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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	ENGINEERING TECHNOLOGY MATHEMATICS II
COURSE CODE	:	BDU 11003
PROGRAMME	:	1 BDU
EXAMINATION DATE	:	JUNE/JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **SECTION A** B) ANSWER **TWO** QUESTIONS ONLY IN **SECTION B**

THIS QUESTION PAPER CONSISTS **OF SIX (6) PAGES**

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SECTION A

Q1 (a) Obtain the particular solution for the differential equation

$$q\frac{dp}{dq} - 3 = 2\left((p + \frac{dp}{dq}\right),$$

which satisfies the initial condition $p(3) = 0$.

(5 marks)

(b) Find the particular solution for the differential equation

$$2\ddot{U} - 2\dot{U} + U = 0, \qquad U(0) = 1, \dot{U}(0) = 1.$$

(5 marks)

(c) A metal object is heated to 200°C and then placed in a large room to cool. The temperature of the room is held constant at 20°C. After 10 min, the object's temperature is 100°C. How long will it take the object to cool to 25°C?

(5 marks)

(d) For population of about 100,000 bacteria in a petri dish, we decide to model population growth by the differential equation

$$\frac{dP}{dt} = kP.$$

Suppose, 2 days later, that the population has grown to about 150,000 bacteria. Find the growth rate k and estimate the bacteria population after 7 days.

(5 marks)

Q2 (a) The motion of a particle satisfies the equation

$$\frac{d^2x}{dt^2} + 2\gamma\frac{dx}{dt} + 169x = 0, \qquad \gamma > 0,$$

which satisfies the initial conditions $x(0) = 0$ and $\dot{x}(0) = 8$.

(i) Find the value of γ such that its characteristic equation has equal real roots and determine x in term of t.

(ii) If $\gamma = 12$, find x in term of t.

(iii) If $\gamma = 14$, find x in term of t.

(10 marks)

(b) Find the solution of the differential equation by using variation of parameters technique

$$\ddot{V} + 4\dot{V} + 3V = te^{-t},$$

which satisfies the conditions $V(0) = 0$ and $\dot{V}(0) = 1$.

(10 marks)

Q3 (a). Find the Laplace transforms of the following functions.

(i) $f(t) = 5t^3 + 6t$.

(4 marks)

(ii) $f(t) = (t + 1)^3$.

(4 marks)

(b). Find the inverse Laplace transforms of the following expressions.

(i) $\frac{s+3}{4s^2+9}$.

(6 marks)

(ii) $\frac{3s+5}{16s^2-9}$.

(6 marks)

SECTION B

Q4 By using Laplace transform, solve the initial value problems

(a). $y' + y = \cos t, \quad y(0) = 0.$

(10 marks)

(b). $\ddot{p} + 4p = e^{-t}, \; p(0) = 2, \; \dot{p}(0) = 1.$

(10 marks)

Q5 (a). A periodic function $f(x)$ is defined by

$$f(x) = \begin{cases} 1, & -1 < x < 0, \\ 3, & 0 < x < 1, \end{cases}$$

and

$$f(x) = f(x+2).$$

(i) Sketch the graph of the function over $-3 < x < 3$.

(3 marks)

(ii) Find the Fourier coefficients corresponding to the function.

(10 marks)

(b). Sketch the graph of the following function and find the Laplace transforms.

$$g(t) = e^t, \; 0 \le t < 1,$$

$$g(t) = g(t+1).$$

(7 marks)

Q6 (a) Use the method of separation of variables to solve the following initial-boundary value problem

PDE: $$\frac{\partial u}{\partial t} = 3\frac{\partial^2 u}{\partial x^2}$$

Boundary conditions: $u(0,t) = u(\pi,t) = 0, \quad (t > 0),$

Initial conditions: $u(x,0) = x(\pi - x), (0 < x < \pi).$

(10 marks)

(b) By using undetermined coefficients technique, find the solution of the differential equation

$$\ddot{y} - 2\dot{y} + y = 2x^2 - 1, \quad y(0) = 1 \text{ and } \dot{y}(0) = 2.$$

(10 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION : SEM 2/2014/2015 PROGRAMME : 1 BDD
COURSE NAME : ENG. TECH. MATH. 2 COURSE CODE: BDU11003

Formulae

$f(x)$	$y_p(x)$
$P_n = A_n x^n + A_{n-1}x^{n-1} + \cdots + A_0$	$x^r(B_n x^n + B_{n-1}x^{n-1} + \cdots + B_0)$
$Ce^{\lambda x}$	$x^r(Ke^{\lambda x})$
$C\cos\omega x$ or $D\sin\omega x$ $C\cos\omega x + D\sin\omega x$	$x^r(k\cos\omega x + l\sin\omega x)$
$W = \begin{vmatrix} y_1 & y_2 \\ y'_1 & y'_2 \end{vmatrix}, u = -\int \frac{y_2 f(x)}{aW}dx = A$	$v = \int \frac{y_1 f(x)}{aW}dx + B$
$u(x,t) = \sum_{n=1}^{\infty} D_n \sin\left(\frac{n\pi x}{l}\right) e^{-\frac{n^2\pi^2k^2t}{l^2}}$	$D_n = \frac{2}{l}\int_0^l f(x)\sin\left(\frac{n\pi x}{l}\right)dx,\ n = 1,2,3,\ldots$

$f(t)$	$F(s)$	**Condition on s**
a	a/s	$s > 0$
$t^n, n = 0,1,2,\ldots$	$n!/s^{n+1}$	$s > 0$
e^{at}	$\frac{1}{s-a}$	$s > 0$
$\sin at$	$\frac{a}{s^2+a^2}$	$s > 0$
$\cos at$	$\frac{s}{s^2+a^2}$	$s > 0$
$\sinh at$	$\frac{a}{s^2-a^2}$	$s > \|a\|$
$\cosh at$	$\frac{s}{s^2-a^2}$	$s > \|a\|$