TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSISCS

DIPLOMA IN ELECTRICAL POWER ENGINEERING
DIPLOMA IN TELECOMMUNICAITON & INFORMATION
DIPLOMA IN INSTRUMENTATION & CONTROL ENGINEERING

AMA 2351: ENGINEERING MATHEMATICS VI

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Mathematical Table/Scientific Calculator*
- *Drawing Instruments*

This paper consist of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Given the scalar field $\Phi(x, y, z) = x^2 yz^2 + 4xyz$ Find:

(i) The unit vector normal to $\Phi(1,0,1)$ **(4 marks)**

(ii) The directional deviation of Φ in the direction of the vector $2\underset{\sim}{i} + \underset{\sim}{j} - \underset{\sim}{k}$ at the point (1, 0, 1) **(3 marks)**

(iii) The direction of maximum increase of Φ **(4 marks)**

(6 marks)

b) Determine the Eigen value and corresponding Eigen vectors of the matrix $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ **(8 marks)**

c) Use triple integral to determine the volume of the solid bounded by the surface z = 0, z = x + 2, y = x^2 and y = 2x + 3 **(8 marks)**

d) Show that $\int_0^{\pi/4} \int_0^{\tan\theta \sec\theta} r^3 \cos^2\theta \, dr \, d\theta = 1/20$ **(4 marks)**

Question Two

a) Determine the value of P such that the three vectors are coplanar when:
$A = \underset{\sim}{i} - \underset{\sim}{j} + 3\underset{\sim}{k} \quad B = \underset{\sim}{i} + 2\underset{\sim}{j} - 3\underset{\sim}{k}, \quad C = 3\underset{\sim}{i} + p\underset{\sim}{j} + \underset{\sim}{k}$ **(3 marks)**

b) Given that $A = n\underset{\sim}{i} + \underset{\sim}{j} - \underset{\sim}{k}$ and $B = 2\underset{\sim}{i} + \underset{\sim}{j} - \underset{\sim}{k}$ find n so that the angle between A and B is 2π **(7 marks)**

c) If $A = x^2 y\underset{\sim}{i} + (xy + yz)\underset{\sim}{j} + xz^2\underset{\sim}{k}, \quad B = 2yz\underset{\sim}{i} - 4xz\underset{\sim}{j} + 3xy\underset{\sim}{k}$ and $\phi = 3x^2 y + 2xyz - 6y^2 z^2 - 4$.
Determine at the point (2, 1, 0)

(i) grad Φ (2 marks)
(ii) Div A **(3 marks)**
(iii) Div B **(2 marks)**
(iv) Curl B **(3 marks)**

Question Three

$$A = \begin{bmatrix} 2 & 1 & 0 \\ -1 & 3 & b \\ 0 & b & c \end{bmatrix}$$

$[1\ 0\ 1]^{-1}$

a) Given that is an Eigen vector of the matrix
Find:

a) The value of c and b **(10 marks)**

b) Eigen values and corresponding Eigen vectors of A **(10 marks)**

Question Four

$$\oint (x^2 + y^2)dx + (x + 2y)dy$$

a) Using Green's theorem, evaluate taken round the boundary curve C defined by:

$y = 0 \qquad 0 \le x \le 2$

$x^2 + y^2 = 4 \quad 0 \le x \le 2$

$x = 0 \qquad 0 \le y \le 2$

$\underset{\sim}{a} = -3\underset{\sim}{i} + 7\underset{\sim}{j} + 5\underset{\sim}{k},\ \underset{\sim}{b} = -3\underset{\sim}{i} + 7\underset{\sim}{j} - 3\underset{\sim}{k}$

b) (i) Determine the volume of a parallel pied if and

$c = 7\underset{\sim}{i} - 5\underset{\sim}{j} - 3\underset{\sim}{k}$

(3 marks)

$\underset{\sim}{A} = 2\underset{\sim}{i} + \underset{\sim}{j} - \underset{\sim}{k},\ \ \underset{\sim}{B} = \underset{\sim}{i} - \underset{\sim}{j} + 2\underset{\sim}{k}$

(ii) Find a unit vector perpendicular to both of the vectors

(4 marks)

Question Five

$$\int_0^1 \int_{-1}^{2x} \int_0^{y+1} dz\ dy\ dx$$

a) Evaluate the triple integral **(7 marks)**

b) Use double integral to find the volume of the solid bounded by the surface z = 4 – x2 – y2 and the planes x = 0, x = 1, y = 0, y = -x + 1 **(9 marks)**

$0\underset{\sim}{A}\ \underset{\sim}{O}\ \underset{\sim}{B} \qquad 0\underset{\sim}{C}$

c) Find the volume of a parrallopiped whose edges are and where A(1, 2, 3), B(1, 1, 2) C (2, 1, 1) **(3 marks)**