GUJARAT TECHNOLOGICAL UNIVERSITY

BE 7 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Smart Grids - 3170922

Chapter 1: Basics of Load and Generation, Grid operation, Concepts of Power Flow Analysis, Economic Dispatch and Unit Commitment, Difference between conventional & smart grid, Architecture of Smart Grid, Smart Grid standards, Policies Applications, Smart Grid control layer and elements, Smart Grid Initiative for Power Distribution Utility in India

Repeated Questions:

1. Smart Grid vs Conventional Grid:

- **Q.** Compare the smart grid and conventional grid system / Give the comparison between the Smart Grids and Existing Grids / Overall view on Smart Grid Vs Conventional Grid / Mention the benefits of smart grid w.r.t. conventional Grid / Give comparison of smart grid with conventional inherited grid / Explain the advantages of a smart grid over the conventional grid system. **(SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Discuss changes to be made in conventional power grid to transform the same into smart grid. / How the conventional power grid converts into the smart grid. State technical and infrastructural requirements for smart grid. **(SUMMER 2022; WINTER 2025, 4 Marks)**

2. Architecture of Smart Grid:

- **Q.** Discuss generalized smart grid architecture with appropriate diagram / Draw smart grid architecture and discuss function of each component / Draw and explain the architecture of smart grid / Draw and discuss in brief the architecture of Smart Grids / Draw and Explain in Brief: Generalized smart grid architecture. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

3. Economic Dispatch and Unit Commitment:

- **Q.** Discuss the term Unit commitment in your words / Write short technical note about Unit commitment. **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks)**
- **Q.** Discuss Economic Dispatch in your words / Explain Economic Dispatch and unit commitment / Explain the terms, (a) Economic dispatch, and (b) Unit Commitment. **(SUMMER 2022, 3 Marks; WINTER 2023, 4 Marks; SUMMER 2025, 7 Marks OR; SUMMER 2026, 4 Marks OR)**

4. Challenges, Indian Initiatives and Deployment:

- **Q.** What are the challenges of smart grid implementation? / Write short Notes on: Challenges in India for Smart Grid Implementation. / List the Challenges to implement of Smart Grid setup. / What are the challenges of smart grid implementation in India? **(WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks)**
- **Q.** Discuss the smart grid initiatives taken by Indian national power grid till date and their importance. / Discuss: The Indian scenario and updates for implementing the smart Grid setup. / Discuss in detail the status of smart grid implementation in India. / Identify "smart grid initiatives for the power distribution utility in India" **(SUMMER 2022, 4 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

5. Load and Generation Models:

- **Q.** Enlist types of loads and load models **(SUMMER 2022, 3 Marks; WINTER 2023, 4 Marks)**
- **Q.** Enlist types of generators and mathematical models for the same. **(SUMMER 2022, 3 Marks; WINTER 2023, 3 Marks)**

6. Definition, Features and Domains of Smart Grid:

- **Q.** Define smart grid. What are the necessities of smart grid in existing electric power system network? / Give the Definition of Smart grid. What are the necessities of smart grid in existing electric power system network? **(WINTER 2022, 7 Marks; WINTER 2024, 7 Marks OR)**
- **Q.** List out the features of smart grid. / What are the key features of smart grid? **(WINTER 2022, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Define: Smart Grid. List the Smart Grid Domains. **(SUMMER 2023, 3 Marks; SUMMER 2024, 3 Marks)**

7. Standards and Policies:

- **Q.** Discuss the various Smart Grids Standards in brief. / Describe the various Standards of Smart Grid Establishment. **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks)**

8. Grid Operation and Power Flow Analysis:

- **Q.** Specify the conditions in which power system operates in a normal state. What are the various analysis to be carried out for it? **(WINTER 2022, 7 Marks OR; SUMMER 2025, 4 Marks)**
- **Q.** Explain Energy management system (EMS) in detail. **(WINTER 2023, 7 Marks; WINTER 2024, 3 Marks OR)**

Other Important Questions:

1. Standards and Policies:

- **Q.** Discuss the role of policies and policies in implementation of smart grid in the nation. **(SUMMER 2022, 4 Marks)**

2. Challenges, Indian Initiatives and Deployment:

- **Q.** List the Name the latest technologies that enable smart Grid Deployment. **(SUMMER 2025, 4 Marks)**

Chapter 2: Power Line Communications, Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems, Advanced Metering Infrastructure, Fiber Optical Networks, Wide Area Network WAN based on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Bluetooth, ZigBee, GPS, Geographic Information System (GIS), Broadband over Power line (BPL)

Repeated Questions:

1. Communication Protocols and Network Architecture:

- **Q.** Elaborate different communication protocols to be used in smart grid architecture. State specific application of each. / Elaborate on different communication protocols to be used in smart grid architecture and write specific applications for each. / List out the different communication protocols used with smart grid architecture. Elaborate upon its applications at the appropriate levels. **(SUMMER 2022, 7 Marks; WINTER 2023, 7 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** List the features of Smart Grid Communication Networks in brief. / Draw and Explain the Communications Infrastructure of Smart Grid. / Draw the diagram showing the various networks in smart grid Infrastructure. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks OR; SUMMER 2023, 7 Marks OR; SUMMER 2024, 7 Marks OR; SUMMER 2024, 7 Marks OR; SUMMER 2025, 4 Marks OR)**
- **Q.** List the Challenges in Modeling a Communication Infrastructure of Smart Grid. **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks)**

2. Smart Metering and AMI:

- **Q.** Draw the functional Block Diagram of Smart metering / Describe functional block diagram of a smart metering / Draw and explain smart metering architecture and its components / What is smart metering? Briefly explain it with the necessary block diagram / Elaborate Advanced metering and communicating infrastructure in smart grid with appropriate diagram / Explain advanced metering infrastructure (AMI) with block diagram / What is AMI? Describe functional block diagram of smart metering / Write a brief note on advanced metering infrastructure. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; WINTER 2022, 7 Marks OR; SUMMER 2023, 4 Marks OR; SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks OR; SUMMER 2024, 4 Marks OR; WINTER 2024, 4 Marks; SUMMER 2025, 7 Marks OR; WINTER 2025, 3 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 4 Marks)**
- **Q.** Discuss changes to be made in conventional energy meter to smart energy meter / Distinguish between automated meter reading and smart meter. **(SUMMER 2022; SUMMER 2026, 3 Marks OR)**
- **Q.** Discuss in brief: Automatic meter reading / Explain in brief: Automatic meter reading **(WINTER 2023, 3 Marks OR; WINTER 2024, 3 Marks OR)**

3. Power Line Communication:

- **Q.** What is power line communication? Classify PLC technologies. / What is PLC? / List the methods of power line communication along with its key characteristics. **(WINTER 2022, 4 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

4. Wireless Technologies (ZigBee, Bluetooth, WiMax):

- **Q.** What is the role of ZigBee in smart grid? / What is the role of ZigBee? State the role of ZigBee in the smart grid. / Explain the Role of Fiber optic communication and Zigbee in smart grid / List the merits and demerits of Zigbee. **(WINTER 2022, 3 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; SUMMER 2025, 7 Marks OR; WINTER 2025, 3 Marks)**

- **Q.** Write technical features of Bluetooth technology. / List the technical features of Bluetooth technology. / List the main feature of Bluetooth technology. **(WINTER 2022, 3 Marks OR; WINTER 2024, 4 Marks OR; SUMMER 2025, 3 Marks OR)**

5. Geographic Information System (GIS):

- **Q.** Mention the benefits of geographic information system (GIS) in smart grid. / Mention the benefits of geographic information systems (GISs) in a smart grid. **(WINTER 2022, 4 Marks OR; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Communication Protocols and Network Architecture:

- **Q.** List the key feature of communication technology in smart grid. **(SUMMER 2025, 4 Marks)**

2. Wireless Technologies (ZigBee, Bluetooth, WiMax):

- **Q.** Explain Wi-Max based communication and wireless mesh network. **(WINTER 2023, 7 Marks)**

Chapter 3: Distributed generation resources, Advantages and disadvantages of DG, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid Smart Grid components control elements, Smart Grid Technologies

Repeated Questions:

1. Distributed Generation – Advantages and Disadvantages:

- **Q.** Explain the advantages of Distributed Generation. List the types of Distributed Generations in practice. / Mention the advantages of distributed generation. / Describe the advantage and disadvantage of distributed generations / List the advantage and disadvantage of distributed generations / Give advantages and disadvantages of distributed generators being used with the smart grid / List the advantages of Distributed Generation. **(WINTER 2022, 3 Marks; SUMMER 2023; WINTER 2023, 4 Marks; SUMMER 2024; WINTER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

2. DG Integration with Grid and Barriers:

- **Q.** Discuss the various issues encountered while interconnecting distributed generation with the main grid. / Discuss in detail the issues of distributed generation integration with the existing power grid network. **(WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks)**
- **Q.** What are the barriers to utilize the distributed generation? Suggest the remedies to overcome it. / List the barriers to utilize the distributed generation? How to overcome it? / Discuss the barriers to Distributed Generation's integration in the electric grid and suggest possible solutions. **(WINTER 2022, 7 Marks OR; WINTER 2024, 7 Marks OR; SUMMER 2026, 7 Marks OR)**

3. Comparison of Distributed and Conventional Generation:

- **Q.** Compare distributed renewable energy generators and fossil fueled generators based on reliability. / Compare distributed generators with fossil fueled generators. **(SUMMER 2022; WINTER 2023, 4 Marks OR; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Distributed Energy Resources and Renewable Sources:

- **Q.** Which are the distributed energy resources (DERs) used in the smart grid operations? Write the maximum and minimum power capacities of such DERs. **(WINTER 2025, 3 Marks)**
- **Q.** Enlist the generators those can be located optimally as Distributed generators. / Discuss the term Distributed generation. **(SUMMER 2022, 3 Marks)**
- **Q.** Explain solar thermal based electricity generation. **(WINTER 2022, 4 Marks)**
- **Q.** Discuss the methods of estimation of energy generation from Renewable energy sources. **(SUMMER 2022, 4 Marks)**
- **Q.** Explain in brief: Types of Smart Energy Sources. **(SUMMER 2025, 7 Marks)**

2. Comparison of Distributed and Conventional Generation:

- **Q.** Differentiate between conventional power generation and distributed power generation. **(WINTER 2025, 4 Marks)**

Chapter 4: Micro Grids, Concept of micro grid, need & applications of micro grid, formation of micro grid, Modelling of AC Smart Grid components, Modelling of DC Smart Grid components, Modelling of storage devices, issues of interconnection, Operation, protection & control of micro grid. Simulation and case study of AC micro grid Islanding, need and benefits, different methods of islanding detection.

Repeated Questions:

1. Concept and Applications of Microgrid:

- **Q.** Define microgrid and list out its applications. / Define Micro grid. What are the various applications of Micro grids? / Discuss the term "microgrid" in your words / Describe the concept of Micro grids. / Define microgrid, and specify the reason of its emergence. **(SUMMER 2022, 3 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks OR; SUMMER 2024, 4 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 3 Marks; SUMMER 2026, 3 Marks OR)**

2. Islanding – Need, Benefits and Operation:

- **Q.** What is islanding? Explain the need and benefits of islanding / What is islanding? Why is islanding needed? Specify the benefits of islanding. **(WINTER 2023, 3 Marks OR; WINTER 2024, 4 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Explain the islanding operation in microgrid. **(WINTER 2022, 3 Marks OR; SUMMER 2025, 3 Marks OR)**

3. Islanding Detection Methods:

- **Q.** Explain in brief: Various Methods of Islanding Detection / Write active and passive methods of islanding detection / Explain the different features of islanding Detection methods / Give detailed classification of various island detection methods and explain each of them in brief. / What is islanding? Discuss in detail the methods of islanding detection. **(WINTER 2022, 4 Marks OR; SUMMER 2023, 3 Marks OR; SUMMER 2024, 3 Marks OR; SUMMER 2025, 4 Marks OR; SUMMER 2025, 4 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**

4. Microgrid Interconnection, Operation and Control:

- **Q.** Discuss the various issues encountered while interconnecting Micro grid with the main power grid. **(SUMMER 2023, 4 Marks OR; SUMMER 2024, 4 Marks OR)**

5. Microgrid Modelling and Case Studies:

- **Q.** Given that a home distribution system to be upgraded with DC microgrid for integrating solar PV and battery storage. Discuss DC microgrid architecture and all its components with appropriate diagram for the same. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2023, 7 Marks)**
- **Q.** Given that, Electric Vehicle parking lot with V2G and G2V facility at office area. Discuss the microgrid model with appropriate diagram and strategy for operation and management of the same. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2023, 7 Marks OR)**

Other Important Questions:

1. Islanding – Need, Benefits and Operation:

- **Q.** Given that, a home microgrid has PV panel connected such that, PV can only supply to grid and can not be utilized in house wiring loads. Discuss the islanding method for the same with appropriate diagram. [Diagram required – refer to the original question paper] **(SUMMER 2022)**

2. Comparison of Microgrid with Conventional and Smart Grid:

- **Q.** How does the Microgrid differ from the conventional grid? Justify your answer. **(WINTER 2025, 3 Marks OR)**

- **Q.** Compare the micro grid and smart grid. **(WINTER 2024, 7 Marks OR)**
- **Q.** Compare the performance of microgrid integrated power grid system and centralized conventional power grid system with respect to quality, reliability and green energy aspects. **(SUMMER 2022, 4 Marks)**

3. Microgrid Interconnection, Operation and Control:

- **Q.** List out the control techniques available with the control of microgrids, and explain any one of them in brief. **(SUMMER 2026, 4 Marks)**

4. Microgrid Modelling and Case Studies:

- **Q.** List the storage technologies that can be used with electrical system. Provide Modelling of any one of them. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Given that, a PV, Battery and Wind generators are connected to an isolated microgrid for the commercial load pattern. Discuss the microgrid model with appropriate diagram and strategy for operation and management of the same. [Diagram required – refer to the original question paper] **(SUMMER 2022 OR)**

Chapter 5: Load dispatch centers, Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self-Healing Systems, Applications and Challenges, wide-area monitoring system (WAMS), Phasor measurement units PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI); smart metering; smart grid system monitoring, Phasor estimation, Dynamic Phasor estimation.

Repeated Questions:

1. Phasor Measurement Units and Phasor Data Concentrator:

- **Q.** Discuss principle and role of Phasor Measurement Units in smart grid energy management system. / List the Functions of PMU. / List the Applications of PMU. / Draw and explain structure of Phasor Measurement Unit (PMU). / Discuss the basic components of PMU. / List the basic components of PMU / Explain the operational feature of phasor measurement unit (PMU) / Explain: Phasor Measurement Units / Describe the working principle, components, and applications of Phasor Measurement Units. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2023, 3 Marks OR; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 3 Marks; SUMMER 2024, 3 Marks OR; SUMMER 2024, 7 Marks; WINTER 2024, 3 Marks; WINTER 2024, 3 Marks OR; SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** List the Levels of Phasor Data Concentrator. / Write Short Notes on: Phasor Data Concentrator (PDC) / Explain the phasor data concentrator (PDC) with the necessary diagram. [Diagram required – refer to the original question paper] **(SUMMER 2023, 3 Marks; SUMMER 2023, 7 Marks; SUMMER 2024, 3 Marks; SUMMER 2024, 7 Marks; WINTER 2025, 4 Marks)**

2. Wide Area Monitoring (WAMS and WAMPC):

- **Q.** Explain the concept of wide area monitoring system (WAMS) / What is a wide area measurement system (WAMS)? Explain the functions of WAMS. **(WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks; WINTER 2025, 3 Marks OR; SUMMER 2026, 7 Marks)**

3. SCADA, RTU, IED and IEC 61850:

- **Q.** Explain SCADA system and their limitations / Explain the application of the SCADA system for smooth monitoring and control of smart grid operations with the necessary diagram. [Diagram required – refer to the original question paper] **(WINTER 2023, 3 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks OR)**

4. Fault Detection and Self-Healing:

- **Q.** Discuss concept of "self-healing" and elaborate generalized fault detection and self healing strategy at feeder level with appropriate diagram. / Explain the operational features of fault detection and self-healing systems. / Compare generalized fault detection with self-healing strategy. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks OR; WINTER 2025, 7 Marks OR; SUMMER 2026, 3 Marks)**

5. Load Dispatch Centers:

- **Q.** Describe the role of load dispatch centers in smart grid operations. / The role of load dispatch centers in smart grid operations: Discuss / Describe the role of load dispatch centers (LDC) in smart grid operations. **(SUMMER 2023, 3 Marks; WINTER 2023, 4 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks OR; SUMMER 2026, 3 Marks OR)**

6. Cyber Security:

- **Q.** Explain the necessity of cyber security for smart grid operations / Explain the Role of cyber security for smart grid operations **(WINTER 2023, 4 Marks OR; WINTER 2024, 7 Marks OR)**

Other Important Questions:

1. Wide Area Monitoring (WAMS and WAMPC):

- **Q.** Draw and explain structure of wide area monitoring, protection and control system (WAMPC). [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR)**

2. SCADA, RTU, IED and IEC 61850:

- **Q.** What is a remote terminal unit (RTU)? Explain the evolution of RTU and its components. **(WINTER 2025, 7 Marks OR)**
- **Q.** What is an intelligent electronic device (IED)? Briefly explain the IED with its functional block diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 3 Marks OR)**
- **Q.** What is IEC 61850? Briefly explain the GOOSE client-server communication with a block diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 3 Marks OR)**

Chapter 6: Demand side management of Smart Grid, Demand response analysis of Smart Grid, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics and Challenges, Electric Vehicles and Vehicle-to-Grid Systems, Demand Side Ancillary Services Energy Management, Practical study of Smart Grid

Repeated Questions:

1. Demand Side Management:

- **Q.** What do you mean by demand side management? / Define: Demand Side Management. Give the classification of DSM. Also List the constraints of DSM. / Discuss the constraints of Demand Side management. / Define demand side management. List out the methods of DSM along with its posing constraints. / Classify the Demand Side Management / List the constraints of DSM. / What are the challenges of demand side management of smart grid. **(WINTER 2022, 3 Marks; SUMMER 2023, 4 Marks; SUMMER 2023, 7 Marks OR; WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks; SUMMER 2024, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 3 Marks OR; SUMMER 2025, 4 Marks OR; SUMMER 2026, 7 Marks)**

2. Demand Response:

- **Q.** List out types of demand response / List the Types of Demand Responses. / List out types of demand response and explain them in brief with a necessary diagram. [Diagram required – refer to the original question paper] **(WINTER 2022, 3 Marks OR; WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks OR; SUMMER 2024, 3 Marks OR; SUMMER 2025, 3 Marks; WINTER 2025, 7 Marks)**

3. Pricing and Tariff Mechanisms:

- **Q.** Classify time based tariff. / List and explain various Tariff Mechanisms. **(WINTER 2022, 4 Marks OR; WINTER 2024, 4 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks OR)**

4. Electric Vehicles and Vehicle-to-Grid:

- **Q.** Discuss vehicles to grid and grid to vehicles system. / Discuss the electric vehicle to grid system in detail. / What is electric vehicle (EV)? Write the advantages of EVs over conventional vehicles. / What is a V2G system? Explain in detail the challenges of the V2G system. **(WINTER 2022, 7 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks OR; WINTER 2025, 7 Marks OR; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Demand Response:

- **Q.** Discuss role of demand response management in smart grid energy management system. **(SUMMER 2022, 4 Marks OR)**

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