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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ENGINEERING TECHNOLOGY MATHEMATICS III
COURSE CODE	:	BWM 22003
PROGRAMME	:	2BDC / 2BDM
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. ALL CALCULATIONS AND ANSWERS MUST BE IN **THREE (3)** DECIMAL PLACES.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a) Evaluate $\int_1^1 \int_0^2 \int_0^x x^2 \, dydxdz$.

(3 marks)

(b) Use the cylindrical coordinate to evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} \int_0^{\sqrt{4-x^2-y^2}} z \, dzdxdy$.

(7 marks)

(c) Use the spherical coordinate to find the volume of a solid G which lies above the cone $z = \sqrt{x^2 + y^2}$ and below the sphere $x^2 + y^2 + z^2 = 9$.

(10 marks)

For Q2-Q5 please iterate until the stopping criteria has error, $\varepsilon < 0.005$.

Q2 (a) An airfoil has non-uniform thickness. The thickness varies between the leading and trailing edges, $0 \le x \le 1$, following the equation

$$T = 3.1\sqrt{x} - 1.3x - 3.6x^2 + 2.7x^3 - x^4.$$

Given the thickness is a maximum at $\frac{dT}{dx} = 0$. Find the location x where the thickness is maximum using bisection method.

Hint: Let $\frac{dT}{dx} = f(x)$ and the initial values, $x_0 = 0.2$ and $x_1 = 0.4$.

(13 marks)

(b) Solve **Q2(a)** by using Newton-Raphson method.

(7 marks)

Q3 (a) Find the smallest eigenvalue for the matrix $A = \begin{pmatrix} 3 & 4 & 1 \\ 4 & 3 & 0 \\ 1 & 4 & 3 \end{pmatrix}$ by using Shifted Power method with initial eigenvector, $v^{(0)} = \begin{pmatrix} 1 & 1 & 1 \end{pmatrix}^T$.

(13 marks)

(b) Solve **Q3(a)** by using Inverse Power method.

(7 marks)

Q4 (a) A mixture company has three sizes of packs of nuts. The *Large* size contains 2 kg of walnuts, 2 kg of peanuts and 1 kg of cashews. The *Mammoth* size contains 3 kg of walnuts, 6 kg of peanuts and 2 kg of cashews. The *Giant* size contains 1 kg of walnuts, 4 kg of peanuts and 2 kg of cashews. Suppose that the company receives an order for 14 kg of walnuts, 26 kg of peanuts and 12 kg of cashews.

(i) By taking *a, b* and *c* represent *Large*, *Mammoth* and *Giant* size, obtain the system of linear equations for this company.

(ii) By using Gauss elimination method, determine how this company can fill this order with the given sizes of packs.

(10 marks)

(b) Suppose that the mixture company above is planning to expand their mixing productions. Their planning can be summarized as **Table Q4(b)** below:

	Walnuts	Peanuts	Cashews	Almond
Large	10	4	2	2
Mammoth	1	5	11	1
Giant	4	14	2	1
Small	3	3	2	9

Table Q4(b)

If the company receives a new order for 13 kg of walnuts, 34 kg of peanuts, 15 kg of cashews and 28 kg of almond, determine the possible solutions of the system by using Gauss-Seidel iteration method.

(10 marks)

Q5 A certain lab experiment produced the following data shown in **Table Q5.**

x	$y(x)$
0	-100
20	280
40	1460
60	3440
80	6220

Table Q5

Predict $y(x)$, when $x = 70$ by using

(a) Lagrange polynomial interpolation and

(b) Newton divided-difference interpolation.

(20 marks)

- END OF QUESTION -

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Cylindrical coordinates $\iiint_G f(x,y,z)dV = \int_{\theta=\theta_0}^{\theta=\theta_1}\int_{r=r_0}^{r=r_1}\int_{z=z_0}^{z=z_1} f(r,\theta,z)\,dz\,r\,dr\,d\theta$

Spherical coordinates $\iiint_G f(x,y,z)dV = \int_{\theta=\theta_0}^{\theta=\theta_1}\int_{\phi=\phi_0}^{\phi=\phi_1}\int_{\rho=\rho_0}^{\rho=\rho_1} f(\rho,\phi,\theta)\rho^2 \sin\phi\, d\rho\, d\phi\, d\theta$

Bisection method for nonlinear equations: $c_i = \dfrac{a_i + b_i}{2}$

Newton-Raphson method: $x_{i+1} = x_i - \dfrac{f(x_i)}{f'(x_i)}$

Gauss-Seidel iteration $x_i^{(k+1)} = \dfrac{b_i - \sum_{j=1}^{i-1} a_{ij}x_j^{(k+1)} - \sum_{j=i+1}^{n} a_{ij}x_j^{(k)}}{a_{ii}}, i = 1,2,\ldots,n$

Lagrange polynomial:

$P_n(x) = \sum_{i=0}^{n} L_i(x) f(x_i), i = 0,1,2,\ldots,n$ where $L_i(x) = \prod_{\substack{j=0 \\ j\neq i}}^{n} \dfrac{(x-x_j)}{(x_i-x_j)}$

Newton's divided difference method

$$P_n(x) = f_0^{[0]} + f_0^{[1]}(x-x_0) + f_0^{2}(x-x_0)(x-x_1) + \ldots$$
$$f_0^{[n]}(x-x_0)(x-x_1)\ldots(x-x_{n-1})$$

Power Method for eigenvalue: $v^{(k+1)} = \dfrac{1}{m_{k+1}} A v^{(k)}, \quad k = 0,1,2,\ldots..$