TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN MARINE ENGINEERING (DMAE 4)

EMR 2214: ENGINEERING MATHEMATICS IV

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

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
-   *Answer Booklet*
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) Determine $\dfrac{dy}{dx}$ of the following:

(i) $y = \dfrac{z}{x} - \dfrac{1}{2\sqrt{x}}$ **(2 marks)**

(ii) $y = \dfrac{1}{\sqrt{x^2 - 6x}}$ **(2 marks)**

(iii) $y = e^{\sin 2x}$ **(2 marks)**

(iv) $y = \cos^4 6x$ **(2 marks)**

b) (i) Integrate $\int \sin \dfrac{2x}{3}\, dx$ **(3 marks)**

(ii) Evaluate the following integral $\int_0^1 x e^x\, dx$ **(3 marks)**

(iii) Integrate the following $\int \dfrac{1}{x(x+1)}\, dx$ **(4 marks)**

c) (i) Given $z = e^{-y} \sin x$ show that $\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial^2 z}{\partial y^2} = 0$ **(5 marks)**

(ii) If $z = \dfrac{x-y}{x+y}$ determine $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$ **(4 marks)**

d) In a company manufacturing parts of an equipment, 94% produced are defective. Determine the probability that a sample of 4 parts contain 2 defectives ones. **(3 marks)**

Question Two

a) Calculate the slope of the tangent to the curve $2y^3 + xy - x^4 + y^2 = 0$ at (1, 1) **(5 marks)**

b) Determine and distinguish the turning points of the curve $y = x^3 - 12x + 5$ **(7 marks)**

c) A rectangular box having a square base and open top contain 108 cubic metres. Determine the dimension so that the material to make it will be a minimum **(8 marks)**

Question Three

a) Integrate
$$\int x \sec^2 x \, dx$$
(3 marks)

b) Evaluate the following integral
$$\int_0^2 e^{-2x} dx$$
(4 marks)

c) For the region enclosed by the curve $y = 4x^2 - x^2$ and x-axis determine:
   (i) The area of the enclosed region
   (ii) The volume of solid generated when the enclosed area is rotated about the x-axis.

Question Four

a) The volume (v) of a cone is given by
$$V = \frac{1}{3}\pi r^2 h$$
where r is the base radius and h is the height of the cone. If the error in r is 2% and that of h is -1%, determine the percentage error in calculated value of volume. **(7 marks)**

b) Determine and distinguish the stationary values of the function
$$z = f(x, y) = 2x^3 - 6x^2 - 2y^3 + 6y + z$$
(13 marks)

Question Five

a) Twenty percent of bolts produced by a certain supplier are defective. Determine the probability that a sample of 4 bolts contains at most 2 defectives. **(5 marks)**

b) If two out of twenty of electric bulbs produced by a company are defective, determine the probability that in a sample of 100 bulbs at least 3 bulbs will be defective. **(6 marks)**

c) A machine produces components having mean length of 15cm and standard deviation of 0.2cm. Assuming lengths are normally distributed, determine in a batch of 1000 components.
   (i) Number of components likely to have length less than 14.95cm
   (ii) Number of components likely to lie between 14.95cm and 15.15cm
   (iii) Number of components likely to be larger than 15.43cm **(9 marks)**

(17 marks)