty} f(t)e^{-st} dt = F(s)$			
$f(t)$	$F(s)$	$f(t)$	$F(s)$
a	$\frac{a}{s}$	$H(t-a)$	$\frac{e^{-as}}{s}$
e^{at}	$\frac{1}{s-a}$	$f(t-a)H(t-a)$	$e^{-as}F(s)$
$\sin at$	$\frac{a}{s^2+a^2}$	$\delta(t-a)$	e^{-as}
$\cos at$	$\frac{s}{s^2+a^2}$	$f(t)\delta(t-a)$	$e^{-as}f(a)$
$\sinh at$	$\frac{a}{s^2-a^2}$	$\int_0^t f(u)g(t-u) du$	$F(s) \cdot G(s)$
$\cosh at$	$\frac{s}{s^2-a^2}$	$y(t)$	$Y(s)$
$t^n, n = 1, 2, 3, \dots$	$\frac{n!}{s^{n+1}}$	$y'(t)$	$sY(s) - y(0)$
$e^{at}f(t)$	$F(s-a)$	$y''(t)$	$s^2Y(s) - sy(0) - y'(0)$
$t^n f(t), n = 1, 2, 3, \dots$	$(-1)^n \frac{d^n}{ds^n} F(s)$		

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