Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	MATHEMATICAL PHYSICS
COURSE CODE	:	BWC 20103
PROGRAMME	:	2 BWC
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS. B) ALL CALCULATIONS AND ANSWERS MUST BE IN **THREE (3)** DECIMAL PLACES.

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

Q1 (a) Define the Stokes' Theorem in written and integration form.

(5 marks)

(b) Sketch σ, a portion of paraboloid $z = 16 - x^2 - y^2$ where $z \geq 0$, oriented outward and sketch C, the boundary of σ in the $xy-$plane.

(5 marks)

(c) Using the answers from **Q1(a)** and **Q1(b)**, calculate both side of the integral in the Stokes' Theorem if $F(x, y, z) = 4z\hat{i} + 3x\hat{j} + 5y\hat{k}$.

(8 marks)

(d) Verify the Stokes' Theorem in **Q1(c).**

(2 marks)

Q2 (a) What is a complex number? Show the graphical representation of complex number.

(5 marks)

(b) Compute $(1+i)^5$. Give your answer in the Argand diagram.

(5 marks)

(c) The voltage in a circuit is $30+10\hat{j}$ V. The impedance is $5+3\hat{j}\,\Omega$.. What is the current? Why do you use $\hat{j}$ instead of $\hat{i}$?

(4 marks)

(d) The voltage in a circuit is $4+3\hat{j}$ V. The frequency is 200Hz. Transform the complex number into polar coordinates.

(6 marks)

Q3 Syarikat Dinamik Satria wishes to produce three types of bridge screws: types A, B and C. During manufacturing process, a type-A screw requires 2 minutes on machine I, 1 minute on machine II and 2 minutes on machine III. A type-B screw requires 1 minute on machine I, 3 minutes on machine II and 1 minute on machine III. A type-C screw requires 1 minute on machine I and 2 minutes each on machine II and III. There are 3 hours available on machine I, 5 hours available on machine II and 4 hours available on machine II for processing the order.

(a) Based on the above problem, construct a system of linear equations. (10 marks)

(b) Hence, by using appropriate method from Gauss Elimination, Doolittle or Gauss Seidel Iteration, determine the number of each type Syarikat Dinamik Satria should make in order to use all of the available time. (10 marks)

Q4 (a) Represent Fourier series in the form a series of sines and cosines. (2 marks)

(b) Represent the function $f(x)=x$ for $-\pi<x<\pi$, in the form of a Fourier series. (8 marks)

(c) Represent **Q4(b)** in the form of a complex Fourier series. (8 marks)

(d) Hence, show that $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\frac{1}{9}-\ldots=\frac{\pi}{4}$ (2 marks)

Q5 A uniform string of length π is fastened at both of its ends $x = 0$ and $x = \pi$. The string is oscillating with initial velocity given as $\frac{\delta u}{\delta t}(x,0) = g(x) = 0$ and the initial state of the string is given by $u(x,0) = f(x) = 2 + x, \quad 0 < x < \pi$.

This is a wave problem given by,

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

The series solution of this problem is,

$$u(x,t) = \sum_{n=1}^{\infty} \left\{ a_n \cos\left(\frac{n\pi ct}{l}\right) + b_n \sin\left(\frac{n\pi ct}{l}\right) \right\} \sin\left(\frac{n\pi x}{l}\right)$$

(a) Write

(i) the value of the physical constant c,

(2 marks)

(ii) the initial conditions,

(3 marks)

(iii) the boundary conditions of the given problem.

(3 marks)

(b) By using

$$a_n = \frac{2}{\pi} \int_0^{\pi} f(x) \sin(nx)\, dx, \text{ and } b_n = \frac{2}{n\pi c} \int_0^{\pi} g(x) \sin(nx)\, dx$$

determine a_n and b_n.

(10 marks)

(c) Hence, write the particular solution $u(x,t)$.

(2 marks)

- END OF QUESTION -