

NAME OF THE EXAMINATION: B.E. POWER ENGINEERING THIRD YEAR SECOND SEMESTER -
2023

SUBJECT: SMART GRID SYSTEMS (HONS.)

TIME: 3 HOURS

FULL MARKS: 100

Answer *Q1* and *any Four* questions from the rest

1. Choose the correct option for any TEN questions: (10@2 = 20)
- (i) A smart grid envisages to empowering customers by the following ways: [CO1, CO2, CO3]
- A. Reducing ATC losses
 - B. Consumer education and awareness
 - C. Self-healing feature
 - D. Residential consumer energy management
 - E. Information and communication technology
 - F. Load forecasting
- Out of the above, the correct choices are:
- (a) A, B, E
 - (b) B, D, E
 - (c) C, D, F
 - (d) A, C, F
- (ii) The market domain in smart grid has the functions of: [CO1, CO2, CO3]
- A. Market management
 - B. DER aggregation
 - C. Billing
 - D. Wholesaling
 - E. Budgeting
 - F. Trading
- Out of the above, the correct choices are
- (a) A, B, E, F
 - (b) B, C, D, E
 - (c) C, D, E, F
 - (d) A, B, D, F
- (iii) What are the main goals of Automatic Gain Controller (AGC)? " [CO1, CO2, CO3]
- A. keep the voltage and frequency of supply within specified tolerance band
 - B. keep the operating frequency under prescribed limits
 - C. maintain the interchange power between grids through tie-lines at the intended level
 - D. curtail load so as to match supply with demand
 - E. keep overshoot and settling time of the governor within the acceptable ranges
- Out of the above, the correct choices are
- (a) B, C, E
 - (b) A, B, D
 - (c) A, C, D
 - (d) B, D, E
- (iv) Use of Electric Vehicles (EV) as a component of smart grid enables CO2 reduction by: [CO4]
- A. Reducing gasoline usage
 - B. Serving as distributed storage
 - C. Reducing gasoline based emission
 - D. Alter EV charging period towards off-peak hours
 - E. Reducing distribution losses
 - F. Enabling smart communication
- Out of the above, the best combination for correct choices are:
- (a) A, B, C, E
 - (b) A, B, D, F
 - (c) A, B, C, D
 - (d) A, D, E, F

- (v) Permissible frequency band in Indian grid is from _____ Hz (lower limit) to _____ Hz (upper limit) [CO1, CO2, CO3]
- 48.5 50.5
 - 49.5 50.5
 - 49.5 50.2
 - 49.8 50.2
- (vi) Limitations of centralized Energy Management System (EMS) architecture are [CO1, CO2, CO3]
- Global optimization
 - Customer privacy is less
 - Reduction in overall operating cost
 - A dedicated strong communication link is needed
 - Computational burden is high
 - Uniform for the whole network
- Out of the above, the best combination for correct choices are:
- A, C, F
 - A, C, D
 - B, D, E
 - B, D, F
- (vii) Distribution Management System (DMS) in smart grid brings in improvements in the distribution system in the following ways: [CO1, CO2, CO3]
- supply reliability and quality
 - better asset management
 - reduced transmission losses
 - generator AGC control
 - greater customer satisfaction
 - voltage/frequency control of bulk power transfer
- Out of the above, the best combination for correct choices are:
- A, C, F
 - A, B, E
 - B, D, E
 - B, C, F
- (viii) The major objectives of demand side management (DSM) in smart grid are: [CO1, CO2, CO3]
- Electricity cost minimization
 - Real time detection of line faults
 - Optimized control of generation to meet demand
 - Maximize usage of local energy generation
 - Automated temperature control of Air conditioner
 - Minimize peak demand
 - Energy efficient devices
 - Minimize peak to average ratio
- Out of the above, the best combination for correct choices are:
- A, B, F, G
 - A, D, E, H
 - B, F, E, H
 - A, D, F, H
- (ix) Major functions of Outage Management System (OMS) in smart grid are: [CO1, CO2, CO3]
- Bill generation
 - Prioritization of grid restoration activities
 - Performing DRM
 - Collecting and communicating accurate records of outages to the affected customers
 - Implementing EMS
 - Estimating maintenance times and schedules
 - Assigning maintenance crews
 - Recording peak load demand
- Out of the above, the best combination for correct choices are:
- A, B, F, G

- (b) B, D, F, G
(c) B, F, E, H
(d) A, D, F, H
- (x) Smart meter is an important element in building Advanced Metering Infrastructure (AMI) in smart grid. These advanced meters (may have more than one correct choice) [CO1, CO2, CO3]
(a) Measure electricity usage in real time.
(b) Can send data to and from electric companies and their customers.
(c) Measure only active power consumption
(d) Allows companies to give consumers more information about their electricity usage, and communicate current electricity prices.
- (xi) Some of the main enabling features of an AMI infrastructure in smart grid include: [CO1, CO2, CO3]
A. smart energy meter
B. energy management
C. communication medium
D. automatic gain control
E. meter data management (MDM)
F. tamper detection
Out of the above, the best combination for correct choices are:
(a) A, C, F
(b) B, D, E, F
(c) A, D, E, F
(d) A, C, E, F
- (xii) Meter Data Management (MDM) systems in AMI of a smart grid infrastructure consist of following different parts: [CO1, CO2, CO3]
A. Head-End System (HES)
B. Consumer Information System (CIS), billing system
C. Automatic Generation Control (AGC)
D. Outage Management System (OMS).
E. Automatic Voltage Regulation (AVR)
F. Mobile Workforce Management (MWM)
G. Geographic Information System (GIS)
Out of the above, the best combination for correct choices are:
(a) A, C, F, G
(b) B, D, F, G
(c) B, C, E, F
(d) A, B, D, F

Answer any Four (4) Questions

- 2 (a) Define "Smart Grid" as per IEEE mentioning the various layers of it as per IEEE. Which of these layers enables the existing grid to become **smarter**? (5) [CO1, CO2, CO3, CO4]
(b) Compare between conventional power grid and smart grid with respect to any FIVE of the following characteristics: Architecture, Generation and storage options, Communication, Components, Fault response, Control strategies, sensitivity to market (10)
(c) List the various cyber-physical threats envisaged in a smart grid infrastructure that can compromise the safety, security, and reliability of the power network. (5)
- 3 (a) Highlight how the features of smart grid enable effective integration of renewable energy sources in the power network. (5) [CO1, CO2,

- | | | | | |
|---|-----|---|------|-------------------------------|
| | (b) | In a tabular form, list the technical challenges involved and the possible solutions for integrating renewable energy sources to smart grid. | (10) | CO3,
CO4] |
| | (c) | What are the objectives and functions of Renewable Energy management Centre (REMC) in the issue of RE integration to smart grid? | (5) | |
| 4 | (a) | What are the components of a smart AGC system? Describe the interrelation between these components with the help of a schematic block diagram. | (8) | [CO1,
CO2,
CO3,
CO4] |
| | (b) | What are the disadvantages of conventional OLTC for use as an AVR in conventional grids? How are these overcome? | (5) | CO4] |
| | (c) | What is SVC in relation to AVR? Draw schematic diagram showing different types of SVC components used for AVR purpose. What are the main objectives of SVC? What are the advantages of SVC? | (7) | |
| 5 | (a) | Define Energy Management System (EMS) in the context of Smart Grids. What are the main functions of an EMS in smart grid? | (6) | [CO1,
CO2,
CO3] |
| | (b) | With the help of a schematic diagram, explain the features of a centralized EMS. What are its objectives, merits and demerits? | (6) | CO3] |
| | (c) | What are the primary functions of a SCADA used for DMS? With suitable schematic diagrams, explain the attributes of SCADA system used for DMS in smart grid. | (8) | |
| 6 | (a) | Define Demand Side Management (DSM) as applied to Smart Grid technology? How is DSM beneficial to the utility as well as to the consumer? | (6) | [CO1,
CO2,
CO3] |
| | (b) | Discuss the different load management techniques in DSM with suitable diagram | (6) | |
| | (c) | Define Demand Response Management (DRM) in Smart Grid Technology. With a suitable schematic diagram, discuss the different communication standards employed for implementing DRM. | (8) | |
| 7 | (a) | What are the major functions of Outage Management system (OMS) in smart grid? State the advantages of implementing OMS in smart grid. | (5) | [CO1,
CO2,
CO3] |
| | (b) | Define Advanced Metering Infrastructure (AMI) in smart grid. List the main features of AMI. | (5) | |
| | (c) | List the components of a smart energy meter. Draw its internal architecture. How is it different from a conventional energy meter? | (5) | |
| | (d) | What are the different parts of a Meter Data Management (MDM) system in smart grid? | (5) | |