UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	ENGINEERING MATHEMATICS II
COURSE CODE	:	BWM10203/BSM1923
PROGRAMME	:	4BFF/ 4BDD/ 3BFF/ 3BDD
EXAMINATION DATE	:	DECEMBER 2013/ JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Find the general solution of differential equation

$$\frac{d^2y}{dx^2}+5\frac{dy}{dx}+4y=0; \quad y(0)=1, y'(0)=1.$$

(10 marks)

(b) A simple electrical circuit consists of electric current i (an amperes), resistance R (in ohms), inductance L (in henry), capacitance C (in farads), and electromotive force $E(t)$ (in volts). According to Kirchhoff's Second Law, the current i satisfies the differential equation

$$L\frac{d^2q}{dt^2}+R\frac{dq}{dt}+\frac{1}{C}q=E(t)$$

where q is the charge (in coulombs), and R, L, and C are assumed constants and that $i=\frac{dq}{dt}$ and $\frac{di}{dt}=\frac{d^2q}{dt^2}$.

Given that $R = 10$, $L = 0.5$, $C = 0.01$, $E(t) = 150$, and the initial condition $q = 1$, and $i = 0$ when $t = 0$. Find i and q and describe i and q when $t \to \infty$.

(15 marks)

Q2 (a) Find the Laplace transform of $f(t)=4e^{5t}-10\sin(2t)$

(5 marks)

(b) Evaluate $\ell^{-1}\left\{\frac{s^2+6s+9}{(s-1)(s^2+2s-8)}\right\}$

(10 marks)

(c) Use Laplace transforms to solve the initial value problem

$$y''+5y'+4y=0; \qquad y(0)=1, y'(0)=0.$$

(10 marks)

Q3 The driven spring/mass system with damping could be represented by the differential equation

$$m\frac{d^2x}{dt^2}+\beta\frac{dx}{dt}+kx=f(t); \qquad x(0)=0, x'(0)=0.$$

where the driving function f is the square wave and given in the Fig. Q3(b) with amplitude 5, and $a = \pi$, $0 \le t \le 4\pi$.

(a) Express f in a frequency domain.

(5 marks)

(b) By using the Laplace transform, solve the model for $m = 1$, $\beta = 2$, $k = 1$ and f is the square wave above.

(20 marks)

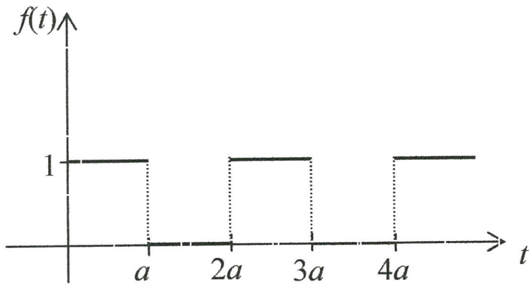

FIGURE. Q3(b)

Q5 A periodic function f is defined by

$$f(x)=\begin{cases}0, & -\pi<x<0\\ x^2, & 0\le x<\pi\end{cases}$$

and

$$f(x)=f(x+2\pi)$$

(a) Sketch the graph of the function over $-3\pi < x < 3\pi$.

(4 marks)

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

(17 marks)

(c) Write the corresponding Fourier series.

(4 marks)

Q6 (a) A rod of length L coincides with the interval [0, L] on the x-axis. Set up the boundary-value problem for the temperature $u(x,t)$, if the left end is held at temperature zero, and the right end is insulated. The initial temperature is $f(x)$ throughout.

(4 marks)

(b) Solve the following initial-boundary value problem by the method of separation of variables

$$\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}, \qquad 0 < x < \pi, \qquad t > 0,$$

$$u(0,t) = 0, \qquad \frac{\partial^2 u(\pi,t)}{\partial x^2} = 0, \quad t > 0,$$

$$u(x,0) = x, \qquad 0 < x < \pi.$$

(21 marks)

- END OF QUESTION -