7E4172

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B. Tech. (Sem. VII) (Main/Back) Examination- Dec. 2013
Electrical Engineering
EE2 Power System Analysis

Total Marks : 80
Min. Passing Marks : 24

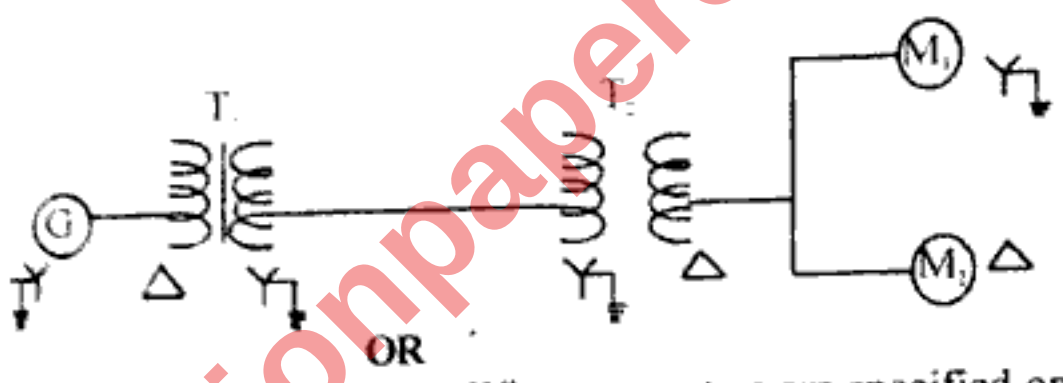
3 hours

Instructions to Candidates
Attempt any five questions selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

UNIT–I

1 (a) What is Per Unit System? How are the base quantities selected? What are the advantages of per unit system? (8)

(b) A 30 MVA, 11 kV, 3-φ(Phase), generator has a reactance of 25%. The generator supplies two motors through transformers and transmission line as shown in fig. Transformer T_1 is a 3 phase X_{mer} 100 MVA, 10/132 kV, 6% reactance. Transformer T_2 is composed of 3 single phase units each rated 30 MVA, 66/10 kV, 5% reactance. Motors are rated 50 MVA, and 40 MVA both 10 kV and 20% reactance. Taking generator rating as base draw reactance diagram and indicate reactances in per unit. The reactance of line is 1000 ohms. (8)



OR

1. (a) Enumerate the difference types of buses in power system. What parameters are specified on these buses? (4)

(b) Fig. shows a 4 bus system. The shunt admittances at the buses are negligible. The line impedance are as below :

Line (Bus to bus)	1-2	2-3	3-4	1-4
R(pu)	0.025	0.02	0.05	0.04
X(pu)	0.10	0.08	0.20	0.16

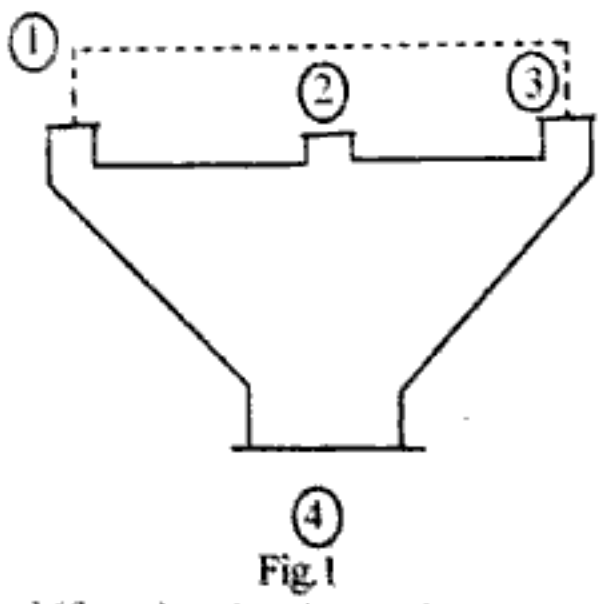


Fig.1

(i) Assume that the line shown dotted (from bus 1 to bus 3) is not present. Formulate Y_{Bus} matrix.

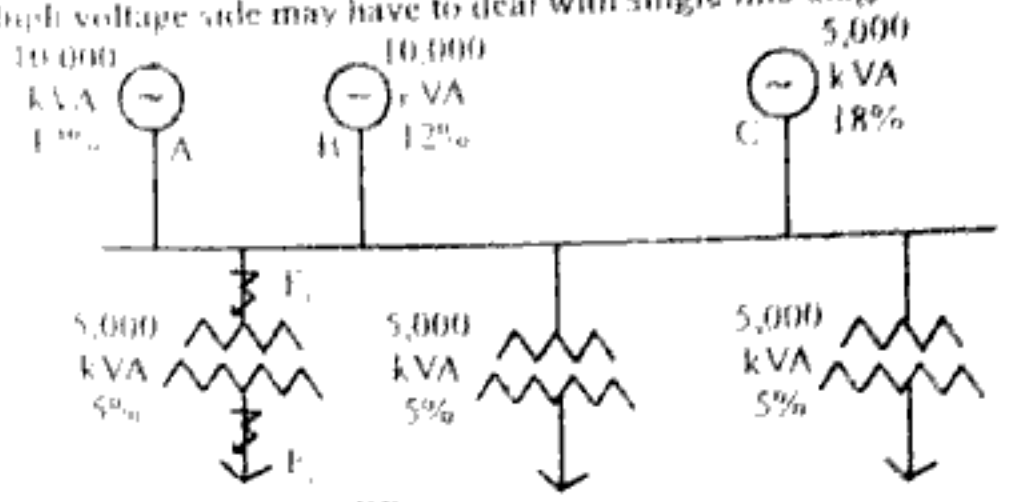
(ii) Which element of the Y_{Bus} obtained above are affected when the line from bus 1 to 3 is added? (The new line has no mutual coupling with other lines) If the p.u impedance of this line is 0.1 + j0.4. Find new Y_{Bus} matrix. (12)

UNIT–II

2. (a) Discuss the analysis of short circuit on a loaded synchronous machine and draw models for computing subtransient current, transient current etc. (8)

(b) The plant capacity of a 3-φ generating station consists of two 10,000 kVA generator of reactance 12% each and one 5000 kVA generator of reactance 18%. The generators are connected to the station bus-bars from which load is taken through thre

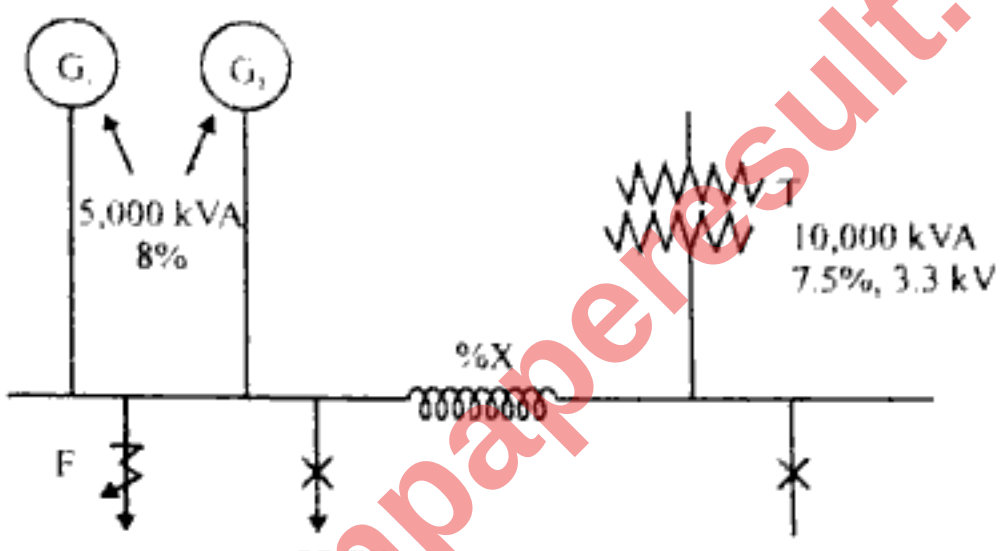
5000 kVA step up transformer each having a reactance of 5%. Determine the maximum fault MVA which the circuit breakers on (i) low voltage side and (ii) high voltage side may have to deal with single line diagram is shown in Fig. **(8)**



OR

(a) Draw equivalent ckts of synchronous machine under subtransient, transient and steady state conditions. **(6)**

(b) A small generating station has two alternators each of 5000 kVA and 8% reactance. The circuit breakers (on outgoing feeders) are rated at 150 MVA. This system is to be extended by taking supply from a grid via a 10,000 kVA transformer having negligible resistance and 7.5% reactance. If the same circuit breakers are to be used find the reactance (in ohms) which should be placed between the bus bar section of generating station and the supply from grid. The generation voltage of the station is three-phase 3.3 kV



(10)

UNIT – III

3. (a) What are symmetrical components? Explain clearly with the help of vector diagrams the positive, negative and zero sequence quantities. **(8)**

(b) An unbalanced star-connected three-phase supply having negligible internal impedance is connected to three identical voltmeters in star connections. Each voltmeter has a resistance of 10,000 ohms and negligible Reactance. The supply voltages of the three-phases from line-to-neutral are respectively.

$E_R = 100\angle 0°$,

$E_Y = 200\angle 270°$,

$E_B = 100\angle 120°$.

Using the method of symmetrical components determine the reading of the voltmeter connected to the yellow line. **(8)**

OR

4. An 11 kV, 100 MVA, alternator with solidity grounded neutral has positive sequence and negative sequence reactance of 0.2 pu each and zero sequence reactance of 0.05 pu. It is supplying an 11 kV, 50 MVA motor with positive and negative reactance of 0.2 pu and zero sequence rectance of 0.05 pu through a short line. The neutral of the motor is also solidly grounded. The transmission line has positive and negative sequence reactance of 0.05 pu and zero sequence reactance of 0.15 pu on 100MVA base. The motor is drawing 40 MW, at 0.8 pf leading with terminal voltage of 10.95 kV when a single line to ground fault occurs at the generator terminals of phase a. Calculate total current in the phase a of generator and motor under fault condition. **(16)**

UNIT – IV

5. (a) Derive necessary equation to determine fault current for a line to line fault through a fault impedance of Z_f. Draw the diagram showing interconnection of sequence networks. **(8)**

(b) A balanced star connected load takes 90A from a balanced 3 phase, 4 wire supply. If the fuses in Y and B phases are removed, find the symmetrical Components of the line currents–

(i) Before the fuses are removed

(ii) After the fuses are removed. **(8)**

OR

6. Two 11kV, 50MVA, 3 phase alternators are connected in parallel. Each alternator has a reactance to positive, negative and zero sequence, currents of 0.6 ohms, 0.40 ohms and 0.20 ohms respectively, and has its neutral earthed through a reactance of 0.2 ohm.

The alternators supply a substation through a feeder having impedances of 0.4 + j0.7 ohms to positive and negative sequence currents and 0.7 + j3.0 ohms to zero sequence currents.

A double line to ground fault occurs at the substation. Calculate -

(a) The fault currents,

(b) Potential above ground attained by alternator neutrals. (8)

UNIT–V

5. (a) Derive the static load flow equations and define clearly the conditions and assumptions made in obtaining these equations. (8)

(b) Discuss the Newton Raphson method for load flow study in brief and derive various Jacobian matrix elements. (8)

OR

5. (a) Discuss the Fast decoupled method with assumptions and obtain the final form of it. (8)

(b) Fig. shows the one line diagram of a simple 3 bus system with generators at buses 1 and 3. The magnitude of voltage at bus 1 is adjusted to 1.05 p.u. voltage magnitude at bus 3 is fixed at 1.04 pu with a real power generation of 200MW. A load consisting of 400 MW and 250 Mvar is taken from bus 2. Line impedances are marked in per unit. On a 100 MVA base, and the line changing susceptances are neglected. Obtain the power flow solution by the fast decoupled method. (only one iteration).