



# MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS STATISTICS AND ACTUARIAL SCIENCE

SECOND YEAR SECOND SEMESTER EXAMINATION FOR  
DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

DIPLOMA IN BUILDING AND CIVIL ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

ECU 0302: ENGINEERING MATHS VIII

DATE: 30/4/2019

TIME: 8:30 – 10:30 AM

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## INSTRUCTIONS:

Answer Question One and Any Other Two Questions

### QUESTION ONE (COMPULSORY) (30 MARKS)

- a) State at least three conditions that must be satisfied for a function to have a fourier series (2 marks)

- b) A function  $f(x)$  is defined by the

$$f(x) = \begin{cases} 0 & -4 \leq x \leq 0 \\ 4 & 0 \leq x \leq 4 \\ f(x+8) \end{cases}$$

- i) Sketch the function over the interval  $-4 \leq x \leq 8$  (4 marks)  
ii) find the corresponding fourier series (8 marks)
- c) Obtain the half -range cosine series for the function

$$f(x) = \begin{cases} x & 0 \leq x \leq \pi \\ f(x+2\pi) \end{cases} \quad (8 \text{ marks})$$

- d) Derive the fourier series co-efficeints  $a_0$   $a_n$  and  $b_n$  for period  $2\pi$  (8 marks)

### QUESTION TWO (20 MARKS)

Determine the fourier series for the function  $f(t)$  defined by

$$f(t) = \begin{cases} 0 & -2 \leq t \leq 0 \\ \frac{3t}{2} & 0 \leq t \leq 4 \\ f(t+6) & \end{cases}$$

Calculate also its percentage third harmonic.

### QUESTION THREE (20 MARKS)

A periodic function is defined by

$$f(x) = \begin{cases} 1 - \frac{x}{\pi} & -\pi \leq x \leq 0 \\ 1 + \frac{x}{\pi} & 0 \leq x \leq \pi \\ f(x+2\pi) & \end{cases}$$

- i) Sketch the graph for three periods (3 marks)
- ii) Determine the fourier series for the function (13 marks)
- iii) Using the substitution  $x = \pi$  in the fourier series obtained show that

$$\frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2} \quad (4 \text{ marks})$$

### QUESTION FOUR (20 MARKS)

- a) A periodic function is  $f(t)$  defined within the period  $0 \leq t \leq 2\pi$

$$\text{by } f(t) = \begin{cases} t & 0 \leq t \leq \frac{\pi}{2} \\ \frac{\pi}{2} & \frac{\pi}{2} \leq t \leq \pi \\ \pi - \frac{t}{2} & \pi \leq t \leq 2\pi \end{cases}$$

sketch the function over the interval  $-2\pi \leq t \leq 3\pi$  and obtain the fourier series expansion for the function. (10 marks)

- b) Obtain the half-range sine series for the function

$$f(x) = \begin{cases} -1 & -\pi \leq x \leq 0 \\ 1 & 0 \leq x \leq \pi \\ f(x+2\pi) & \end{cases} \quad (10 \text{ marks})$$