GUJARAT TECHNOLOGICAL UNIVERSITY

BE-5 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Power System- II- 3150911

Unit 1: Basic Principles

Repeated Questions:

1. **Advantages of Per Unit System:** Explain the advantages of the per-unit system for power system calculations.
    - **SUM24-03, WIN22-03, SUM22-03, SUM25-03**
2. **Balanced Three-Phase Power:** Prove that under balanced conditions, the sum of the three-phase voltage or current phasors is zero.
    - **SUM25-04**
3. **Power in AC Circuits / Parallel Loads (Numerical):** Three loads are connected in parallel. Find total kW, kVAR, kVA, power factor, and calculate the capacitor rating for power factor correction.
    - **SUM24-07, WIN22-07**

Other Important Questions:

4. **Power in Single Phase AC Circuits:** Explain power in single-phase AC circuits briefly.
    - **SUM22-04**
5. **Three-Phase Balanced Circuit Definition:** What is meant by a three-phase balanced circuit? Write down expressions of three-phase balanced voltage phasors in polar form.
    - **WIN24-03**

Unit 2: Representation of Power System Components

Repeated Questions:

1. **Per Unit Representation of Transformers:** Prove that the per-unit impedance of a transformer is the same whether computed from the primary or secondary side. / Write a short note on it.
    - **SUM23-07, WIN22-07**
2. **Synchronous Generator on Infinite Bus:** Explain the working of a synchronous generator connected to an infinite bus. Draw the equivalent circuit and phasor diagram.
    - **SUM22-07, SUM25-07**
3. **Operating Chart:** Draw and discuss the operating chart of a synchronous generator.
    - **SUM23-04**
4. **Per Unit Diagram (Numerical):** Create a per-unit impedance/reactance diagram for a given power system with multiple generators, transformers, and lines.
    - **SUM23-07, WIN24-07**

Other Important Questions:

5. **Salient Pole Generator:** Explain the salient pole synchronous generator with a power-angle curve.
    - **SUM22-04, SUM25-04**
6. **Equivalent Per Unit Reactance (Numerical):** Find the overall equivalent per-unit reactance of generators connected in parallel on a common base.
    - **SUM24-04**

Unit 3: Transmission Line Modeling and Performance

Repeated Questions:

1. **Ferranti Effect:** What is the Ferranti effect? Explain its reason and how it can be prevented. / Show that receiving-end voltage can exceed sending-end voltage under no-load.
    - **SUM23-03, SUM22-03, WIN23-03, WIN24-04**
2. **Rigorous Solution of Long Lines:** Using the rigorous solution method, derive the expression for ABCD constants of a long transmission line in terms of hyperbolic functions. / Define propagation constant and characteristic impedance.
    - **SUM23-07, SUM22-07, WIN23-07**
3. **Nominal T vs. Nominal π Circuits:** Compare Nominal-T and Nominal-π methods for the analysis of medium transmission lines with phasor diagrams and expressions. / Draw phasor diagrams and derive expressions for sending-end voltage and current.
    - **WIN22-07, WIN23-07, WIN24-07**
4. **Short Line Numerical:** For a short transmission line, determine sending-end voltage, voltage regulation, etc., given load and line parameters.
    - **SUM23-07, SUM25-07**
5. **ABCD Constants & Power Flow:** Derive equations for power flow through a transmission line. / Determine the power that can be received using given ABCD constants.
    - **SUM22-07, SUM25-07**
6. **Equivalent π vs. Equivalent T:** Why is the equivalent π circuit of a long line preferred to the equivalent T circuit?
    - **SUM24-04, WIN23-04**
7. **Voltage Control Methods:** Explain in brief the different methods of voltage control employed in power systems.
    - **WIN22-07, SUM25-04**

Other Important Questions:

8. **Classification of Lines:** Differentiate between short, medium, and long transmission lines. Define voltage regulation and transmission efficiency.
    - **WIN22-03, SUM22-03**
9. **Medium Line Modeling:** Obtain the equivalent circuit of the medium transmission line using nominal-π representation.
    - **SUM25-04**
10. **Receiving End Circle Diagram:** What is a receiving-end power circle diagram? How can it be drawn? What information does it provide? / Find the center of the circle diagram (Numerical).
    - **SUM24-07, SUM22-04, SUM23-04**
11. **Voltage Regulation (Numerical):** Evaluate the percentage voltage regulation using given ABCD parameters.
    - **WIN24-03**

Unit 4: Symmetrical Fault Analysis

Repeated Questions:

1. **Transients on Transmission Line:** Discuss transients on a transmission line during a short circuit. / Analyze the behavior of short-circuit current with expressions and waveforms.
    - **WIN22-07, SUM22-07, WIN24-07**
2. **Circuit Breaker Selection:** Discuss the criteria for the selection of circuit breakers. / Write a short note on it.
    - **SUM23-04, WIN23-04, SUM22-04**
3. **Zbus Matrix Modifications:** Show how the Zbus matrix gets modified for different types of modifications (e.g., adding a branch from a new bus to an old bus).
    - **SUM23-07, WIN22-07**
4. **Fault Current Calculation (Numerical):** Determine the fault current for a three-phase fault at a bus bar or generator terminals.
    - **WIN22-07, WIN23-07**

Other Important Questions:

5. **Doubling Effect:** What is meant by the doubling effect? Explain briefly.
    - **SUM24-03**
6. **Sub-transient vs. Steady-State Current:** Why are we interested in the computation of sub-transient current rather than the steady sustained short-circuit current?
    - **SUM24-03**
7. **Zbus for Fault Calculation:** What is the bus impedance matrix? Explain the method of fault calculation using it. (Numerical on fault current and post-fault voltage).
    - **SUM24-07, WIN22-07**

Unit 5: Symmetrical Components

Repeated Questions:

1. **Symmetrical Component Transformation:** Prove that the symmetrical component transformation is power invariant.
    - **WIN22-04, SUM23-03, SUM25-03**
2. **Phase Quantities to Components (and vice versa):** Derive the necessary equations to obtain symmetrical components from the phase quantities and vice versa.
    - **SUM25-04, WIN23-04**
3. **Phase Shift in Y-Δ Transformers:** Explain the phase shift of symmetrical components in Y-Δ transformer banks.
    - **SUM22-07, SUM24-04**
4. **Zero Sequence Networks of Transformers:** Draw the zero-sequence network for transformers with various connections (e.g., Δ-Y, Y-Y).
    - **SUM23-03, SUM24-04, WIN23-04**

Other Important Questions:

5. **Need for Symmetrical Components:** What are symmetrical components and why are they needed?
    - **WIN23-03, SUM24-03**
6. **Finding Symmetrical Components (Numerical):** Given three-phase unbalanced currents or voltages, find their symmetrical components.
    - **SUM23-04, WIN23-07, SUM24-04**
7. **12-Phase System:** How many symmetrical components are required to analyze a 12-phase unbalanced system? What will be the sequence operator?
    - **WIN24-03**

Unit 6: Unsymmetrical Fault Analysis

Repeated Questions:

1. **Symmetrical vs. Unsymmetrical Faults:** Differentiate between symmetrical and unsymmetrical faults, listing various types.
    - **SUM23-03, SUM22-03, WIN23-03**
2. **Line-to-Line (L-L) Fault Analysis:** Explain the analysis of a line-to-line fault. Derive the equation for the fault current, considering fault impedance Z_f.
    - **SUM22-04, SUM24-07, WIN23-07**
3. **Single Line-to-Ground (L-G) Fault Analysis:** Explain the analysis of a single line-to-ground fault. / Derive the expression for fault current.
    - **WIN22-04, SUM25-07**
4. **Double Line-to-Ground (LLG) Fault Analysis:** Explain the analysis of a double line-to-ground fault. Derive the expression for the fault current and show the interconnection of sequence networks.
    - **SUM23-07, SUM25-07**
5. **Fault Current Calculation (Numerical):** Calculate the sub-transient current in the faulted phase for an L-G fault or other unsymmetrical faults on a generator or system, given sequence impedances.
    - **WIN24-07, SUM23-07, WIN23-07**

Other Important Questions:

6. **Sequence Network Interconnection:** Sketch the interconnection of sequence networks for a single line-to-ground fault with equations.
    - **WIN24-07**
7. **Severity of L-G vs. Three-Phase Fault:** Justify that for a fault at alternator terminals, a single line-to-ground fault is generally more severe than a three-phase fault.
    - **SUM25-03**
8. **LLG Fault Simulation (Numerical):** Evaluate per unit sequence currents for a solid LLG fault given positive, negative, and zero sequence impedances.
    - **WIN24-07**
9. **Generator Sequence Models:** Draw the single-phase model of positive, negative, and zero sequence networks of a three-phase synchronous generator with neutral grounding impedance Z_n.
    - **WIN24-07**

Unit 7: Corona

Repeated Questions:

1. **Corona Phenomenon:** What is corona? Why does it occur? Explain the corona phenomena in transmission lines.
    - **WIN23-03, SUM22-03, SUM24-03**
2. **Factors Affecting Corona:** Discuss in detail the factors and conditions affecting corona loss. / State factors affecting corona loss.
    - **WIN23-07, SUM24-04**
3. **Critical Disruptive Voltage:** Write the formula for Disruptive Critical Voltage and describe each variable. / Differentiate between disruptive critical voltage and visual critical voltage.
    - **SUM22-03, WIN23-04, SUM24-03**
4. **Methods to Reduce Corona:** Describe methods to reduce corona loss.
    - **WIN22-03, SUM24-03**
5. **Corona Numerical:** Find the critical disruptive voltage and corona loss for a given 3-phase line configuration.
    - **SUM25-07, SUM23-04, WIN23-07**

Other Important Questions:

6. **Effect of Parameters on Corona:** What will be the effect of increasing conductor diameter, reducing spacing, etc., on disruptive critical voltage and corona?
    - **WIN24-03**
7. **Peck's Formula:** Write down the corona loss formula given by Peck and name the parameters.
    - **WIN24-03**
8. **Radio Interference:** Write a short note on radio interference.
    - **SUM22-03**

Unit 8: Over-voltages in Power Systems

Repeated Questions:

1. **Types of Lightning Strokes:** Explain the types of lightning strokes.
   - **SUM22-07, SUM25-07**
2. **Protection against Lightning:** Compare protection provided by an earthing screen and ground wires. / Explain the working of a lightning arrester or surge absorber.
   - **WIN24-04, SUM22-07, SUM25-07**
3. **BIL (Basic Insulation Level):** What is BIL? Define and explain BIL in the context of insulation coordination.
   - **SUM25-03, WIN23-03**

Other Important Questions:

4. **Direct vs. Indirect Strokes:** Differentiate between direct and indirect lightning strokes.
   - **WIN24-04**
5. **Arcing Grounds & Overvoltages:** Explain the phenomena of arcing grounds in isolated neutral systems. Discuss why it can cause severe overvoltages.
   - **SUM23-07, SUM22-04**

Unit 9: Transients in Power Systems

Repeated Questions:

1. **Travelling Waves Concept:** Explain the concept of travelling waves on transmission lines.
    - **WIN22-07, SUM25-07**
2. **Wave Reflection & Refraction:** Discuss the phenomenon of wave reflection and refraction. Derive expressions for the reflection and refraction (transmission) coefficients.
    - **WIN23-04, SUM24-07**
3. **Termination Conditions:** Explain the reflection of a travelling wave in a line terminated by (i) an open circuit and (ii) a short circuit. Show the waveforms.
    - **WIN22-07, WIN24-07**
4. **Reflection at T-Junction:** Explain reflection and refraction at a T-junction for a travelling wave with necessary equations.
    - **SUM22-04, SUM23-07**
5. **Capacitance Switching:** Write a brief note on capacitance switching.
    - **SUM25-03, SUM22-03**

Other Important Questions:

6. **Velocity of Travelling Wave:** Prove that a travelling wave on a transmission line travels at the speed of light. What would be the velocity in a cable?
    - **SUM23-07**
7. **Attenuation of Waves:** Derive the equation for the attenuation of travelling waves.
    - **SUM22-07**
8. **Transient in R-L Circuit:** Discuss switching transients in an R-L circuit supplied by an AC source.
    - **WIN22-04**
9. **Transient Numerical:** A surge travels from a line to a cable or is terminated by a capacitance. Find the value of the refracted or transmitted wave.
    - **SUM23-03, WIN23-03**

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