

# GUJARAT TECHNOLOGICAL UNIVERSITY

## POWER ELECTRONICS (29)

APPLICATION OF POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEM

SUBJECT CODE: 2722908

SEMESTER: II

**Type of course:** Major Elective -III

**Prerequisite:** Fundamental knowledge of Power Electronics Converters, Control System etc.

**Rationale:** PG Students of Power Electronics Engineering need to acquire good understanding of the fundamentals and applications of renewable sources. PG students will understand the integration and control of power converters for renewable resources as it is an emergent field.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	30	0	10	10	150

**Content:**

Sr. No.	Content	Total Hrs	% weightage
<b>1</b>	<b>Introduction:</b> Environmental aspects of electric energy conversion: Features of Renewable Generation impacts of renewable energy generation - Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Solar PV, Fuel cells, wind electrical systems-control strategy, operating area, operating principles and characteristics.	6	15%
<b>2</b>	<b>Solar Energy-Introduction to Solar Energy:</b> Solar radiation, availability, measurement and estimation, Solar thermal conversion devices and storage, solar cells, solar cell interconnection, solar cell characteristics and photovoltaic conversion – PV systems – analysis of PV systems- MPPT - Applications of PV Systems – solar energy collectors and storages-power electronics in solar Energy Utilization-DC-DC converters for solar PV systems.	7	20%
<b>3</b>	<b>Wind Energy:</b> Wind Energy-Introduction – Basic principles of wind energy conversion system– Nature of wind – site selection consideration – basic components of wind energy conversion system – Types of wind machines – basic components of wind electric conversion systems. Schemes for electric generations – generator control, load control, energy storage – applications of wind energy – Inter connected systems- power electronics in Wind Energy Utilization.	7	20%

<b>4</b>	<b>Fuel Cells, Energy storage systems:-</b> Introduction, Types of fuel Cells, Energy conservation, The structure of Power Storage Devices, Flywheels, Compressed Air Energy storage systems, Battery Storage, Applications of Energy storage systems.	6	10%
<b>5</b>	<b>AC-DC-AC Converters for Distributed Power Generation Systems &amp; Power Quality problems:-</b> Overview of Power Electronics Converters, Bidirectional AC-DC-AC Topologies, Filters, PWM for AC-DC-AC topologies, Control of converters, selection and sizing of the Converters, Matrix converter, and Multilevel Converters, Power Quality and Electromagnetic conservation, Power Quality Issues, Mitting Methods and EMC related Phenomena in Electrical Power systems.	10	20%
<b>6</b>	<b>Grid Connected Wind &amp; Solar Energy Conversion Systems</b> Grid connectors – Connection issues- Wind farm and its accessories – Grid related problems – Generator control – Performance improvements - Different schemes –Power converters for Grid connected Wind Energy Conversion System and Grid connected Solar Energy Converter systems, Hybrid Systems, Types of Cogeneration processes.	6	15%

#### Reference Books:

1. Mukund R. Patel, “Wind and Solar Power Systems: Design, Analysis, and Operation, Second Edition”, CRC Taylor & Francis, 2006.
2. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, Second Edition, John Wiley, New York, 1991.
3. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principles of Solar Engineering”, Taylor and Francis, Second Edition, 1999.
4. D. D. Hall and R.P. Grover, “Bio-Mass Regenerable Energy, John Wiley, Newyork, 1987.
5. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications”, Wiley Publications, 2014.
6. Ewald F. Fuchs, Mohammad A.S. Masoum, “Power Conversion of Renewable Energy Systems”, Springer, 2012.

#### Course Outcome:

After learning the course the students should be able to:

1. Learn about the modern power converters for renewable energy power harnessing.
2. Study about the interfacing of power converters.
3. Equip with required skills to derive the criteria for the design of power converters for Renewable energy applications.
4. Learn maximum power point tracking algorithms.

#### Learning website:

[www.nptel.ac.in](http://www.nptel.ac.in)

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers,

integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website