PP2

TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY **SUPPLEMANTARY AND SPECIAL EXAMINATIONS** FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE 4504: POWER SYSTEM ANALYSIS 1

TIME: 2 HOURS SERIES July, 2025

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for this examination;
   - Answer Booklet
   - A Non- Programmable Scientific Calculator

2. This paper consists of **FIVE** Questions.
3. Answer Question **ONE** (**COMPULSORY)** and any other **TWO** Questions
4. This paper consists of **FIVE** printed pages.

Question 1 (Compulsory)

(a) Explain the following with reference to load flow studies

(i) Importance of load flow studies
(ii) Why the solution of power flow problem is not possible by conventional methods.
(iii) Majority of buses in power systems are PQ buses
(iv) Why one of the buses in a power system is taken as reference bus for power flow studies **(8 marks)**

(b) Solve the following equation by Gauss Seidel method $x^2 - 6x + 2 = 0$ **(4 marks)**

(c) A one – line diagram for a four-bus system is shown in Figure Q1 (c). The line impedance are given in table 1. Determine the Y_{bus}. **(6 marks)**

TABLE 1

S/NO	LINE (BUS TO BUS)	R_{PU}	X_{PU}
1	1-2	0.05	0.15
2	1-3	0.10	0.30
3	2-3	0.15	0.45
4	2-4	0.10	0.30
5	3-4	0.05	0.15

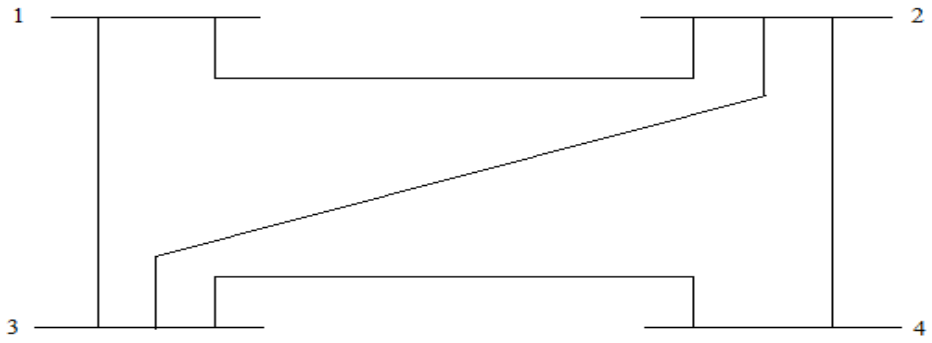

Figure Q 1 (C)

(d) For the two bus system of Figure Q1 (d) with data as shown and with

$Y_{11} = Y_{22} = 1.6 \angle 80^{o}$ pu and $Y_{21} = Y_{12} = 1.9 \angle -100^{o}$ pu. Determine;

(i) The per unit voltage at bus 2 by Gauss –Seidel method.
(ii) Compute the power on the Swing bus of the network **(12 marks)**

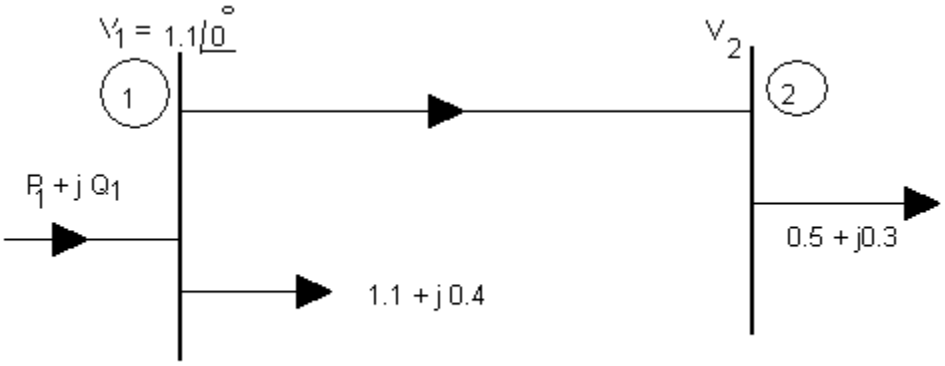

Figure Q1 (d)

QUESTION TWO

(a) Solve the following equations by the Newton-Raphson method:

$X_1^2 - 4 = 0$
$2x_1 - x_2 = 0$

Let $x_1^{(0)} = 1$ and $x_2^{(0)} = -1$ be the starting point for the first iteration. **(6 marks)**

(b) For the system shown in Figure Q2(b) the Y_{bus} is given as:

$$Y_{bus} = \begin{bmatrix} 24.23\angle -75.95^0 & 12.31\angle 104.04^0 & 12.31\angle 104.04^0 \\ 12.31\angle 104.04^0 & 24.23\angle -75.95^0 & 12.31\angle 104.04^0 \\ 12.31\angle 104.04^0 & 12.31\angle 104.04^0 & 24.23\angle -75.95^0 \end{bmatrix}$$

Give the per-unit voltages and power as shown, determine V_2 by the Newton-Raphson method. **(14 marks)**

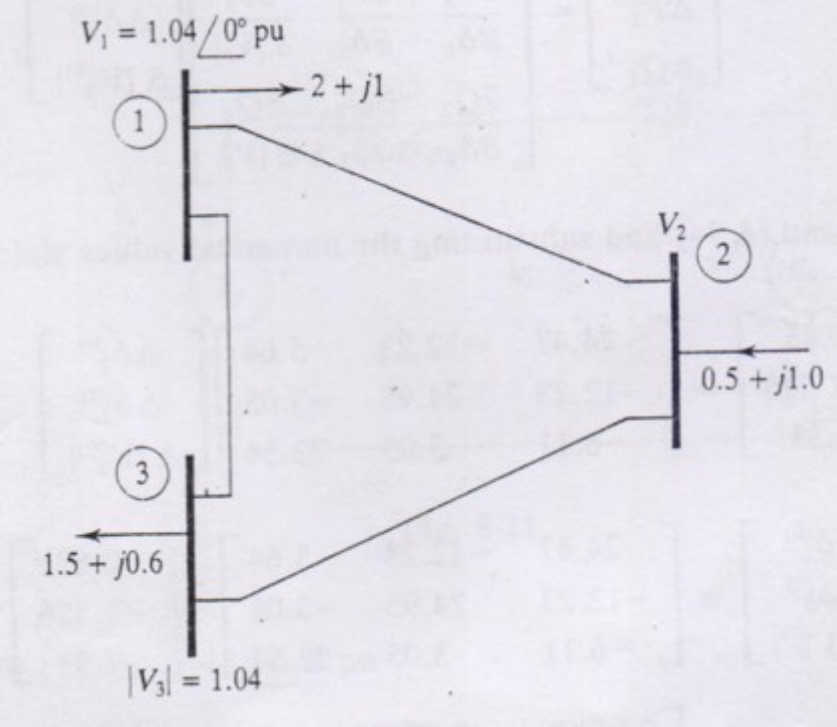

Figure 2Q (b)

QUESTION THREE

(a) Derive the following;

(i) Gauss Seidel Power flow equation

(ii) Mathematical model of a phase shifting transformer to be used in power flow equation.

(9 Marks)

(b) For the system shown in Figure Q3(b). The bus admittance matrix is given by:

$$Y_{bus} = \begin{bmatrix} 3 - j9 & -2 + j6 & -1 + j3 & 0 \\ -2 + j6 & 3.666 - j11 & -1 + j2 & -1 + j3 \\ -1 + j3 & -0.666 + j2 & 3.666 - j11 & -2 + j6 \\ 0 & -1 + j3 & -2 + j6 & 3 - j9 \end{bmatrix} pu$$

With complex power buses 2, 3 and 4 as shown in the Figure Q3 (b) determine the value for V_2 that is produced by the first and second iteration of the Gauss-Siedel procedure. Also determine V_3 and V_4

(11 Marks)

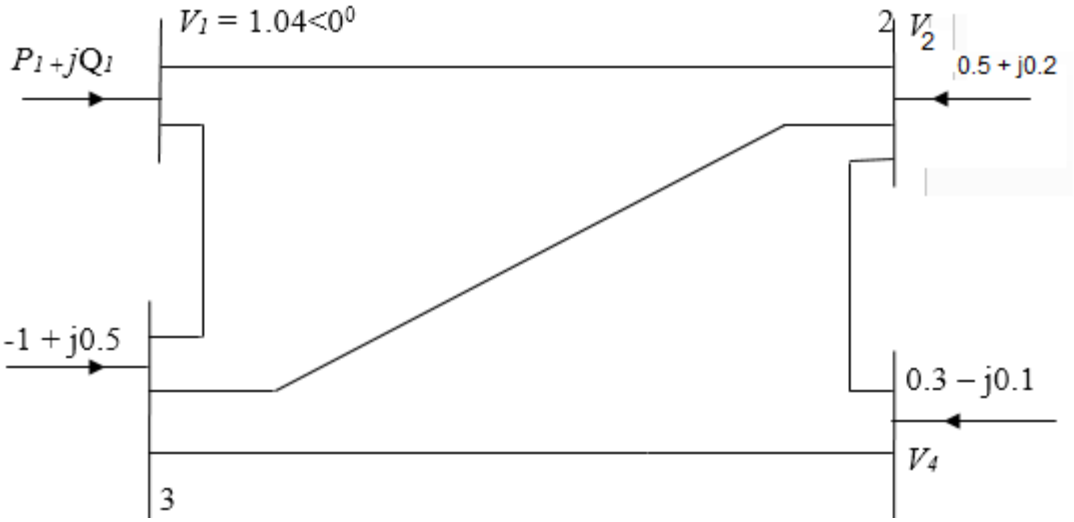

Figure Q3 (b).

QUESTION FOUR

(a) Explain any **THREE** types of Bus-bars used in power system.

(6 Marks)

(b) Compare the Gauss Seidel Method with the Newton Raphason method stating situation where each is applicable.

(6 Marks)

(c) With aid of a flow chart explain the Newton-Raphson iterative method of solving load flow problems. **(8 Marks)**

QUESTION FIVE

(a) Short term demand forecasting plays an important role in the process of regulation. Hence, a precise estimate of demand is important for the purpose of setting tariff. Explain any **THREE** reasons for a detailed consumer category-wise consumption forecast.

(6 Marks)

(b) (i) Describe the econometric approach of STLF and show how you can calculate the Electricity Demand (ED).

(ii) Explain any **TWO** demerits of Econometric approach.

(7 Marks)

(c) Explain any **THREE** reasons why we need good predictions.

(6 Marks)