



# GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering Power Electronics

Subject Code: 3722908

Semester – II

Subject Name: Power Electronics Applications in Renewable Energy System

Type of course: Program Elective III

Prerequisite:

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	<b>INTRODUCTION:</b>  Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems: operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.	9
2	<b>ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION:</b>  Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.	9
3	<b>POWER CONVERTERS:</b>  Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion- mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.	9
4	<b>ANALYSIS OF WIND AND PV SYSTEMS:</b>	9



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	Standalone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system.	
5	HYBRID RENEWABLE ENERGY SYSTEMS: Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV- Maximum Power Point Tracking (MPPT).	9

### Reference Books:

1. S. N. Bhadra, D. Kasta, & S. Banerjee “Wind Electrical Systems”, Oxford University Press,2009
2. Rashid. M. H “power electronics Hand book”, Academic press, 2001.
3. Rai. G.D, “Non-conventional energy sources”, Khanna publishes, 1993.
4. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
5. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
6. Non-conventional Energy Sources B. H. Khan Tata McGraw-hill Publishing Company, New Delhi.

### Course Outcomes:

#### Student will understand:

Sr. No.	CO statement	Marks % weightage
CO-1	To Provide knowledge about the stand alone and grid connected renewable energy systems.	20
CO-2	To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.	20
CO-3	To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.	20
CO-4	To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.	20
CO-5	To develop maximum power point tracking algorithms.	20



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## **List of Experiments:**

1. To study characteristics of solar photovoltaic cell.
2. To study characteristics of Fuel cell.
3. To study characteristics of wind electrical system.
4. To study principle of operation of : Induction Generator
5. To study principle of operation of Permanent magnet synchronous generator.
6. To study principle of operation of squirrel cage induction generator.
7. To study principle of operation of doubly fed induction generator.
8. To study working of DC-DC converter with solar PV cell.
9. To study and simulate operation of various converters interfacing renewable source to grid system.

## **Major Equipment:**

- ✓ Simulation software like MATLAB along with necessary toolbox, PSIM or Scilab

## **List of Open Source Software/learning website:**

1. Courses available through NPTEL.  
- website : [nptel.ac.in](http://nptel.ac.in)