QPC: RN20BTECH651 AR 20 Reg. No | | | | | | | | | | |

# GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Seventh Semester – Regular) Examinations, November – 2023

## BPEEL7011 / BPEEE7011 - Smart Grid

(EE & EEE)

Time: 3 hrs Maximum: 70 Marks

**Answer ALL Questions**

**The figures in the right hand margin indicate marks.**

**PART – A: (Multiple Choice Questions)** **(1 x 10 = 10 Marks)**

Q.1. Answer ***ALL*** questions [CO#] [PO#]

a. Which of the following is a primary goal of a smart grid? CO1 PO2

(i) Increasing greenhouse gas emissions (ii) Reducing energy efficiency

(iii) Enhancing grid resilience and reliability (iv) Promoting energy waste

b. What is the primary function of a smart meter? CO1 PO2

(i) Measuring water consumption (ii) Monitoring indoor air quality

(iii) Recording and transmitting energy usage data (iv) Regulating home heating and cooling systems

c. What role does grid stability play in the issues of micro-grid interconnection? CO2 PO2

(i) Grid stability is not relevant to micro-grid interconnection. (ii) Grid stability ensures a seamless interconnection process.

(iii) Grid stability is important to maintain the reliability of both grids. (iv) Grid stability is only relevant to the main grid.

d. In which application is a micro-grid particularly useful? CO2 PO2

(i) Large urban areas with abundant power supply (ii) Remote communities with no access to the main grid

(iii) High-density industrial zones with consistent power (iv) Suburban neighbourhoods with steady grid connectivity

e. What is the primary goal of power quality management in a smart grid? CO3 PO2

(i) Maximizing energy consumption (ii) Ensuring a stable and reliable power supply

(iii) Minimizing renewable energy integration (iv) Reducing utility profits

f. What is a typical source of electromagnetic interference (EMI) in a smart grid? CO3 PO2

(i) Grid operators (ii) Smart meters

(iii) Renewable energy sources (iv) Electronic devices and equipment

g. What does pitch control refer to in variable speed wind generators? CO4 PO1

(i) The turning of the wind turbine toward the prevailing wind direction (ii) The regulation of the rotor speed

(iii) The adjustment of blade angles to optimize energy capture (iv) The control of generator output voltage

h. Which energy storage technology is known for its fast response time and suitability for high-power applications? CO4 PO1

(i) Batteries (ii) Superconducting Magnetic Energy Storage (SMES)

(iii) Pumped Hydro Storage (iv) Compressed Air Energy Storage (CAES)

i. Which organization is typically responsible for installing and maintaining smart meters in a utility's service area? CO1 PO2

(i) The federal government
(ii) The utility company
(iii) The local municipality
(iv) Independent metering companies

j. What is the purpose of protection and control systems in a micro-grid? CO2 PO2

(i) To create energy without interruptions
(ii) To maximize energy consumption
(iii) To ensure the safety and reliability of the micro-grid
(iv) To control the micro-grid's environmental impact

## PART – B: (Short Answer Questions) (2 x 10 = 20 Marks)

Q.2. Answer ***ALL*** questions

| | | CO# | PO# |
|---|---|---|---|
| a. | What is Automatic meter reading? | CO1 | PO2 |
| b. | What is the role of smart appliances in smart grid? | CO1 | PO1 |
| c. | What is the role of Wams in smart grid? | CO2 | PO1 |
| d. | What challenges are associated with connecting a micro-grid to the main grid or other micro-grids? | CO2 | PO1 |
| e. | What power quality challenges are associated with the integration of renewable energy sources, such as solar and wind, into the grid? | CO3 | PO1 |
| f. | What is the purpose and scope of a power quality audit in an electrical system? | CO3 | PO1 |
| g. | Explain the role of power electronics and control systems in optimizing the performance of variable speed wind generators. | CO4 | PO2 |
| h. | Define distributed generation and enumerate the benefits it offers in terms of grid resilience and energy security. | CO4 | PO2 |
| i. | What is a micro-grid, and how does it differ from a traditional power grid? | CO2 | PO1 |
| j. | Describe about feeder automation. | CO1 | PO1 |

## PART – C: (Long Answer Questions) (10 x 4 = 40 Marks)

Answer ***ALL*** questions

| | | Marks | [CO#] | [PO#] |
|---|---|---|---|---|
| 3. a. | Explain about the main fundamental features of Smart grid. | 5 | CO1 | PO2 |
| b. | Explain about Outage management system along with overall benefits. | 5 | CO1 | PO1 |
| | (OR) | | | |
| c. | What is IED and how it will monitor smart grid operation? | 5 | CO1 | PO2 |
| d. | What is the need of the smart grid and elaborate with various constraints? | 5 | CO1 | PO1 |
| 4. a. | Discuss the various control modes that a micro-grid can operate in, including grid-connected, islanded, and transitional modes. What are the key considerations for switching between these modes? | 5 | CO2 | PO2 |
| b. | Explain the operation of WAMS with its benefits. | 5 | CO2 | PO1 |
| | (OR) | | | |
| c. | Describe the core components and functionalities of protection and control systems in micro-grids, highlighting their role in fault detection, isolation, and system restoration. | 5 | CO2 | PO1 |
| d. | Explore the technical challenges associated with interconnecting micro-grids with the main power grid, focusing on synchronization, protection, and voltage regulation. | 5 | CO2 | PO2 |

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|---|---|---|---|---|
| 5. a. | Describe the role of energy storage systems in mitigating power quality issues associated with variable renewable energy generation. How do these systems contribute to grid stability and reliability? | 5 | CO3 | PO2 |
| b. | Discuss the various dimensions of power quality, including voltage stability, frequency regulation, and harmonic distortion, in the context of a smart grid. How do these aspects affect both utility operations and end-users? | 5 | CO3 | PO2 |
| | (OR) | | | |
| c. | Outline the step-by-step process of conducting a comprehensive power quality audit, from initial data collection to the generation of actionable recommendations. | 5 | CO3 | PO2 |
| d. | Explore the emerging technologies and methods for improving power quality in smart grids, including the use of power electronics and energy storage systems. What are the benefits and challenges associated with these technologies? | 5 | CO3 | PO2 |
| 6. a. | Explain the operational principles of variable speed wind generators, including the role of power electronics and variable rotor speeds. How do these features enhance energy capture and efficiency? | 5 | CO4 | PO2 |
| b. | Write short notes on Pumped Hydro and Compressed Air Energy Storage. | 5 | CO4 | PO2 |
| | (OR) | | | |
| c. | Discuss the various practical applications of micro-turbines, with a focus on distributed energy generation and combined heat and power (CHP) systems. How do micro-turbines enhance energy efficiency in these applications? | 5 | CO4 | PO2 |
| d. | Provide a detailed explanation of the electrochemical processes that occur within a fuel cell, highlighting the conversion of fuel into electricity and the associated efficiencies. | 5 | CO4 | PO2 |

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