CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	MATHEMATICAL PHYSICS
COURSE CODE	:	BWC 20103
PROGRAMME CODE	:	BWC
EXAMINATION DATE	:	JANUARY/FEBRUARY 2022
DURATION	:	4 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS A **TAKE HOME ASSESSMENT** AND CONDUCTED VIA **OPEN BOOK**

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

CONFIDENTIAL

Q1 (a) Find the first order partial derivative in terms of x and y of the function

$$f(x,y,z) = xy^2z^3 + e^{\sin(x^3y^2z)}x^2 - y^3 + z - 7$$

(5 marks)

(b) Hannah Delisha received a square based gift box without a lid. If 90 cm^2 of material is used, determine the maximum possible volume of the box.

(5 marks)

(c) Determine the local extreme value of the function

$$f(x,y) = 2x^2 - y^3 - 2xy + 4$$

(10 marks)

Q2 (a) A curve C has a polar equation of

$$r = \tan\theta, 0 \le \theta \le \frac{\pi}{2}$$

Find a Cartesian equation of C in the form $y = f(x)$.

(4 marks)

(b) Calculate the surface area of the portion of the plane $z = 2 - x - y$ that lies above the circle $x^2 + y^2 \le 1$ in the first octant.

(7 marks)

(c) Express an iterated integrals of $\iint_R (x+y)dA$, where R is the region bounded by

$$y = x^2, y = -x \text{ and } x = 2$$

(3 marks)

(d) Given

Cylinder: $x^2 + y^2 = 1$
Sphere: $x^2 + y^2 + z^2 = 16$

Determine the total volume of the cylinder and sphere that occupied in the space by using

$$\iiint x^2 \ dV$$

(6 marks)

Q3 (a) What is a complex number?

(2 marks)

(b) Compute $\sqrt[3]{(3-7i}$ and give the answer in the argand diagram.

(6 marks)

(c) Approximate the value of $f(12)$ using Newton's divided-difference method for a set of data given in Table **Q3(c)**

Table **Q3(c)**

x	0	10	20	30	40
$f(x)$	7	18	32	48	85

(6 marks)

(d) Calculate the R-squared, R^2 from the data of Table **Q3(c).**

(6 marks)

Q4 (a) A small factory produces three types of product called product A, B and C. Each product needs to undergo three different processes–as shown in Table **Q4(a).** The cutting, assembly, and packaging departments have maximum of 380, 330, and 120 labour-hours per week, respectively. Determine how many products of each type must be produced per week for the factory to operate at full capacity.

Table **Q4(a)**

	Product A (hours)	Product B (hours)	Product C (hours)
Cutting	0.5	1.0	1.5
Assembly	0.6	0.9	1.2
Packaging	0.2	0.3	0.5

(10 marks)

(b) A matrix A is given as

$$A = \begin{bmatrix} 3 & 0 & 0 \\ 1 & 1 & 1 \\ 4 & -1 & 3 \end{bmatrix}$$

(i) Show that A has only **TWO (2)** eigenvalues.

(4 marks)

(ii) Calculate the eigenvectors correspond to each eigenvalue.

(6 marks)

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

$$f(x)=\begin{cases}1-x, & 0<x<1,\\ 0, & 1<x<2.\end{cases}$$

(i) Sketch the graph of function $f(x)$ over $-6<x<6$.

(4 marks)

(ii) Determine the Fourier series of function $f(x)$.

(6 marks)

(b) (i) Show that the Laplace transform $L\left\{\frac{1}{2}\sin 2t - t\cos 2t\right\} = \frac{8}{(s^2+4)^2}$.

(4 marks)

(ii) Use the Laplace transform to solve the Initial Value Problem (IVP),

$$y'' - 3y' + 2y = e^{3t},\ y(0)=1,\ y'(0)=5.$$

(6 marks)

- END OF QUESTIONS -