Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
ONLINE EXAMINATIONS, JANUARY- FEBRUARY 2021

POWER SYSTEM ANALYSIS [ELE 3154]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 04 February 2021** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. For the 3-phase power system network shown in Fig. Q1(A), A and B are the generating plants while C, D, E and F are substations. The percentage reactances given in the table are based on the rating of the particular parts of the network. Choose a base of 200MVA. Determine transient short circuit current (in kA) for a 3-phase fault occurring at point X using Thevenin's method.

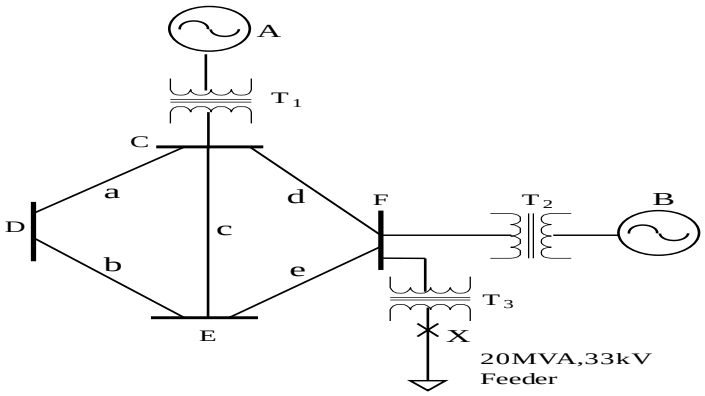

Fig. Q1(A)

Circuit Component	Capacity (MVA)	% reactance
Transmission lines		
a	40	10
b	20	5
c	50	20
d	30	15
e	10	6
Transformers		
T1	150	10
T2	50	8
T3	20	5
Generators		
A	150	X_d'=30
B	50	X_d'=17.5

(06)

1B. For the 3-phase power system network shown in Fig. Q1(A), determine the voltage at substation C. ***(04)***

2A. For the system shown in Fig. Q2(A), determine the generator terminal voltage. The transformer T comprises of 3 single-phase units each rated 16.6667 MVA, 14/127 kV and 10% reactance. Choose 100 MVA, 14 kV in the generator circuit.

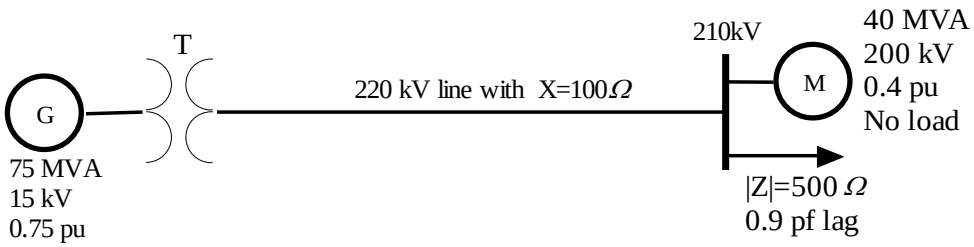

Fig. Q2(A) ***(06)***

2B. A 125 MVA, 22 kV generator having $X_d''=X_2=20\%$ and $X_0=6\%$ has a current limiting reactor of 0.18 Ω in the neutral. A single line to ground fault occurs at the terminals of the generator through a fault reactance of 0.1 Ω while it is operating at 20 kV. Compute the fault current in kA and phase voltage V_b. ***(04)***

3A. A synchronous generator supplies power to two identical synchronous motors. The reactances of the machines are in pu as shown:

Machine	X_1	X_2	X_0	X_n
Generator	0.4	0.3	0.2	0.0
Motor (each)	0.3	0.2	0.1	0.05

The neutral of the machines are grounded. A double line to ground fault occurs at the terminals of the motor. Neglecting prefault current, find the fault current and line currents of generator. ***(07)***

3B. A balanced resistive load in delta is connected across a 3 phase ABC system. The unbalanced phase currents are I_{ab} = 10 + 6j; I_{bc} = 12 – 14j; I_{ca} = –20 + 9j; Calculate the symmetrical components of line and phase currents. ***(03)***

4A. A generator with a sequence reactance of 0.2 pu is grounded through a reactance of 0.05 pu. It supplies a motor through a transformer. Zero sequence reactance of motor is 0.3 pu and its neutral is solidly grounded. The leakage reactance of transformer is 0.1 pu. Draw the zero sequence networks for the following connections of transformer: i) star grounded-delta ii) delta –delta iii) star isolated – star grounded. Also find the zero sequence Thevenin's impedance, if a fault occurs at the primary of transformer in all the cases. ***(04)***

4B. A 50 Hz, 100 MVA synchronous generator having an inertia constant of 2.5 MJ/MVA represented by a voltage source of 1.03 pu in series with a transient reactance of 0.15 pu is connected through a transmission line of reactance 0.25 pu to an infinite bus of 1.0 pu. The generator is transmitting an active power of 80 MW. Calculate (i) the maximum input mechanical power beyond which the system loses transient stability, (ii) clearing angle, maximum swing of the rotor and transient stability of the system if a 3-phase short circuit fault occurs at the terminals of the generator and is cleared in 5 cycles using equal area criterion. ***(06)***

5A. Form the bus admittance matrix of the system shown in Fig. Q5(A) whose impedance values are given in pu. The total shunt admittance of each line is 0.03 pu. Reduce the network by matrix algebra.

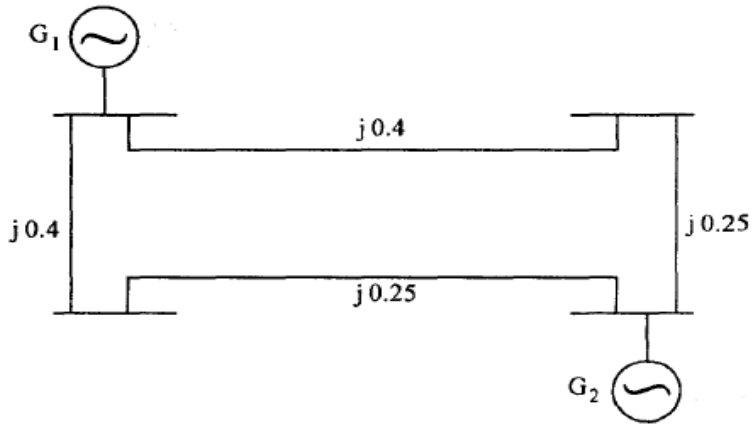

Fig. Q5(A) ***(04)***

5B. For a 3-bus system, bus 1 is slack bus with V_1=1+j0 pu. Bus 2 is a PV bus with $|V_2|$=1.03 pu & 3 is PQ bus. The Bus admittance matrix is given below. Compute the elements of Jacobian matrix for the first iteration using N-R method. Assume flat start.

$$Ybus = \begin{bmatrix} 10 - j20 & -10 + j20 & -10 + j20 \\ -10 + j20 & 10 - j20 & -10 + j20 \\ -10 + j20 & -10 + j20 & 10 - j20 \end{bmatrix}$$ ***(06)***