GUJARAT TECHNOLOGICAL UNIVERSITY
MECHANICAL ENGINEERING (19)
RENEWABLE ENERGY ENGINEERING
SUBJECT CODE: 2181910
B.E. 8TH SEMESTER

Type of course: Core

Prerequisite: Fluid Mechanics, Heat Transfer

Rationale: The course is designed to give knowledge of various renewable energy sources, systems and applications in the present context and need.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	0	4	70	20	10	0	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Scenario of Renewable Energy (RE) Sources:** Needs of renewable energy, advantages and limitations of RE, present energy scenario of conventional and RE sources	2	03
2	**Solar Energy:** Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation, radiation on tilted surface solar energy conversion into heat, types of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, thermal analysis of liquid flat plate collector, air heater and cylindrical parabolic collector, solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning, solar pond, heliostat, solar furnace photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages	22	40
3	**Wind Energy:** Energy available from wind, basics of lift and drag, basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm	12	22
4	**Bio Energy :** Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages, biomass energy, energy plantation, gasification, types and applications of gasifiers	03	05
5	**Ocean Energy**: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations,	08	12

	wave energy, wave energy conversion devices, advantages and disadvantages, ocean thermal energy **Geothermal energy**: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications **MHD Power generation:** concept and working principle		
6	**Economic Analysis:** Initial and annual cost, basic definitions, present worth calculations, repayment of loan in equal annual installments, annual savings, cumulative saving and life cycle cost, economic analysis of add on solar system, payback period, clean development mechanism	09	18

Demonstration of following equipment should be given to the students.
(a) Solar water heater (b) Solar air heater (c) Pyranometer (d) Pyrhelioemeter (e) Solar PV system (f) Wind mill (g) Biogas plant (h) Gasifier (i) Solar cooker

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	25	10	05	05

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. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, McGraw-Hill Education
2. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley, New York
3. Non-conventional energy resources, Shobh Nath Singh, Pearson India
4. Solar Energy Engineering, Soteris Kalogirou, Elsevier/Academic Press.
5. Principles of Solar Energy, Frank Krieth & John F Kreider, John Wiley, New York

Course Outcome:
After learning the subject, student will be able to understand,
- Importance of RE sources
- Applications of different RE sources
- Carry our preliminary economic analysis of RE systems

List of Open Source Software/learning website:
http://nptel.ac.in/courses/112104117/18
http://nptel.ac.in/courses/112104117/4
http://nptel.ac.in/courses/112104117/17

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.