Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

Fifth Semester

Electrical and Electronics Engineering

EE3501 – Power System Analysis

Regulations - 2021

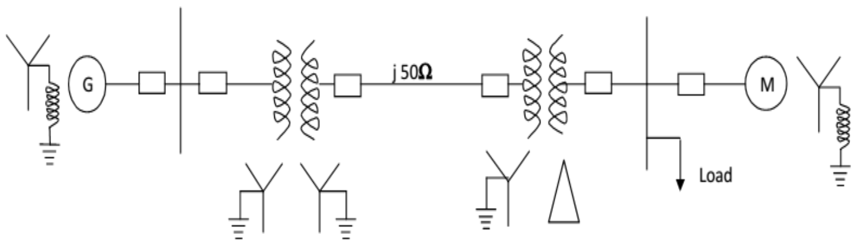
Duration : 3 Hrs ***Maximum : 100 Marks***

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BLT	CO	Marks
1.	State the need for system analysis in the planning and operation of the power system.	L2	1	2
2.	An alternator rated at 30 MVA, 11 kV has a reactance of 20%. Calculate its p.u. reactance for a base of 50 MVA and 10 kV.	L3	1	2
3.	Compare the Gauss-Seidel method with the Newton-Raphson method.	L4	2	2
4.	Analyze the effects of using a flat voltage start on the convergence speed and accuracy of load flow calculations in power systems.	L4	2	2
5.	A network has a transient reactance of 25% with generator emf equal to 1 p.u. Compute the transient current in the network.	L3	3	2
6.	Draw the oscillation characteristics of a generator when a sudden 3ϕ short circuit fault occurs at the terminals of an unloaded generator.	L3	3	2
7.	Define unsymmetrical fault and mention its types.	L1	4	2
8.	Draw the sequence network for line-to-line fault in a power system network.	L3	4	2
9.	State equal area criterion.	L1	5	2
10.	Draw the power angle curve of a synchronous machine.	L3	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

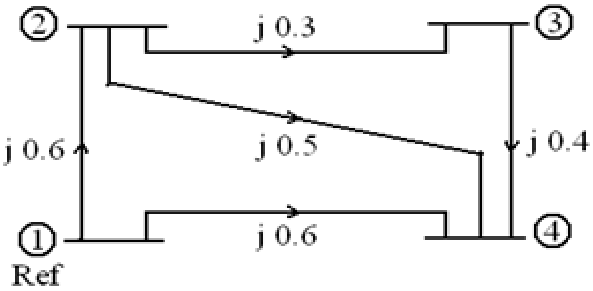
Q.No			Questions	BLT	CO	Marks
11.	a	i	Obtain the reactance diagram for the figure below using a base of 100 MVA, 220 kV in the j50Ω line.	L3	1	8



Generator: 40 MVA, 25 kV, X'' = 20%
Synchronous motor: 50 MVA, 11 kV, X'' = 30%
Star – Star transformer: 40 MVA, 33/220 kV, X= 15%
Star – Delta transformer: 30 MVA, 11/220 kV, X= 15%

Load: 11kV, 50 MW + j 68 MVAR

ii	Formulate Y_{bus} using the singular transformation method for the network shown in Fig. The impedance is given in p.u. Use node 1 as a reference.	L2	1	8



Or

b i	Formulate the bus admittance matrix for a four-bus system data, as given in the table below.	L3	1	8

S. No	Line (bus to bus)	Resistance in p.u	Reactance in p.u
1.	1-2	0.05	0.15
2.	1-3	0.10	0.30
3.	2-3	0.15	0.45
4.	2-4	0.10	0.30
5.	3-4	0.05	0.15

ii	Explain the modeling of the Generator and Transformer for the power flow study in detail.	L2	1	8
12. a i	For a three-bus power system network, obtain the complex bus bar voltage at bus 2 at the end of Gauss-Seidel's first iteration. The line impedance connected between buses 1 and 2 is (0.04+j0.06) p.u and the impedance between buses 2 and 3 is (0.02+j0.03) p.u. Voltage V_1= 1.0 p.u. P_2+jQ_2= (-0.2+j0.5), V_3= 1.02p.u.	L3	2	8
ii	Explain the steps in the Gauss-Seidel method for power flow analysis and draw a flowchart illustrating each step.	L2	2	8

Or

b i	A four-bus system has the following line reactances:	L3	2	8

Line code	Reactance in p.u
1-2	j0.5
2-3	j1.0
3-4	j1.0
1-4	j0.5

The bus specifications and values of injected powers are as follows:

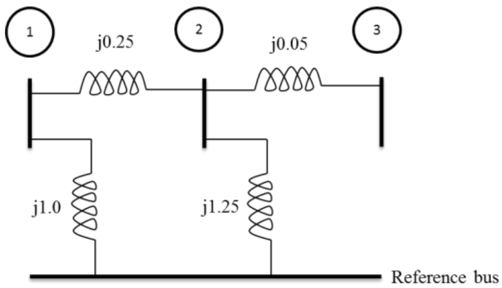
Bus	P	Q	V	Bus Specifications
1	-	-	1.05	Slack bus
2	-0.1	0	-	Load bus
3	0.5	-	1.04	Generator bus

4	-0.4	-0.05	-	Load bus

Use the Gauss-Seidel method and find the value of V_2 after the first iteration.

ii Construct a flowchart for the Newton-Raphson method, detailing each stage of the iterative process in power flow analysis. L1 2 8

13\. a i Find the bus impedance matrix for the network shown in the following figure. L3 3 8



ii Explain the procedure for calculating the fault current and fault MVA of a typical power system network. L2 3 8

Or

b i The current flowing in the lines toward a balanced load connected in Δ are $I_a = 100 \angle 0^0$, $I_b = 141.4 \angle 225^0$ and $I_c = 100 \angle 90^0$. Find the symmetrical components of the given line currents and draw phasor diagrams of the positive and negative- -sequence line and phase currents. L4 3 8

ii With the help of a detailed flowchart, explain how a symmetrical fault can be analyzed using Z_{bus}? L2 3 8

14\. a i Derive the necessary equation to determine the fault current for a single line to ground fault for an unloaded generator with its sequence networks. L3 4 8

ii Draw and explain the sequence impedance networks of transmission lines using symmetrical components. L3 4 8

Or

b i Derive the fault current for a double line to ground fault for an unloaded generator using symmetrical components. L3 4 10

ii The positive sequence impedance matrix of a 2-bus system is $j\begin{bmatrix} 0.15 & 0.20 \\ 0.10 & 0.30 \end{bmatrix}$ p.u. Find the fault current when the symmetrical fault occurs at bus 2. L3 4 6

15\. a i Derive the power angle equation of a two-machine system. L3 5 8

ii Derive the expression for equal area criterion for a single machine connected to an infinite bus system. L3 5 8

Or

b	i	Solve the swing equation using modified Euler's method in the study of power system.	L3	5	8
	ii	A 50 Hz, 4 pole alternator rated 100 MVA, 11 kV has an inertia constant of 5 MJ / MVA. (i) Determine the stored energy in the rotor at synchronous speed (ii) Calculate rotor acceleration for P_m=60 MW and P_e=40 MW.	L3	5	8