SRM VALLIAMMAI ENGINEERING COLLEGE

(Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

M.E POWER SYSTEMS ENGINEERING

QUESTION BANK

VII SEMESTER

PPS202 – WIND AND SOLAR ENERGY SYSTEMS

Regulation – 2023

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EVEN SEMESTER

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SUBJECT &SUBJECTCODE: PPS202 –WIND AND SOLAR ENERGY SYSTEMS

SEM / YEAR: II /I ME PSE

UNIT I – WIND ENERGY CONVERSION				
SYLLABUS: Wind resources-Nature and occurrence of wind –Power in the wind – Wind characteristics –Principles of wind energy conversions-Components of wind energy conversion system(WECS)- Classification of WECS- Advantages and disadvantages of WECS				
PART – A (2 Marks)				
Q.No	**Questions**	**BT Level**	**Competence**	**CO**
1.	What is the primary source of wind energy?	BTL-1	Remember	CO1
2.	Explain the renewable nature of wind power.	BTL-1	Remember	CO1
3.	Define wind speed and its importance in wind energy	BTL-2	Understand	CO2
4.	How does wind direction influence the design of wind turbines?	BTL-1	Remember	CO1
5.	Describe the process by which wind turbines convert kinetic energy into mechanical energy.	BTL-2	Understand	CO1
6.	What role does the generator play in a Wind Energy Conversion System (WECS)?	BTL-2	Understand	CO2
7.	Identify the main components of a wind turbine's nacelle.	BTL-1	Remember	CO3
8.	Explain the purpose of the tower in a wind energy system.	BTL-2	Understand	CO1
9.	Distinguish between Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT).	BTL-4	Analyze	CO1
10.	Which type of wind turbine is more common, why?	BTL-2	Understand	CO1
11.	Discuss the environmental advantages of wind energy compared to fossil fuels.	BTL-1	Remember	CO3
12.	How does wind energy contribute to reducing	BTL-3	Apply	CO1

	dependence on non-renewable resources?			
13.	Express the mechanism of Yaw control.	BTL-5	Evaluate	CO1
14.	Illustrate the site selection factor for wind turbine	BTL-2	Understand	CO3
15.	Define tip speed ratio (TSR)	BTL-2	Understand	CO3
16.	Discuss the impact of wind energy on reducing greenhouse gas emissions	BTL-1	Remember	CO3
17.	Examine the challenges associated with the aesthetic concerns related to wind turbines	BTL-6	Create	CO3
18.	Predict potential technological advancements to address the intermittency of wind energy.	BTL-6	Create	CO3
19.	Given a scenario, explain how wind speed influences the power output of a wind turbine.	BTL-4	Analyze	CO1
20.	Evaluate the economic considerations for implementing wind energy projects.	BTL-3	Apply	CO1
21.	Analyze the social implications of establishing wind farms in a local community	BTL-4	Analyze	CO1
22.	Discuss the environmental impact of wind energy projects on ecosystems	BTL-3	Apply	CO1
23.	Compare the initial costs of setting up wind energy systems with their long-term benefits.	BTL-4	Analyze	CO1
24.	Evaluate the role of government policies in promoting or hindering the growth of wind energy	BTL-4	Analyze	CO1
	PART – B (16 Marks)			
1.	What is Wind power and derive the equation of power in wind	BTL-3	Apply	CO1
2.	Define Tip speed ratio and write the necessary equation and also write the advantages of wind power systems	BTL-4	Analyze	CO1
3.	Explain in detail about the pitch control and Yaw control	BTL-1	Remember	CO1
4.	Discuss Principle used in the measurement of speed of the wind an Tabulate the main applications of wind energy.	BTL-6	Create	CO1
5.	Explain the construction and working of Vertical Axis Wind Turbine (VAWT).	BTL-3	Apply	CO1

6.	Explain about the various Types of Wind Power Plant (WPPs).	BTL-1	Remember	CO1
7.	Explain about the Components of WPPs with necessary diagram	BTL-2	Understand	CO1
8.	Describe With a neat sketch about Horizontal axis wind mills.	BTL-2	Understand	CO1
9.	Summarize the working principle of Wind Energy Conversion System (WECS)	BTL-5	Evaluate	CO1
10.	Distinguish the difference between vertical Axis Wind Turbine and Horizontal Axis Wind Turbine.	BTL-4	Analyze	CO1
11.	Explain in details about the various components present in the wind power plant with neat sketch.	BTL-1	Remember	CO1
12.	Classify the various types of rotor used in the wind turbine	BTL-4	Analyze	CO1
13.	Generalize the factors to be consider for the site selection to install the wind power plant.	BTL-6	Create	CO1
14.	Evaluate the potential impact of advancements in energy storage technology on addressing the intermittency challenge in wind energy	BTL-4	Analyze	CO1
15.	Evaluate the advantages and disadvantages of horizontal axis wind turbines in comparison to vertical axis wind turbines.	BTL-2	Understand	CO1
16.	Given a scenario, recommend the most suitable type of wind turbine (HAWT or VAWT) based on specific geographical and environmental conditions	BTL-5	Evaluate	CO1
17.	Given a case study, analyze the potential social and cultural conflicts arising from the establishment of wind farms in a community	BTL-4	Analyze	CO1

UNIT II - WIND ELECTRIC GENERATOR				
SYLLABUS: Characteristics of Induction generator-Permanent magnet generators-single phase operation of induction generators-Doubly fed generators-Grid Connected and Standalone systems-Controllers for wind driven self –excited systems and capacitor excited isolated systems-Synchronized operation with grid supply-Real and reactive power control.				
PART – A (2 Marks)				
Q.No	**Questions**	**BT Level**	**Competence**	CO
1.	Define the main characteristic of an induction generator that allows it to operate without an external power source	BTL-2	Understand	CO2
2.	Explain how an induction generator self-excites during operation	BTL-2	Understand	CO2
3.	Discuss the advantages of using permanent magnet generators in wind energy applications	BTL-1	Remember	CO2
4.	Compare the efficiency of permanent magnet generators with other types of generators in the context of wind energy conversion	BTL-4	Analyze	CO2
5.	Explain the conditions under which an induction generator can operate in single-phase mode	BTL-2	Understand	CO2
6.	Discuss the limitations of single-phase operation in induction generators and potential solutions.	BTL-1	Remember	CO2
7.	Define the term "doubly fed" in the context of generators and explain its significance in wind energy systems.	BTL-2	Understand	CO2
8.	Analyze the advantages of using doubly fed generators over other types in terms of control and efficiency.	BTL-4	Analyze	CO2
9.	Differentiate between grid-connected and standalone wind energy systems, highlighting their key features.	BTL-2	Understand	CO2
10.	Explain the challenges associated with integrating wind energy into the existing electrical grid	BTL-4	Analyze	CO2
11.	Describe the role of controllers in maintaining the stability of wind-driven self-excited systems	BTL-3	Apply	CO2
12.	Evaluate the impact of controller settings on the efficiency of a wind-driven self-excited system	BTL-3	Apply	CO2
13.	Explain the function of capacitors in isolated wind energy systems and their role in system stability	BTL-2	Understand	CO2
14.	Discuss the factors influencing the selection of capacitor parameters for wind energy systems	BTL-4	Analyze	CO2
15.	Outline the steps involved in synchronizing a wind	BTL-3	Apply	CO2

	energy system with the grid supply			
16.	Examine the importance of synchronization in maintaining the stability of the grid-connected wind energy system	BTL-4	Analyze	CO2
17.	Define real power and reactive power in the context of wind energy systems	BTL-5	Evaluate	CO2
18.	Discuss the methods employed for real and reactive power control in wind energy converters	BTL-5	Evaluate	CO2
19.	Explain the significance of pitch control in wind turbines and its impact on power output	BTL-6	Create	CO2
20.	Evaluate the trade-offs involved in using different types of controllers for wind-driven self-excited systems	BTL-4	Analyze	CO2
21.	Discuss the role of energy storage systems in capacitor-excited isolated wind energy systems	BTL-3	Apply	CO2
22.	Analyze the impact of varying load conditions on the performance of a capacitor-excited isolated system	BTL-4	Analyze	CO2
23.	.Examine the importance of frequency control in maintaining synchronized operation with the grid	BTL-4	Analyze	CO2
24.	Given a scenario, propose strategies for improving the efficiency of real and reactive power control in a grid-connected wind energy system	BTL-5	Evaluate	CO2
	PART – B (16 Marks)			
1.	Explain the principle behind self-excitation in induction generators and how it enables their operation without an external power source	BTL-2	Understand	CO2
2.	Compare the operational efficiency of induction generators with and without self-excitation in a wind energy context	BTL-4	Analyze	CO2
3.	Discuss the key advantages of utilizing permanent magnet generators in wind energy systems, emphasizing their impact on overall performance	BTL-4	Analyze	CO2
4.	Analyze the cost-effectiveness of implementing permanent magnet generators in comparison to other generator types for wind energy applications	BTL-6	Create	CO2
5.	Examine the conditions under which an induction generator can efficiently operate in single-phase mode, and provide practical applications for such scenarios	BTL-4	Analyze	CO2

6.	Evaluate the challenges associated with single-phase operation in induction generators, proposing potential solutions to enhance performance	BTL-4	Analyze	CO2
7.	.Define the term "doubly fed" concerning generators and explain its significance in enhancing control capabilities in wind energy systems	BTL-2	Understand	CO2
8.	Analyze how the doubly fed feature contributes to the overall efficiency and stability of wind energy systems	BTL-4	Analyze	CO2
9.	Explain the key differences between grid-connected and standalone wind energy systems, highlighting the advantages and disadvantages of each	BTL-2	Understand	CO2
10.	Discuss the technical challenges and solutions involved in integrating wind energy into existing electrical grids, considering grid stability and reliability.	BTL-4	Analyze	CO2
11.	Describe the role of pitch control systems in wind turbines and how they contribute to optimizing power output	BTL-3	Apply	CO2
12.	Evaluate the impact of different controller settings on the dynamic response of wind-driven self-excited systems, considering both stability and efficiency	BTL-4	Analyze	CO2
13.	Explain the function of capacitors in isolated wind energy systems and how they influence the stability of the overall system	BTL-2	Understand	CO2
14.	Evaluate the trade-offs involved in selecting capacitor parameters for a specific wind energy application, considering both technical and economic factors	BTL-4	Analyze	CO2
15.	Outline the essential steps involved in synchronizing a wind energy system with the grid supply, emphasizing safety and efficiency	BTL-3	Apply	CO2
16.	Examine the role of frequency control in maintaining synchronized operation with the grid, and discuss potential challenges and solutions	BTL-4	Analyze	CO2
17.	Define real power and reactive power in the context of wind energy systems, and discuss the methods employed for effective control of both parameters	BTL-2	Understand	CO2

UNIT III – PHOTO VOLTAIC MODELS

SYLLABUS: Solar cells and panels-structure of PV cells –Semiconductor materials for PV cells- I-V Characteristics of PV systems-V models and equivalent circuits –Effects of irradiance and temperature on PV characteristics.

PART – A
(2 Marks)

Q.No	Questions	BT Level	Competence	CO
1.	Define the term "photovoltaic" and explain how solar cells contribute to the generation of electricity	BTL-1	Remember	CO3
2.	Discuss the primary applications of solar panels and their role in renewable energy systems	BTL-2	Understand	CO3
3.	Explain the significance of the anti-reflective coating in enhancing the performance of PV cells.	BTL-3	Apply	CO3
4.	Evaluate the significance of the "knee point" in the I-V curve of a PV system and its relevance to maximum power output	BTL-4	Analyze	CO3
5.	Analyze the effects of temperature variations on the efficiency and performance of PV cells	BTL-1	Remember	CO3
6.	Examine the role of the front and rear contacts in the structure of a photovoltaic cell and their impact on electrical conductivity.	BTL-1	Remember	CO3
7.	Describe the basic structure of a photovoltaic cell, highlighting the function of each layer in converting sunlight into electricity	BTL-1	Remember	CO3
8.	Compare the characteristics of p-type and n-type semiconductor materials used in the fabrication of photovoltaic cells	BTL-2	Understand	CO3
9.	Discuss the role of doping in semiconductor materials for improving the efficiency of PV cells	BTL-3	Apply	CO3
10.	Discuss the role of doping in semiconductor materials for improving the efficiency of PV cells	BTL-1	Remember	CO3
11.	Explain the I-V characteristics of a photovoltaic system and how they represent the electrical behavior under varying conditions	BTL-2	Understand	CO3
12.	Define the equivalent circuit model of a photovoltaic cell and explain how it represents the electrical behavior of the cell	BTL-5	Evaluate	CO3
13.	Discuss the role of the diode in the equivalent circuit of a PV cell and its impact on the overall	BTL-4	Analyze	CO3

	performance.			
14.	Express the basic principle of SPV conversion	BTL-2	Understand	CO3
15.	Formulate the I-V Characteristics of PV System	BTL-6	Create	CO3
16.	List the different types of PV Systems.	BTL-5	Evaluate	CO3
17.	Illustrate the difference between monocrystalline and polycrystalline solar panels, considering efficiency and cost factors	BTL-2	Understand	CO3
18.	Explain the impact of changes in irradiance on the electrical characteristics of a photovoltaic cell	BTL-3	Apply	CO3
19.	Discuss the importance of encapsulation in protecting the internal components of PV cells from environmental factors.	BTL-1	Remember	CO3
20.	Evaluate the advantages and disadvantages of thin-film solar cells in comparison to traditional silicon-based cells.	BTL-6	Create	CO3
21.	Examine the environmental considerations in the selection of semiconductor materials for sustainable photovoltaic technologies	BTL-2	Understand	CO3
22.	Explain how changes in the load resistance affect the I-V characteristics of a PV system	BTL-1	Remember	CO3
23.	Evaluate the role of the series and shunt resistances in the equivalent circuit of a PV cell and their impact on the performance	BTL-2	Understand	CO3
24.	Examine the strategies employed in photovoltaic systems to mitigate the negative effects of temperature on efficiency	BTL-1	Remember	CO3
	PART – B (16 Marks)			
1.	Describe the working principle of solar cells and explain how they convert sunlight into electricity.	BTL-2	Understand	CO3
2.	Compare and contrast the structural characteristics of monocrystalline and polycrystalline solar panels.	BTL-3	Apply	CO3
3.	Provide a detailed explanation of the internal structure of a photovoltaic cell. Discuss the functions of each layer and how the overall design enhances the conversion efficiency of solar energy	BTL-1	Remember	CO3
4.	Analyze the characteristics of p-type and n-type semiconductor materials used in photovoltaic cells. Explain how the doping process enhances the electrical properties of these materials,	BTL-4	Analyze	CO3

	contributing to the overall efficiency of solar cells.			
5.	Explain the I-V characteristics of a photovoltaic system. Discuss how variations in solar irradiance and temperature influence the shape and position of the I-V curve, and explain the significance of the maximum power point	BTL-4	Analyze	CO3
6.	Examine the Environmental impact of solar power generation.	BTL-2	Understand	CO3
7.	Define the equivalent circuit model of a photovoltaic cell. Analyze the components of the equivalent circuit, with a focus on the diode, and discuss how this model represents the electrical behavior of a solar cell.	BTL-4	Analyze	CO3
8.	Discuss in detail about the principle of Solar Photo Voltaic (SPV) conversion.	BTL-4	Analyze	CO3
9.	Explain the various types of Photo Voltaic (PV) Systems.	BTL-4	Analyze	CO3
10.	Explain in detail about the construction of solar cell, solar module and solar array.	BTL-1	Remember	CO3
11.	Describe in detail about the PV Module equivalent Circuit and its I-V Characteristics	BTL-1	Remember	CO3
12.	Discuss about the working operation of Photovoltaic (PV) system in series and parallel connections	BTL-4	Analyze	CO3
13.	Examine the impact of changes in solar irradiance on the electrical characteristics of a photovoltaic cell. Discuss strategies employed in photovoltaic systems to optimize power output under varying irradiance conditions	BTL-5	Evaluate	CO3
14.	Formulate the application of Photovoltaic system in various fields.	BTL-6	Create	CO3
15.	Analyze the effects of temperature variations on the efficiency and performance of PV cells. Discuss thermal management strategies and technological advancements aimed at mitigating the negative impact of temperature on solar power generation.	BTL-1	Remember	CO3
16.	With a neat sketch explain the construction and the principle operation of solar photovoltaic system	BTL-4	Analyze	CO3
17.	Evaluate the series and parallel connection of Solar Photovoltaic system with neat sketch	BTL-1	Remember	CO3

UNIT IV PHOTO VOLTAIC ENERGY CONVERSION SYSTEM				
SYLLABUS: Basic Photo voltaic system for power generation-Advantages and disadvantages of photo voltaic solar energy conversion –Application of solar photovoltaic system-Components of PV systems –Design of PV systems- Power condition and storage arrangement-Maximum Power Point Tracking (MPPT) – Introduction to string inverters.				
Part-A (2 Marks)				
Q.No	**Questions**	**BT Level**	**Competence**	**COs**
1	Define a basic photovoltaic (PV) system and explain how it converts sunlight into electrical power	BTL-2	Understand	CO4
2	Discuss the primary function of a charge controller in a basic PV system and its role in optimizing battery health.	BTL-1	Remember	CO4
3	List three advantages of photovoltaic solar energy conversion over conventional power generation methods	BTL-1	Remember	CO4
4	Analyze two disadvantages associated with photovoltaic solar energy conversion and propose potential solutions.	BTL-4	Analyze	CO4
5	Provide examples of practical applications of solar photovoltaic systems in both residential and industrial settings.	BTL-4	Analyze	CO4
6	Discuss the economic benefits of integrating solar photovoltaic systems into off-grid or remote areas.	BTL-4	Analyze	CO4
7	Identify and explain the role of the major components in a PV system, including solar panels, charge controllers, inverters, and batteries.	BTL-2	Understand	CO4
8	Evaluate the importance of bypass diodes in solar panels and how they enhance the reliability of PV systems.	BTL-4	Analyze	CO4
9	Discuss the factors to consider when designing a PV system for a residential building, including location, load assessment, and system sizing	BTL-2	Understand	CO4
10	Explain the significance of shading analysis in the design of PV systems and how it affects the overall efficiency of the system	BTL-2	Understand	CO4
11	Define power conditioning in the context of PV systems and explain the role of inverters in this process.	BTL-3	Apply	CO4
12	Evaluate the advantages of incorporating energy storage systems, such as batteries, in PV systems	BTL-4	Analyze	CO4

13	Explain the concept of Maximum Power Point Tracking (MPPT) and its importance in optimizing the performance of solar panels	BTL-5	Evaluate	CO4
14	Discuss the role of MPPT algorithms in adjusting the operating point of a PV system for maximum power output.	BTL-6	Create	CO4
15	Define a string inverter and explain how it is different from other types of inverters used in PV systems	BTL-1	Remember	CO4
16	Discuss the advantages of using string inverters in large-scale solar photovoltaic installations	BTL-1	Remember	CO4
17	Examine the significance of net metering in the context of grid-tied photovoltaic systems	BTL-2	Understand	CO4
18	Discuss the environmental impact of manufacturing and disposing of photovoltaic panels in the life cycle of a PV system	BTL-3	Apply	CO4
19	Evaluate the impact of intermittent sunlight on the efficiency of photovoltaic solar energy conversion.	BTL-4	Analyze	CO4
20	Discuss the potential advantages and disadvantages of integrating photovoltaic systems with energy	BTL-6	Create	CO4
21	Explain how solar photovoltaic systems can contribute to energy independence for both residential and commercial users	BTL-1	Remember	CO4
22	Analyze the role of government incentives and policies in promoting the widespread adoption of solar photovoltaic systems.	BTL-4	Analyze	CO4
23	Discuss the advancements in solar panel technologies and how they impact the efficiency and cost-effectiveness of PV systems.	BTL-3	Apply	CO4
24	Examine the role of grounding systems in PV installations and their significance in ensuring safety and system reliability.	BTL-4	Analyze	CO4
Part-B (16 Marks)				
1	Describe the key components of a basic photovoltaic system for power generation. Discuss how each component contributes to the overall functionality of the system	BTL-1	Remember	CO4
2	Examine the role of a charge controller in a photovoltaic system. Illustrate how a charge controller optimizes battery health and discuss the	BTL-1	Remember	CO4

	implications of not using one in a PV system			
3	Provide a comprehensive analysis of three advantages associated with photovoltaic solar energy conversion. Discuss specific examples and real-world applications that highlight these advantages	BTL-4	Analyze	CO4
4	Critically evaluate two disadvantages of photovoltaic solar energy conversion. Explore potential technological advancements or strategies to mitigate these disadvantages	BTL-3	Apply	CO4
5	Discuss the practical applications of solar photovoltaic systems in residential and industrial settings. Evaluate the economic and environmental benefits of adopting PV systems in these applications	BTL-4	Analyze	CO4
6	Examine the role of solar photovoltaic systems in providing power to off-grid or remote areas. Analyze the economic impact and social benefits of implementing PV systems in such locations	BTL-5	Analyze	CO4
7	Provide an in-depth explanation of the major components in a photovoltaic system, including solar panels, charge controllers, inverters, and batteries. Analyze how each component contributes to the overall efficiency and reliability of the system.	BTL-1	Remember	CO4
8	Evaluate the importance of bypass diodes in solar panels. Discuss scenarios in which these diodes are crucial and how they enhance the overall reliability and performance of PV systems	BTL-4	Analyze	CO4
9	Discuss the critical factors involved in designing a residential PV system, including location, load assessment, and system sizing. Analyze the interplay of these factors in ensuring an optimal design.	BTL-4	Analyze	CO4
10	Examine the significance of shading analysis in the design of PV systems. Discuss how shading impacts system efficiency and propose strategies to mitigate shading effects for maximum performance.	BTL-1	Remember	CO4
11	Define power conditioning in the context of PV systems and discuss the role of inverters in this	BTL-2	Understand	CO4

	process. Evaluate different types of inverters and their applications in solar power generation			
12	Critically evaluate the advantages of incorporating energy storage systems, such as batteries, in PV systems. Discuss different battery technologies and their suitability for various applications in solar power.	BTL-3	Apply	CO4
13	Explain the concept of Maximum Power Point Tracking (MPPT) and its importance in optimizing the performance of solar panels. Discuss different MPPT algorithms and their effectiveness in various conditions	BTL-4	Analyze	CO4
14	Critically evaluate the role of MPPT in adjusting the operating point of a PV system for maximum power output. Discuss real-world scenarios where MPPT is particularly beneficial and its impact on overall system efficiency	BTL-6	Create	CO4
15	Define a string inverter and compare it with other types of inverters used in PV systems. Discuss the advantages and disadvantages of string inverters and their suitability for different applications	BTL-2	Understand	CO4
16	Discuss the role of string inverters in large-scale solar photovoltaic installations. Evaluate their performance, scalability, and the economic considerations associated with the use of string inverters in such projects	BTL-2	Understand	CO4
17	Examine the role of net metering in grid-tied photovoltaic systems. Discuss the benefits of net metering for both consumers and the utility grid. Evaluate the potential challenges and solutions associated with net metering	BTL-4	Analyze	CO4

UNIT V RECENT ADVANCEMENTS IN WIND AND PV SYSTEMS

SYLLABUS: Wind farms and grid connections-grid related problems on absorption of wind - Grid interfacing arrangement-operation, control and technical issues of wind generated electrical energy-interconnected operation-hybrid systems. Recent advances in PV applications: Building integrated PV systems, Grid connected PV systems, Hybrid systems ,solar cars, solar energy storage systems and their economic aspects

Part-A
(2 Marks)

Q.No	Questions	BT Level	Competence	COs
1	What is a wind farm, and how does it contribute to electricity generation	BTL-1	Remember	CO5
2	Explain one challenge associated with connecting wind farms to the electrical grid	BTL-2	Understand	CO5
3	Why is grid stability important in the context of wind energy absorption?	BTL-3	Apply	CO5
4	Name one strategy to address intermittency issues related to wind energy absorption into the grid	BTL-4	Analyze	CO5
5	Define grid interfacing arrangement in wind energy systems.	BTL-1	Remember	CO5
6	What is the role of grid codes and standards in the design of grid interfacing arrangements	BTL-2	Understand	CO5
7	Name any two operational challenge of wind-generated electrical energy.	BTL-3	Apply	CO5
8	How can control strategies improve the stability of wind power integration	BTL-6	Create	CO5
9	In simple terms, what does interconnected operation mean in wind energy systems?	BTL-4	Analyze	CO5
10	Explain why communication systems are important for the interconnected operation of wind farms.	BTL-1	Remember	CO5
11	Define a hybrid energy system and provide one advantage of integrating multiple energy sources	BTL-2	Understand	CO5
12	What are the challenges associated with the integration of wind energy into hybrid systems?	BTL-4	Analyze	CO5
13	What is a grid-connected PV system, and how does it contribute to decentralized energy generation	BTL-1	Remember	CO5
14	Briefly explain the concept of building-integrated PV systems	BTL-2	Understand	CO5
15	How does net metering impact the economic viability of grid-connected PV systems	BTL-3	Apply	CO5
16	Name the environmental benefit of integrating PV systems into the electrical grid	BTL-1	Remember	CO5
17	Explain, in simple terms, the concept of a hybrid energy system involving both PV and other renewable sources.	BTL-5	Evaluate	CO5
18	What are the potential advantages of integrating multiple energy sources in a hybrid system	BTL-6	Create	CO5
19	What is a solar car, and how does it utilize solar energy for propulsion	BTL-1	Remember	CO5
20	Name the technological advancement that enables the	BTL-1	Remember	CO5

	use of solar energy in electric vehicle			
21	How do energy storage systems contribute to the reliability of solar power?	BTL-2	Understand	CO5
22	In simple terms, what economic aspects should be considered when implementing solar energy storage systems?	BTL-2	Understand	CO5
23	How can government policies and incentives influence the adoption of wind and solar energy systems	BTL-2	Understand	CO5
24	Name the environmental consideration associated with the deployment of wind and solar energy systems.	BTL-2	Understand	CO5
Part-B (16 Marks)				
1	Design a wind farm layout considering factors such as wind patterns, turbine placement, and grid connection points. Discuss the key considerations and challenges in optimizing the efficiency of the wind farm.	BTL-4	Analyze	CO5
2	Analyze the challenges associated with grid-related problems during the absorption of wind energy. Propose strategies to address issues such as voltage fluctuations and frequency variations	BTL-3	Apply	CO5
3	Evaluate the role of energy storage systems in addressing intermittency issues related to wind energy absorption into the grid. Discuss the economic implications and potential technological advancements in storage solutions.	BTL-6	Create	CO5
4	.Design a grid interfacing arrangement for a wind farm, considering grid codes and standards. Discuss the components involved and their functions in ensuring compliance and optimal performance	BTL-4	Analyze	CO5
5	Evaluate the role of grid codes and standards in shaping the design and operation of grid interfacing arrangements for wind farms. Discuss the implications for developers and operators	BTL-3	Apply	CO5
6	Examine the technical challenges associated with the variability of wind-generated electrical energy. Discuss advanced forecasting techniques and control strategies to optimize the performance of wind power systems.	BTL-2	Understand	CO5
7	.Design a control system for wind-generated electrical energy, focusing on addressing operational challenges. Discuss how the control system contributes to grid stability and reliability	BTL-4	Analyze	CO5

8	Evaluate the advantages and challenges of interconnected wind farms. Discuss the impact on grid stability and the role of communication systems in facilitating real-time monitoring and control	BTL-1	Remember	CO5
9	Design a communication system for interconnected wind farms, considering factors such as data transfer, cyber security, and real-time control. Discuss the importance of effective communication in optimizing performance	BTL-2	Understand	CO5
10	Define a hybrid energy system involving wind and other renewable sources. Analyze the benefits of integrating multiple energy sources and discuss challenges related to the hybridization of wind energy	BTL-6	Create	CO5
11	Design a hybrid energy system that combines wind and solar power. Discuss the technical considerations, economic feasibility, and potential environmental benefits of such a system	BTL-2	Understand	CO5
12	Analyze recent advances in building-integrated PV systems. Discuss the architectural benefits and energy efficiency implications of integrating PV technology into building structures	BTL-4	Analyze	CO5
13	Define hybrid system? Discuss the need for hybrid system, its range and its types. (13)	BTL-1	Remember	CO5
14	.Evaluate the technical challenges and benefits of grid-connected PV systems. Discuss their impact on overall grid stability, distribution, and the potential for decentralized energy generation (16)	BTL-5	Evaluate	CO5
15	Design a grid-connected PV system for a residential area. Discuss the key components, system sizing considerations, and economic aspects associated with such a system	BTL-6	Create	CO5
16	Examine the impact of net metering on the economic viability of grid-connected PV systems. Discuss its role in encouraging renewable energy adoption and its implications for end-users	BTL-1	Remember	CO5
17	Discuss the advantages and challenges of hybrid energy systems that integrate both PV and other renewable sources. Analyze the optimization strategies and economic aspects associated with such hybrid systems.	BTL-4	Analyze	CO5

Course Outcome

- Ability to understand the basics of wind energy conversion system & solar energy conversion systems
- Ability to implement the appropriate power extraction techniques.
- Ability to apply power electronics to the renewable energy systems
- Ability to understand the grid integration techniques and power quality issues
- Ability to apply the technology and techniques in variety of applications.