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M.Tech. (Pow Engg.) (Sem.–1)

ADVANCED POWER SYSTEM ANALYSIS

Subject Code : PEE-502

Paper ID : [E0482]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWENTY marks.

1) For the network with details as given below and bus 1 as the slack bus, use FDLF method to obtain three iterations for the load flow solution. The line and bus data is given in Table-1 and Table-2, respectively. (20)

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

Line Number	Between Buses	Line Impedance	Half Line charging admittance
1	1-2	j0.15	0
2	2-3	j0.25	0
3	1-3	j0.35	0

Table-2: Bus data

Bus No.	Type	Generator		Load		Voltage magnitude	Reactive power limit	
		P	Q	P	Q		Q_{min}	Q_{max}
1	Slack	-	-	-	-	1.0	-	-
2	P-V	5.3217	-	-	-	1.1	0	5.3217
3	P-Q	-	-	3.6412	0.5459	-	-	-

2) Explain with a five bus system, the formation of Z-bus using Z-bus building algorithm. (20)

3) a) What is a '*Load Flow Study*'? What is its need? What are the various methods to solve the Load flow problem? Compare these methods. (10)

b) Explain the Newton Raphson method to obtain the load flow solution. Also, write the detailed algorithm to solve load flow problem using this method. (10)

4) a) What do you understand by '*Per Unit*' system? What are the advantages of using the per unit system? Derive the related results. (5)

b) What are symmetrical components? Discuss their significance. Derive the expressions to convert the phase quantities to the sequence components and vice- versa. (5)

c) Show the interconnection of sequence networks for a L-L fault occurring in a power system network. Derive the relevant results. (10)

5) a) A 10MVA, 6.9kV star connected generator has positive, negative and zero sequence reactances of 26, 22 and 8% respectively. An inductive reactor with 6% reactance based on the rating of the generator is placed in the line from neutral to ground. For a L-L-G fault at the generator terminals when it is operating at rated voltage and is disconnected from the system determine, (a) initial symmetrical r.m.s. line and neutral currents and (b) line to line and line to neutral voltages. (10)

b) Two alternators operate in parallel and have the following capacity and percentage reactance

Component	Capacity	Percentage reactance
Alternator A	7 MVA	6.5
Alternator B	10MVA	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 5.4%. The resistance and reactance of the transmission line per km of its length are 0.003 ohm and 0.020 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. (10)

6) a) Discuss the contingency analysis for power systems using Brown's method. (10)

b) What do you understand by state estimation? In what application areas state estimation concepts are beneficial? How can the bad measurements be measured and identified? Write the orthogonal decomposition method used for state estimation. (10)

7) a) Discuss the application of graph theory to construct Y-bus for a 3-bus system. (10)

b) Distinguish between symmetrical and unsymmetrical faults. List the steps in the symmetrical fault calculations. How can the load current be taken into account in fault calculations? (10)

8) Write short notes on the following :

a) Formation of network matrices using non-singular transformation

b) Weighted least squares method for state estimation

c) Optimal ordering and Sparsity technique

d) L-G fault (5×4)