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University Examinations 2023/2024

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING, BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING AND BACHELOR OF TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

SME 3150: ALGBRA/MATHEMATICS II

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Define the following terms (2 marks)

i. Set

ii. Compliment of a set

b) Given that set $P = \{1,2,3,4,5,6,7,8\}, Q = \{2,7,9,11\}, R = \{5,6,7,8\}$

Find:

i. $P \cap Q$ (1 mark)

ii. $Q \cup R$ (2 marks)

c) Express the following complex numbers in polar form

$Z = -5 + 5i$ (5 marks)

d) The 7^{th} term of an A.P is 29 and the 11^{th} term is 54. Determine the 16^{th} term.

(3 marks)

e) Express $\frac{3x^2-10x-4}{x^2-6x+8}$ as partial fractions (5 marks)

f) Find the inverse of the following 3x3 matrix M

$$M=\begin{bmatrix}2 & 3 & 5\\ 4 & 1 & 6\\ 1 & 4 & 0\end{bmatrix}$$ (6 marks)

g) Solve the following system of equations using Crammer's rule

$$4x+5y+z=2$$
$$x-2y-3z=7$$
$$3x-y-2z=1$$ (6 marks)

QUESTION TWO (20 MARKS)

a) In a class of 80 students, 50 know English, 55 know French and 46 know German, 37 students know English and French. 28 students know French and German, 25 students know English and German and 7 students know none of the languages. Find

(10 marks)

i. How many students know all the 3 languages?

ii. How many students know exactly two languages?

iii. How many students know only one language?

iv. Represent the information in a Venn diagram

b) Find the Eigen values of the matrix below

$$A=\begin{bmatrix}6 & -2 & 2\\ -2 & 3 & -1\\ 2 & -1 & 3\end{bmatrix}$$ (6 marks)

c) Solve by row reduction

$$2a + 3b = 4$$
$$a + 2b = -2$$

(4 marks)

QUESTION THREE (20 MARKS)

a) Use the Gaussian elimination method to solve the set of linear equations

$$x_1 + 2x_2 - 3x_3 = 3$$
$$2x_1 - x_2 - x_3 = 11$$
$$3x_1 + 2x_2 + x_3 = -5$$

(10 marks)

b) Apply De-Moivre's theorem to find Z^5 given that $z = 1 + \sqrt{3i}$ (6 marks)

c) Find the value of $(-2 + 3i)^6$ (4 marks)

QUESTION FOUR (20 MARKS)

a) Find the Eigen values and the corresponding Eigen vectors of $\begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$ (10 marks)

b) Find the square root of the following complex number $-15 - 8i$ (10 marks)

QUESTION FIVE (20 MARKS)

a) Find matrix P such that $P^{-1}AP$ is a diagonal matrix given that matrix

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

(10 marks)

b) Find the Rank of matrix M below $M = \begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix}$ (4 marks)

c) Find the adjoint of matrix M below $M = \begin{bmatrix} 3 & 2 & -1 \\ 2 & -1 & 2 \\ 1 & -3 & -4 \end{bmatrix}$ (6 marks)