Reg. No.

B. E / B. TECH.DEGREE EXAMINATION, MAY 2023

Fifth Semester

EE18501 – POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

(Regulation 2018)

TIME:3 HOURS **MAX. MARKS: 100**

CO1	Develop the equivalent model of power system and construct the admittance and impedance matrices.
CO2	Formulate the steady-state power flow problem and apply numerical solution algorithms for analysis.
CO3	Compute short circuit capacity (SCC) of power system using matrix building algorithm under balanced fault.
CO4	Compute short circuit capacity (SCC) of power system using symmetrical components under various faults.
CO5	Formulate power system stability problem under large disturbance and apply numerical solution algorithms for analysis.

PART- A(10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Represent a transformer with off nominal tap ratio into its π-model equivalent circuit.	1	3
2.	Write the expression to determine new elements of Y-bus matrix after eliminating n^{th} node using Kron's reduction technique.	1	3
3.	Why one of the buses is taken as slack bus in power system?	2	2
4.	What is the best value of acceleration factor in Gauss-Seidel load flow solution method? Why is it necessary?	2	2
5.	The positive sequence impedance 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 symmetrical fault occurs at bus 2.	3	3
6.	Synchronous impedance is more than transient reactance – Justify.	3	4
7.	If the phase currents are $I_a = 2 + j3$, $I_b = 0$ and $I_c = -3 + j4\ Amp$ in a 3-phase, 4-wire system. Determine the current through the neutral.	4	3
8.	Why the neutral grounding impedance Z_n appears as $3Z_n$ in the zero sequence network?	4	4
9.	What is small signal stability and how it is analyzed?	5	4
10.	Write the expression for stiffness coefficient of synchronous machine.	5	4

Q. Code:379364

PART- B (5x 14=70Marks)

		Marks	CO	RBT LEVEL
11. (a)	Draw the reactance diagram for the power system shown in Figure 1. Neglect resistance and use a base of 100 MVA, 220 kV in 50Ω line. The ratings of the generator, motor and transformer are given below. Generator: 40 MVA, 25 kV, X''=20% Synchronous motor: 50 MVA, 11 kV, X''=15% Y-Y Transformer: 40 MVA, 33/220 kV, X=15% Y- Δ Transformer: 30 MVA, 11/220 kV (Δ/Y), X=15%	**(14)**	1	3

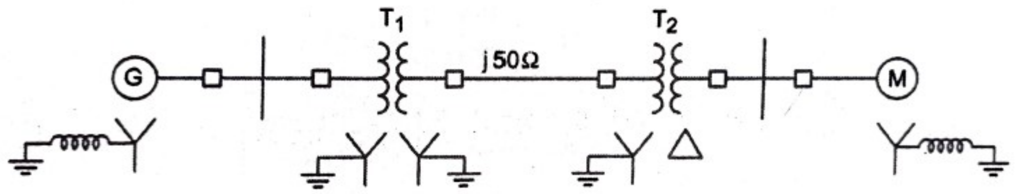

Figure 1

(OR)

		Marks	CO	RBT LEVEL
(b)	Form Y-bus by singular transformation for the network shown in Figure 2. The impedance data is given in Table 1. Take ① as reference node.	**(14)**	1	3

Table 1

Element No.	Self	
	Bus code	Impedance
1	1 – 2 (1)	0.6
2	1 – 3	0.5
3	3 – 4	0.5
4	1 – 2 (2)	0.4
5	2 – 4	0.2

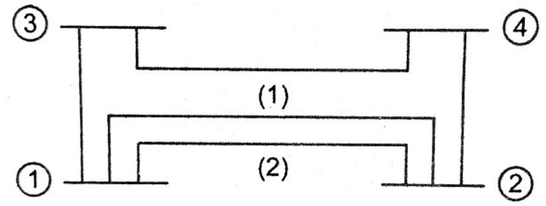

Figure 2

		Marks	CO	RBT LEVEL
12. (a)	Using Gauss-Seidal method, determine bus voltages for the power system shown in Figure 3. Take a base of 100 MVA and α=1.1.	**(14)**	2	3

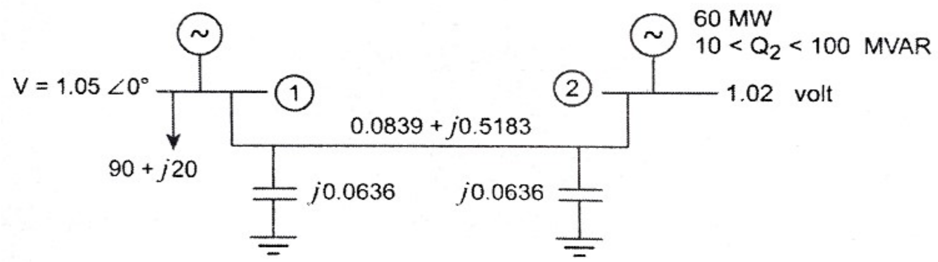

Figure 3

(OR)

(b) Explain the step by step computational procedure for the Newton-Raphson method of load flow studies. **(14) 2 3**

13. (a) A 3-phase 5 MVA, 6.6 kV alternator with a reactance of 8% is connected to a feeder of impedance (0.12+j0.48) Ω/phase/km through a step up transformer. The transformer is rated at 3 MVA, 6.6 kV/33 kV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9 kV, when a 3-phase symmetrical fault occurs at a point 15 km along the feeder. **(14) 3 3**

(OR)

(b) Explain the procedure for making short circuit studies of a large power system network using digital computers. **(14) 3 3**

14. (a) Determine the fault current and fault MVA for the L-G fault occurs at bus 3 for the power system shown in Figure 4. **(14) 4 4**

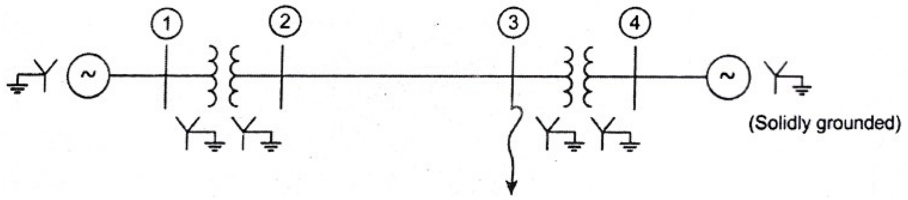

Figure 4

G_1, G_2: 100 MVA; 20 kV; $X_d''=X_1=X_2=20\%$; $X_0=4\%$

T_1, T_2: 100 MVA; 20/345 kV ( ) X=8%

Transmission line: $X_1=X_2=15\%$; $X_0=50\%$

(OR)

(b) Derive the expression for fault current in Double line-to-ground fault on an unloaded generator in terms of symmetrical components. **(14) 4 4**

15. (a) (i) Derive the expression for swing equation. **(10) 5 3**

(ii) Enumerate the expressions for critical clearing angle and time. **(4) 5 3**

(OR)

(b) With a neat flow chart explain the steps involved in Runge-Kutta method to determine stability. **(14) 5 3**

PART- C(1x 10=10Marks)

(Q.No.16 is compulsory)

	Question	Marks	CO	RBT LEVEL
16.	The currents flowing in the lines toward a balanced load connected in Δ are $I_a=10\angle 0^0$, $I_b=141.4\angle 225^0$ 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 currents.	**(10)**	**4**	**4**

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