TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN MARINE ENGINEERING (DMAE 6)

EMR 2311: ENGINEERING MATHEMATICS VI

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consist of **FOUR** 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) (i) Given $\underset{\sim}{A} = 2i + 2j - k$ and $\underset{\sim}{B} = 3i - 6j + 2k$ determine the direction cosines of $\underset{\sim}{A}$ and $\underset{\sim}{B}$, and hence the angle between them **(6 marks)**

(ii) Given $\underset{\sim}{A} = i + 3j - 2k,\ \underset{\sim}{B} = 2i - j + 2k$ and $\underset{\sim}{C} = pi + j - k$ and $\underset{\sim}{A}, \underset{\sim}{B}$ *and* $\underset{\sim}{C}$ are coplanar determine the value of P. **(4 marks)**

b) (i) Evaluate the integral:

$$\int_{-1}^{2}\int_{-3}^{3}\left(y^2 - 2xy\right)dx\ dy$$

(4 marks)

(ii) Use double integrals to determine the area bounded by the curve $y = x^2$ and the $y = 2x + 3$ **(8 marks)**

c) Use determinants to solve the following simultaneous equations:

$$2x + 3y - z - 4 = 0$$
$$3x + y + 2z - 13 = 0$$
$$x + 2y - 5z + 11 = 0$$

(9 marks)

Question Two

a) If $\underset{\sim}{F} = \underset{\sim}{A} \times \left(\underset{\sim}{B} \times \underset{\sim}{C}\right)$ where $\underset{\sim}{A} = 3t^2 i + \left(2t - 3\right)j + 4tk$ and $\underset{\sim}{B} = 2i + 4tj + \left(3 - 3t\right)k$ $\underset{\sim}{C} = 2ti - 3t^2 j - 2tk$

determine $\int_0^1 \underset{\sim}{F}\,dt$ **(7 marks)**

b) Given $\phi = xy^2 + yz^2 - x^2$ and $\underset{\sim}{A} = x^2 yzi + xy^3 j - 3y^2 z^3 k$, determine at point (1, +2, -1):

ϕ

(i) Grad
(ii) Unit normal vector
(iii) Div A
(iv) Curl A **(13 marks)**

Question Three

a) Evaluate the following integrals:

(i) $\int_0^2 \int_0^{\pi/2} 5\cos\theta \cdot d\theta \; dx$

(ii) $\int_1^2 \int_2^4 (x+2y) \; dx \; dy$

(iii) $\int_0^1 \int_0^1 \int_0^x (x-2y+z) dz \, dy \, dx$ **(13 marks)**

b) Evaluate $\iint (x^2+y^2) dy dx$ over the region in the positive quadrant for which $x+y \le 1$ **(7 marks)**

Question Four

a) Determine the value of x which satisfy the following equation.

$$\begin{vmatrix} x & x+3 & x+2 \\ 3 & -3 & -1 \\ 2 & -2 & -2 \end{vmatrix} = 0$$

(3 marks)

b) Solve the following simultaneous using inverse matrix.

$$2x + y + z = 6$$
$$x + 2y + 3z = 6.5$$
$$4x - 2y - 5z = 2$$

(17 marks)

Question Five

a) If $\underset{\sim}{V} = xy^2 i + 2x^2 y^2 j - 3yz^2 k$ determine curl $\underset{\sim}{V}$ at point (1, -1, -1) **(8 marks)**

b) (i) Evaluate $\int_1^2 \int_0^3 x^2 y \; dx \; dy$ **(4 marks)**

(ii) Use double integral to determine the area enclosed by the polar curve $r = 4(1+\cos\theta)$ and the radius vector at $\theta = 0$ and $\theta = \pi$ **(8 marks)**