CBCS SCHEME

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15EE62

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Power System Analysis – I

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Define Per Unit Quantity. Enumerate the advantages of per unit representation. **(06 Marks)**

b. A 90 MVA, 11KV, 3-phase generator has a reactance of 25%. The generator supplies two motors through transformers and transmission line as showing in Fig Q1(b). The transformer T_1 is a 3-phase transformer, 100MVA, 10/132kV, 6% reactance. The transformer T_2 is composed of 3 single phase units each rated at 30MVA, 66/10kV with 5% reactance. The motors are rated at 50MVA and 40MVA both 10kV and 20% reactance. Taking the generator rating as base. Draw reactance diagram and indicate the reactance's in per unit. The reactance of line is 10Ω.

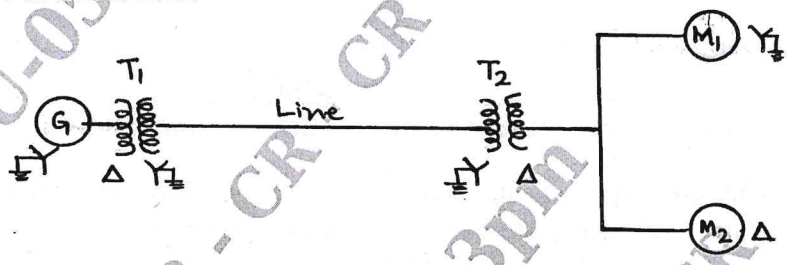

Fig Q1(b) **(10 Marks)**

OR

2 a. State the criteria for the selection of base quantities and show that the perunit impedance of a transformer is the same when referred to either its primary side or secondary side. **(08 Marks)**

b. A 3- phase generator rated 80MVA, 7.5kV with a reactance of 20% is connected through a Δ-Y transformer to a HV transmission line. The series impedance of the line is (30+j70) Ω. The other end of the line is connected to a load circuit of 50mW at 0.9 power factor lag at 13.8kV through a step-down transformer connected in Y-Y. Both transformer banks are composed of single phase transformers connected for three phase operation. Each of the single phase transformers in each bank is rated 30MVA, 8/127kV with a reactance of 10%. Draw the impendence diagram and mark all reactance in p.u. on a base of 100MVA, 220KV in the transmission line. **(08 Marks)**

Module-2

3 a. Write a note on selection of circuit Breakers. **(06 Marks)**

b. Two generators are connected in parallel to the low voltage side of a three phase Δ-Y transformer. The ratings of the machine are ;

Generator G_1 : 50 MVA, 13.8 KV, $X_d'' = 25\%$

Generator G_2 : 25 MVA, 13.8 KV, $X_d'' = 25\%$

Transformer T : 75MVA, 13.8 Δ-69 YKV, X = 10%

Before the fault occurs, the voltage on the high voltage side of transformer is 66kV, the transformer is unloaded, and there is no circulating current between the generators. Find the subtransient current in each generator when three phase fault occurs on the high voltage side of the transformer. **(10 Marks)**

OR

4 a. With the oscillogram of the short circuit current of a synchronous machine, define subtransient reactance, transient and steady state reactance. **(06 Marks)**

b. A synchronous generator and a synchronous motor each rated 25MVA, 11kV having 15% sub-transient reactance are connected through transformers and a line as a shown in Fig Q4(b). The transformers are rated 25MVA, 11/66kV and 66/11kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25MVA, 66kV. The motor is drawing 15mW at 0.8 power factor leading and a terminal voltage of 10.6kV when a symmetrical 3-ϕ fault occurs at the motor terminals. Find the subtransient current in the generator, motor and fault.

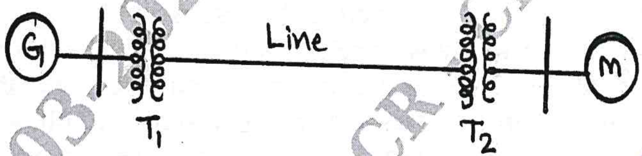

Fig Q4(b) **(10 Marks)**

Module-3

5 a. Derive an expression for the 3-ϕ complex power in terms of symmetrical components. **(08 Marks)**

b. What are sequence impedances and sequence network? Draw the zero sequence networks for any four combinations of 3-ϕ transformer bank. **(08 Marks)**

OR

6 a. With the help of relevant diagram for voltages and currents establish the phase shift of symmetrical components in Y-Δ transformer. **(08 Marks)**

b. Three phase unbalanced voltages with $V_{a1} = 1\angle 0^\circ$ p.u; $V_{a2} = 0.3\angle 90^\circ$ p.u and $V_{a0} = 0.1\angle -90^\circ$ p.u are applied across a load with $Z_1 = Z_2 = 1.2\angle 30^\circ$ p.u and $Z_0 = 2.5\angle 45^\circ$ p.u. Determine the 3-phase complex power delivered in p.u and in MVA on a base of 10MVA. **(08 Marks)**

Module-4

7 a. A single line to ground fault occurs at the terminals of an unloaded generator with neutral grounded. Derive an expression for the fault currents; draw the connection of sequence networks. **(10 Marks)**

b. What are the different types of unsymmetrical faults and explain in brief their frequency of occurrence? **(06 Marks)**

OR

8 a. For two conductor open fault, derive expression for current and draw connections of sequence network to represent the fault. **(08 Marks)**

b. A 3-phase generator with line to line voltage of 400V is subjected to an LLG fault. If $Z_1 = j2\Omega$, $Z_2 = j0.5\Omega$, and $Z_0 = j0.25\Omega$. Determine the fault current. **(08 Marks)**

Module-5

9 a. Derive power angle equation of a salient pole synchronous machine. **(08 Marks)**

b. A 200MVA, 2 pole, 50Hz alternator has a moment of inertia of 50×10^3 kg/mt^2.

i) What is energy stored in the rotor at the rated speed?

ii) Find the valve of H and determine the corresponding angular momentum. **(08 Marks)**

OR

10 a. Explain, equal area concept when a power system is subjected to sudden loss of one of parallel line. **(08 Marks)**

b. A generator operating at 50Hz delivers 1.0pu power to an infinite bus through a transmission current in which resistance is ignored. A fault take place reducing the maximum power transferable to 0.5pu, whereas before the fault, this power was 2.0pu and after clearance of the fault it is 1.5pu. By the use of equal area criteria, determine the critical clearing angle. **(08 Marks)**

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