THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY
DEPE5/DEAE5/DTIE5/DCSE5/DMRE5/DICE5
YEAR III

EEP 3501 ENGINEERING MATHEMATICS V

END OF SEMSTER EXAMINATIONS

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

<u>Instructions to Candidates:</u>
You should have the following for this examination

- *Question paper*
- *Answer booklet*
- *Scientific calculator*
- *Drawing instruments*
- *S.M.P Table*

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

Question 1 (Compulsory) – 30 Marks

a)

i) Determine by double integral the area bounded by

$y = x^3 + 4x,$
$y = 0$, $x = 0$ and $x = 4$ (3 marks)

ii) Evaluate the following integrals

(a) $\int_1^3 \int_0^{Iny} dx\, dy$ (4 marks)

(b) $\int_1^1 dx \int_0^x dy \int_0^y dz$ (3 marks)

b) Evaluate $\int_c \underset{\sim}{F} \bullet \underset{\sim}{dr}$ where $\underset{\sim}{F} = \left(x^2 + y^2\right)\underset{\sim}{i} - zxy\,\underset{\sim}{j}$ given that c is the rectangle in the *x*-*y* plane bounded by $y = 0$, $x = a$, $y = b$ and $x = 0$ (7 marks)

c)

i) Sketch the following functions for at least 3 periods and state whether the function are odd, even or neither. Give reason for your answer.

(a) $f(t) = \begin{cases} -\cos x & -\pi < x < 0 \\ \cos x & o < x < \pi \end{cases}$ (2 marks)

(b) $f(t) = \begin{cases} \pi + x & -\pi \le x \le 0 \\ \pi - x & 0 \le x \le \pi \end{cases}$ (2 marks)

ii) Determine the Fourier series for the periodic function $f(t)$ defined by

$$f(t) = \begin{cases} 0 & -\pi < t < 0 \\ 4t & o < t < \pi \end{cases}$$

(9 marks)

Question 2

a) Determine the volume of a solid bounded by the planes $x = 0$, $z = 0$, $x = 2$, $y = x^2 + 1$ and the surface $z = x^2 + y^2$

b) The periodic wave function in fig. 1 below represents an electromotive force in an electric circuit

i) Sate whether the function is ODD, EVEN or NEITHE VV resulting Fourier series.

$$\frac{\pi^2}{8} = \sum_{n=1}^{N} \frac{1}{(2n-1)^2}$$

ii) Using a suitable substitution and series in b(i), show that (1 mark)

Question 3

$x^2 + y^2 = 4$ $y + z = 3$

a) Determine the volume bounded by the cylinder and the planes and $z = 0$ (10 marks)

$f(t)$

b) The function is symmetrical about (0,0) and is defined by

$$f(t)\begin{cases} \frac{2}{\pi}t & 0 \le t \le \frac{\pi}{2} \\ 2\left(1 - \frac{t}{\pi}\right) & \frac{\pi}{2} < t \le \pi \end{cases}$$

$f(t + 2\pi)$

$f(t)$ $-\pi < t < \pi$

i) Sketch the function over the interval

$f(t)$

ii) Determine the half-range Fourier series for the function

$f(t)$

iii) By evaluating and its half-range Fourier series deduce that

$$\frac{\pi^2}{4} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$$

(10 marks)

Question 4

a) Evaluate the following integrals

$$\int_0^{\frac{\pi}{2}} \int_{\frac{\pi}{4}}^{\tan^{-(2)}} \int_0^4 x \sin\, y \; dx\, dy\, dz$$

(4 marks)

b) Verify Green's theorem in the plane for $\int (xy + y^2)dx + x^2 dy$ where C is the curve closed by the region bounded by $y = x$ and $y = x^2$ (6 marks)

c) (i) If $f(x, y) = x^2 + y$ is defined on a rectangular region $0 \le x \le 1, \quad 1 \le y \le 2$, show that $\int_1^2 \int_0^1 f(x, y) = \int_1^2 dy \int_0^1 f(x, y)dx = \int_0^1 \int_1^2 f(x, y)dy = \frac{\pi}{6}$

(4 marks)

(ii) Find the area integral $\int_\Delta \left(\frac{\partial f_1}{\partial x_1} + \frac{\partial f_2}{\partial x_2} \right) dx_1 \, dx_2$ where $\Delta = -1 \le x_1 \le 1, \quad -1 \le x_2 \le 1 \; and \quad F_1(x_1, x_2) = x_1 - x_2$

$F_2(x_1 x_2) = x_2 - x_1$

(6 marks)

Question 5

a) State and proof Green's theorem for a simple region (9 marks)

b) Given that D is a square defined by $-1 \le x_1 \le 1, \quad -1 \le x_2 \le 1$ and F_1 and F_2 are defined on Δ by $F_1(x_1, x_2) = -x_2 e^{x1}$ and $F_1(x_1, x_2) = x, e^{x2}$, proof Green's theorem in the given region.
(11 marks)