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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech (EE) (Sem.-7)

COMPUTER AIDED POWER SYSTEM ANALYSIS

Subject Code : EE-402

Paper ID : [A0429]

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) Answer the following in short :**

- a) What is the need of Load Flow Studies?
- b) What is the significance of slack bus in a power system network?
- c) What is a single line diagram of electrical networks?
- d) What are the various representations of an electrical load?
- e) A 60Hz generator connected directly to an infinite bus operating at a voltage of $(1+j0)$ p.u., has a synchronous reactance of 1.35 p.u. The generator no-load voltage is 1.1 p.u. and its inertia constant is 4 MJ/MVA. The generator is suddenly loaded to 60% of its maximum power limit. Determine the frequency of the resulting oscillation of the generator rotor.
- f) Compare the generator bus and the voltage controlled bus.
- g) A 50Hz, 4 pole turbo generator rated at 20 MVA, 13.2 kV has an inertia constant $H = 9$ kW-sec/kVA. Find the kinetic energy stored at synchronous speed. Find the accelerating torque if the shaft input less the rotational losses is 26,800 H.P. and the electrical power developed is 1600 kW.
- h) A single-phase, 66/11 kV, 17.5 MVA transformer has 1% resistance and 2.8% leakage reactance drop. Find the resistance and reactance of the transformer referred to HT side.
- i) Classify the various faults that can occur in a power system network.
- j) What are symmetrical components?

SECTION-B

- 2) 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?
- 3) Discuss the modeling of synchronous machines in a power system network.
- 4) What do you understand by the term 'Stability' of a power system? What are the various types of stability? Discuss these in brief. What are the factors that affect transient stability?
- 5) What do you understand by 'Per Unit' system? What are the advantages of using the per unit system? Derive the related results.
- 6) Prove that symmetrical component transformation is power invariant.

SECTION-C

- 7)
 - a) State and prove 'Equal Area Criterion'.
 - b) A generator with constant excitation supplies 30MW through a step-up transformer and a high voltage line to an infinite busbar. If the steady- state stability limit of the system is 60MW, 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	8.5MVA	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 5.5%. The resistance and reactance of the transmission line per km of its length are 0.0018 ohm and 0.018 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 Newton-Raphson 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	$j0.15$	0
2	2-3	$j0.22$	0
3	1-3	$j0.33$	0

Table-2 : Bus data

Bus No.	Type	Generator		Load		Voltage magnitude
		P	Q	P	Q	
1	Slack	-	-	-	-	1.0
2	P-V	5.3217	-	-	-	1.1
3	P-Q	-	-	3.6392	0.5339	-