CHUKA **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EENG 361: POWER SYSTEMS I

STREAMS: BSC EENG **TIME: 2 HOURS**

DAY/DATE: THURSDAY 19/12/2024 **11.30 P.M – 1.30 P.M.**

INSTRUCTIONS:

Answer question ONE and any other TWO questions

Do not write on the question paper

QUESTION ONE (30 MARKS)

a) Outline the merits of using per unit quantities in power systems analysis. [3 Marks]

b) A three Phase generator with rating 1000KVA, 33KV has its armature resistance and synchronous reactance as 20Ω/Phase and 70Ω/Phase. Calculate p.u. impedance of the generator. [3 Marks]

c) Outline the advantages of GIS over conventional open air substations.[4 Marks]

d) Draw the impedance diagram of the given SLD system in.

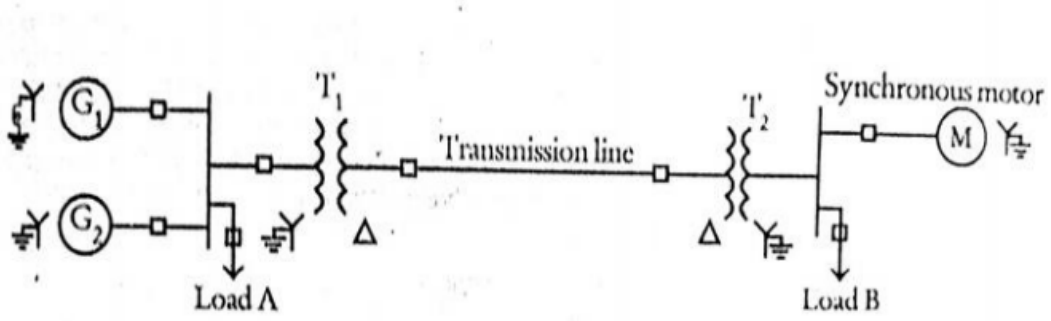

Fig 1[4 Marks]

e) Highlight the quantities specified and the quantities to be determined from load flow study for various types of buses. [4 Marks]

f) Given $Z_0 = 0.199\angle 90^0 pu, Z_1 = 0.175\angle 90^0 pu$,$Z_2 = 0.175\angle 90^0 pu$,compute the fault currents and voltages for a single line-to-ground fault. [6 Marks]

g) Explain the structure of modern power system with neat sketch.[5 Marks]

h) Define the term 'Flat start voltage' in load flow analysis. [1 Mark]

QUESTION TWO (20 MARKS)

a) Draw the per unit impedance diagram for the power system shown in Fig.2. Neglect resistance and use a base of 100 MVA and 220 kV in 50 Ω line. The ratings of the generator, motor and transformers are:
Generator : 40 MVA, 25 kV, X = 20%
Motor : 50 MVA, 11 kV, X = 30%
Y- Y Transformer: 40 MVA, 33/220 kV, X = 15%
Y- Δ Transformer: 30 MVA, 220/11 kV, X = 15%.

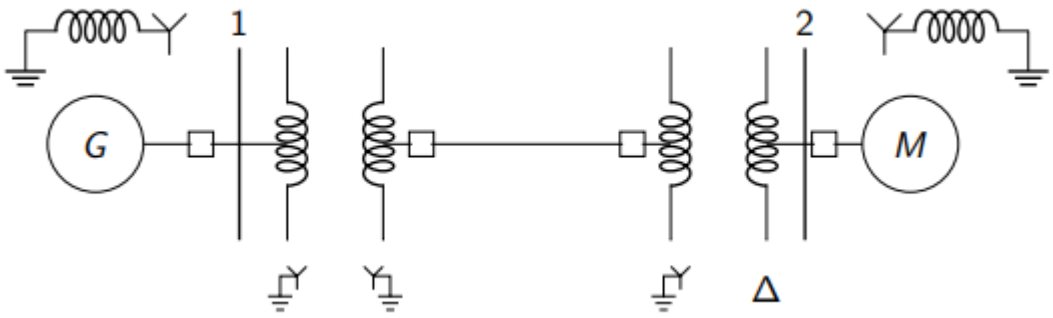

Fig.2 [10 Marks]

b) Given$Z_0 = 0.199\angle 90^0 pu, Z_1 = 0.175\angle 90^0 pu$,$Z_2 = 0.175\angle 90^0 pu$,compute the fault currents and voltages for a single line-to-ground fault.[6 Marks]

c) Outline the assumptions made in short circuit studies [4 Marks]

QUESTION THREE (20 MARKS)

a) For the network shown in Fig 3, form the bus admittance matrix. Determine the reduced admittance by eliminating node 4. The values are marked in p.u.

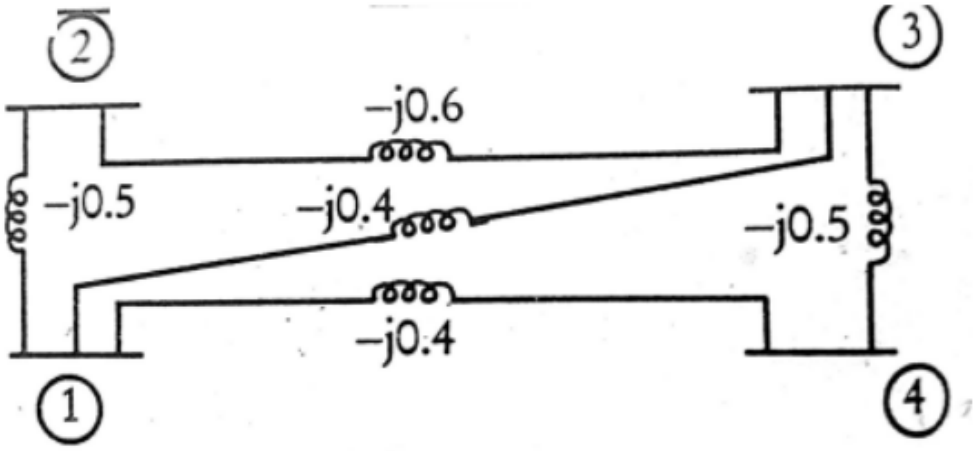

Fig.3 [10 Marks]

b) Given $V_0 = 3.5\angle 122^0, V_1 = 5.0\angle -10^0, V_2 = 1.9\angle 92^0$, find the phase sequence components. [6 Marks]

c) Define Jacobian Matrix and outline how the elements of the Jacobian matrix are computed. [4 Marks]

QUESTION FOUR (20 MARKS)

a) Figure 4 shows a three bus power system.
Bus 1: Slack bus, V=1.05∠0°p.u.
Bus 2: PV bus, |V|=1.0 p.u., Pg=3p.u.
Bus 3: PQ bus, PL=4p.u., QL=2p.u.

Carry out one iteration of load flow solution by Gauss seidel method. Neglect limits on reactive power generation.

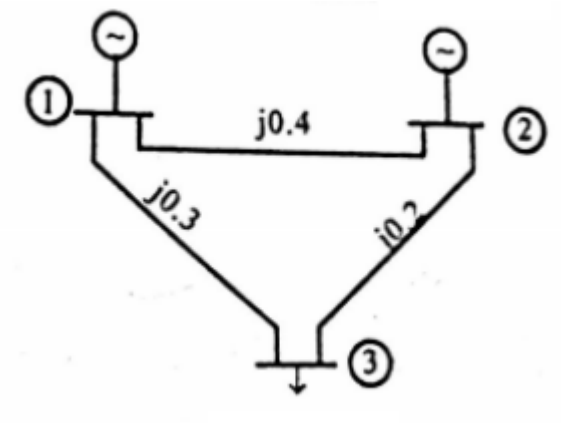

Fig.4 [14 Marks]

a) Explain load flow analysis and give its significance in power systems analysis. [4 Marks]

b) Highlight the disadvantages of Newton-Rhaphson method of load flow analysis and explain how they are overcome. [6 Marks]
