SAMPLE PAPERS

DIPLOMA FIFTH SEMESTER EXAMINATION 2025 (JUT)

SMART GRID TECHNOLOGY

DIPLOMA WALLAH

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Full Marks: 70 marks | Time: 3 Hours

Instructions:

- Question No. 1 is compulsory.
- Answer any **FOUR** questions from the remaining (Q.2 to Q. 7 marks).

GROUP A: Multiple Choice Questions (Compulsory)

Q. 1. Choose the correct option for the following (7 *2 = 14 Marks)

i. What is the key advantage of Renewable Energy Technologies being integrated into the grid as Distributed Generation (DG)?

(a) Increased transmission losses

(b) Reduced dependency on centralized power plants

(c) Requires less data management

(d) Eliminates the need for storage

ii. The planning of a Smart Grid is heavily dependent on ensuring interoperability between:

(a) AC and DC power flow

(b) Existing infrastructure and new digital technologies

(c) Generators and Transmission lines

(d) Consumers and the market

iii. The term "Synchro-Phasor" implies that the measurements are synchronized using:

(a) Internet time protocol

(b) Local clock

(c) GPS (Global Positioning System) signal

(d) Radio frequency signal

iv. Which of the following is considered a major Barrier to the widespread adoption of Smart Grid technology?

(a) Abundant availability of enabling technology

(b) Low operational cost

(c) High initial capital investment

(d) Simple control logic

v. Which technology is best described as an interconnected network of physical objects (sensors, actuators) in the Smart Grid environment?

(a) WAMS

(b) Advanced Metering Infrastructure

(c) Internet of Things (IoT)

(d) Two-way Digital Communications

vi. The primary function of Energy Management under DSM is to:

(a) Provide fast fault isolation

(b) Control and optimize energy use for efficiency

(c) Measure phasor angles

(d) Regulate voltage during emergencies

vii. Which type of Smart Grid aims to minimize conversion losses for DC-based sources and loads?

(a) AC Smart Grid

(b) Distribution Smart Grid

(c) Hybrid Smart Grid

(d) DC Smart Grid

Q. 2.

A. Define Smart Grid. Explain the concept and main elements of the Smart Grid structure with a suitable description. (7 Marks)

B. Discuss the major Opportunities and Barriers associated with the implementation of Smart Grid technology. (7 Marks)

Q. 3.

A. Describe the essential Components and Architecture of Smart Grid Design. Explain the role of Advanced Metering Infrastructure (AMI) in this architecture. (7 Marks)

B. Explain the working principle and importance of Synchro-Phasor Measurement Units (PMUs). Describe how PMUs are utilized in a Wide Area Measurement System (WAMS). (7 Marks)

Q. 4.

A. Define a Micro Grid. Explain its structure and discuss the benefits it offers in terms of reliability and resilience. (7 Marks)

B. Why is Cyber Security crucial for the Smart Grid? Discuss the potential cyber security threats faced by the grid. (7 Marks)

Q. 5.

A. Provide a detailed comparative analysis between the Conventional Grid and the Smart Grid, focusing on differences in monitoring, complexity, and future outlook. (7 Marks)

B. Define Demand Side Management (DSM). Elaborate on the concepts of Demand Response (DR) and Energy Management within the DSM framework. (7 Marks)

Q. 6.

A. Write a detailed note on Storage Technologies in the Smart Grid context. Explain their necessity for Renewable Integration. (7 Marks)

B. Define the Internet of Things (IoT). Elaborate on the various key Applications of IoT in Smart Grid operations. (7 Marks)

Q. 7. Write short notes on any FOUR of the following: (4 * 3.5 = 14 Marks)

A. Enablers of the Smart Grid

B. Distribution Automation

C. Two-way digital communications paradigm

D. Key Challenges for Smart Grid

E. Economic Issues (related to DG/Storage)

Solutions & Model Answers for SAMPLE PAPER 3

MCQ Answer Key (Q. 1)

Q. No.	Correct Option
i.	(b) Reduced dependency on centralized power plants
ii.	(b) Existing infrastructure and new digital technologies
iii.	(c) **GPS (Global Positioning System)** signal
iv.	(c) High initial capital investment
v.	(c) **Internet of Things (IoT)**
vi.	(b) Control and optimize energy use for efficiency
vii.	(d) **DC Smart Grid**

Short Answer Solutions (Q. 7)

- **A. Enablers of the Smart Grid:** Key factors/technologies enabling the transition, including: advanced sensing, two-way communication, smart controls, and flexible power electronics.
- **B. Distribution Automation:** The use of automated controls, sensors, and communication at the distribution level (lower voltage) to rapidly locate and isolate faults, reconfigure the network, and optimize voltage levels.
- **C. Two-way digital communications paradigm:** The bidirectional exchange of information between all points of the grid (utility <>customer <>devices) essential for real-time control and dynamic pricing.
- **D. Key Challenges for Smart Grid:** Cybersecurity, ensuring interoperability between legacy and new systems, high initial cost, and managing the vast amounts of data generated.
- **E. Economic Issues (related to DG/Storage):** High capital cost of DG and storage systems, need for new financial models (e.g., net metering), and complexity in valuing the non-energy benefits (e.g., reliability, reduced congestion) provided by these resources.

Model Answers for Long Questions (Q. 2 - Q. 6)

- **Q. 2. A (Smart Grid Definition/Structure):** (Similar to Q. 3. A, Paper 1).
- **Q. 2. B (Opportunities and Barriers):** (Similar to Q. 2. B, Paper 1). Focus on the contrast between potential benefits (opportunities) and hurdles (barriers).
- **Q. 3. A (Architecture/AMI):** (Similar to Q. 3. B, Paper 1). Detail the components and the central role of AMI in customer domain communication.

- **Q. 3. B (PMUs/WAMS):** (Similar to Q. 5. A, Paper 1). Emphasize the GPS synchronization of PMUs and how WAMS uses this for wide-area awareness.
- **Q. 4. A (Micro Grid Definition/Benefits):** (Similar to Q. 3. A, Paper 2). Define and discuss benefits like enhanced reliability and local resilience.
- **Q. 4. B (Cyber Security/Threats):** (Similar to Q. 6. B, Paper 1). Highlight why a digitized grid is a target and the specific nature of cyber threats (e.g., integrity and availability risks).
- **Q. 5. A (Comparative Analysis):** (Similar to Q. 2. A, Paper 1 & 2). Ensure points cover complexity (simple vs. highly complex), monitoring (passive vs. active/real-time), and outlook (static vs. dynamic/flexible).
- **Q. 5. B (DSM/DR/EM):** (Similar to Q. 5. B, Paper 1). Define the three related concepts clearly.
- **Q. 6. A (Storage/Renewable Integration):** (Similar to Q. 5. B, Paper 2). Explain how storage buffers the intermittent nature of renewables.
- **Q. 6. B (IoT/Applications):** (Similar to Q. 6. A, Paper 1).