



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

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

EEE 4504: POWER SYSTEM ANALYSIS I

TIME: 2 HOURS

SERIES NOVEMBER, 2024

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

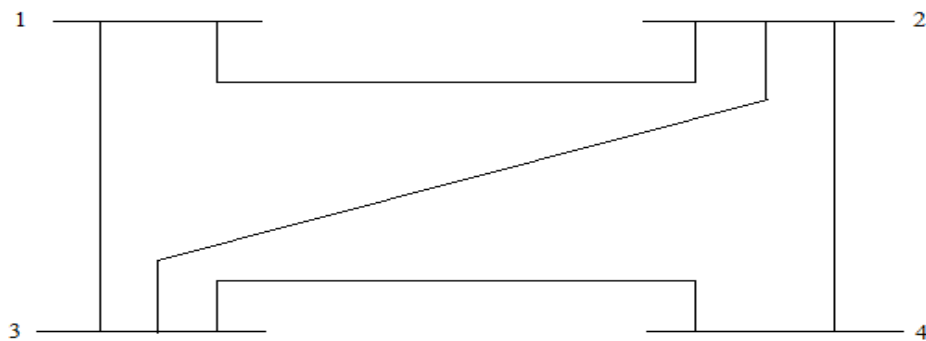


Figure Q 1 (C)

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

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

- The per unit voltage at bus 2 by Gauss -Seidel method.
- Compute the power on the Swing bus of the network

(12 marks)

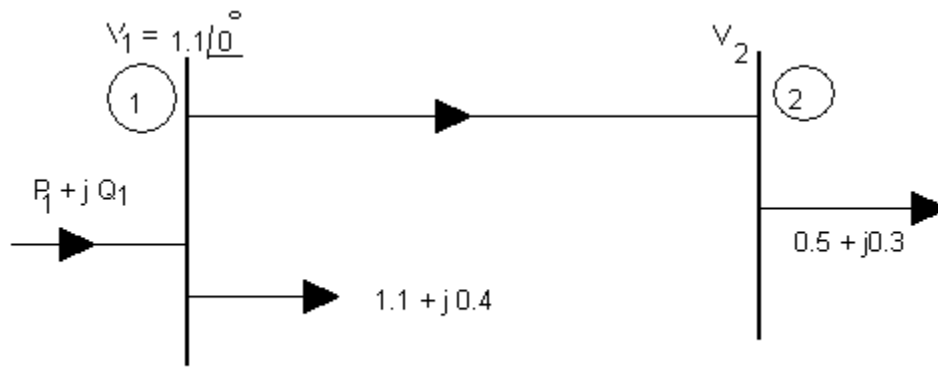


Figure Q1 (d)

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:

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

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

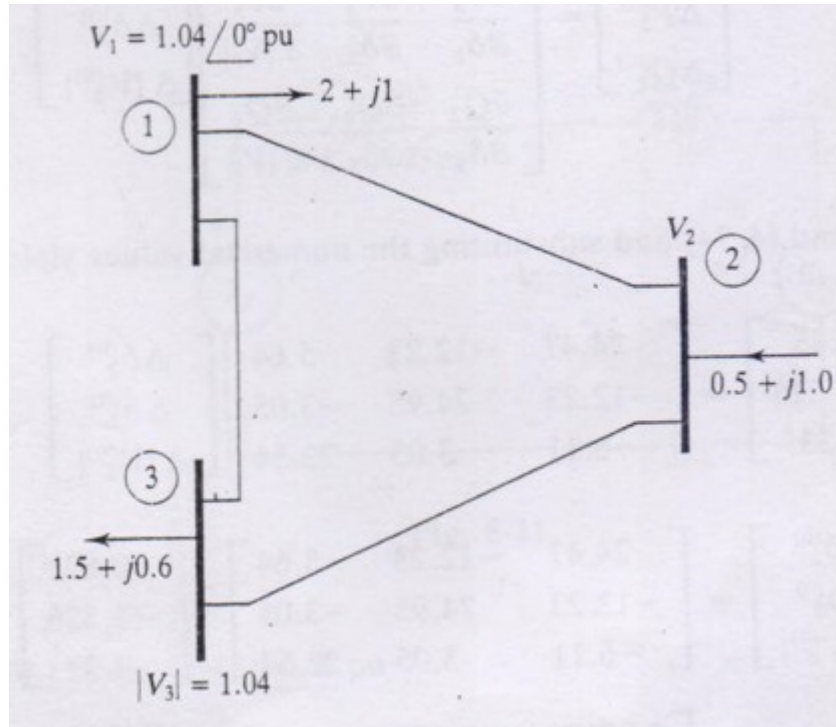


Figure 2Q (b)

QUESTION THREE

- (a) Derive the following;
- Gauss Seidel Power flow equation
 - 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)

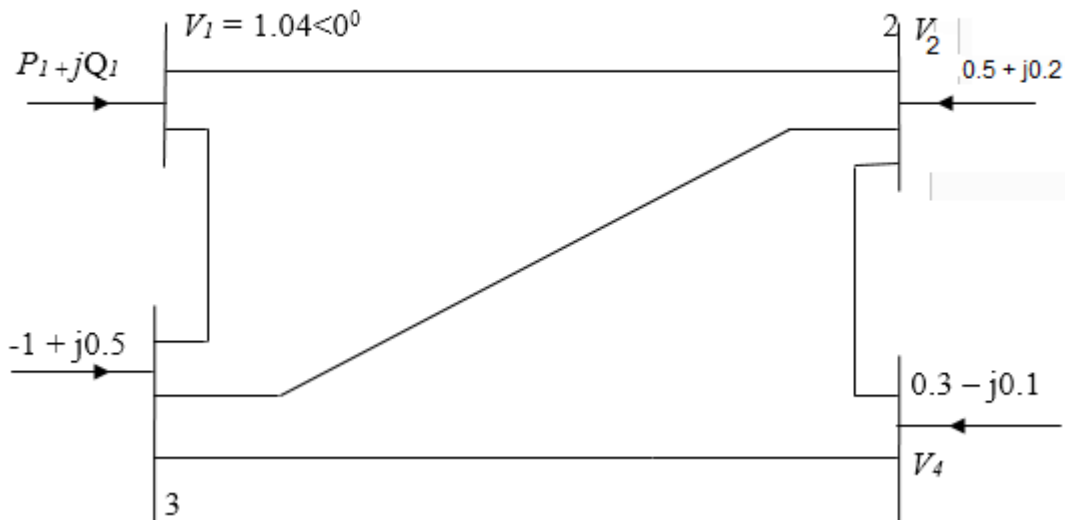


Figure Q3 (b).

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)

