GUJARAT TECHNOLOGICAL UNIVERSITY

BE 5 SEMESTER – OLD PAPER – SUMMER 2022 TO SUMMER 2026 – QUESTION BANK

Subject Name & Code: Power System-II - 3150911

Chapter 1: Basic Principles

Repeated Questions:

1. Power in Single Phase AC Circuits:

- **Q.** Discuss power in single phase AC circuits. **(SUMMER 2022, 4 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Single Phase AC Power (Numerical):

- **Q.** Two single phase loads having $Z_1 = 50 + j40$ and $Z_2 = 80 - j30$ connected in parallel and this combination supplied from source 200 V, AC. Calculate current drawn and complex power drawn by the load. **(SUMMER 2026, 4 Marks)**
- **Q.** Three loads are connected in parallel across a 1400 V rms, 60 Hz single phase supply as follows: Load 1: Inductive load, 125 kVA at 0.28 power factor; Load 2: Capacitive load, 10 kW and 40 kvar; Load 3: Resistive load of 15 kW. (i) Find the total kW, kvar, kVA and the supply power factor (ii) Determine the kvar rating of a capacitor (of negligible resistance) and capacitance in µF to improve the power factor to 0.8 lagging. (iii) Find the reduction in current after PF improvement. **(SUMMER 2024, 7 Marks)**
- **Q.** 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: Resistive 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. **(WINTER 2022, 4 Marks)**

2. Three-Phase Balanced Systems:

- **Q.** What is the balanced three-phase power? Prove that under balance conditions, the sum of phasors is zero. **(SUMMER 2025, 4 Marks)**
- **Q.** What is meant by three-phase balanced circuit? Write down expressions of three-phase balanced voltage phasors in polar form. **(WINTER 2024, 3 Marks)**

Chapter 2: Representation of Power System Components

Repeated Questions:

1. Per Unit System:

- **Q.** What is the p.u. system? Give the advantages of p.u. system. **(SUMMER 2022, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain per unit representation of transformers. **(WINTER 2022, 7 Marks; WINTER 2025, 7 Marks)**

2. Synchronous Generator:

- **Q.** Explain working of a synchronous generator connected to infinite bus. Draw equivalent circuit and phasor diagram. **(SUMMER 2022, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Explain salient pole synchronous generator with power angle curve in short. **(SUMMER 2022, 4 Marks OR; SUMMER 2025, 4 Marks)**

Other Important Questions:

1. Per Unit System (Theory):

- **Q.** Explain advantages of per unit system for power system calculations. **(SUMMER 2024, 3 Marks)**
- **Q.** Prove that per-unit impedance of a transformer is same whether it is computed from primary or secondary side. **(SUMMER 2023, 7 Marks)**

2. Per Unit Reactance Diagrams (Numerical):

- **Q.** Following three generators are connected in parallel. Generator G1 = 10MVA, 10kV, Xm = 10%; Generator G2 = 12MVA, 10.6kV, Xm = 15%; Generator G3 = 15MVA, 12kV, Xm = 20%. Find the overall equivalent per unit reactance of these the system considering 20 MVA, 11 kV system base. **(SUMMER 2024, 4 Marks)**
- **Q.** A 100MVA, 33kV, 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 40MVA, 30MVA and 20MVA with 20% reactance each. Draw the per-unit reactance diagram. Assume a base of 100MVA and 33kV in generator circuit. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks)**
- **Q.** 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. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**
- **Q.** 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. Load: Impedance of (0.1 + j0.5)Ω. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks OR)**

3. Synchronous Machines (Theory):

- **Q.** Why synchronous compensators can supply leading as well as lagging vars? **(SUMMER 2024, 3 Marks)**
- **Q.** Draw and discuss the operating chart of a synchronous generator. **(SUMMER 2023, 4 Marks OR)**

Chapter 3: Transmission Line Modeling and Performance

Repeated Questions:

1. Ferranti Effect, Classification and Regulation:

- **Q.** Discuss Ferranti effect. / Write a short note on Ferranti effect. / What is the reason behind occurrence of Ferranti Effect? How Ferranti effect can be prevented? **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks OR; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Give classification of transmission lines. Define voltage regulation and efficiency of a transmission line. **(SUMMER 2022, 3 Marks; WINTER 2025, 3 Marks)**

2. Medium and Long Transmission Line Modelling:

- **Q.** Explain Nominal-T and Nominal-π methods for analysis of medium transmission lines. **(WINTER 2022, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** Explain rigorous solution of long transmission line. / Derive expression for sending end voltage and current for long transmission line using rigorous method. **(SUMMER 2022, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**
- **Q.** Discuss why equivalent π of a long line is preferred to the equivalent T circuit. / Why equivalent π circuit of a long line is preferred to the equivalent T circuit? **(WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks)**

3. Power Circle Diagram and Voltage Control:

- **Q.** What is a receiving end power circle diagram? How can it be drawn? What information does it provide? / What is receiving end power circle diagram? Write down steps to draw it. **(SUMMER 2022, 4 Marks; SUMMER 2024, 7 Marks)**
- **Q.** Explain in brief the different methods of voltage control employed in power systems. / Briefly discuss various methods of voltage control in power systems. **(WINTER 2022, 7 Marks OR; SUMMER 2023, 4 Marks; SUMMER 2025, 4 Marks)**

Other Important Questions:

1. Classification of Transmission Lines:

- **Q.** Differentiate between Short, medium and long transmission lines and state how the method of analysis differs in each type. **(WINTER 2022, 3 Marks)**

2. Short Transmission Line (Theory):

- **Q.** 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. **(WINTER 2022, 4 Marks)**

3. Medium Line – Nominal T / π and ABCD Constants (Theory):

- **Q.** Evaluate the generalized circuit constants for medium transmission line - nominal T method. **(SUMMER 2026, 7 Marks)**
- **Q.** What is nominal circuit? Find ABCD constants for nominal π and nominal T circuits of a transmission line? **(SUMMER 2024, 7 Marks OR)**
- **Q.** Explain ABCD constant for medium transmission line. **(SUMMER 2022, 3 Marks OR)**
- **Q.** Obtain the equivalent circuit of the medium transmission line using nominal-π (PI) representation. **(SUMMER 2025, 4 Marks)**
- **Q.** How capacitance present between the line and ground is taken into account while modelling medium length transmission line? **(SUMMER 2023, 3 Marks)**
- **Q.** Compare nominal-T and nominal-π method for analysis of medium transmission line with phasor diagrams and necessary expressions. **(WINTER 2024, 7 Marks)**
- **Q.** Differentiate between nominal T and equivalent T circuits. **(WINTER 2023, 3 Marks)**

- **Q.** 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. **(WINTER 2023, 7 Marks)**

4. Long Transmission Line (Theory):

- **Q.** Using rigorous solution method, derive the expression for ABCD constants of a long transmission line in terms of hyperbolic sine and cosine terms. **(SUMMER 2023, 7 Marks)**
- **Q.** Starting from first principles deduce expression for ABCD constants for a long line in terms of its parameters. Define propagation constant and characteristic impedance. **(WINTER 2023, 7 Marks OR)**
- **Q.** Why representation of a line by lumped parameters gives inaccurate results for long lines? **(WINTER 2023, 4 Marks OR)**

5. Ferranti Effect and Surge Impedance Loading:

- **Q.** 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? **(WINTER 2024, 4 Marks)**
- **Q.** Define surge impedance and explain the surge impedance loading of the transmission line. **(SUMMER 2025, 3 Marks)**

6. Power Flow and Circle Diagram (Theory):

- **Q.** Derive equations of power flow through a transmission line. **(SUMMER 2022, 7 Marks OR)**
- **Q.** Show the steps to draw the receiving-end circle diagram to obtain the sending-end voltage magnitude and angle. **(WINTER 2024, 4 Marks)**

7. Transmission Line Performance (Numerical):

- **Q.** An overhead 3-ϕ short transmission line delivers 5000kW at 22 kV at 0.8pf lagging. The resistance and reactance of each conductor is 4Ω and 6Ω respectively. Determine (i) the sending end voltage (ii) percentage regulation. **(SUMMER 2023, 4 Marks)**
- **Q.** 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. **(SUMMER 2023, 4 Marks)**
- **Q.** Evaluate percentage voltage regulation of a medium line that has the following parameters: A = 0.95∠1°, B = 100∠75° Ω. The receiving- end and sending- end voltage magnitudes are found to be |VR| = 132kV and |VS| = 139kV respectively when the transmission line delivers a typical load. **(WINTER 2024, 3 Marks)**
- **Q.** A 3-phase, 11kV, 15km length, transmission line supplying a load of 850kW at 0.8 power factor lagging, has resistance (R) = 0.45Ω/km and reactance (X) = 0.60Ω/km. Calculate, (i) the line current, (ii) receiving end voltage, (iii) voltage regulation, and (iv) the efficiency of power transmission. **(SUMMER 2025, 7 Marks)**
- **Q.** A 275kV transmission line has the following line constants: A = 0.85∠5°, B = 200∠75°. Determine the power at unity power factor that can be received, if the voltage profile at each end will be maintained at 275kV. **(SUMMER 2025, 7 Marks OR)**

Chapter 4: Symmetrical Fault Analysis

Repeated Questions:

1. Faults, Transients and Reactances:

- **Q.** What is the difference between symmetrical and unsymmetrical faults? / Differentiate symmetrical and unsymmetrical faults. List various unsymmetrical faults. **(SUMMER 2022, 3 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** Discuss transients on a transmission line in case of a symmetrical fault. / Discuss: Transients on a transmission line during a short circuit. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Explain in detail sub transient, transient and steady state reactance. / Draw the waveforms for fault current for a 3-phase fault on alternator terminals. Explain the sub-transient, transient and steady state reactance. What is their significance in fault calculations? **(SUMMER 2024, 7 Marks OR; SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks OR)**

2. Zbus and Circuit Breakers:

- **Q.** Show how Zbus matrix gets modified when branch Zb is added from new bus to old bus (type-2 modification). / Explain any one type of modification in Bus Impedance Matrix due to addition of a branch or link in the network. **(WINTER 2022, 3 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2025, 3 Marks OR; SUMMER 2026, 3 Marks OR)**
- **Q.** Write a short note on selection of circuit breaker. / Discuss the criteria for selection of circuit breakers. **(SUMMER 2022, 4 Marks OR; SUMMER 2023, 4 Marks; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Faults – Classification and Basics:

- **Q.** List various types of faults and write the relative frequency of occurrence of various types of faults. **(SUMMER 2024, 4 Marks)**
- **Q.** Give classification of faults and discuss their nature of occurrence. **(WINTER 2023, 3 Marks)**
- **Q.** What is fault? Classify various types of fault conditions of power system. Give the significance of the fault impedance. **(SUMMER 2025, 3 Marks)**

2. Short Circuit Transients:

- **Q.** Explain the short circuit of a synchronous machine for no load condition. **(WINTER 2025, 4 Marks)**
- **Q.** Why are we interested in computation of sub-transient current rather than steady sustained short-circuit current? **(SUMMER 2024, 3 Marks OR)**
- **Q.** What is the reason for transients during short circuit? **(SUMMER 2024, 3 Marks)**
- **Q.** 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 $v = Vm \sin(\omega t + \psi)$ V. Assume that the line is represented as series impedance $Z = (R + jXL)\Omega$ and the fault occurs at $t = 0$. Line charging capacitance is neglected. **(WINTER 2024, 7 Marks OR)**

3. Fault Calculation Methods and Zbus (Theory):

- **Q.** List the steps of fault calculations. **(WINTER 2023, 4 Marks)**
- **Q.** How can the effect of load current be taken into account in fault calculation? **(WINTER 2023, 3 Marks OR)**
- **Q.** What is bus impedance matrix? Explain the method of fault calculation using bus impedance matrix. **(SUMMER 2024, 7 Marks OR)**

- **Q.** Explain how the Breaking Capacity of a circuit breaker can be calculated. Also explain how Fault MVA can be calculated. **(WINTER 2022, 3 Marks)**

4. Symmetrical Fault Analysis (Numerical):

- **Q.** Two synchronous generators in a power plant are connected to a common bus bar. The generator ratings are as follows. Generator- 1: 10MVA, 11kV, Xd'' = 40% Generator- 2: 15MVA, 11kV, Xd'' = 60%. Determine fault current when a three phase fault takes place at the bus bar while the generators were operating at no load. **(WINTER 2022, 4 Marks)**
- **Q.** A three bus power system has its ZBUS matrix given as, [Data truncated in source – refer to the original question paper] 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. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks OR)**
- **Q.** A synchronous generator rated 500kVA, 440V with a sub-transient reactance of 0.25 p.u. is supplying a static load of 400kW at 0.8 p.f. lagging at rated terminal voltage. A three phase fault occurs at the generator terminals. Determine: (i) e.m.f. behind transient reactance (ii) symmetrical short circuit current during subtransient stage. **(WINTER 2022, 7 Marks OR)**
- **Q.** Formulate Zbus 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. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**

Chapter 5: Symmetrical Components

Repeated Questions:

1. Symmetrical Components:

- **Q.** What are the symmetrical components? Explain in short. / What are symmetrical components and its need? **(WINTER 2023, 3 Marks OR; SUMMER 2024, 3 Marks OR; WINTER 2025, 3 Marks OR; SUMMER 2026, 3 Marks)**
- **Q.** Show that symmetrical component transformation is power invariant. **(SUMMER 2022, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2025, 3 Marks OR)**
- **Q.** Derive necessary equations to convert (a) phase quantities into symmetrical components (b) symmetrical components in to phase quantity. / Derive the necessary equations to obtain symmetrical components from the phase quantities. **(WINTER 2023, 4 Marks; SUMMER 2025, 4 Marks OR)**

2. Sequence Impedances and Transformers:

- **Q.** Prove that positive sequence and negative sequence impedance of fully transposed transmission line are always equal. **(SUMMER 2024, 4 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Explain phase shift in star-delta transformer. / Explain phase shift in star-delta transformer with phasor diagram. **(SUMMER 2022, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 4 Marks OR)**
- **Q.** Explain the zero sequence impedance diagram of transformer for various connection. / Explain the zero- sequence impedance of the transformer for various connections. **(SUMMER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**
- **Q.** What is a significance of zero sequence network? / Discuss the significance of zero sequence circuit. Why should Z_n appear as $3Z_n$ in zero sequence equivalent circuit? **(WINTER 2023, 7 Marks; SUMMER 2026, 3 Marks OR)**

Other Important Questions:

1. Symmetrical Components (Theory):

- **Q.** Explain Symmetrical Component Transformation. **(WINTER 2022, 4 Marks)**
- **Q.** How many symmetrical components are required to analyze 12-phase unbalanced system? What will be the sequence operator in that case? **(WINTER 2024, 3 Marks)**
- **Q.** Express three-phase unbalanced current phasors in terms of sequence components in matrix form using sequence operator. **(WINTER 2024, 3 Marks OR)**
- **Q.** Why is the zero sequence impedance of the transmission line approximately 2.5 times the positive sequence? **(WINTER 2024, 3 Marks)**

2. Sequence Networks:

- **Q.** Draw the zero sequence reactance diagram of transformers having the following connections (i) delta-delta (ii) star-delta with star side grounded. **(SUMMER 2023, 3 Marks)**
- **Q.** Draw zero sequence networks of three phase transformers with the following connections. (i) Δ-Y connection with star side neutral isolated (ii) Y-Y connection with any one side neutral solidly grounded. **(WINTER 2022, 3 Marks OR)**
- **Q.** Draw zero sequence network of a three phase transformer with (1) Star-Star connection with both neutrals grounded (2) Star delta connection with star side neutral grounded. **(WINTER 2023, 4 Marks OR)**
- **Q.** Draw zero sequence network of the power system shown in Fig.-3. The transformers and lines are to be represented as reactance only. [Diagram required – refer to the original question paper] **(WINTER 2024, 4 Marks)**

- **Q.** 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 Zn. **(WINTER 2024, 3 Marks OR)**

3. Phase Shift in Transformers:

- **Q.** Explain in brief phase shift of symmetrical components in Y-Δ transformer banks. **(SUMMER 2024, 4 Marks OR)**

4. Symmetrical Components (Numerical):

- **Q.** In a 3-ϕ, 4-wire system, the currents in phase A, B and C under abnormal loading conditions are given by Ia = 100∠30° A, Ib = 50∠300° A, Ic = 30∠180° A. Calculate the positive and zero sequence currents Ia1, Ia0 and return current in the neutral wire. **(SUMMER 2023, 4 Marks)**
- **Q.** The Line currents in amperes in phases a, b, c respectively are 500 + j150, 100 - j600 and -300 + j600 referred to the same reference vector. Find the symmetrical components of currents? **(SUMMER 2024, 4 Marks OR)**
- **Q.** If α is a complex operator such that α = e^(j120°), then evaluate the following terms: $\alpha^2 - 1$, $1 - \alpha - \alpha^2$. **(WINTER 2022, 3 Marks)**
- **Q.** Find the symmetrical components for the given three phase currents Ia = 10∠0°, Ib = 10∠-90°, Ic = 15∠135°. **(WINTER 2023, 7 Marks OR)**
- **Q.** 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 Ia1, Ia2 and Ia0 of the line current. **(WINTER 2024, 4 Marks OR)**

Chapter 6: Unsymmetrical Fault Analysis

Repeated Questions:

1. Line-to-Line Fault:

- **Q.** Using appropriate interconnection of sequence networks, derive the equation for a line to line fault in a power system with fault impedance of Zf. **(WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain analysis of a line to line fault. **(SUMMER 2022, 4 Marks; WINTER 2022, 4 Marks OR)**

2. Single Line-to-Ground Fault:

- **Q.** Sketch interconnection of sequence networks for single line to ground fault with equations of sequence currents and fault current. **(WINTER 2024, 4 Marks OR; WINTER 2024, 4 Marks OR)**

Other Important Questions:

1. Single Line-to-Ground Fault (Theory):

- **Q.** Discuss the types of Fault? Derive single line to ground fault. **(SUMMER 2026, 7 Marks OR)**
- **Q.** Explain analysis of a line to ground fault. **(WINTER 2022, 7 Marks)**
- **Q.** Justify, that for a fault at alternator terminals, a single line-to-ground fault is generally more severe than a three-phase fault. **(SUMMER 2025, 3 Marks OR)**

2. Line-to-Line Fault:

- **Q.** 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 Zf: $I_f = -jV3\ E_a / (Z_1 + Z_2 + Z_f)$ **(WINTER 2024, 4 Marks)**

3. Double Line-to-Ground Fault (Theory):

- **Q.** 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. **(SUMMER 2023, 7 Marks)**
- **Q.** Derive all components of V and I for double line to ground fault on an unloaded generator with sequence network. (consider 3- phase star connected generator with ground neutral). **(SUMMER 2022, 7 Marks OR)**
- **Q.** Give the analysis of double line to ground fault considering the effect of fault impedance. **(SUMMER 2025, 7 Marks)**

4. Unsymmetrical Fault Analysis (Numerical):

- **Q.** A 25MVA, 11kV 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. **(SUMMER 2023, 7 Marks OR)**
- **Q.** A 4 bus network given in Fig. 1 with following positive, negative and zero sequence reactances: G1:X0 = 0.06pu; X1 = X2 = 0.2pu; G2:X0 = 0.05pu; X1 = X2 = 0.3pu; T1&T2:X0 = X1 = X2 = 0.2pu; Transmission line:X0 = 0.08pu; X1 = X2 = 0.1pu; G1 and G2 neutral ground reactance = 0.3pu. A fault occurs at bus 4 phase R. Draw sequence impedance diagram and find the fault current in p. u. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**
- **Q.** A three phase synchronous generator rated 11kV, 50MVA has positive, negative and zero sequence reactances as 0.2p.u., 0.1p.u. and 0.05p.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: (i) Three phase fault (ii) Line to ground fault at generator terminals. Assume generator at no load prior to fault. **(WINTER 2022, 7 Marks OR)**

- **Q.** 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. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**
- **Q.** A three-phase, 6.9kV, 10MVA alternator has X'' = X2 = 15% and X0 = 5%. The neutral is grounded through an inductive reactance of 0.381Ω. Evaluate the subtransient current in ampere in the faulted phase, when a single line to ground fault takes place on phase-a. **(WINTER 2024, 7 Marks)**
- **Q.** A power system has equivalent positive, negative and zero sequence impedance of j0.2243pu, j0.1741pu and j0.15pu 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. **(WINTER 2024, 7 Marks OR)**

Chapter 7: Corona

Repeated Questions:

1. Corona – Phenomenon, Factors and Reduction:

- **Q.** Explain corona phenomena in transmission lines. / What is meant by corona? Why does it occur? / Explain the phenomena of corona. **(SUMMER 2023, 3 Marks OR; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks OR)**
- **Q.** What is Corona? Explain different methods to reduce corona loss. / Explain methods to reduce corona loss in brief. / Describe methods to reduce corona loss. **(WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks; WINTER 2025, 4 Marks)**
- **Q.** Explain factor affecting corona. / Discuss in detail factors and conditions affecting corona loss. / Explain various factors affecting Corona effect of the transmission line. / Describe the factors affecting corona loss. **(WINTER 2022, 3 Marks OR; WINTER 2023, 7 Marks; SUMMER 2024, 4 Marks OR; SUMMER 2025, 4 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks)**

2. Critical Voltages:

- **Q.** What is Critical Disruptive Voltage? Write a formula of Critical Disruptive Voltage and briefly describe each variable in the formula. **(SUMMER 2022, 3 Marks OR; WINTER 2025, 3 Marks OR)**
- **Q.** What is difference between visual critical voltage and disruptive critical voltage? / Why the disruptive critical voltage is less than visual critical voltage. **(WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks)**

Other Important Questions:

1. Corona (Theory):

- **Q.** Explain the following terms with reference to corona : (i) Critical disruptive voltage (ii) Visual critical voltage (iii) Power loss due to corona. **(SUMMER 2026, 3 Marks OR)**
- **Q.** Write down corona loss formula given by Peek on basis of weather conditions and name each of the parameters in the expression. **(WINTER 2024, 3 Marks)**
- **Q.** What will be the effect of the following on disruptive critical voltage and corona? (i) increasing diameter (ii) reducing spacing between conductors (iii) rise in barometric pressure of air. **(WINTER 2024, 3 Marks OR)**
- **Q.** Write a short note on radio interference. **(SUMMER 2022, 3 Marks)**

2. Corona (Numerical):

- **Q.** Determine the disruptive critical voltage and corona loss for a 3-ϕ phase line operating at 110kV which has conductor of 1.25cm diameter arranged in a 3.05m meter delta. Assume air density factor of 1.07 and dielectric strength of the air to be 21kV/cm. **(SUMMER 2023, 4 Marks OR)**
- **Q.** Find the critical disruptive voltage and critical voltages for local and general corona on a 3-phase overhead transmission line, consisting of three stranded copper conductors spaced 2.5m apart at the corners of an equilateral triangle. Air temperature and pressure are 21°C and 73 cm Hg respectively. The conductor diameter, irregularity factor and surface factor are 10.4mm, 0.85, 0.7 and 0.8 respectively. **(SUMMER 2024, 7 Marks OR)**
- **Q.** A 3 phase overhead line has conductors of 30mm 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 230kV between lines. Breakdown strength of air is 30 kV/cm. **(WINTER 2023, 3 Marks OR)**
- **Q.** Find the critical disruptive voltage and corona loss for a 3-phase line that is operating at 220kV, 50Hz frequency. The line has a conductor of 1.5cm diameter arranged in a 3-meter delta connection. Assume air density of 1.05 and dielectric strength of air to be 21.1kV/cm. **(SUMMER 2025, 7 Marks OR)**

Chapter 8: Over-voltages in Power Systems

Repeated Questions:

1. Lightning and Surge Protection:

- **Q.** What is the harmful effect of lightning on a power system? Discuss the different types of lightning strokes. / Discuss the different types of lightning strokes and their harmful effects on power system. / Explain types of lightning strokes. **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks OR; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** Explain in short Surge absorber. / Write a note on following: (1) Lightning Arresters (2) Surge absorber. **(SUMMER 2022, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

2. Insulation Coordination:

- **Q.** What is insulation coordination? Define and explain BIL. / What is BIL? **(WINTER 2023, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Lightning and Causes of Overvoltage:

- **Q.** What is lightning? Describe the mechanism of lightning discharge. **(SUMMER 2026, 7 Marks OR)**
- **Q.** Discuss the causes of overvoltage. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Compare protection provided against lightning by earthing screen and ground wires. **(WINTER 2024, 4 Marks)**
- **Q.** Differentiate between direct and indirect lightning strokes. **(WINTER 2024, 4 Marks OR)**

2. Protective Devices:

- **Q.** Explain the working of Thyrite valve type surge arresters for protection against overvoltages. **(WINTER 2022, 4 Marks OR)**

Chapter 9: Transients in Power Systems

Repeated Questions:

1. Travelling Waves:

- **Q.** Write short note on an attenuation of travelling waves. / Derive the equation for attenuation of travelling waves. **(SUMMER 2022, 7 Marks OR; WINTER 2025, 7 Marks OR)**
- **Q.** What is the phenomenon of wave reflection and refraction? Derive expression for reflection and refraction. **(WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** Explain Reflection and Refraction of Travelling waves at a T-junction on transmission lines. / Derive the expression for refracted voltage wave due to a surge travelling at T-junction. / Explain reflection and refraction at a T- junction for travelling wave with necessary equation. **(SUMMER 2022, 4 Marks OR; SUMMER 2023, 4 Marks OR; SUMMER 2026, 7 Marks)**

2. Arcing Ground and Switching:

- **Q.** Write a short note on the arcing ground phenomenon. / Explain the phenomena of arcing grounds in an isolated neutral systems. Discuss why it can cause severe overvoltages in a power system. / Explain overvoltage due to arcing ground with necessary vector diagram. **(SUMMER 2022, 4 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 4 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Write a brief note on capacitance switching. **(SUMMER 2022, 3 Marks OR; SUMMER 2025, 3 Marks OR)**

Other Important Questions:

1. Travelling Waves (Theory):

- **Q.** 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? **(SUMMER 2023, 7 Marks OR)**
- **Q.** What is meant by doubling effect? Explain in brief. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain reflection of a travelling wave in a line terminated by: (i) open circuit. (ii) short circuit. **(WINTER 2022, 7 Marks)**
- **Q.** Explain in brief the traveling waves of the transmission line when the receiving end is short-circuited. **(SUMMER 2025, 7 Marks OR)**
- **Q.** Voltage and current travelling waves passing through line having surge impedance Zc1 arrive at discontinuity point from where another line having surge impedance Zc2 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. **(WINTER 2024, 7 Marks)**
- **Q.** 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. **(WINTER 2024, 7 Marks OR)**

2. Switching Transients and Definitions:

- **Q.** Discuss switching transients in an R-L circuit (power system) supplied by an a.c. source. **(WINTER 2022, 4 Marks)**
- **Q.** Explain any two causes which are producing transients on a transmission line. **(SUMMER 2025, 4 Marks)**
- **Q.** Define the following terms (i) transient (ii) restriking (iii) recovery voltage. **(SUMMER 2025, 4 Marks OR)**

3. Travelling Waves (Numerical):

- **Q.** 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. **(SUMMER 2023, 3 Marks)**
- **Q.** A 500kV, 2 μs rectangular surge on a line having a surge impedance of 350Ω approaches a station at which the concentrated earth capacitance is 3000pF. Determine the maximum value transmitted wave. **(SUMMER 2023, 3 Marks OR)**

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