Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3150911 Date: 03/07/2023

Subject Name: Power System- II

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	How capacitance present between the line and ground is taken into account while modelling medium length transmission line?	**03**
	(b)	An overhead 3-φ short transmission line delivers 5000 kW at 22 kV at 0.8 pf lagging. The resistance and reactance of each conductor is 4Ω and 6Ω respectively. Determine (i) the sending end voltage (ii) percentage regulation	**04**
	(c)	Prove that per-unit impedance of a transformer is same whether it is computed from primary or secondary side	**07**
Q.2	**(a)**	Distinguish between symmetrical and unsymmetrical faults giving appropriate examples	**03**
	(b)	In a 3-φ, 4-wire system, the currents in phase A,B and C under abnormal loading conditions are given by Ia = $100\underline{/30^0}$ A, Ib = $50\underline{/300^0}$ A, Ic = $30\underline{/180^0}$ A. Calculate the positive and zero sequence currents Ia1, Ia0 and return current in the neutral wire.	**04**
	(c)	Using rigorous solution method, derive the expression for ABCD constants of a long transmission line in terms of hyperbolic sine and cosine terms	**07**
		OR	
	(c)	Prove that travelling wave on a transmission line travels at the speed of light. What would be the velocity of a surge, travelling in cable having relative permittivity of 5?	**07**
Q.3	**(a)**	Show that symmetrical component transformation is power invariant	**03**
	(b)	Discuss the criteria for selection of circuit breakers	**04**
	(c)	A 100 MVA, 33 kV, 3-φ generator has a reactance of 15%. The generator is connected to the motors through a transformer and transmission line as shown in figure 1. Motors have rated inputs of 40 MVA, 30 MVA and 20 MVA with 20% reactance each. Draw the per-unit reactance diagram. Assume a base of 100 MVA and 33 kV in generator circuit.	**07**

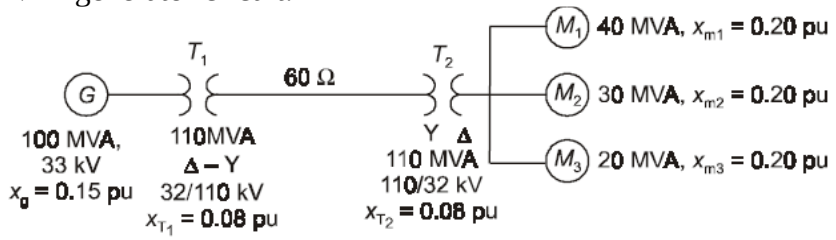

Figure-1

OR

Q.3	**(a)**	Explain Ferranti effect	**03**
	(b)	Draw and discuss the operating chart of a synchronous generator	**04**
	(c)	Show how Zbus matrix gets modified when branch Zb is added from new bus to old bus (type-2 modification), and when Zb connects old bus to reference bus (type-3 modification)	**07**
Q.4	**(a)**	Draw the zero sequence reactance diagram of transformers having the following connections (i) delta-delta (ii) star-delta with star side grounded	**03**
	(b)	A 3-φ short transmission line has a resistance of 5Ω per phase and inductive reactance of 15Ω per phase. If the sending end and receiving end voltage are 140 kV and 132 kV respectively, find the horizontal and vertical co-ordinate of the receiving end power circle diagram (i.e. centre of the circle) in MW and MVAR	**04**
	(c)	Derive the expression for fault current for a double line to ground fault at the generator terminals. Also discuss how sequence networks are connected for L-L-G fault.	**07**
		OR	
Q.4	**(a)**	Explain corona phenomena in transmission lines	**03**
	(b)	Determine the disruptive critical voltage and corona loss for a 3-phase line operating at 110 kV which has conductor of 1.25 cm diameter arranged in a 3.05 meter delta. Assume air density factor of 1.07 and dielectric strength of the air to be 21 kV/cm	**04**
	(c)	A 25 MVA, 11 kV generator has X''d = 0.2 pu. Its negative and zero sequence reactances are 0.3 and 0.1 pu respectively. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line to line voltages for subtransient conditions when an L-G fault occurs at the generator terminals. Assume that generator is operating on no-load before the fault occurs	**07**
Q.5	**(a)**	A wave travels over a line and enters the cable. The surge impedance of overhead line and cable are 400Ω and 40Ω. Find the value of refracted voltage wave as percentage of incident voltage wave	**03**
	(b)	Explain in brief the different methods of voltage control employed in power systems	**04**
	(c)	Explain the phenomena of arcing grounds in an isolated neutral systems. Discuss why it can cause severe overvoltages in a power system.	**07**
		OR	
Q.5	**(a)**	A 500 kV, 2μS rectangular surge on a line having a surge impedance of 350Ω approaches a station at which the concentrated earth capacitance is 3000 pF. Determine the maximum value transmitted wave	**03**
	(b)	Derive the expression for refracted voltage wave due to a surge travelling at T-junction	**04**
	(c)	Discuss the different types of lightning strokes and their harmful effects on power system	**07**

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