CBCS SCHEME

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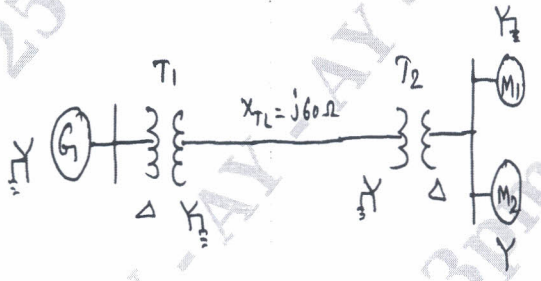
BEE601

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.	Define per unit quantity, mention the advantages of per unit system.	6	L1	CO1
	b.	Draw the reactance diagram of the system shown in Fig Q1(b). The ratings of the components are, $X_{TL} = j\,60\Omega$ Gen : 15 MVA, 6.6 KV, $X'' = 12\%$ T_1 : 20 MVA, 6.6/66 KV, $X = 8\%$ T_2 : 20 MVA, 66/6.6 KV, $X = 8\%$ M1 and M2 : 5 MVA, 6.6 KV, $X'' = 20\%$  Fig Q1(b)	8	L3	CO1
	c.	Draw the per phase basis, representation of synchronous machine and Transmission line.	6	L3	CO1
		OR			
Q.2	a.	Show that per unit impedance of two winding transformer will remain as well as secondary.	6	L2	CO1
	b.	Derive an equation for per unit impedance if changes of base occur.	6	L2	CO1
	c.	Two generators rated 10MVA, 13.2 KV and 15 MVA, 13.2 KV are connected in parallel to a bus bar. They feed supply to two motors of input 8 MVA and 12 MVA respectively. The operating voltage of the motors of inputs 12.5 KV. Assuming base quantities as 50 MVA and 13.8 KV, draw the reactance diagram, The percentage reactance of generators is 15% and that for motor is 20%.	8	L1	CO1
		Module – 2			
Q.3	a.	What is doubling effect in the transmission line? Substantiate with equations.	10	L3	CO2
	b.	Explain with the help of oscillogram if short circuit current of synchronous generation operating on no load, distinguish between sub transient, transient and steady state periods. Also show that $x''_d < x'_d < x_d$ with equivalent circuit diagram.	10	L3	CO2

		OR			
Q.4	**a.**	A synchronous generator and motor are rated for 30,000 KVA, 13.2 KV and both have sub transient reactance of 20%. The line connecting them has a reactance of 10% on the base of machine ratings. The motor is drawing 20,000 KW at 0.8 p.f lead. The terminal voltage of motor is 12.8 KV. When a symmetrical 3 Phase Fault occurs art motor terminals, find the sub transient current in generator, motor and the fault point.	**10**	**L4**	**CO2**
	b.	What are the causes for faults in power system and how symmetrical faults are differ from unsymmetrical faults and how to analyze these faults. Explain the procedure to solve the problems using different methods.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Determine the sequence components of the three voltages. $V_a = 200\angle 0°$, $V_b = 200\angle 245°$ and $V_c = 200\angle 105°$.	**8**	**L2**	**CO3**
	b.	Prove that a balanced set of three phase voltages will have only positive sequence components of voltages only.	**6**	**L2**	**CO3**
	c.	Explain the concept of phase shift in star – Delta transformer bank.	**6**	**L1**	**CO3**
		OR			
Q.6	**a.**	Derive relation between sequence components of phase and line currents in delta connected system.	**10**	**L3**	**CO3**
	b.	Draw positive, negative and zero sequence network for the power system shown in Fig 6 (b). Per unit impedance Z_n in neutral of G_1 = j0.02 pu.	**10**	**L4**	**CO3**

Power system Components	Positive sequence Z_1	Negative sequence Z_2	Zero sequence Z_0
G_1, G_2, G_3	J 0.12 Pu	J0.08 Pu	J 0.03 pu
T_1, T_2, T_3	J0.1 Pu	J 0.1 Pu	j 0.1 pu
TL_1, TL_2, TL_3	J 0.084 Pu	J0.08 Pu	J 0.12 Pu

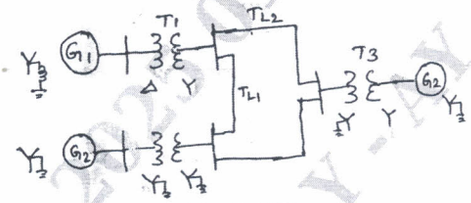


Fig Q6(b)

		Module – 4			
Q.7	**a.**	Derive the expression for fault current if Line – Line (LL) fault occurs through fault impedance Z_f in power system. Show the connection of sequence network to represent the fault.	**10**	**L3**	**CO4**
	b.	A 3-phae generator with an open circuit voltage of 400V is subjected to an LG fault through a fault impedance of j2 Ω. Determine the fault current is Z_1 = j 4Ω, Z_2 = j2 Ω, and Z_0 = j1 Ω. Also calculate the fault current for LL and LLG fault.	**10**	**L3**	**CO4**

		OR			
Q.8	**a.**	What are symmetrical faults? What are the different types of unsymmetrical fault and mention their frequency of occurrence.	**6**	**L1**	**CO4**
	b.	Draw inter connection of sequence network and mention the terminal condition for LG, LL and LLG faults.	**9**	**L2**	**CO4**
	c.	Derive the symmetrical component relation for one conductor open fault.	**5**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Derive an expression for the swing equation and explain swing curve.	**8**	**L2**	**CO5**
	b.	A loss free alternator supplies 50 mW to an infinite bus, the SSSL being 100 mW. Determine if the alternator will remain stable if the input to the prime mover of the alternator is abruptly increased by 40 MW.	**8**	**L3**	**CO5**
	c.	Explain methods of improving transient stability.	**4**	**L1**	**CO5**
		OR			
Q.10	**a.**	Explain Equal area criteria concept when a power system is subjected to sudden change in mechanical input?	**10**	**L3**	**CO5**
	b.	Derive an expression for critical clearing angle and critical clearing time.	**10**	**L3**	**CO5**

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