GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS & ELECTRICAL DRIVES (45)
APPLICATION OF POWER ELECTRONICS IN RENEWABLE ENERGY CONVERSION
SUBJECT CODE: 2724509
SEMESTER: II

Type of course: Engineering Science (Electrical)

Prerequisite: NA

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2#	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Solar Energy Systems:** Fundamentals of Solar Energy **-** The sun and earth, sun-earth movement, Local Apparent Time, Sunrise, sunset, path of son's motion, optimal angle for fixed collector surface, estimation of solar radiation Solar PV modules - Solar PV modules from PV cells, Mismatch in series and parallel connection, Design and structure of PV modules, PV module characteristics Solar Energy Conversion Systems - DC to DC converters for Solar Energy Systems: Buck, Boost , Buck-Boost converter and their control, Charge Controller, DC to AC inverter, Pulse Width Modulation of inverter, Maximum Power Point Tracking Algorithms: Perturb and Observe, Incremental Conductance method, MPPT voltage and current definition, Stand-alone PV system Configurations, Hybrid PV System, Grid connected PV system	16	40
2	**Wind Energy Systems:** Development of Wind Power Generation, Wind Power Conversion, Power Equation for wind turbine, Power converter for Wind Turbines, Control and Grid requirement for Modern Wind Turbines, Types of Wind Generators, Singly Excited Induction Generator (SEIG), Stand alone operation of fixed and variable speed energy conversion systems, Capacitance Requirement, Doubly Fed Induction Generator: Principle, Operation and their analysis, Vector Control of DFIG using an AC-DC-AC converter, DFIG based Wind Energy Conversion Systems	12	30
3	**Controllability Analysis of Renewable Energy Systems:**	6	15

	Zero dynamics of Nonlinear systems, Controllability of wind turbine connected to grid through L and LCL filter, Controllability and Stability Analysis of PV systems connected to Current Source Inverter		
4	**Fuel Cell Systems:** Basic of Fuel Cell - Fuel Cell Principles, Fuel Cell Commercial Technologies, Power Characteristics of Fuel Cell- Static Characteristics, dynamic behaviour, Fuel Cell Modeling - Fuel cell electrical equivalent circuit, PEMGC Modeling, Power Electronic converter for Fuel Cell- Review of DC-DC Power Converter, Isolated DC-DC Power Converter, Other Power Electronic converters	6	15

Reference Books:

1. C.S. Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd, 2nd Edition, 2011
2. H. Abu Rab, M. Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", Wiley-IEEE Press, 2014
3. E.F. Fuchs, M.A.S. Masoum, "Power Conversion of Renewable Energy Systems", Springer, 2011.
4. G.L. Johnson, "Wind Energy Systems", Prentical Hall, 1985
5. S. Chakraborty, M. G. Simoes, W. E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems", Springer, 2013

Course Outcome:

After learning the course the students should be able to:

- To understand the concepts related to working and control of power electronics converter based renewable energy systems

- To develop and handle power electronic converter based renewable energy system.

List of Open Source Software/learning website:

- E-materials available at the website of NPTEL- http://nptel.ac.in/
- MATLAB (Trial version): Software is useful for simulation and analysis of electrical systems

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