GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Master of Technology	Branch/Spec.	Electrical (Renewable Energy)
Semester	I	Version	1.0.0.0
Effective from Academic Year	2025-2026	Effective for the batch Admitted in	July 2025
Course code	3EE11PE12	Course Name	Grid Integration of Renewable Energy

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	1	0	4	Theory	40	60	100
Hours	3	0	2	0	5	Practical	30	20	50

Pre-requisites:

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Course Outcomes:

On successful completion of the course, the students will be able to:

CO1	Understand the need, challenges, and concepts related to integrating renewable energy sources into the grid
CO2	Analyze the operation and integration of synchronous and induction generators with grid-connected systems.
CO3	Evaluate power quality issues and apply grid management techniques for reliable operation.
CO4	Apply principles of wind and solar energy systems for efficient energy extraction and integration.

Theory syllabus

Unit	Content	Hrs
1	**Introduction:** Various techniques of utilizing power from renewable energy sources, Concept of nano/micro/mini grid, Need of integrating large renewable energy sources, Issues related to integration of large renewable energy sources, Rooftop plants. Concept of VPP.	**5**
2	**Power System Equipment's for Grid Integration:** **Synchronous generator:** Synchronization/integration to existing grid, Load sharing during parallel operation, Stability (swing equation and solution) **Induction Generator:** Working principle, Classification, Stability due to variable speed and counter measures **Power Electronics:** Need of power electronic equipment's in grid integration, Converter, Inverter, Chopper, AC regulator and cyclo converters for AC/DC conversion	**12**
3	**Power Quality and Management:** THD, voltage sag, Voltage swell, Frequency change and its effects, Network voltage management, Frequency management, System protection, Grid codes	**7**
4	**Wind Energy System:** Principles of wind energy extraction, Grid Integration Challenges, Electromechanical energy conversion, Characteristics of wind turbines, Voltage regulation in wind systems	**6**
5	**Solar Energy Systems:** Photovoltaic (PV) cells**,** Energy conversion principles, Electrical modelling, Optimal power extraction, Effects of shading, Solar thermal systems, Operating principles Storage capability.	**6**
6	**Integration of Alternate Sources of Energy:** Introduction, Principles of power injection, Converting technologies, power flow, Instantaneous active and reactive power control approach, Integrating multiple renewable energy sources, DC link integration, AC link integration, HFAC link integration Islanding and interconnection.	**9**

Practical content

Assignments and tutorials are based on the above syllabus.

Text Books

1	Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press – Wiley-Inter science publication.
2	Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P. Kothari, CRC Press (Taylor & Francis group).
3	Marco H. Balderas, "Renewable Energy Grid Integration", Nova Science Publishers, New York.

Reference Books

1.	Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme and J. Nayak, Tata McGraw Hill, 2008(3rd edition)

2.	Analysis of demand response and wind integration in Germany's electricity market, M. Klobasa, IET Renew. Power Generation., Vol. 4, No.1, pp. 55–63 55, 2010.
3.	Comparative analyses of seven technologies to facilitate the integration of fluctuating renewable energy sources, B.V. Mathiesen H. Lund, IET Renew. Power Generation., Vol. 3, NO. 2, pp. 190– 204, 2009.
ICT/MOOCS	
1.	https://www.youtube.com/watch?v=MocCm-3mA7c
2.	https://onlinecourses.nptel.ac.in/noc23_ee60/preview
3.	https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee42/

Mapping of CO with PO and PSO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	1	3	2	1	1	1	2	2	1	3	1	3
CO2	3	2	0	0	2	2	1	1	0	0	2	0	1	1	0
CO3	1	1	1	0	2	1	2	2	0	0	0	0	3	3	0
CO4	1	1	2	2	1	0	1	2	3	3	1	1	1	1	2