MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

THIRD YEAR **SECOND** SEMESTER EXAMINATION FOR THE DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

SEE 1306 – ENGINEERING MATHEMATICS VI

DURATION: 2 HOURS

DATE: 18TH APRIL, 2018

TIME: 9.00 – 11.00 A.M.

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE

a) Let f(x) be a function of period 2π such that

$$f(x) = \begin{cases} 1 & -\pi < x < 0 \\ 0 & 0 < x < \pi \end{cases}$$

i. Sketch a graph of f(x) in the interval $-2\pi < x < 2\pi$ (5 marks)

ii. Show that the Fourier Series for f(x) in the interval $-\pi < x < \pi$ is

$$\frac{1}{2} - \frac{2}{\pi}\left[\text{Sin } x + \frac{1}{3}\text{ Sin } 3x + \frac{1}{5}\text{ Sin } 5x + \cdots\right]$$ (15 marks)

b) Sketch the graphs of the following functions inserting relevant values

i. $f(t) = \begin{cases} 3t & 0 < t < 1 \\ 3 & 1 < t < 2 \\ f(t+2) & \end{cases}$ (2 marks)

ii. $f(t) = \begin{cases} 0 & -2 < t < 0 \\ 1 & 0 < t < 2 \\ f(t+4) & \end{cases}$ (2 marks)

c) Verify Gauss' theorem for the vector field

$\underline{F} = y^2 j - xzk$ and the triangular prism with vertices at (0, 0, 0), (2, 0, 0), (0, 0, 1), (0, 4, 0), (2, 4, 0) and (0, 4, 1) (6 marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO

a) A function f(x) = $x/2$ over the interval $0 < x < 4\pi$ and has period 2π.

i. Sketch a graph of f(x) in the interval $0 < x < 4\pi$ (5 marks)

ii. Obtain Fourier Series representation of f(x) in th interval $0 < x < 2\pi$ (15 marks)

QUESTION THREE

a) For the function f(x) = x^2 defined only in the $0 < x < \pi$

Complete the definition of the above function $f(x)^2$, $0 < t < \pi$ by defining it over $-\pi < t < 0$ such that the resulting functions will have a Fourier Series containing

i. Only cosine terms

ii. Only sine terms

Obtain the half range Fourier Sine Series to represent f(x) = x^2 $0 < t < 3$ (10 marks)

b) Obtain a half-range Fourier Cosine Series to represent the function

f(t) = 4 – t $\quad 0 < t < 4$ (10 marks)

QUESTION FOUR

a) Use Gauss' theorem to evaluate the surface integral $\iint_s \underline{F} \cdot \underline{ds}$ where $\underline{F}$ is the vector field $x^2 y\underline{i} + 2xy\underline{j} + z^3\underline{k}$ and S is the surface of the unit cube $0 \le x \le 1,\ 0 \le y \le 1, 0 \le z \le 1$

(20 marks)