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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

V SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: POWER SYSTEM ANALYSIS [ELE 3105]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 24 November 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Graph sheet shall be supplied if required.

1A Derive the equivalent circuit parameters of a three winding transformer. Explain how to obtain the per unit impedances. ***(03)***

1B The single line diagram of a two machine system is as shown in Fig.1B. Draw the impedance diagram of the system choosing a base of 11.5 kV, 60 MVA in the motor circuit. The transformer T2 comprises of 3 single phase units each rated 15 MVA, 11/127 kV and 10% reactance.

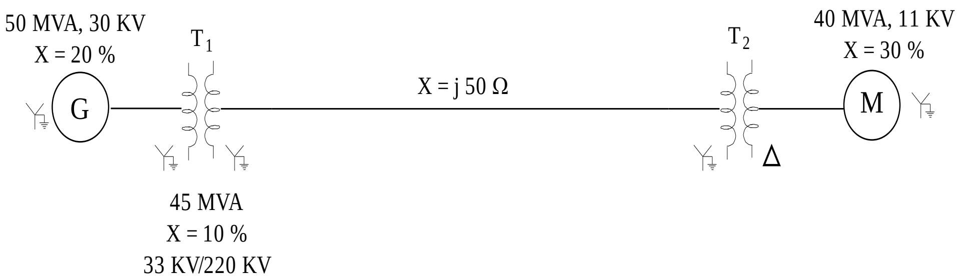

Fig.1B ***(07)***

2A Derive an expression for three phase power in terms of symmetrical components ***(02)***

2B A three phase fault occurs on the feeder on the busbar of station **D** in the 33 kV system shown in Fig. 2B. Estimate the rating of the circuit breaker in the faulty feeder.

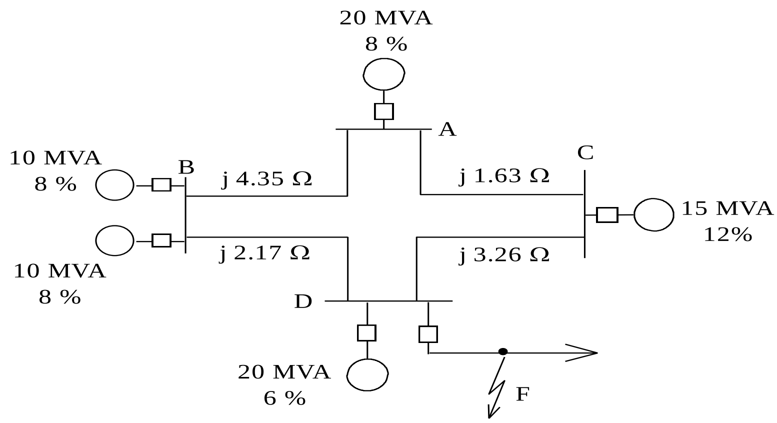

Fig.2B ***(08)***

3A A 100 MVA, 13/110 kV delta-star transformer is connected to a transmission line. When subjected an unsymmetrical fault, positive, negative and zero sequence currents in transmission line are – j 1.5 pu, + j 0.5 pu and + j 1.0 pu respectively. Obtain the unbalanced line currents in Amp on LT side of transformer. ***(03)***

3B The single line diagram of a power system is shown in Fig. 3B. The reactances are in pu on a common base are as shown below:

G_1, G_2, M : $X_1 = X_2 = j\,0.1$; $X_0 = j\,0.08$; $X_{Gn} = j\,0.03$
T_1, T_2, T_3 : $X = j\,0.1$
L_1 : $X_1 = X_2 = j\,0.3$; $X_0 = j\,0.5$;
L_2, L_3 : $X_1 = X_2 = j\,0.2$; $X_0 = j\,0.4$;

Draw the positive, negative and zero sequence networks of the power system. For an unsymmetrical fault at motor terminals C, determine equivalent positive, negative and zero sequence reactance in pu.

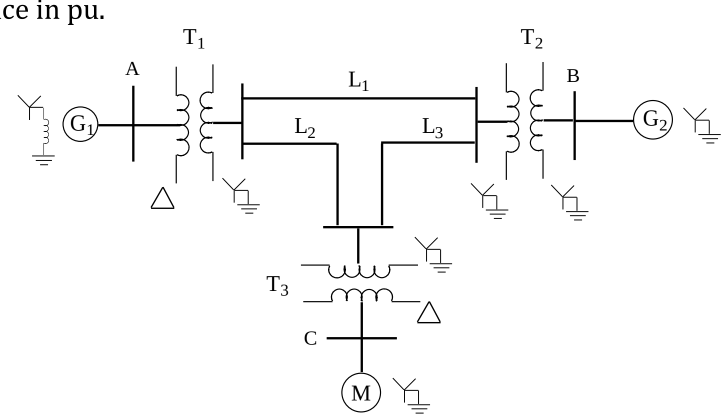

Fig.3B ***(07)***

4A The steady state power limit of a power network is 100 MW. Under stable conditions it is supplying 60 MW. Calculate the upper limit in MW for sudden change in mechanical input without loss of stability. ***(03)***

4B A typical 50 Hz power network with an inertia constant of 4.5 MJ/MVA has maximum power transfer capability of 2.5 pu, 0.8 pu and 1.6 pu before, during and after isolating the fault respectively. Before fault occurs, the system is stable supplying 1.0 pu of active power. Plot swing curve for sustained fault up to 0.5 second with a step interval of 0.05 second and hence determine critical clearing time. ***(07)***

5A Using matrix algebra eliminate node 3 of the network given in Fig.5A and obtain the reduced network. Verify the result by star delta transformation.

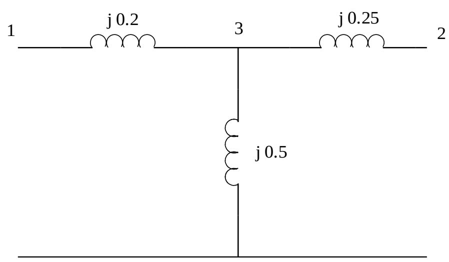

Fig.5A ***(03)***

5B A 3-bus network is described as shown below:

Bus no.	Per Unit Voltage	Per Unit Injected power
1	$1.05\angle 0^o$	?
2	$1.08\angle 3.8^o$	1.0 + j 0.6
3	$0.98\angle -1.7^o$	– 1.2 – j 0.5

The line impedance between any two bus is (0.03 + j 0.12) p.u. Determine line losses and injected power of slack bus. Use Gauss-Siedel Method. ***(07)***