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(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR
SECOND YEAR FIRST SEMESTER
MAIN EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: MAT 251

COURSE TITLE: ENGINEERING MATHEMATICS I

DATE: 04/02/2022

TIME: 9:00 AM - 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

(a) Express $Z = \frac{3+j\sqrt{3}}{2+j\sqrt{7}}$ in the form $Z = a + jb$ (5 Marks)

(b) Solve the equation $\begin{vmatrix} 1 & -1 & -2 \\ 2 & 3x & 1 \\ 2 & 1 & x \end{vmatrix} = 2$ (5 Marks)

(c) Find the eigenvalues and the corresponding eigenvectors for the matrix

$$A = \begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix} \quad (5 \text{ Marks})$$

(d) Given the vectors $\mathbf{a} = 3\mathbf{i} - \mathbf{j} + 4\mathbf{k}$, $\mathbf{b} = -\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{c} = 2\mathbf{j} - \mathbf{k}$, show that $\mathbf{a} \cdot \mathbf{b} + \mathbf{a} \cdot \mathbf{c} = \mathbf{a} \cdot (\mathbf{b} + \mathbf{c})$ (5 Marks)

(e) Use Leibniz theorem to evaluate $\frac{d^4 y}{dx^4}$ if $y = \cos x \sin 3x$ (5 Marks)

QUESTION TWO (20 MARKS)

(a) (i) Find the inverse of the matrix $\begin{bmatrix} 2 & -3 & 4 \\ -3 & 4 & 2 \\ 4 & -2 & -3 \end{bmatrix}$ (7 Marks)

(ii) Hence solve the system of simultaneous equations

$$2x - 3y + 4z = -9, \quad -3x + 4y + 2z = -12, \quad 4x - 2y - 3z = -3 \quad (6 \text{ Marks})$$

(b) Show that the system of equations below has no solutions

$$3x - y - 2z = 2, \quad 2y - z = -1, \quad 3x - 5y \quad (7 \text{ Marks})$$

QUESTION THREE (20 MARKS)

(a) Convert

(i) $Z = 3 - 8j$ to polar form

(ii) $Z = [2, 1.3^c]$ to Cartesian form (6 Marks)

(b) Find the three cube roots of $Z = 5 + 12j$ (7 Marks)

(c) Given that $Z_1 = 2 - 4j$ and $Z_2 = 5 + 5j$, find $\frac{Z_1 + Z_2}{Z_1 + Z_2}$ giving your answer in the form $Z = re^{j\theta}$ (7 Marks)

QUESTION FOUR (20 MARKS)

(a) Distinguish between a sequence and a series giving an example for each. (4 Marks)

(b) In a geometric progression (GP), the sum of the second and the third term is 6 and the sum of the third term and the fourth term is -12. Find the

(i) Common ratio of the GP

(ii) First term of the GP

(iii) Sum of the first 10 terms (6 Marks)

(c) (i) The third and eighth terms of an arithmetic progression (AP) are 12 and 127 respectively. Determine the common ratio and the first term (6 Marks)

(ii) Given the series $10 + 5 + 2.5 + 1.25 + \dots$. Find the sum to infinity of the series (4 Marks)

QUESTION FIVE (20 MARKS)

(a) Show that $\cos 2\theta = 2\cos^2\theta - 1$ (7 Marks)

(b) Given that $\sin A = \frac{3}{5}$ and $\cos B = \frac{12}{13}$, B being obtuse, find the value of

(i) $\sin(A + B)$

(ii) $\cos(A - B)$

(7 Marks)

(c) Show that $\cosh 2x = \cosh^2 x + \sinh^2 x$

(6 Marks)