UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	ENGINEERING TECHNOLOGY MATHEMATICS III
COURSE CODE	:	BWM 22003
PROGRAMME	:	2BDC / 2BDM
EXAMINATION DATE	:	DECEMBER 2012 / JANUARY 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 **FOUR (4)** PAGES

Q1 **(a)** Evaluate $\int_{-1}^{1}\int_{0}^{2}\int_{0}^{x} x^2 \, dydxdz.$

(5 marks)

(b) Use the cylindrical coordinate to evaluate $\int_{0}^{1}\int_{0}^{\sqrt{1-y^2}}\int_{0}^{\sqrt{4-x^2-y^2}} z \, dzdxdy.$

(8 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 $x^2+y^2+z^2=9.$

(12 marks)

Q2 **(a)** Sketch the graph of $f(x,y)=4-x^2-y^2.$

(5 marks)

(b) Given that $z=e^{xy}, \quad x=u+v, \quad y=\frac{u}{v}.$

Find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ using the chain rule.

(10 marks)

(c) Find the surface area of the portion of the paraboloid $z=x^2+y^2$ below the plane $z=2.$

(10 marks)

Q3 **(a)** An airfoil has non-uniform thickness. The thickness varies between the leading and trailing 'ges, $0 \le x \le 1$, 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 secant 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 the following system of equations by using Gauss-Seidel iteration.

$$\begin{aligned} x + 2y + 4z &= 360 \\ 2x + 6x + 3z &= 660 \\ 4x + 2y + z &= 600 \end{aligned}$$

(12 marks)

Q4 **(a)** Using Newton's divided difference method, find the value of y corresponding to $x = 10$ for the following table:

x	5	6	9	11
$y = f(x)$	12	13	14	16

(12 marks)

(b) Find the smallest eigenvalue for the matrix $A = \begin{bmatrix} 4 & 2 & 1 \\ 2 & 4 & 1 \\ 0 & 1 & 4 \end{bmatrix}$ by using Inverse Power method with initial eigenvector, $v^{(0)} = (0 \quad 1 \quad 0)^T$.

(13 marks)

- END OF QUESTION -

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Surface Area $\iint_R \sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1} \quad dA$

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

Secant method for nonlinear equations $x_{i+2} = \dfrac{x_i f(x_{i+1}) - x_{i+1} f(x_i)}{f(x_{i+1}) - f(x_i)}$

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

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: $v^{(k+1)} = \dfrac{1}{m_{k+1}} A v^{(k)}, \qquad k = 0,1,2,.....$