NEW SCHEME

EE61

Reg. No.

Semester B.E. Degree Examination, January/February 2006

Electrical & Electronics Engineering

Power System Analysis and Stability

Time: 3 hrs.) (Max.Marks : 100

Note: *Answer any FIVE full questions.*

1. (a) Define the per unit (p.u) quantity. Mention the advantages of Per unit system. **(6 Marks)**

(b) Prove the per unit impedance of a transformer remains same whether it is referred to primary side or secondary side. **(4 Marks)**

(c) For the given single phase circuit of a power system draw the per unit impedance diagram. By using the base values of 30 KVA and 240 volts in generator circuit, determine the per unit Z's and per unit source voltage. Then calculate the load current both in per unit and Amps.

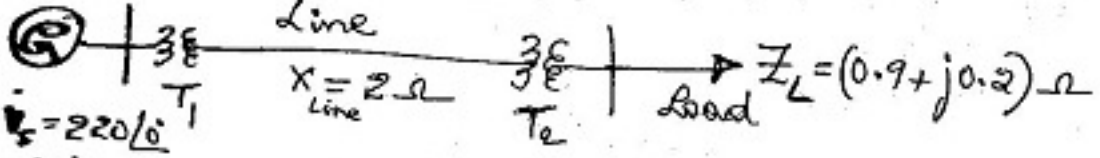

Fig. Q.1(c).

Ratings are : Transformers T_1 : 30 KVA, 240V/480V X_{eq} = 0.1pu

T_2 : 20 KVA, 460V/115V, X_{eq} = 0.1 pu **(10 Marks)**

2. (a) With the help of oscillogram of fault current, explain clearly short circuit currents, and reactances with reference to unloaded synchronous generator under short circuit conditions. **(10 Marks)**

(b) A synchronous generator and motor are rated for 30,000KVA, 13.2 kV and both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of machine ratings. The motor is drawing 20,000 kW at 0.8 p.f leading. The terminal voltage of the motor is 12.8KV. When a symmetrical three phase fault occurs at motor terminals, find the subtransient current in generator, motor and at the fault point. **(10 Marks)**

(c) Deive the expression for 3ϕ power in terms of symmetrical components. **(10 Marks)**

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(b) A balanced star connected load takes 30 amps from balanced $3\phi 4$ wire supply. If the fuses in one and two lines are removed, find the symmetrical components of the line currents, before and after the fuses removed. **(10 Marks)**

4. (a) Prove that only in power systems having balanced impedances, currents of a given sequence produce voltage drops of the same sequence. **(5 Marks)**

(b) In a three phase four wire system, the sequence components of currents and voltages are :

$$I_{a0} = (0.1 + j0.2)pu \qquad V_{a0} = (0.1 + j0.2)pu$$
$$I_{a1} = (0.8 + j0.2)pu \qquad V_{a1} = (1 + j0)pu$$
$$I_{a2} = (0.2 - j0.2)pu \qquad V_{a2} = (0.2 + j0.2)pu$$

Determine the total three phase complex power in MVA if the base is 100 MVA. **(7 Marks)**

(b) Explain the phase shift of symmetrical components in star - delta transformer bank with respect to voltage relations and current relations. **(8 Marks)**

5. (a) A double line to ground (DLG) fault takes place at the terminals of an unloaded alternator. Show that how the sequence networks are to be inter connected to represent the fault and also obtain for the fault current. **(10 Marks)**

(b) Draw the sequence networks for the system shown in figure. Determine the fault current for a line to line fault occurs at F. The p.u. reactances all referred to the same base are as follows :

Components	X_0	X_1	X_2
Gen. G_1	0.05	0.30	0.2
Gen. G_2	0.03	0.25	0.15
Line- 1	0.7	0.30	0.30
Line - 2	0.7	0.30	0.30
Tfr. T_1	0.12	0.12	0.12
Tfr. T_2	0.10	0.10	0.10

Both the generators are generating at 1.0pu. **(10 Marks)**

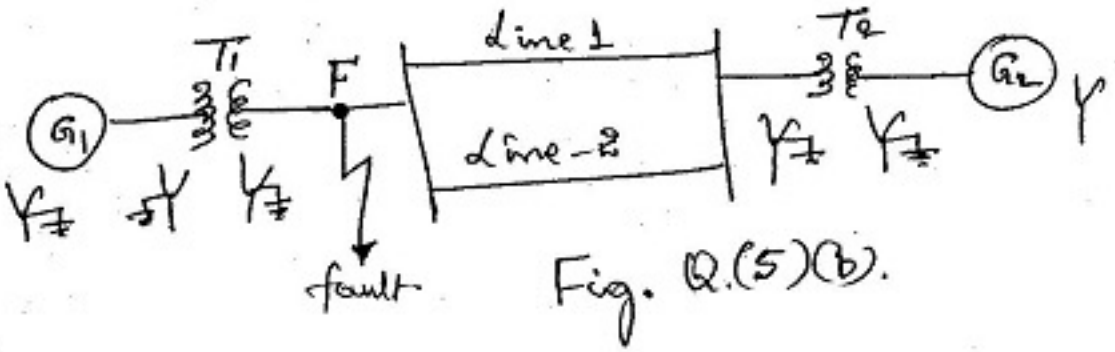

Fig. Q.(5)(b).

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6. **(a)** Explain the following terms:

i) Steady state stability

ii) Dynamic stability

ii) Transient state stability **(6 Marks)**

(b) Derive the steady state stability limit (SSSL) of a two terminal pair network represented by ABCD constants. **(8 Marks)**

(c) A 60 Hz, 4 pole turbogenerator rated 500MVA, 22 KV has an inertia constant of H = 7.5 MJ/MVA. Find :

i) Kinetic energy stored in rotor at synchronous speed

ii) Find the angular acceleration if electrical power developed is 400 MW when the input minus rotational losses is 740,000 HP. **(6 Marks)**

7. **(a)** Derive the expression for critical clearing angle when the fault occurs on one of the double circuit lines. Explain the importance of critical clearing time. **(10 Marks)**

(b) The generator of figure is delivering 1.0pu.power to the infinite bus $[@V_{\infty} = 1.0pu]$. The generator terminal voltage is $|V_t| = 1.0pu$. Calculate the generator e.m.f behind transient reactance. Find the maximum power that can be transmitted under the following conditions.

i) system healthy

ii) one line shorted (3 in ϕ) in the middle

iii) one line open

iv) plot all the three power angle curves **(10 Marks)**

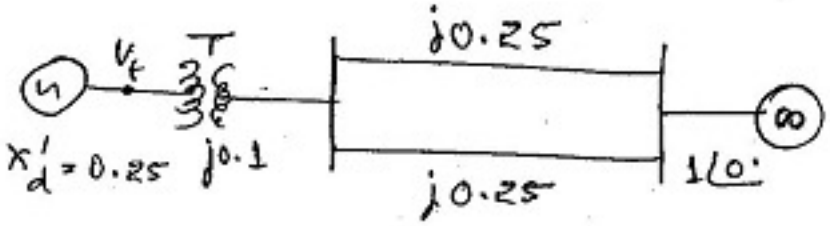

Fig. Q(7)(b)

8. Write short notes on any FOUR of the following : **(5×4=20 Marks)**

a) Per unit impedance of three winding transformer

b) Swing equation

c) Zero sequence networks for various transformer connections

d) Selection of circuit breakers

e) Equal area criterion

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