GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (THERMAL ENGINEERING) (21)

SOLAR ENERGY ENGINEERING

SUBJECT CODE: 2722108

SEMESTER: II

Type of Course: Advance

Prerequisite: NIL

Rationale: The course is designed to give knowledge and relevant technologies in the area of solar energy.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Tutorial/Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Solar Radiation:** Source of radiation, solar radiation geometry, solar radiation measuring instruments, solar constant, solar radiation on tilted surface, solar charts	**5**	12
2	**Solar Concentrating Collectors:** Optical and thermal analysis of compound parabolic collectors, optical and thermal analysis of parabolic through collectors, second law analysis, minimum entropy generation rate, optimum collector temperature, non-isothermal collector, solar non-concentrating collectors, design considerations	**7**	16
3	**Performance of Solar Collectors:** Collector thermal efficiency, collector energy losses, collector incident angle modifier, concentrating collector acceptance angle, collector time constant, dynamic system test method, collector test results and preliminary collector selection, quality test methods, analysis of concentric tube collector	**8**	20
4	**Solar Thermal Applications:** Selection criteria of storage materials for heating and cooling applications, selection of heat transfer fluid for heating and cooling applications, active and passive solar water heating system, solar space heating, solar cooling with absorption and adsorption refrigeration, solar desalination systems, solar powered absorption air conditioning system, solar irrigation system, solar chimney, drier, dehumidifier, solar still	**8**	20
5	**Solar Thermal Power System:** Parabolic through collector system, power tower system, dish systems, thermal analysis of solar thermal power plants, solar ponds, *f*-chart and	**7**	16

	utilizability methods		
6	**Solar Economic Analysis:** Life cycle analysis, time value of money, description of the life cycle analysis method, the P_1, P_2 method, uncertainties in economic analysis, construction concepts, energy storage -sensible, latent heat and thermo-chemical storage - pebble bed etc. Materials for phase change - glauber's salt - organic compounds, solar ponds	**7**	16

Reference Books:

1. Solar Engineering of Thermal Processes, Duffie J A, Beckman W A, Wiley
2. Solar Energy Engineering – Process and Systems, Soteris A Kalogirou, Academic Press
3. Solar Energy – Principles of Thermal Collection and Storage, S P Sukhatme, McGraw Hill
4. Principles of Solar Engineering, D Y Goswami, F Kreith and J F Kreider, Taylor and Francis
5. Solar Energy: Fundamentals and Applications, H P Garg & Jai Prakash, McGraw Hill
6. Engineering Thermodynamics of Thermal Radiation for Solar Power Utilization, Petela R, McGraw-Hill
7. Fundamentals for solar energy conversion, Edward E Anderson, Addison Wesley Publ. Co.
8. Thermal Energy Storage , Dincer I, Rosen M, Wiley

Course Outcome:

After learning the course the students should be able to:

1. To know the concept of solar radiation and principle of measuring instruments.
2. To understand the thermal analysis, thermal efficiency, energy losses of concentrating and non-concentrating collectors of solar radiation system.
3. To know the various applications of solar thermal energy
4. To understand the life cycle analysis method and uncertainties in solar economic analysis.

List of Experiments:

1. Measurement of solar radiation using pyranometer and other solar radiation measuring instruments.
2. Performance evaluation of solar flat plate collector.
3. To study the effect of solar flat plate collector in parallel combination.
4. Performance evaluation of concentrating solar collector.
5. To study the effect of concentrating solar collector in series arrangements.
6. Performance evaluation of solar cooker.
7. Performance evaluation of solar air dryer.
8. Performance evaluation of solar still.
9. To compare of solar thermal power systems.
10. Performance evaluation of solar funnel.

Design Based Problems (DP)/Open Ended Problem:

1. To design / make model concentrated solar power tower technology for illumine LED bulb. Students may use the data of its own location.
2. To develop a model of planetary system to understand the solar geometry.
3. To develop an experimental setup of solar water heater with pumping system.
4. To design / make model of solar A/C system.
5. Power consumption calculation of college building for solar system and find alternative way of conventional power generation system.

Major Equipment:

Solar flat plate collector, Concentrating solar collector, Solar cooker, Solar air heater as drier of any product, Solar still

List of Open Source Software/learning website:

1. http://nptel.ac.in/downloads/112105051/

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.