Reg. No.												

Question Paper Code	12356

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

Fifth Semester

Electrical and Electronics Engineering

20EEPC501 - POWER SYSTEM ANALYSIS

(Regulations 2020)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Show the importance of per unit computation.	*2,K1,CO1*
2.	A three phase transformer has a nameplate rating of 30MVA, 230Y/69Y kV with a leakage reactance of 10% and the transformer connection is Y-Y. Choosing a base of 30MVA and 230kV on high voltage side , calculate the reactance of the transformer in p.u.	*2,K3,CO1*
3.	How the buses are classified and what are its types?	*2,K2,CO2*
4.	Why a slack bus is needed in load flow solution?	*2,K2,CO2*
5.	What do you understand by unsymmetrical faults in a power system?	*2,K2,CO3*
6.	Find the fault current if the prefault voltage at the fault point is 0.98 p.u.	*2,K3,CO3*

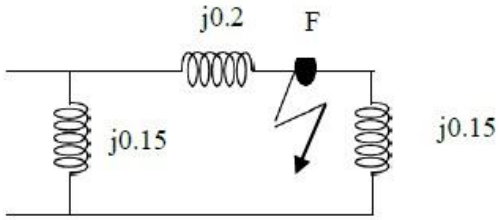

Figure 1

7.	What are symmetrical components in a power system?	*2,K2,CO4*
8.	Find the positive sequence current, if $I_a=18\angle 0^oA, I_b=10\angle -30^oA$, and $I_c=10\angle 30^oA$.	*2,K3,CO4*
9.	Write the expression for maximum power transfer.	*2,K2,CO5*
10.	What are the methods of improving transient stability?	*2,K2,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	The single line diagram of a simple power system is shown in Fig. The rating of the generators and transformers are given below: Generator 1: 25MVA, 6.6kV, X=0.2p.u Generator 2: 5MVA, 6.6kV, X=0.15p.u Generator 3: 30MVA, 13.2kV, X=0.15p.u	*13,K2,CO1*

Transformer1: 30MVA, 6.9Δ/115Y kV, X=10%
Transformer2: 15MVA, 6.9Δ/115Y kV, X=10%
Transformer3: 3 single phase units each rated 10MVA, 6.9/69 kV, X=10%

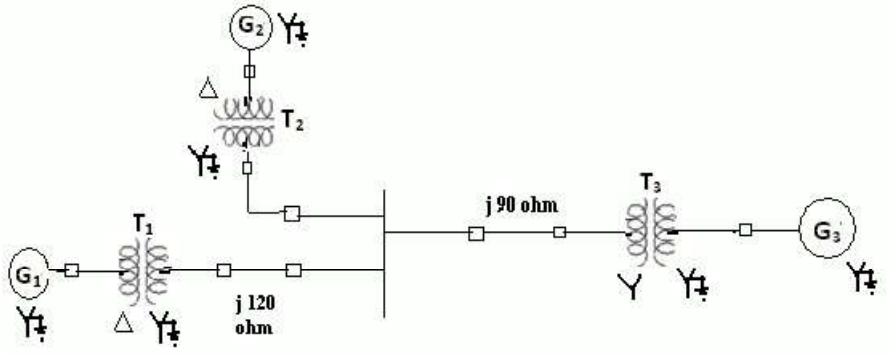

Figure 2

Construct the impedance diagram and mark all values in p.u choosing a base of 30MVA, 6.6kV in the generator 1 circuit.

OR

b) Find the Y matrix of the sample power system as shown in fig. Data for this system is given in table. *13,K3,CO1*

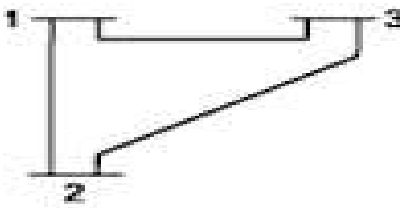

Figure 3

Bus code i-k	Impedance Z_{ik}	Line Charging Admittance Y'
1-2	0.02+j0.06	j0.03
1-3	0.08+j0.24	j0.025
2-3	0.06+j0.18	j0.020

12. a) With a neat flow chart explain the computational procedure for load flow solution using Gauss Seidal method when the system contains all types of buses. *13,K2,CO2*

OR

b) Consider the power system with the following data: *13,K3,CO2*

Y bus = $\begin{pmatrix} -j12 & j8 & j4 \\ j8 & -j12 & j4 \\ j4 & j4 & -j8 \end{pmatrix}$

Bus No.	Type	Generation		Load		Voltage	
		P	Q	P	Q	Magnitude	Angle
1	Slack	-	-	-	-	1.0	0
2	PV	5.0	-	0	-	1.05	-
3	PQ	0	0	3.0	0.5	-	-

Assume that the bus 2 can supply any amount of reactive power. With a flat voltage start, perform the first iteration of power flow analysis using NR method.

13. a) Explain how a symmetrical fault can be analyzed by using Z_{bus}. Also write the algorithm for the same. *13,K2,CO3*

OR

b) A 3 phase transmission line operating at 110kV and having impedance 5+j20 ohms is connected to the generating station through 15000 kVA step up transformer. Two alternators are connected to the bus bars. The ratings of the alternator are 10 MVA, 10%, 16 kV and 5 MVA, 7.5%, 16 kV. Calculate the short circuit MVA for a symmetrical fault at the load end of the transmission line. Take transformers reactance as 8%. *13,K3,CO3*

14. a) Two synchronous machines are connected through three phase transformers to the transmission line as given in fig. The ratings and reactance of the machines and transformers are; *13,K3,CO4*
Machines 1 and 2: 100MVA, 20kV, $X_d''=X_1=X_2=16\%$ $X_0=4\%$ $X_n=5\%$:
Transformers T1 and T2:100 MVA; 20/345 kV; X=7%
Both the transformers are solidly grounded on two sides on a chosen base of 100MVA, 345kV in the transmission line circuit. The line reactances are $X_1=X_2=8\%$ and $X_0=40\%$. The system is operating at nominal voltage without prefault currents when a bolted single to ground fault occurs on phase 'a' at bus 3. Determine the sub-transient current to ground at the fault.

Figure 4

OR

b) Derive the expression for fault current in line to line fault on an unloaded generator and draw an equivalent network showing the interconnection of networks. *13,K2,CO4*

15. a) Consider a single machine system shown in fig. Obtain the expression for critical clearing angle and critical clearing time when a three phase fault occurs at point F in the system. *13,K2,CO5*

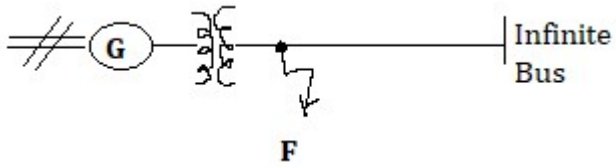

Figure 5

OR

b) Derive the swing equation of a single machine connected to an infinite bus system. *13,K2,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) Two 11kV, 20 MVA, three phase star connected generators operate in parallel. The positive, negative and zero sequence reactance of each being respectively j0.18, j0.15, j0.10 p.u. The star point of one of the generator is isolated and that of the other is earthed through a 2.0 ohm resistor. A single line to ground fault occurs at the terminals of one of the generators. Estimate (i) fault current (ii) current in grounded resistor and (iii) voltage across grounding resistor. *15,K3,CO4*

OR

b) Analyze the transient stability of the system for a sudden change in mechanical input. *15,K3,CO5*