

25MEET402	RENEWABLE ENERGY IN POWER GRIDS	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course introduces the fundamentals of integrating renewable energy sources with power grids and the basic principles of power converter circuits used in renewable energy systems.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain the basic concepts of Distributed Generation and Microgrids.	K2 Understand
CO2	Apply the knowledge of Distributed Energy Resources to select suitable DERs for microgrid applications.	K3 Apply
CO3	Apply the knowledge of microgrid issues and DG integration impacts to assess power quality problems in a microgrid.	K3 Apply
CO4	Apply the working principles of DC-DC converters to optimize power conversion in solar photovoltaic applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	2	2	-	-	-	1	2	1
CO2	3	3	2	-	-	2	3	-	-	-	1	2	2
CO3	3	3	2	2	-	2	3	-	-	-	2	3	2
CO4	3	3	3	2	3	1	2	-	-	-	2	3	3
Avg	3	2.75	2	2	3	1.75	2.5	-	-	-	1.5	2.50	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK 5	WK 6	WK 7	WK8	WK9
CO1	*	*	*	*	-	*	*	-	*
CO2	*	*	*	*	*	*	*	-	*
CO3	*	*	*	*	*	*	*	*	*
CO4	*	*	*	*	*	*	*	*	*

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	-	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS

Module 1 (13 Hours)

Distributed generation and Microgrid concept – Distributed generation, Need for integration of Distributed Energy Resources, Active distribution network, Concept of Microgrid, A typical Microgrid configuration, Technical and economic advantages of Microgrid, Challenges and disadvantages of Microgrid development, Dynamic interactions of Microgrid with main grid.

Module 2 (13 Hours)

Distributed energy resources – Introduction, Combined heat and power (CHP) systems, Wind energy conversion systems (WECS), Solar photovoltaic (PV) systems, Small-scale hydroelectric power generation.

Protection Issues for Microgrids – Introduction, Islanding: separation from utility, Different islanding detection methods, Major protection issues of stand-alone Microgrid - Microgrid distribution system protection, Protection of micro sources.

Module 3 (15 Hours)

Impact of DG Integration on Power Quality – Introduction, Power Quality Disturbances- Transients, Voltage sags and swells, Over-voltages and under-voltages, Outage, Harmonic distortion, Voltage notching, Flicker, Electrical noise, Power quality sensitive customers, Existing power quality improvement technologies, Impact of DG Integration.

Module 4 (15 Hours)

DC-DC converters for distributed generation – Power Devices: The ideal switch, Characteristics of ideal switches, Types of Power Semiconductor Devices - Power ratings. Block diagram of solar photovoltaic system, Types of solar PV system-stand-alone operation and grid integrated solar PV system, Need for DC-DC converters, Buck, Boost and Buck-Boost topologies.

Voltage Source Inverters – Single phase half bridge, full bridge and three phase bridge Voltage Source Inverters-square wave operation, PWM inverters, Grid connected inverters.

Text Books:

1. Keyhani, A. (2019). *Design of smart power grid renewable energy systems* (3rd ed.). Wiley Publications.
2. Erickson, R. W., & Maksimovic, D. (2022). *Fundamentals of power electronics* (3rd ed.). Springer.
3. Dugan, R. C., Granaghan, M. F., & Beaty, H. W. (2017). *Electrical power system quality* (2nd ed.). McGraw-Hill.

Reference Books:

1. Momoh, J. (2015). *Smart grid: Fundamentals of design and analysis*. Wiley-IEEE Press.
2. Teodorescu, R., Liserre, M., & Rodriguez, P. (2011). *Grid converters for photovoltaic and wind power systems* (1st ed.). Wiley Publications.
3. Rashid, M. H. (2014). *Power electronics: Circuits, devices and applications* (4th ed.). Prentice Hall of India.
4. Bausiere, R., Labrique, F., & Segulier, G. (2013). *Power electronic converters: DC-DC conversion*. Springer.
5. Bimbhra, P. S. (2018). *Power electronics* (6th ed.). Khanna Publishers.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER (STC 2025 SCHEME)

Course Code	25MEET402
Course Name	RENEWABLE ENERGY IN POWER GRIDS.
Max. Marks: 60	Duration: 2.5 Hours

Part A

<i>(Answer all questions. Each question carries 3 marks)</i>				
Qn No.	Question	Marks	CO	BL
1	Explain the need for integration of Distributed Energy Resources (DERs).	3	1	L2
2	Summarize the economic advantages of Microgrid systems.	3	1	L2
3	Examine how Distributed Energy Resources (DERs) contribute to microgrid operation.	3	2	L3
4	Demonstrate the application of small-scale hydroelectric generation in distributed power systems.	3	2	L3
5	Evaluate the impact of transients on power quality in a distribution system with distributed generation.	3	3	L3
6	Analyze how flicker influences the operation of electrical loads.	3	3	L3
7	Analyze the role of DC-DC converters in solar photovoltaic systems.	3	4	L3
8	Demonstrate the operation of a stand-alone solar PV system using a block diagram.	3	4	L3
Part B <i>(Answer any one full question from each Module. Each carry 9 marks)</i>				
Module I				
9	Illustrate the components of a Microgrid and explain the function of each component with a suitable diagram.	9	1	L2
OR				
10	Explain the relationship between Distributed Generation, Active Distribution Networks, and Microgrids in modern power systems.	9	1	L2
Module II				
11	Demonstrate the principles of Combined Heat and Power (CHP) systems and analyze their role in distributed energy generation.	9	2	L3
OR				

12	Apply microgrid protection techniques to ensure safe operation under grid-connected and islanded modes.	9	2	L3
Module III				
13	Analyze the impact of distributed generation integration on power quality in modern distribution networks.	9	3	L3
OR				
14	Apply suitable technologies to improve power quality in a distribution network affected by distributed generation integration.	9	3	L3
Module IV				
15	Demonstrate the operation of a three-phase bridge voltage source inverter and analyze its applications in distributed generation systems.	9	4	L3
OR				
16	Evaluate the performance of DC-DC converters and voltage source inverters in solar photovoltaic power conversion and grid integration systems.	9	4	L3

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