BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTECH/PRE-PHD **SEMESTER : I**
BRANCH: EEE **SESSION : MO/2022**

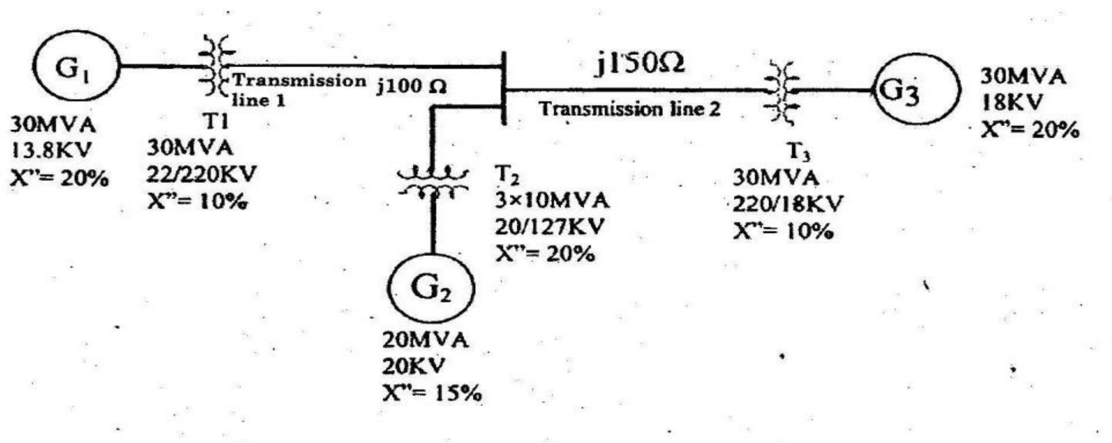
SUBJECT: EE509 ADVANCED POWER SYSTEM ANALYSIS

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. **The question paper contains 5 questions each of 10 marks and total 50 marks.**
2. **Attempt all questions.**
3. **The missing data, if any, may be assumed suitably.**
4. **Before attempting the question paper, be sure that you have got the correct question paper.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

Q.1(a) Discuss the modeling of Transmission line used in load flow and stability analysis? [5]

Q.1(b) The single line diagram of a power system is shown in the figure along with components data. Determine the new per unit values and draw the reactance diagram. Assume 25 MVA, and 20 kV as new base on generator G_1. [5]



Q.2(a) Formulate the power flow equation for n bus system and, also discuss the Sparsity oriented technique for reducing storage requirements with an example. [5]

Q.2(b) For a three bus network carry out one iteration of load flow solution by NRLF method. [5]

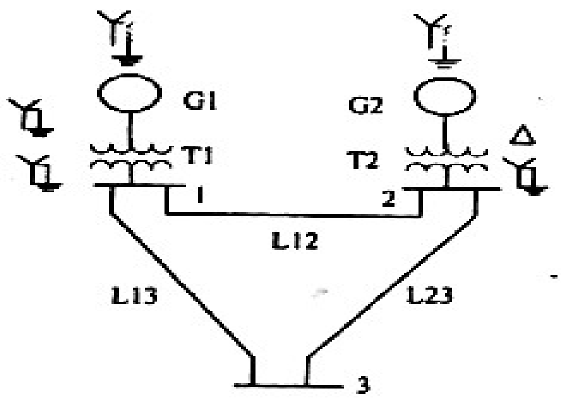
Line data	Line impedance (p.u)	Half line charging admittance (p.u)
1-2	0.021+j0.04	j0.006
2-3	0.013+j0.03	j0.002
1-3	0.016+j0.05	0

Bus 1, Voltage: 1.0<0; Bus2, Load: 50+j60; Bus 3, Load: 40+j20. If required, take the proper assumptions.

Q.3 The one-line diagram of a simple power system is shown in Figure. The neutral of each generator is grounded through a current – limiting reactor of 0.08 pu on 100 MVA base. The system data expressed in per unit on a common 100 MVA base is tabulated below. The generators are running on no- load at their rated voltage and rated frequency with their emfs in phase. Evaluate the fault current (fault occurred in phases b and c), and line voltages for a double line to ground fault at bus 3 through a fault impedance (Z_f=j0.1). Make suitable assumptions if required. [10]

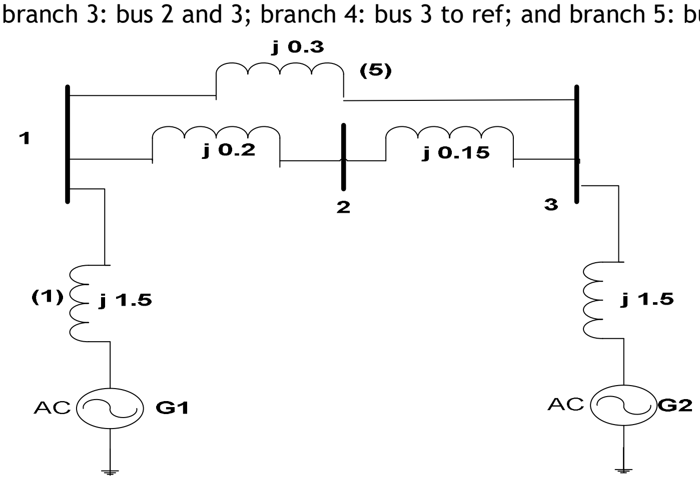
PTO

Element	V-rating	X_1	X_2	X_0
G1	20 kV	0.15	0.15	0.05
G2	20 kV	0.15	0.15	0.05
T1	20/220 kV	0.1	0.1	0.1
T2	20/220 kV	0.1	0.1	0.1
L12	220 kV	0.125	0.125	0.3
L13	220 kV	0.15	0.15	0.35
L23	220 kV	0.25	0.25	0.7125



Q.4(a) Why zero sequence impedance of a transmission line is more than its sequence impedance. [2]

Q.4(b) The generators at buses 1 and 3 of the network have impedances j1.5 p.u. If a 3-phase short circuit fault occurs at bus 3, when there is no load (all bus voltages are 1<0 p.u), find the initial symmetrical fault current in the line 1-3, and post fault voltages using bus building algorithm. Sequence of the branch additions are as follows: branch 1: bus 1 to ref; branch 2: bus 1 to bus 2; branch 3: bus 2 and 3; branch 4: bus 3 to ref; and branch 5: buses 1 to 3. [5]



Q.5(a) A four bus system with Zbus given in per unit has bus voltages V1=1<0, V2=0.98<0, V3=0.96<0, and V4=1.04<0. Using the compensating current method, predict the change in voltages at bus 1, and 3 due to outage of line 1-4 of series impedance j0.2 p.u. [5]

$$Zbus = \begin{bmatrix} j0.041 & j0.031 & j0.027 & j0.018 \\ j0.031 & j0.256 & j0.035 & j0.038 \\ j0.027 & j0.035 & j0.158 & j0.045 \\ j0.018 & j0.038 & j0.045 & j0.063 \end{bmatrix}$$

Q.5(b) Why state estimation is required and evaluates state variables using weighted least square estimate. [5]