



# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

**FIRST YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF TECHNOLOGY IN ELECTRICAL AND ELECTRONICS ENGINEERING**

AMM117 – ENGINEERING MATHEMATICS I

DURATION: 2 HOURS

DATE: 13<sup>TH</sup> DECEMBER 2017

TIME: 2.00PM – 4.00PM

### **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 (Compulsory)

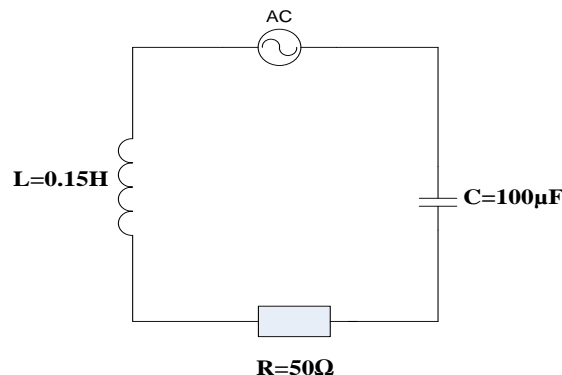
### QUESTION ONE (30 Marks)

- a) Given the function  $f(x) = 2x + 3$ ,  $g(x) = x^2 - 1$  and  $h(x) = 5x - 1$ , find
- $(h \circ (g \circ f))(x)$  (4 Marks)
  - $(g \circ h^{-1})(x)$  (3 Marks)
- b) Find the real number  $x$  and  $y$  such that  $4x + 2yj - jx + 6y = 16 + 3j$  (4 Marks)
- c) Find  $\lim_{x \rightarrow \infty} \left( \frac{2x^2 + 3}{x^2 - 4x + 2} \right)$  (3 Marks)
- d) Express the complex number  $z = \sqrt{3} + j$  in polar form. (3 Marks)
- e) Solve the equation  $3 \cos 2\theta - 4 \cos \theta + 3 = 0$  for  $0 \leq \theta \leq 360^\circ$  (5 Marks)
- f) Define  $z = f(x, y)$  by  $z = x^3y + 4xy^2 - 8y^3$ . Find the second order partial derivatives. (5 Marks)
- g) Find  $\frac{dy}{dx}$  given  $y = (x^3 + 4) \tan(2x)$  (3 Marks)

## SECTION B (Answer any two questions)

### QUESTION TWO (20 Marks)

- a) Let  $A = \{2, 4, 5, 6\}$  and define  $f: A \rightarrow \mathbb{R}$  by  $f(x) = x^2 - 4$ . Find the range of  $f$ . (2 Marks)
- b) Given the function  $f(x) = 3x - 1$ , find  $f^{-1}(x)$  (2 Marks)
- c) Find the principal value of the complex number  $\ln(5 + 2j)$  leaving your answer Cartesian form. (4 Marks)
- d) Find the square roots of the complex number  $z = 3 - 7j$ . (6 Marks)
- e) Determine the magnitude and the phase angle of the current flowing in the circuit diagram below (6 marks)



**QUESTION THREE (20 Marks)**

- a) A ship sails from a port in a direction  $N20^\circ W$  at an average speed of 40km/h. Another ship sails at the same time and from the same port in a direction of  $N50^\circ E$  at an average speed of 30km/h. determine their distance apart after 2 hours. (3 Marks)
- b) Solve the equation  $5 \cos \theta - 12 \sin \theta = 10$  for  $0 \leq \theta \leq 360^\circ$ . (8 Marks)
- c) Find the center, foci and eccentricity of the ellipse  $x^2 + 16y^2 + 96y + 128 = 0$  (6 Marks)
- d) Find the equation of a circle whose center is at a point (1,4) and which passes through the point (3,7). (3 Marks)

**QUESTION FOUR (20 Marks)**

- a) Use first principles to find the derivative of the function  $f(x) = \frac{x}{1+x}$  (6 Marks)
- b) Find  $\frac{dy}{dx}$  given;
- i.  $y = \frac{x^2+3}{\cos 2x}$  (3 Marks)
- ii.  $y = e^{(x^2+2x)}$  (3 Marks)
- c) Find the equations of the tangent and normal to the curve  $y = x^3 - 2x^2 + 4$  at a point (-1,1) (8 Marks)

**QUESTION FIVE (20 Marks)**

- a) Given the function  $u = x^2y^3 + 2xy^2$ , find  $\frac{du}{dx}$  along the curve  $y = x^2 - 4x$ . (5 Marks)
- b) Find the vertex, focus and the directrix of the parabola  $x^2 + 4x + 8y = 12$ . (5 Marks)
- c) Find and classify the stationary points of the surface  $z = x^3 - 6xy - y^3$ . (10 Marks)