Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code:3150911 Date:02-12-2025

Subject Name:Power System- II

Time:10:30 AM TO 01:00 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)**	Discuss Ferranti effect.	**03**
	(b)	What is the p.u. system? Give the advantages of p.u. system	**04**
	(c)	Explain Nominal-T and Nominal-π methods for analysis of medium transmission lines.	**07**
Q.2	**(a)**	Give classification of transmission lines. Define voltage regulation and efficiency of a transmission line.	**03**
	(b)	Discuss power in single phase AC circuits.	**04**
	(c)	Explain per unit representation of transformers.	**07**
		OR	
	(c)	Explain rigorous solution of long transmission line	**07**
Q.3	**(a)**	What is the difference between symmetrical and unsymmetrical faults?	**03**
	(b)	Explain Generalized Circuit Constant and derive ABCD Constant for short transmission lines.	**04**
	(c)	Discuss transients on a transmission line in case of a symmetrical fault.	**07**
		OR	
Q.3	**(a)**	What are the symmetrical components? Explain in short.	**03**
	(b)	Prove that positive sequence and negative sequence impedance of fully transposed transmission line are always equal.	**04**
	(c)	Write short note on an attenuation of travelling waves.	**07**
Q.4	**(a)**	Explain in short Surge absorber	**03**
	(b)	Explain the short circuit of a synchronous machine for no load condition.	**04**
	(c)	Using appropriate interconnection of sequence networks, derive the equation for a line to line fault in a power system with fault impedance of Z_f.	**07**
		OR	
Q.4	**(a)**	Show how Z_{bus} matrix gets modified when branch Z_b is added from new bus to old bus (type-2 modification)	**03**
	(b)	Write a short note on selection of circuit breaker.	**04**
	(c)	Explain phase shift in star-delta transformer.	**07**
Q.5	**(a)**	Write a short note on the arcing ground phenomenon.	**03**
	(b)	What is Corona? Explain different methods to reduce corona loss.	**04**
	(c)	What is the harmful effect of lightning on a power system? Discuss the different types of lightning strokes.	**07**
		OR	

Q.5	**(a)**	What is Critical Disruptive Voltage? Write a formula of Critical Disruptive Voltage and briefly describe each variable in the formula.	**03**
	(b)	Explain factor affecting corona,	**04**
	(c)	What is the phenomenon of wave reflection and refraction? Derive expression for reflection and refraction.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2024

Subject Code:3150911 Date:17-12-2024

Subject Name:Power System- II

Time:10:30 AM TO 01:00 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)**	What is meant by three-phase balanced circuit? Write down expressions of three-phase balanced voltage phasors in polar form.	**03**
	(b)	With the help of phasor diagram for π-model of the transmission line, show that the receiving-end voltage magnitude becomes greater than the sending-end voltage magnitude when the transmission line is under no-load condition. What is the name of this effect?	**04**
	(c)	Compare nominal-T and nominal-π method for analysis of medium transmission line with phasor diagrams and necessary expressions.	**07**
Q.2	**(a)**	Evaluate percentage voltage regulation of a medium line that has the following parameters: $A = 0.95\angle 1^{o}$, $B = 100\angle 75^{o}\,\Omega$ The receiving-end and sending-end voltage magnitudes are found to be $\lvert V_R \rvert = 132\,kV$ and $\lvert V_S \rvert = 139\,kV$ respectively when the transmission line delivers a typical load.	**03**
	(b)	Show the steps to draw the receiving-end circle diagram to obtain the sending-end voltage magnitude and angle.	**04**
	(c)	Create per unit reactance diagram for the power system shown in Fig.-1. Start with base MVA of 100 and base kV of 220 in 50Ω line. The ratings of components are: Generator: 40 MVA, 25 kV, X=20% Motor: 50 MVA, 11 kV, X=30% T1: 40 MVA, 33/220 kV (Y-Y), X=15% T2: 30 MVA, 11/220 kV (Δ-Y), X=15% Line: Inductive reactance of 50Ω	**07**

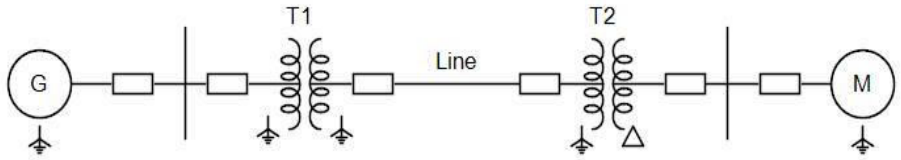

Fig.-1

OR

	(c)	Create per unit impedance diagram for the sample power system shown in Fig.-2. Start with base MVA of 100 and base kV of 10 in generator circuit. The ratings of components are: Generator: 100 MVA, 10 kV, X=j0.5 pu T1: 3-phase, 2-winding, delta-star transformer developed by using three single-phase units, each single-phase unit rated 35 MVA, 10/230 kV, X=j0.1 pu. T2: 90 MVA, 400/10 kV (Y-Δ), X=j0.1 pu Line 1 and Line 2: Inductive reactance of each line 200Ω.	**07**

Load: Impedance of (0.1+j0.5) Ω.

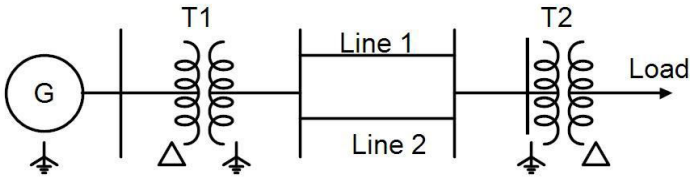

Fig.-2

Q.3 **(a)** How many symmetrical components are required to analyze 12-phase unbalanced system? What will be the sequence operator in that case? **03**

(b) Draw zero sequence network of the power system shown in Fig.-3. The transformers and lines are to be represented as reactance only. **04**

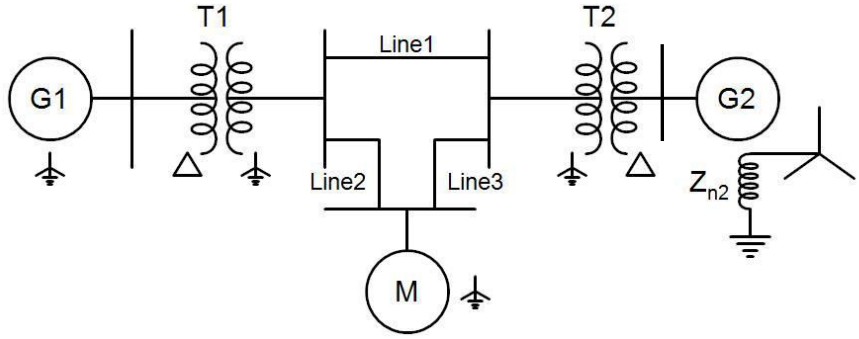

Fig.-3

(c) Formulate Z_{bus} using step-by-step algorithm for symmetrical fault analysis in case of the power network shown in Fig.-4. The reactances are in per unit. **07**

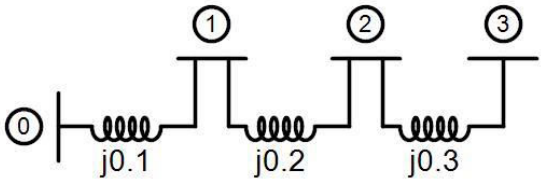

Fig.-4

OR

Q.3 **(a)** Express three-phase unbalanced current phasors in terms of sequence components in matrix form using sequence operator. **03**

(b) A balanced delta-connected load is connected to a three-phase supply and is supplied line current of 15 A. If the line 'b' is opened suddenly, compute symmetrical components I_{a1}, I_{a2} and I_{a0} of the line current. **04**

(c) Analyze behavior of short circuit current with relevant expression and waveforms when a three-phase short circuit occurs suddenly at the end of a transmission line being fed from constant voltage source $v = V_m \sin(\omega t + \psi)$ V. Assume that the line is represented as series impedance $Z=(R+jX_L)\Omega$ and the fault occurs at $t=0$. Line charging capacitance is neglected. **07**

Q.4 **(a)** Why is the zero sequence impedance of the transmission line approximately 2.5 times the positive sequence? **03**

(b) Prove that the fault current is given by the following expression when an LL (line-to-line) fault takes place between terminals *"b"* and *"c"* of an unloaded synchronous generator through Z^f: **04**

$$I^f = \frac{-j\sqrt{3}E_a}{Z_1 + Z_2 + Z^f}$$

where notations have their usual meaning.

(c) A three-phase, 6.9 kV, 10 MVA alternator has $X'' = X_2 = 15\%$ and $X_0 = 5\%$. The neutral is grounded through an inductive reactance of 0.381 Ω. Evaluate the subtransient current in ampere in the faulted phase, when a single line to ground fault takes place on phase-*a*. **07**

OR

Q.4 **(a)** Draw single-phase model of positive, negative and zero sequence network of a three-phase synchronous generator whose star-point of stator winding is connected to ground through Z_n. **03**

(b) Sketch interconnection of sequence networks for single line to ground fault with equations of sequence currents and fault current. **04**

(c) A power system has equivalent positive, negative and zero sequence impedance of *j0.2243* pu, *j0.1741* pu and *j0.15* pu respectively. Evaluate per unit positive sequence current, zero sequence current and fault current if a solid LLG (line-to-line-to-ground) fault is to be simulated. **07**

Q.5 **(a)** Write down corona loss formula given by Peek on basis of weather conditions and name each of the parameters in the expression. **03**

(b) Compare protection provided against lightning by earthing screen and ground wires. **04**

(c) Voltage and current travelling waves passing through line having surge impedance Z_{c1} arrive at discontinuity point from where another line having surge impedance Z_{c2} starts. For this configuration, derive ratio of (i) the reflected voltage wave to incident voltage wave and (ii) the transmitted (refracted) voltage wave to incident voltage wave with usual notations. **07**

OR

Q.5 **(a)** What will be the effect of the following on disruptive critical voltage and corona? **03**
(i) increasing diameter
(ii) reducing spacing between conductors
(iii) rise in barometric pressure of air

(b) Differentiate between direct and indirect lightning strokes. **04**

(c) A line is terminated with (i) short circuit and (ii) open circuit. In these two cases, show by waveforms how voltage and current travelling waves move with time and distance. Assume rectangular wave shape of the waves. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2023

Subject Code:3150911 Date:20-12-2023

Subject Name: Power System- II

Time:10:30 AM TO 01:00 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)**	What is BIL?	**03**
	(b)	What is arcing ground phenomenon?	**04**
	(c)	Discuss the phenomenon of wave reflection and refraction. Derive expression for reflection and refraction.	**07**
Q.2	**(a)**	What is meant by corona? Why does it occur?	**03**
	(b)	What is difference between visual critical voltage and disruptive critical voltage?	**04**
	(c)	Discuss in detail factors and conditions affecting corona loss.	**07**
		OR	
Q.2	**(c)**	A 3 phase overhead line has conductors of 30 mm diameter and arranged in the form of equilateral triangle. Assume fair weather conditions, air density factor of 0.95 and irregular factor of 0.95. Find minimum spacing between conductors if disruptive critical voltage is not to exceed 230 kV between lines. Breakdown strength of air is 30 kV/CM	**07**
Q.3	**(a)**	Differentiate between nominal T and equivalent T circuits.	**03**
	(b)	Why equivalent π circuit of a long line is preferred to the equivalent T circuit?	**04**
	(c)	Draw the phasor diagrams of nominal π circuit and nominal T circuit of a transmission line. Derive expressions for sending end voltage and current in each case.	**07**
		OR	
Q.3	**(a)**	What is Ferranti effect?	**03**
	(b)	Why representation of a line by lumped parameters gives inaccurate results for long lines?	**04**
	(c)	Starting from first principles deduce expression for ABCD constants for a long line in terms of its parameters. Define propagation constant and characteristic impedance.	**07**
Q.4	**(a)**	What is the difference between symmetrical and unsymmetrical faults?	**03**
	(b)	List the steps to calculations fault calculations.	**04**
	(c)	Calculate the sub transient fault current in each phase for a dead short circuit on one phase to ground at bus Q for the system shown in Fig. 1	**07**

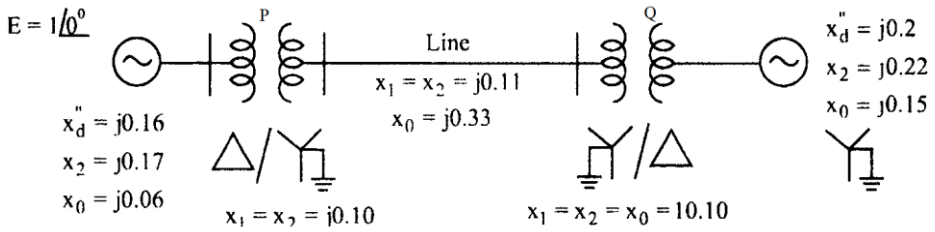

Fig. 1

All reactance are in p.u. on generator base.

OR

Q.4 **(a)** How can effect of load current can be taken in to account in fault calculation? **03**

(b) Write a short note on selection of circuit breaker. **04**

(c) Using appropriate interconnection of sequence networks, derive the equation for a line to line fault in a power system with fault impedance of Zf. **07**

Q.5 **(a)** Give classification of faults and discuss their nature of occurrence. **03**

(b) Derive necessary equations to convert (a) phase quantities into symmetrical components (b) symmetrical components in to phase quantity. **04**

(c) Discuss the significance of zero sequence circuit. Why should Zn appear as 3Zn in zero sequence equivalent circuit? **07**

OR

Q.5 **(a)** What are the symmetrical components and its need? **03**

(b) Draw zero sequence network of a three phase transformer with **04**
(1) Star-Star connection with both neutrals grounded
(2) Star delta connection with star side neutral grounded

(c) Find the symmetrical components for the given three phase currents **07**

$$I_a = 10\angle 0^\circ$$
$$I_b = 10\angle -90^\circ$$
$$I_c = 15\angle 135^\circ$$

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2022

Subject Code:3150911 Date:11-01-2023

Subject Name:Power System- II

Time:10:30 AM TO 01:00 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)**	Differentiate between Short, medium and long transmission lines and state how the method of analysis differs in each type.	**03**
	(b)	Three loads are connected in parallel across a 1400 V rms, 60 Hz, single phase a.c. supply. Load-1: Inductive load, 125 kVA at 0.28 power factor Load-2: Capacitive load, 10 kW and 40 kvar Load-3: Resisitive load of 15 kW Find the total active, reactive and apparent power drawn from the supply and the overall power factor as viewed from the supply side.	**04**
	(c)	Write a short note on per unit representation of transformers.	**07**
Q.2	**(a)**	What is the reason behind occurrence of Ferranti Effect? How Ferranti effect can be prevented?	**03**
	(b)	Draw phasor diagram for a short transmission line when operating at (i) lagging power factor load (ii) leading power factor load Is it possible to have zero voltage regulation when operating at some load? Explain.	**04**
	(c)	Explain Nominal-T and Nominal-π methods for analysis of medium transmission lines.	**07**
		OR	
	(c)	Briefly discuss various methods of voltage control in power systems.	**07**
Q.3	**(a)**	Explain how the Breaking Capacity of a circuit breaker can be calculated. Also explain how Fault MVA can be calculated.	**03**
	(b)	Two synchronous generators in a power plant are connected to a common bus bar. The generator ratings are as follows. Generator-1: 10 MVA, 11 kV, $X_d^{"}$ =40 % Generator-2: 15 MVA, 11 kV, $X_d^{"}$ =60 %	**04**

Determine fault current when a three phase fault takes place at the bus bar while the generators were operating at no load.

(c) Discuss: Transients on a transmission line during a short circuit. **07**

OR

Q.3 **(a)** Explain any one type of modification in Bus Impedance Matrix due to addition of a branch or link in the network. **03**

(b) A three bus power system has its Z_{BUS} matrix given as, **04**

$$Z_{BUS} = \begin{bmatrix} j0.25 & j0.1 & j0.15 \\ j0.1 & j0.25 & j0.1 \\ j0.15 & j0.1 & j0.15 \end{bmatrix} \text{ p.u.}$$

A three phase fault occurs at bus-2 of the system.
Assuming all pre-fault voltages to be 1.0 p. u., determine,

(i) Fault current when a 3-phase fault occurs at bus-2
(ii) Voltage at bus-3 when the fault occurs on bus-2

(c) A synchronous generator rated 500 kVA, 440 V with a sub-transient reactance of 0.25 p.u. is supplying a static load of 400 kW at 0.8 p.f. lagging at rated terminal voltage. A three phase fault occurs at the generator terminals. Determine: **07**

(i) e.m.f. behind transient reactance
(ii) symmetrical short circuit current during sub-transient stage

Q.4 **(a)** If α is a complex operator such that $\alpha = e^{j120^\circ}$, then evaluate the following terms: **03**

(i) $\alpha^2 - 1$
(ii) $1 - \alpha - \alpha^2$

(b) Explain Symmetrical Component Transformation **04**

(c) Explain analysis of a line to ground fault. **07**

OR

Q.4 **(a)** Draw zero sequence networks of three phase transformers with the following connections. **03**

(i) $\Delta - Y$ connection with star side neutral isolated
(ii) $Y - Y$ connection with any one side neutral solidly grounded

(b) Explain analysis of a line to line fault. **04**

(c) A three phase synchronous generator rated 11 kV, 50 MVA has positive, negative and zero sequence reactances as 0.2 p.u., 0.1 p.u. and 0.05 p.u. respectively with machine ratings as base values. The generator is star connected with the neutral point solidly grounded. Find the magnitude of fault current in the event of a: **07**

(i) Three phase fault
(ii) Line to ground fault

at generator terminals. Assume generator at no load prior to fault.

Q.5 **(a)** Describe methods to reduce corona loss. **03**

(b) Discuss switching transients in an R-L circuit(power system) supplied by an a.c. source. **04**

	(c)	Explain the concept of Travelling Waves.	**07**
		OR	
Q.5	**(a)**	Describe the factors affecting corona loss.	**03**
	(b)	Explain the working of Thyrite valve type surge arresters for protection against overvoltages.	**04**
	(c)	Explain reflection of a travelling wave in a line terminated by: (i) open circuit. (ii) short circuit	**07**

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