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B.Tech. (Electronics & Electrical Engg.) (2012 to 2019) (Sem.7,8)

POWER SYSTEM ANALYSIS

Subject Code : BTEE-801

M.Code : 71930

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt ANY FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt ANY TWO questions.**

SECTION-A

1. Write briefly :

a) What is the significance of single line diagram?

b) Prove that per unit impedance of transformer referred to any side of transformer remains same if the base voltage on each side is assumed proportional to the turns ratio.

c) What is a transient?

d) Write the limitations of Newton Raphson method.

e) What are the various faults that occur in a power system network?

f) A 2-pole, 50Hz, 60MVA turbo-generator has a moment of inertia of 9.2×10^{3} Kg-m^2. Calculate the kinetic energy in MJ at rated speed; and the inertia constants M and H.

g) What are the various different representations of an electrical load?

h) What is synchronizing power coefficient? State the steady state stability criterion for a simple system.

i) What information does an equal area criterion of stability provide?

j) Draw the zero sequence networks of Yg-Δ and Yg-Y transformers.

SECTION-B

2. Show the interconnection of sequence networks for a L-L fault occurring in a power system network. Derive the relevant results.

3. What are symmetrical components? Derive the relations to convert the phase quantities to symmetrical components.

4. A double-circuit three-phase feeder connects a single generator to a large network. The power corresponding to the limit of steady-state stability for each circuit is 90MW. The line is transmitting 75MW when one of the circuits is suddenly switched out. Determine with reference to appropriate diagram whether the generator is likely to remain in synchronism.

5. What are the various buses that exist in a power system network? Discuss the role of each bus. How is voltage controlled bus different from a PV bus?

6. A small generating station has two alternators, each 5MVA with a reactance of 10%, connected to a bus bar. The circuit breakers at the out-feed are rated 150MVA. A new supply is added rated 10MVA with a reactance of 8%. Can the same breakers be used? If not, what is the value of the reactance to be connected in series with the bus bar section, if the bus bar voltage is 3.3kV?

SECTION-C

7. a) State and prove 'Equal Area Criterion'.

   b) A generator with constant excitation supplies 25MW through a step-up transformer and a high voltage line to an infinite busbar. If the steady-state stability limit of the system is 50MW, estimate the maximum permissible sudden increase of generator output (resulting from a sudden increase in prime mover input) if the stability is to be maintained. The resistances of the generator, transformer and line may be neglected.

8. a) Two alternators operate in parallel and have the following capacity and percentage reactance :

Component	Capacity	Percentage reactance
Alternator A	7MVA	7.5
Alternator B	11MVA	10

   The generating station is connected to a transmission line of 2500km length, through a step-up transformer of capacity 10MVA and having a percentage reactance of 5.0%. The resistance and reactance of the transmission line per km of its length are 0.002 Ohm and 0.02 Ohm respectively and it operates at 66kV. Calculate the short-circuit MVA for a three phase fault at the receiving end of the transmission line, and at the sending end.

   b) Assume a four bus power system network and construct its Z-bus using Z-bus building algorithm.

9. For the network with details as given below and bus 1 as the slack bus, use Gauss-Seidal method to obtain two iterations for the load flow solution. The line and bus data is given in Table-1 and Table-2, respectively.

Table-1: Line data (All quantities are in p.u.)

Line Number	Between Buses	Line Impedance	Half line charging admittance
1	1-2	j0.10	0
2	2-3	j0.15	0
3	1-3	j0.25	0

Table-2: Bus data

Bus No.	Type	Generator		Load		Voltage magnitude
		P	Q	P	Q	
1	Slack	-	-	-	-	1.0
2	P-V	5.3115	-	-	-	1.08
3	P-Q	-	-	3.6284	0.5227	-

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.