GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3173630
Semester – VII
Subject Name: Renewable Energy Sources

Type of course: Open Elective Course

Prerequisite: None

Rationale: To provide an idea of the challenges in the field of energy management and to provide a perspective on energy technology. Students will learn the systems dimensions of the energy problems and its historical perspective on energy technology and system development. For different types of energy sources utilization in industries, the procedure of power generation, transportation along with conventional and advanced application in different sectors should be known by the student.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Renewable Energy Sources:** Energy sources (conventional & non-conventional), primary & secondary energy sources, Renewable energy sources, classification and their prospects, Energy consumption, world energy future, energy needs for growing economy, energy sector reforms, energy conservation and its importance	06
2	**Solar Energy:** Solar radiation and related terms, measurement of solar radiation, solar energy collectors-flate plate collector, air collector, concentrating collectors, application and advantages of various collectors, solar energy storage system (thermal, chemical, mechanical), solar pond, application of solar energy.	10
3	**Wind Energy:** Basic principles, power content in wind and utilization, force on blades and turbines, wind energy conversion system, site selection, basic components of wind energy conservation system (WECS), classification of WECS, wind energy collectors, applications of wind energy.	07
4	**Geothermal and Ocean Energy:** Geothermal field and resources, hydrothermal resources, liquid dominated systems, applications of geothermal energy, Principle, OTEC, energy from tides, components of	06

	tidal power plants, operation, methods of utilization of tidal energy, storage	
5	**Biomass Energy:** Introduction, biomass conversion technology, photosynthesis, biogas generation, factors affecting biogas generation, classification of biogas plants and their comparison, types of biogas plant, biogas from plant wastes, community plants and site selection, digester design consideration, design calculations, methods of maintaining and starting of biogas plant, properties and utilization of biogas	**10**
6	**Fuel Cells and Hydrogen Energy:** Introduction, hydrogen- oxygen fuel cell, ion exchange membrane cell, fossil fuel cell, molten carbonate cell. Advantages and disadvantages, conversion efficiency, type of electrodes, application of fuel cell, hydrogen storage, production and transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.	**06**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	**25**	**15**	**10**	**10**	**--**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Non-Conventional Energy Sources, Rai .G. D., Khanna Publishers.
2. Energy Resources: Utilization and Technologies, Anjaneyulu Y, Francis T., BS Publication.
3. Non-Conventional Energy Sources, Khan B. H.,, Tata McGraw Hill.
4. Renewable Energy Resource: Basic Principles and Applications, Tiwari G. N, Ghosal M. K., Narosa Publishing House.
5. Solar Energy: Principles of Thermal Collections and Storage, S. P. Sukhatame and J. K. Nayak, Tata McGraw Hill, New Delhi
6. Energy Technology by Rao & Parulaker, Khanna Publishers.

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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To identify the present energy scenario and the need for energy conservation for future	10%
CO-2	To appreciate various methodologies of tapping energy from solar energy sources	15%
CO-3	To understand the design and applications of power generating devices using wind energy	20%
CO-4	To adopt the various aspects of geothermal and ocean energy with its utilization	20%
CO-5	To devise application strategies by converting non-conventional energy sources into usable form	20%
CO-6	To explore non-renewable energy resources and effective technologies	15%

List of Open Source Software/learning website:

- Literature and Research articles available on internet
- CDs which are available with some reference books
- NPTEL Lectures