CBCS SCHEME - Make-Up Exam

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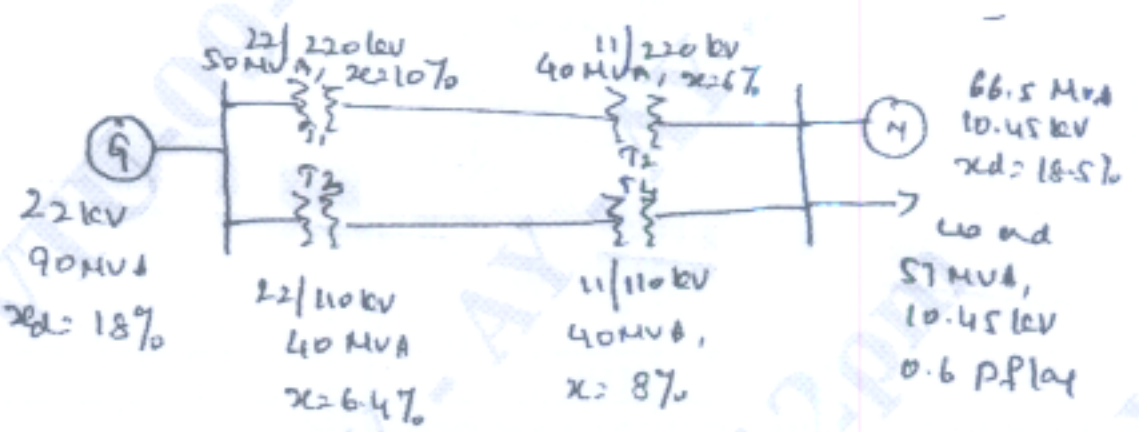
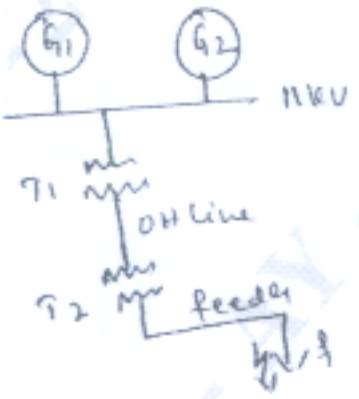
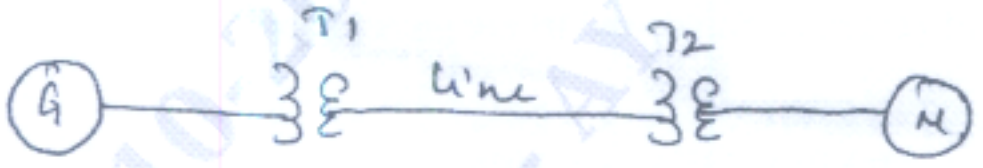
BEE601

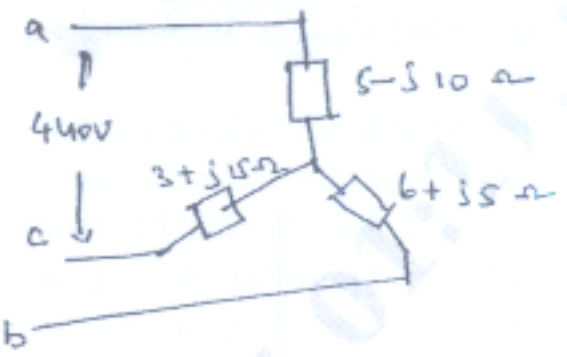
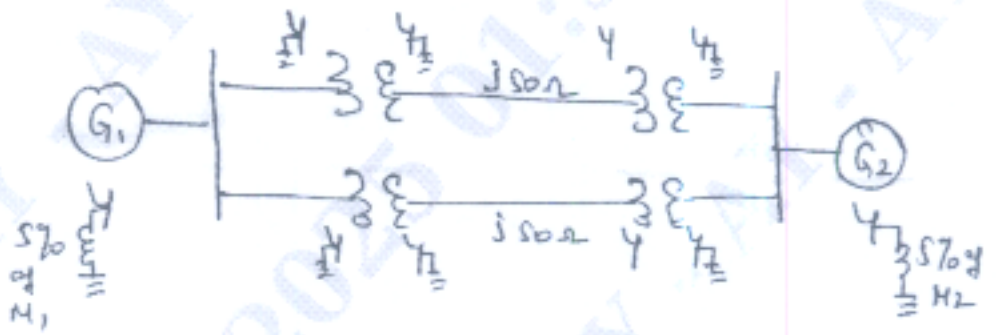
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Power System Analysis – I

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	What is per unit system? List the advantages of a per-unit system.	5	L1	CO1
	b.	Show that the per unit impedance of a two winding transformer on either of its side in equal.	5	L1	CO1
	c.	For the single line diagram of power system shown in Fig.Q.1(c). Draw the PU impedance diagram, select KV_b = 22 kV (generator side) MVA_b = 100.  Fig.Q.1(c)	10	L3	CO1
		OR			
Q.2	a.	What is single line diagram? What is the need of single line diagram? Explain the procedure for finding the per-unit reactance diagram by stating all the assumptions involved.	10	L1	CO1
	b.	A single line diagram of a power system is shown in the Fig.Q.2(b). Draw its impedance diagram. Choose a base of 100 MVA, 220 KV, in 50Ω line. The rating of generator, motor and trf are given below: Generator : 40 MVA, 25KV, x = 20% Sy. Motor : 50 MVA, 11KV, x = 30% y-y-Trf : 40 MVA, 33/220 KV, x = 15% y-Δ Trf : 30 MVA, 11/220 KV (Δ/y), x = 15%  Fig.Q.2(b)	10	L3	CO1

		Module – 2			
Q.3	**a.**	With the oscillogram of the short circuit current of a synchronous machine, define direct axis synchronous reactance, transient and sub-transient reactance.	**10**	**L2**	**CO2**
	b.	For the radial network shown, a 3 phase fault occurs at point f. Determine the fault current. Choose the generator ratings as base values: Generator G_1 : 10 MVA, 11KV, x = 20% Generator G_2 : 10 MVA, 11KV, x = 12.5% Transformer T_1 : 10 MVA, 11/33 KV, x = 10% Transformer T_2 : 25 MVA, 33/6.6 KV, x = 8.7% Overhead line Imp Z = 6 + j10Ω Feeder Impedance Z = 0.5 + j0.15Ω  Fig.Q.3(b)	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Derive the equation of a transient on a transmission line.	**10**	**L2**	**CO2**
	b.	A synchronous generator and a synchronous motor each rated 25 MVA, 11 KV having 15% sub – transient reactance are connected through transformers and a line as shown in the Fig.Q.4(b). The transformers are rated 25 MVA, 11/66 KV and 66 KV/11 KV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25 MVA, 66 KV. The motor is drawing 15 MW at 0.8 p.f. leading and a terminal voltage of 10.6 KV, when a symmetrical 3Q fault occurs at the motor terminals. Find the subtransient current in the generator, motor and faults.  Fig.Q.4(b)	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	What are symmetrical components? How they are useful in the solution of power system?	**5**	**L1**	**CO3**
	b.	Derive an expression for the 3ϕ complex power in terms of symmetrical components.	**5**	**L2**	**CO3**

	c.	A 3 phase, star connected load as shown, is connected to a 3 phase supply having a line voltage of 440 volts. Calculate the current in line 'a'.  Fig.Q.5(c)	10	L3	CO3
		OR			
Q.6	a.	Draw the zero sequence impedance networks of a transformer for the following connection: 	6	L1	CO3
	b.	Draw the positive, negative and zero sequence network for the power system shown, choose a base of 50 MVA, 220 KV in the 50Ω, T line and mark are reactance's in PU. The ratings of the generator and transformer are: G – 1 : 25 MVA, 11 KV x" = 20% G – 2: 25 MVA, 11 KV, x" = 20% 3ϕ transformer each : 20 MVA, 11/220 KV, x = 15%. The negative sequence reactance of each machine is equal to the subtransient reactance. The zero sequence reactance of each machine is 8%. Assume that the zero sequence reactance of lines are 250% of their positive sequence reactance.  Fig.Q.6(b)	14	L3	CO3
		Module – 4			
Q.7	a.	Derive an expression for fault current when single line to ground fault occurs through a fault impedance z_f in a power system. Draw the sequence network to represent the fault.	10	L2	CO4
	b.	Derive an expression for fault current when – double line to ground fault through impedance occurs on power systems.	10	L2	CO4

		OR			
Q.8		A 50 Hz turbo generator is rated 10 MVA, 13.8 KV. It is star connected and solidly grounded and in operation at rated voltage at no-load. It is disconnected from the rest of the system. Its reactance are $x_1 = x_2 = 0.15$ Pu and $x_0 = 0.05$ Pu. Find : i) The ratio of the subtransient line current for a single line to ground fault to the sub-transient line current for a symmetrical 3ϕ fault. ii) The ratio of sub-transient line current for a line to line-fault to the sub-transients current for a symmetrical 3ϕ fault. iii) The Ohm's of inductive reactance to be inserted in the neutral connection of the generator to limit the subtransient line current for a single line to ground fault to that for a 3ϕ fault.	**20**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain equal area criteria concept when a power system in subjected to sudden loss of one of the parallel lines.	**10**	**L2**	**CO5**
	b.	Define: i) Steady state stability ii) Transient stability	**5**	**L1**	**CO5**
	c.	Discuss the methods of improving transient stability.	**5**	**L2**	**CO5**
		OR			
Q.10	**a.**	Derive the power angle equation for salient pole machine.	**10**	**L2**	**CO5**
	b.	Derive an expression for the swing equation.	**10**	**L2**	**CO5**

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