

MAKERERE



UNIVERSITY

COLLEGE OF ENGINEERING, DESIGN, ART AND TECHNOLOGY

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

EMT 1201: ENGINEERING MATHEMATICS II EXAMINATION 2015/2016

Date: 09th May 2016

Time: 09:00-12:00 Noon

Instructions: Attempt any five (5) questions for full marks

Question 1 [20 Marks]

1.1: Use Crammer's rule to solve the set of linear simultaneous equations; (8 marks)

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

$$x + y + z = 2$$

$$2x - y + 3z = -3$$

1.2: With the aid of an argand diagram, find the cube roots of the complex number $z = 5(\cos 225^\circ + j \sin 225^\circ)$ (6marks)

1.3: If $z = x + jy$, find the equation of the locus $\arg(z^2) = -\frac{\pi}{4}$ (6 marks)

Question 2 [20 Marks]

2.1: If x and y are real, solve the equation; $\frac{jx}{1+jy} = \frac{3x+j4}{x+3y}$ (5 marks)

2.2. Figure 1 shows an ac circuit; the values of the impedances are $Z_1 = (2+3j) \text{ k}\Omega$, $Z_2 = (3-4j) \text{ k}\Omega$ and $Z_3 = (-5+12j) \text{ k}\Omega$. Determine the supply voltage E , if the current that flows through Z_1 is given by $I = (5+6j) \text{ A}$? (7 marks)

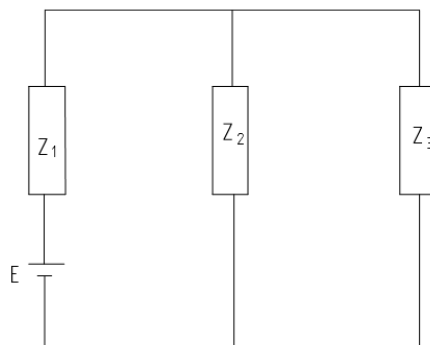


Figure 1: ac circuit

2.3: Determine the eigen values and eigen vectors of $\mathbf{Ax}=\lambda\mathbf{x}$ where $\mathbf{A}=\begin{pmatrix} 1 & 0 & 4 \\ 0 & 2 & 0 \\ 3 & 1 & -3 \end{pmatrix}$ (8 marks)

Question 3 [20 Marks]

3.1: Vectors \mathbf{a} and \mathbf{b} are defined by $\mathbf{a}=8\mathbf{i}+2\mathbf{j}-3\mathbf{k}$ and $\mathbf{b}=3\mathbf{i}-6\mathbf{j}+4\mathbf{k}$, where \mathbf{i} , \mathbf{j} and \mathbf{k} are mutually perpendicular unit vectors.

- i) Calculate $\mathbf{a} \cdot \mathbf{b}$ and hence show that \mathbf{a} and \mathbf{b} are perpendicular vectors (4 marks)
- ii) Find the magnitude and direction cosines of the vector $\mathbf{a} \times \mathbf{b}$ (5marks)

3.2: If $\mathbf{F}=(2xyz)\mathbf{i}+(x^2z)\mathbf{j}+(x^2y)\mathbf{k}$, evaluate the line integral $\int \mathbf{F} \cdot d\mathbf{r}$ between A(0,0,0) and B(2,4,6)

- i) Along the curve c whose parametric equations are $x = u, y = u^2, z = 3u$ (4 marks)
- ii) Along the 3 straight lines C_1 : (0,0,0) to (2,0,0); C_2 : (2,0,0) to (2,4,0); C_3 : (2,4,0) to (2,4,6) (4 marks)
- iii) Determine whether \mathbf{F} is a conservative field (3 marks)

Question 4 [20 Marks]

4.1: If $\mathbf{F}=2\mathbf{i}+4u\mathbf{j}+u^2\mathbf{k}$ and $\mathbf{G}=u^2\mathbf{i}-2u\mathbf{j}+4\mathbf{k}$, determine $\int_0^2 (\mathbf{F} \times \mathbf{G}) du$ (5 marks)

4.2: Find the directional derivative of the function $\phi = x^2y - 2xz^2 + y^2z$ at the point (1, 3, 2) in the direction of the vector $\mathbf{a}=3\mathbf{i}+2\mathbf{j}-\mathbf{k}$. (5 marks)

4.3. Use Simpson's rule to evaluate $\int_0^{\pi/3} \sqrt{\sin x} dx$ using 6 intervals (10 marks)