GUJARAT TECHNOLOGICAL UNIVERSITY
Syllabus for Bachelor of Vocation (B.Voc.), 4th Semester
Branch: Solar & Renewable Energy
Subject Name: Electrical Component for Wind and Solar
Subject Code: 1140702

Type of course: Core
Prerequisite: NA
Rationale: This subject is offered to emphasize the role of renewable energy technologies (especially wind and solar energy) and their potentials. The course aims to introduce the basic concepts of wind and solar energy and the preliminary analysis to estimate the energy generation from the wind and solar systems. Various components involved in the wind and solar system are covered and the control approaches to improve the performance of the systems are also included. In addition to the various applications of solar and wind energy generation systems, the course also covers the issues related to the integration of these systems in the existing network. Thus, the course is intended to provide the foundation for the solar PV and thermal as well as wind energy generation systems.
Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical		
L	T	P	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	0	3	50	0	0	0	50

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit;
ESE- End Semester Examination; PA-Progressive Assessment

Content:

Sr. No.	Content	Total Hrs.	Module % Weightage
1	**Basic of Wind energy** History of wind power, Origin of wind, Advantage and disadvantage of wind energy, application of Wind energy, wind power station in Gujarat and India, Inside the wind turbine, Terminology used in wind turbine, Power in the wind, main components and classification of wind mills, site selection for wind mill.	04	10%
2	**Generators and power electronics converter for wind plant** Working principal of generator, Introduction to the wind generator and turbine topology, fixed and Variable speed wind turbine, pitch and yaw control system Asynchronous Generator-squire cage induction generator, wound rotor induction generator , doubly fed induction generator, synchronous generator-permanent magnet synchronous generator, wound rotor synchronous generator, generator-converter configuration - back to back connected power converters, Rectifier converter(AC to DC),Inverter converter(DC to AC), Capacitor bank, transformer ,substation ect	12	30%
3	**Basic of solar energy** Introduction to solar energy, advantage and disadvantage of solar energy, solar radiation spectrum, type of solar radiation, working principal of solar cell ,cell, module and array, series and parallel pv configuration, Application of solar energy, solar power generation, V-I characteristics of a PV cell, Maximum Power Point Tracking (MPPT) algorithms, Solar PV applications.	04	10%
4	**Solar panel ,inverter and battery for solar plant** Solar cell fundamental , Solar Cell technology-Mon crystalline, multicrystalline, Amorphous module, Solar-pv module, panel, array; Power Electronic Converters for Solar	14	30%

	Systems(Inverter),charge controller for solar system, Types of battery used in solar power plant, battery ratting, charging and discharging of battery ,efficiency of battery, life of battery.		
5	**Network Integration Issues** Overview of grid code technical requirements, real and reactive power regulation, voltage and frequency operating limits, Power quality issues, Advantage and disadvantage of interconnection system, problems associated with the inter connected system, supervisory control and data acquisition(SCADA),safety and protection system.	08	20%
	Total	**42**	**100**

Reference Books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme and J.K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 3 rd ed., 2008.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.
7. B.H. Khan, "Non-Conventional Energy Resources", McGraw Hill 2nd Edition 2017.
8. G.D. Rai, "Non-Conventional Sources of Energy", Khanna Publishers, 4th Edition, 2009

Distribution of marks weightage for cognitive level:

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	10	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Course Outcomes:

Sr. No.	CO Statement	Marks %Weightage
CO-1	Demonstrate the importance of renewable energy source and various applications of solar and wind systems.	20
CO-2	Identify the generators and power electronics converters used for wind energy systems.	30
CO-3	Identify the solar panel, inverter, charge controller and battery used for wind energy systems.	30
CO-4	Describe the issues related to the renewable energy in the electrical utility network.	20