TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSISCS

DIPLOMA IN MECHANICAL ENGINEERING (DMEN VI)

AMA 2351: ENGINEERING MATHEMATICS VI

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Mathematical Table*

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

b) (i) Evaluate the integral:

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

(4 marks)

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

c) A machine produces 20% defectives components. In a sample of 6 drawn at random, determine he probability:

(i) There will be 4 defective items
(ii) There will not be more than 3 defective items **(8 marks)**

Question Two

a) Given

$$\underset{\sim}{A} = 3t^2 i + (2t - 3)j + 4tk$$

$$\underset{\sim}{B} = 2i + 4tj + (3 - 3t)k$$

$$\underset{\sim}{C} = 2ti - 3t^2 j - 2tk$$

$$\underset{\sim}{A}\times\left(\underset{\sim}{B}\times\underset{\sim}{C}\right) = \left(\underset{\sim}{A}\cdot\underset{\sim}{C}\right)\underset{\sim}{B} - \left(\underset{\sim}{A}\cdot\underset{\sim}{B}\right)\underset{\sim}{C}$$

and determine $\int_0^1 \underset{\sim}{F}\,dt$ where $\underset{\sim}{F} = \underset{\sim}{A}\times\left(\underset{\sim}{B}\times\underset{\sim}{C}\right)$ **(7 marks)**

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

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

Question Three

a) Evaluate the following integrals:

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

(ii) $\int_1^2 \int_2^4 (x+2y)dxdy$

(iii) $\int_0^1 \int_0^1 \int_0^x (x-2y+z)dzdydx$ **(13 marks)**

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

Question Four

a) The mean diameter of a sample of 400, rollers is 22-50mm and the standard deviation is 0.50cm. Rollers are acceptable within diameters $22.36 \pm 0.53mm$. Determine the probability of a roller being within the acceptable limits. **(6 marks)**

b) If 2% of components produced by a company are defective, determine the probability that a sample of 60 components:
   (i) Not more than 3 components are defective
   (ii) At least 2 components are defective **(8 marks)**

c) A quality control Engineer in charge of testing whether or not 90% of the DVD players produced by his company conform to specifications. To do this, the Engineer randomly selects a batch of twelve DVD players from each day's production. The day's production is acceptable provided not more than one DVD player fails to meet specification. Determine the probability:
   (i) The Engineer incorrectly passes a day's production as acceptable if only 80% of the days DVD actually conform to specification
   (ii) The Engineer unnecessarily requires the entire day's production to be tested if in fact 90% of the DVD players conform to specification. **(6 marks)**

Question Five

a) (i) If $Q = xyz - 2y^2z + x^2z^2$, determine $div(grad\phi)$ at point (2, 4, 1) **(5 marks)**

(ii) If $\underset{\sim}{F} = x^2yzi + xyz^2j + y^2z$, determine curl F at point (2, 1, 1) **(7 marks)**

b) Evaluate $\iiint_R (x+y+)zdxdydz$ where R is bounded by $0 \le x \le 1,\ 1 \le y \le 2,\ 2 \le z \le 3$ **(8 marks)**