

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Power System Operation and Control- 3170919

Unit 1: Automatic Generation Control and Voltage Control

Repeated Questions:

1. **Explain the Turbine speed governing mechanism/system.**
 - Appeared in: W22 (Q1c, 07 marks), W23 (Q1c, 07 marks), W24 (Q2c, 07 marks), SUM25 (Q4c, 07 marks)
2. **Explain Load Frequency Control (LFC).**
 - Appeared in: SUM22 (Q1b, 04 marks), SUM23 (Q4b, 04 marks), SUM25 (Q4b, 04 marks)
3. **What are GRC Constraints? What is its effect on Load Frequency control?**
 - Appeared in: W23 (Q1a, 03 marks), SUM24 (Q2c, 07 marks OR)
4. **Explain Automatic Voltage Control / Excitation control for a generator.**
 - Appeared in: W22 (Q1a, 03 marks), SUM25 (Q4a, 03 marks)

Other Important Questions:

5. Explain the combined operation of load frequency control & Economic Dispatch control. (SUM22 - Q1b, 04 marks)
6. Explain optimal load frequency control for a two-area control system. (SUM22 - Q1c, 07 marks)
7. Draw and explain the block diagram of AGC (Automatic Generation Control). (W24 - Q2b, 04 marks)
8. Explain the principle of frequency control in a power system. (W24 - Q2a, 03 marks)
9. Explain speed governor dead-band and its effect on AGC. (SUM23 - Q1a, 03 marks)
10. Draw a Block diagram model of load frequency control for an isolated power system. (SUM23 - Q4b, 04 marks)
11. With a neat schematic diagram, explain the process of selective frequency control. (SUM23 - Q3b, 04 marks OR)
12. What is meant by free governor operation? (SUM23 - Q5b, 04 marks)
13. **Numerical:** Two turbo alternators rated for 110MW and 210MW have governor drop characteristics of 5% from no load to full load. They are connected in parallel to share a load of 250MW. Determine the load shared by each machine assuming free governing action. (SUM23 - Q5c, 07 marks)

14. **Numerical:** The governor speed regulation of Gen-1 and Gen-2 is of the order of 5.0 and 4.0 percentage from no-load to full load, respectively. The generation capacity of Gen-1 and Gen-2 is 100 MW and 200 MW, respectively. They are operating parallel and sharing a load of 300 MW. Assuming free governor action and no-load frequency of the generator is 50 Hz. Determine the load shared by each unit. (SUM24 - Q2c, 07 marks)
15. **Numerical:** Determine the primary load frequency control parameters K_{ps} , T_{ps} and B of a control area having the following data: Total rated capacity = 1000 MW, Inertia Constant $H=5$ kWs/kVA, Normal operating load = 500MW at 50Hz. Assume change in load 1% for 1% change in frequency. (W23 - Q2b, 04 marks)
16. Derive the expression of the transfer function of a generator load model and draw its equivalent block diagram. (W23 - Q2c, 07 marks OR)

Unit 2: Reactive Power and Voltage Control

Repeated Questions:

1. **What is Surge Impedance Loading (SIL)? Explain with its expression and implications.**
 - Appeared in: W22 (Q2b, 04 marks), SUM22 (Q1a, 03 marks), W23 (Q3a, 03 marks), SUM23 (Q3c, 07 marks OR), SUM25 (Q4b, 04 marks)
2. **Explain voltage regulation of a transmission line and its relation with reactive power.**
 - Appeared in: W22 (Q2c, 07 marks), SUM24 (Q4b, 04 marks OR), SUM25 (Q4a, 03 marks), W24 (Q5a, 03 marks)
3. **Define voltage collapse. Enlist the main factors that contribute to the phenomena.**
 - Appeared in: W22 (Q5c, 07 marks OR), W23 (Q4a, 03 marks), SUM24 (Q2b, 04 marks)
4. **Enlist different types of reactive power compensation methods. Explain Static VAR Compensators (SVCs) in detail.**
 - Appeared in: W22 (Q2c, 07 marks OR), SUM23 (Q5c, 07 marks OR), W24 (Q3c, 07 marks)
5. **Explain the Q-V coupling concept / Derive a relation between voltage and reactive power at a node.**
 - Appeared in: SUM22 (Q2c, 07 marks), SUM24 (Q4c, 07 marks OR)

Other Important Questions:

6. Discuss the sources of reactive power generation in power systems. (W22 - Q2a, 03 marks)
7. Explain the reactive loss characteristics of a transmission line. (SUM22 - Q3a, 03 marks)
8. Explain the operation of an uncompensated radial transmission line under no-load condition with the help of a vector diagram. (W23 - Q3b, 04 marks)
9. Explain why voltage control is necessary in a power system. Describe methods to control voltage. (SUM23 - Q2c, 07 marks)
10. What is decoupling concept? Show that for a lossless transmission two-bus model, Q-V and P- δ quantities are closely coupled. (SUM22 - Q2c, 07 marks OR)
11. Differentiate between voltage stability and angle stability of the power system. (SUM24 - Q4a, 03 marks)
12. List out the methods for improving voltage stability. (SUM24 - Q4b, 04 marks)
13. Explain the use of Off-load and On-load tap changers for voltage control. (W24 - Q3a, 03 marks)
14. What are the drawbacks of series capacitors used for voltage control? (W24 - Q3b, 04 marks)
15. Explain various methods of voltage control for a transmission line. (SUM25 - Q4c, 07 marks OR)
16. Explain P-V curves of a transmission line with different power factors. (W24 - Q5b, 04 marks)
17. Obtain the necessary relation between maximum power and line length. (SUM22 - Q4b, 04 marks)
18. How do you obtain a relation for maximum power and line angle/line length of a power line? (SUM23 - Q2c, 07 marks OR)
19. What is line loadability? Obtain an expression for loadability. (SUM22 - Q4a, 03 marks OR)
20. **Numerical:** A 220 kV, 3-Phase, 50Hz and 100 km long lossless transmission line has an inductive reactance of $0.6 \Omega/\text{km}$ and a capacitive admittance of $50 \mu\text{S}/\text{km}$ operating under no load. Calculate: (i) Surge Impedance, (ii) SIL, (iii) Receiving end voltage (no load), (iv) Sending end current, (v) Sending end reactive power. (W23 - Q3c, 07 marks)
21. **Numerical:** Find the capacity of a static VAR compensator to be installed at a bus with $\pm 5\%$ voltage fluctuation. The short-circuit ratio is 500 MVA. (SUM23 - Q2b, 04 marks)

Unit 3: Power System Security

Repeated Questions:

1. **Describe the various operating states of a power system from a security point of view.**
 - Appeared in: W22 (Q3a, 03 marks), W23 (Q2c, 07 marks), SUM24 (Q1a, 03 marks), SUM25 (Q3c, 07 marks OR)
2. **What is Power System Security? Explain its major functions (Security Assessment & Control) and system state classification.**
 - Appeared in: W22 (Q3c, 07 marks), SUM23 (Q4c, 07 marks OR), SUM24 (Q1b, 04 marks)
3. **Explain Generation Shift Factor (GSF) and Line Outage Distribution Factor (LODF).**
 - Appeared in: W22 (Q1b, 04 marks), W24 (Q4c, 07 marks OR), SUM23 (Q5a, 03 marks)

Other Important Questions:

4. Explain the role of Power System Security in Power System Operation. (SUM22 - Q2a, 03 marks)
5. Give a flow chart for contingency selection/analysis. (W22 - Q3b, 04 marks), (W23 - Q2a, 03 marks), (SUM25 - Q3b, 04 marks OR)
6. Explain contingency analysis of a power system. (W22 - Q3b, 04 marks OR)
7. Discuss different sensitivity factors used for power system security analysis. (SUM24 - Q1c, 07 marks)
8. Write short notes on sensitivity factors used in security analysis. (SUM23 - Q5b, 04 marks)
9. Explain the concept of contingency analysis and derive the equations of sensitivity factors in the system. (SUM22 - Q3c, 07 marks)
10. Discuss the concept of a blackout. (SUM23 - Q1b, 04 marks)

Unit 4: State Estimation

Repeated Questions:

1. **What is State Estimation? Explain its concept and necessity.**
 - Appeared in: SUM22 (Q3b, 04 marks), W22 (Q3a, 03 marks OR), W24 (Q3a, 03 marks), SUM25 (Q3a, 03 marks)
2. **Explain the Least Square Estimation technique for State Estimation.**
 - Appeared in: SUM22 (Q5a, 03 marks), SUM23 (Q1c, 07 marks), W23 (Q4b, 04 marks), W24 (Q3c, 07 marks), SUM25 (Q3c, 07 marks)
3. **Compare Static and Dynamic State Estimation.**
 - Appeared in: SUM22 (Q4a, 03 marks), SUM23 (Q3a, 03 marks), SUM25 (Q3a, 03 marks)
4. **What is Bad Data? Explain its detection and suppression/treatment in State Estimation.**
 - Appeared in: W22 (Q3c, 07 marks OR), W23 (Q4c, 07 marks), W24 (Q5c, 07 marks OR)
5. **Explain the application of State Estimation with a suitable diagram/block diagram.**
 - Appeared in: SUM22 (Q5c, 07 marks OR), W24 (Q3b, 04 marks), SUM25 (Q2c, 07 marks OR)

Other Important Questions:

6. Explain Network Observability and Pseudo-Measurements. (SUM22 - Q3a, 03 marks OR), (SUM24 - Q3a, 03 marks OR), (SUM24 - Q3b, 04 marks OR)
7. Explain the Weighted Least Square Estimation method. (W24 - Q5c, 07 marks), (W23 - Q4b, 04 marks OR)
8. Explain Tracking State Estimation of Power Systems. (SUM22 - Q5c, 07 marks OR)
9. Express Computational Considerations of state estimation of a power system. (SUM22 - Q5a, 03 marks OR)
10. Give a Flow chart of one scheme of Fast Decoupled State Estimation. (SUM22 - Q4b, 04 marks OR)
11. Elaborate on the importance of Pseudo measurement used in state estimation. (SUM24 - Q3a, 03 marks OR)
12. Discuss the Chi-square test used in state estimation. (SUM24 - Q3c, 07 marks OR)
13. Derive the equation for the Least square estimate $\hat{x} = (H^T H)^{-1} H^T z$. (W23 - Q4b, 04 marks)
14. Derive the equation for the Weighted Least square estimate $\hat{x} = (H^T W H)^{-1} H^T W z$. (W23 - Q4b, 04 marks OR)
15. What is Network observability analysis? How is it ensured in state estimation? (W23 - Q4a, 03 marks OR)
16. **Numerical/Theory:** Determine the following terms from Figure-1 [Assuming figure with 3 measurements]. Considering the Weighted least square estimation technique determine (i) Size and Elements of weighting matrix, (ii) Size of H-matrix, (iii) Size of Gain matrix (G), (iv) Size of measurement variable matrix, (v) Size of state variables matrix, (vi) Size of error matrix. (SUM24 - Q3c, 07 marks)

Unit 5: Load Forecasting

Repeated Questions:

1. **What is Load Forecasting? What are its objectives?**
 - Appeared in: W22 (Q4a, 03 marks), SUM22 (Q3b, 04 marks OR), W24 (Q4a, 03 marks), SUM25 (Q5a, 03 marks)
2. **Explain the Regression Analysis method of load forecasting.**
 - Appeared in: W24 (Q4c, 07 marks), SUM25 (Q5c, 07 marks)
3. **Differentiate between Short, Medium, and Long-term load forecasting / Summarize the nature of load forecasting based on lead time.**
 - Appeared in: SUM23 (Q3b, 04 marks), W22 (Q4a, 03 marks OR), SUM25 (Q5b, 04 marks)
4. **Explain Auto-Regressive (AR) and Auto-Regressive Moving Average (ARMA) models for load forecasting.**
 - Appeared in: SUM22 (Q4c, 07 marks OR), W22 (Q4c, 07 marks OR)

Other Important Questions:

5. List out different Load Forecasting Methods. (SUM22 - Q5b, 04 marks OR)
6. Discuss the estimation of average and trend terms for any load data. (W22 - Q4c, 07 marks), (W24 - Q5b, 04 marks OR)
7. Explain the Kalman Filtering Approach for load forecasting. (W22 - Q4b, 04 marks OR)
8. Explain long-term load forecasting using an econometric model. (W23 - Q5c, 07 marks OR)
9. What are the uses of long-term load forecasting? (W24 - Q5a, 03 marks)
10. Explain the factors affecting load demand. (SUM25 - Q5a, 03 marks OR)
11. What is a load survey? Explain it briefly. (W24 - Q4b, 04 marks), (SUM25 - Q5b, 04 marks OR)
12. List various methods for the prediction of the deterministic part and stochastic part of the load. (W23 - Q5a, 03 marks OR)
13. Explain the effect of Temperature Humidity Index and Wind Chill Index on the power system load. (W24 - Q5b, 04 marks OR)
14. Discuss auto-regressive models used for load forecasting. (SUM24 - Q5a, 03 marks OR)
15. Discuss Estimation of Periodic Components used in load forecasting. (SUM24 - Q5b, 04 marks OR)
16. Discuss the different natures of load forecasting. (SUM24 - Q5a, 03 marks)

Unit 6: Introduction to Power System Deregulation and Restructuring

Repeated Questions:

1. **Explain the function of different entities in a Deregulated Power System.**
 - Appeared in: SUM22 (Q3c, 07 marks OR), W22 (Q5b, 04 marks), W23 (Q5c, 07 marks), SUM25 (Q1c, 07 marks)
2. **Explain the concept, motivation, and need for Regulation, Deregulation, and Restructuring in the power system.**
 - Appeared in: SUM22 (Q5c, 07 marks OR), SUM23 (Q3a, 03 marks OR), SUM24 (Q5c, 07 marks), SUM25 (Q1a, 03 marks), SUM25 (Q1c, 07 marks)
3. **What are the major provisions/important points of the Electricity Act 2003?**
 - Appeared in: SUM23 (Q5a, 03 marks), SUM25 (Q2b, 04 marks), W24 (Q1b, 04 marks)
4. **Explain the functioning of a Vertically Integrated System / Draw and explain the typical structure of a deregulated power industry.**
 - Appeared in: SUM25 (Q1b, 04 marks), W24 (Q1a, 03 marks)
5. **Discuss the major issues/problems faced by the Indian power sector and their remedies.**
 - Appeared in: SUM25 (Q2c, 07 marks), W24 (Q1c, 07 marks)

Other Important Questions:

6. Enlist various Public Sector and Private players in the Indian Power Sector. (SUM25 - Q2a, 03 marks)
7. Discuss the present scenario of the power system structure in India. (W22 - Q5c, 07 marks)
8. Explain the historical background of the implementation of deregulation in the world / Milestones of deregulation. (SUM23 - Q4c, 07 marks), (SUM25 - Q5c, 07 marks OR)
9. What is deregulation? Enlist the advantages of deregulation. (W22 - Q5a, 03 marks OR)
10. What are the advantages of a Deregulated Power Industry compared to a Vertically Integrated Power Industry? (W24 - Q2c, 07 marks OR)
11. List various factors which motivated the deregulation of the power industry. (W23 - Q5a, 03 marks)
12. Explain the Electricity market entities and model / List the entities involved in the Electricity market and their role. (SUM22 - Q4c, 07 marks OR), (SUM24 - Q5c, 07 marks OR)
13. Explain the Retail competition model with the help of a block diagram. (W23 - Q5b, 04 marks)
