22EEHO207	GRID CONVERTERS FOR RENEWABLE ENERGY APPLICATIONS	SEMESTER				
PREREQUISTIES		**CATEGORY**	**PEC**	**Credit**		**3**
Power electronics		**Hours\Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1. To introduce the inverter structures and grid integration methods for solar and wind energy systems.

UNIT I	**PHOTOVOLTAIC INVERTER STRUCTURES**	**9**	**0**	**0**	**9**

Power circuit, operation modes and Solar PV integration with H5 Inverter, HERIC Inverter, REFU Inverter, Neutral Point Clamped (NPC) Half-Bridge Inverter, Conergy NPC Inverter, Three-Phase PV Inverter, Control Structures

UNIT II	**GRID SYNCHRONIZATION IN SINGLE-PHASE POWER CONVERTERS**	**9**	**0**	**0**	**9**

Grid Synchronization Techniques for Single-Phase Systems, Grid Synchronization Using the Fourier Analysis, Grid Synchronization Using a Phase-Locked Loop, PLLs Based on In-Quadrature Signal Generation, PLL Based on the Hilbert Transform , PLL Based on the Inverse Park Transform, PLLs Based on Adaptive Filtering

UNIT III	**GRID CONVERTER STRUCTURES FOR WIND TURBINE SYSTEMS**	**9**	**0**	**0**	**9**

Wind Turbine System Power Configurations, Grid Power Converter Topologies: Single-Cell (Voltage Source Converter or Current Source Converter), Multicell (Interleaved or Cascaded), Wind Turbine System Control: Generator-Side Control, Wind Turbine System Control Grid Control

UNIT IV	**GRID SYNCHRONIZATION IN THREE-PHASE POWER CONVERTERS**	**9**	**0**	**0**	**9**

Synchronous Reference Frame PLL under Unbalanced and Distorted Grid Conditions, Decoupled Double Synchronous Reference Frame PLL (DDSRF-PLL): Double Synchronous Reference Frame, Decoupling Network and Analysis of the DDSRF, Double Second-Order Generalized Integrator FLL (DSOGI-FLL), Structure of the DSOGI, Relationship between the DSOGI and the DDSRF

UNIT V	**GRID CONVERTER CONTROL FOR WIND TURBINE SYSTEMS**	**9**	**0**	**0**	**9**

Voltage Oriented Control and Direct Power Control: Synchronous Frame VOC: PQ Open-Loop Control, Synchronous Frame VOC: PQ Closed-Loop Control, Stationary Frame VOC: PQ Open-Loop Control, Stationary Frame VOC: PQ Closed-Loop Control, Virtual-Flux-Based Control, Direct Power Control, Stand-alone, Micro-grid, Droop Control and Grid Supporting: Grid-Connected/Stand-Alone Operation without Load Sharing, Micro-Grid Operation with Controlled Storage, Droop Control

Total (45L+0T)= 45 Periods

Text Books:

1. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, 'Grid Converters for Photovoltaic and Wind Power Systems, Wiley-IEEE Press, 2017

Reference Books:

1. Chetan Singh Solanki, " Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011.

E-Reference

1. https://onlinecourses.nptel.ac.in/noc22_ee71

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the configurations for inverter structures for solar photovoltaic system	L1: Remembering
CO2	:	Use grid synchronization technique for single phase converters	L3: Applying
CO3	:	Draw the topology structure of three phase converter for wind energy conversion system	L3: Applying

CO4	:	Understand the principle of grid converter control for wind energy conversion system	L1-Remembering
CO5	:	Select an grid synchronization scheme for three phase converters	L4-Analyzing

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	2	2			1		2		2	2	1	3
CO2	1	3		2	2					2		1	1	2	
CO3	1	1	2			1	2		1				1	1	2
CO4	1	1	1				2	2	1		2	2	1	1	1
CO5	1	2	1	1	1	2	1			1	3		2	2	1
Avg	1.2	1.8	1.75	1.67	1.67	1.5	1.67	1.5	1	1.67	2.5	1.67	1.4	1.4	1.75

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)