



QUESTION BANK

Year / Semester: **III B. Tech VI Semester**

Regulation: **R23**

Subject and Code: **Renewable and Distributed Energy Technologies and 23EEE364C**

SYLLABUS

UNIT-1: ENERGY SCENARIO AND SOLAR ENERGY:

Introduction: Fundamentals of renewable energy sources, Types of energy, Renewable and Non-renewable energy, SWOT analysis, Global warming and climate change, World energy transformation by 2050, Prospects of renewable energy in the world, Renewable energy availability in India.

Solar Energy Fundamentals: Solar Spectrum, propagation of solar radiation from the sun to earth; solar radiation geometry: sun-earth geometry, extra-terrestrial and terrestrial radiation.

Solar Thermal: Solar Collectors, Solar parabolic trough, Solar tower, Solar cooker, Solar water heater, Solar dryer, Solar Pond. Solar Electric Power Generation: A Generic PV Cell, PV Materials, Equivalent Circuits for PV Cells, Modules and Arrays; I-V Curve under Standard Testing Conditions; Impact of Temperature and Insolation on I-V curves; Shading Impacts on I-V curves; Maximum Power Point Trackers (MPPT).

UNIT-2: WIND AND OTHER ENERGY SYSTEMS:

Wind Energy: Air, Wind, Global and Local Wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Classification of wind energy conversion system (WECS)- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft). Tidal Power: fundamental characteristics of tidal power, harnessing tidal energy, advantages, and limitations.

UNIT-3: ENERGY STORAGE AND GREEN ENERGY:

Energy Storage: Stationary Battery Storage – Basics of Lead-Acid batteries, Battery Storage Capacity, Coulomb efficiency instead of energy efficiency, Battery Sizing. Different Battery storage technologies and comparison of their performance. Introduction to Super capacitors. Green Energy: Historical Development, Basic Operation of a Fuel Cell, Fuel Cell Thermodynamics, Entropy and the theoretical efficiency of Fuel Cells, Gibbs Free Energy and Fuel Cell efficiency, Electrical output of an Ideal Cell, Electrical Characteristics of Real Fuel Cells, Types of Fuel Cells, H₂: Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy

UNIT-4: INTRODUCTION TO DG AND ITS GRID INTEGRATION

Introduction: Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems. Grid integration of DGs: Different types of interfaces - Inverter based DGs and rotating machine-based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultracapacitors, flywheels.

UNIT-5: TECHNICAL IMPACT, ECONOMIC AND CONTROL ASPECTS OF DG

Technical impacts of DGs: Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems Economic and control aspects of DGs: Market facts, issues, and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.



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S.No.	CO	Questions	BT
UNIT-1: ENERGY SCENARIO AND SOLAR ENERGY			
1	1	Explain the fundamentals of renewable energy sources. Discuss the importance in sustainable development and energy security?	L4
2	1	Classify the different types of energy sources. Clearly distinguish between renewable and non-renewable energy with suitable examples?	L3
3	1	Discuss global warming and climate change. Explain the role of conventional energy sources in climate change and how renewable energy mitigates it?	L4
4	1	a) Explain the concept of world energy transformation by 2050? b) Explain technological, economic, and policy factors influencing i growth?	L3
5	1	Explain the solar spectrum. Discuss its components and significance in solar energy conversion?	L5
6	1	Describe the propagation of solar radiation from the sun to the earth. Explain attenuation mechanisms in the atmosphere?	L4
7	1	Distinguish between extra-terrestrial radiation and terrestrial radiation. Explain factors affecting terrestrial solar radiation?	L3
8	1	a) Explain the solar tower power plant? b) Explain the construction and working of a solar cooker?	L5
9	1	a) Explain the working of a solar water heater system? b) Describe solar dryers and solar ponds?	L4
10	1	Explain the construction and working of a generic PV cell. Discuss P materials and their characteristics?	L3



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UNIT-2: WIND AND OTHER ENERGY SYSTEMS			
1	2	Derive the expression for power available in wind and explain the effect of wind velocity?	L4
2	2	a) Explain the major problems associated with wind power generation b) Classify Wind Energy Conversion Systems (WECS) with neat diagrams?	L3
3	2	Explain the construction and working of a horizontal axis single-blade wind turbine?	L4
4	2	a) Explain the construction and working of Savonius wind turbine with advantages and disadvantages? b) Explain the construction and working of Darrieus wind turbine with advantages and disadvantages?	L3
5	2	Explain biomass energy and its importance in renewable power generation?	L5
6	2	Explain different types of biofuels and their applications?	L4
7	2	a) Discuss various biomass resources available for energy production? b) Describe urban waste-to-energy conversion methods?	L3
8	2	Explain the construction and working of a fixed dome biogas plant with neat sketch?	L5
9	2	a) Explain the principle and process of biomass gasification? b) Describe the construction and working of a downdraft biomass gasifier?	L4
10	2	a) Explain the fundamental characteristics of tidal power in detail? b) Describe the methods of harnessing tidal energy with neat diagrams	L3



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UNIT-3: ENERGY STORAGE AND GREEN ENERGY			
1	3	Explain the construction, working principle, chemical reactions during charging and discharging, advantages, limitations, and applications of a Lead-Acid battery used for stationary energy storage.	L4
2	3	a) Define Battery Storage Capacity. Derive the relation between Ah rating, discharge current, time, and energy stored. b) Explain factors affecting battery capacity such as temperature, depth of discharge, and C-rate.	L3
3	3	a) Explain Coulombic Efficiency and justify why it is preferred over Energy Efficiency in battery performance evaluation. b) Compare Coulomb efficiency and energy efficiency with suitable expressions and interpretation	L4
4	3	a) Explain the procedure for Battery Sizing for a standalone renewable energy system. b) Include load estimation, autonomy days, depth of discharge, system voltage, and safety factors in your explanation.	L3
5	3	Compare the performance of the battery storage technologies with respect to energy density, power density, cycle life, cost, safety, and applications?	L5
6	3	a) explain the construction and working principle of a Supercapacitor. b) Compare batteries and supercapacitors in terms of energy density, power density, cycle life, and charging time.	L4
7	3	a) Explain the Historical Development and Basic Operation of a Fuel Cell. b) Discuss the electrochemical reactions in a hydrogen fuel cell and differentiate it from conventional thermal power generation	L3
8	3	a) Derive the relation between Gibbs Free Energy, Entropy, and Theoretical Efficiency of a Fuel Cell. b) Explain how temperature affects fuel cell efficiency using thermodynamic relations.	L5
9	3	a) Explain the Electrical Output of an Ideal Fuel Cell and discuss the practical voltage losses in a real fuel cell (activation, ohmic, and concentration losses). b) Draw and explain the polarization curve.	L4
10	3	Explain the following aspects of Hydrogen Energy Systems? give its applications?	L3



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UNIT-4: INTRODUCTION TO DG AND ITS GRID INTEGRATION			
1	4	Define Distributed Generation (DG). Explain the need for distributed generation in modern power systems, highlighting technical, economic, and environmental motivations?	L4
2	4	a) Explain the role of renewable energy sources in Distributed Generation. b) Discuss solar PV, wind, biomass, and small hydro as DG sources with suitable block diagrams?	L3
3	4	a) Discuss the current scenario of Distributed Generation in electrical power systems. b) Explain trends, penetration levels, and challenges faced by utilities with increasing DG integration?	L4
4	4	Explain the planning of Distributed Generation systems. Discuss objectives, constraints, and the step-by-step methodology adopted in DG planning?	L3
5	4	a) Explain the concepts of siting and sizing of DG units in distribution networks. b) Discuss the impact of proper and improper siting and sizing on system performance?	L5
6	4	Explain different optimization techniques for optimal placement of DG sources in distribution systems. Discuss objectives such as loss minimization, voltage profile improvement, and reliability enhancement?	L4
7	4	Describe the working principles and characteristics of: (a) Inverter-based DG interfaces. (b) Rotating machine-based DG interfaces	L3
8	4	Explain the concept of aggregation of multiple DG units. Discuss coordinated control, microgrids, and virtual power plants in DG aggregation?	L5
9	4	Discuss the working principle, advantages, limitations, and applications of: (a) Batteries (b) Ultracapacitors (c) Flywheels	L4
10	4	Explain the grid integration of Distributed Generation systems. Discuss major technical issues such as synchronization, protection coordination, islanding, and power quality?	L3



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UNIT-5: TECHNICAL IMPACT, ECONOMIC AND CONTROL ASPECTS OF DG			
1	5	a) Explain the technical impacts of Distributed Generation (DG) on transmission systems. b) Discuss effects on power flow, congestion, voltage profile, short-circuit levels, and system losses?	L4
2	5	Discuss the technical impacts of DGs on distribution systems and Explain how DG penetration affects voltage regulation, reverse power flow, protection coordination, and power quality?	L3
3	5	Explain the concept of power system deregulation. Discuss the impact of DGs in a deregulated electricity market, highlighting operational, economic, and regulatory challenges?	L4
4	5	Explain the impact of Distributed Generation on protective relaying. Discuss issues related to relay coordination, fault current variation, blinding of protection, and false tripping with suitable diagrams?	L3
5	5	Explain the impact of DGs on transient and dynamic stability of existing distribution systems? Discuss the influence of inverter-based and rotating-machine-based DGs on system stability?	L5
6	5	a) Explain the market facts, issues, and challenges associated with Distributed Generation. b) Discuss tariff structures, market participation of DGs, ancillary services, and regulatory barriers?	L4
7	5	Discuss the limitations of Distributed Generation systems. Explain technical, economic, environmental, and operational constraints that restrict large-scale DG deployment?	L3
8	5	Discuss the role of inverters, on-load tap changers, capacitor banks, and FACTS devices?	L5
9	5	Explain the harmonic issues and power quality problems introduced by DGs. Discuss sources of harmonics, their effects on equipment, and mitigation techniques?	L4
10	5	Explain the reliability of DG-based power systems. Discuss steady-state and dynamic analysis of DG systems with respect to continuity of supply, fault tolerance, and system resilience?	L3

Note: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, and L6-Creating