

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

ENERGY TECHNOLOGY

SUBJECT CODE: 2723007

SEMESTER: II

Type of course: Chemical Engineering (Open Elective)

Prerequisite: Basic knowledge of Energy Sources

Rationale: The ever increasing use of non conventional energy sources have led to a requirement of incorporation of study of these energy sources. This will develop some curiosity in the students and also give them the basic knowledge of all such sources of energy and its commercial applications. Conventional Energy sources, their sources, energy extraction mechanism, applications, advantages and disadvantages.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			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.	Indian Energy Scenario: Energy resources & Consumption: Commercial and non-commercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption, Impact of Energy on Economy, Development and Environment, Energy for Sustainable Development, Energy and Environmental policies, Need for use of new and renewable energy sources, Status of Nuclear and Renewable Energy: Present Status and future promise, Energy Policy Issues: Fossil Fuels, Renewable Energy, Power sector reforms, restructuring of energy supply sector, energy strategy for future	5	9
2.	An Introduction To Energy Sources: Energy Sources (Conventional & Non-Conventional), Renewable Energy Resources, Primary & Secondary Energy Sources, Energy Chain, Energy Demand, National Energy Strategy & Plan, Energy Management, Energy Audit & Conservation	4	8
3.	Definitions, Units & Measures Of Solid Fuels: Proximate & Ultimate Analysis, Calorific Values, Rank Of Coal, Coking & Caking, Gasification, Basis For Reporting Results Of Analysis, Units & Conversion Factors, Wood & Charcoal, Peat, Lignite, Sub-Bituminous & Bituminous Coals, Semi- Anthracite And Anthracite Coals, Origin of Coal, Composition of Coal, Analysis & Properties Of Coal	5	9

4.	Wind Energy: Basic Principles, Power In Wind, Force On Blades & Turbines, Wind Energy Conversion, Site Selection, Basic Components Of Wind Energy Conversion Systems (WECS), Classification Of WECS, Wind Energy Collectors, Applications Of Wind Energy.	5	9
5.	Solar Energy: Solar Constant, Solar Radiation & Related Terms, Solar Energy Collectors – Flat Plate Collector, Air Collector, Concentrating Collectors, Applications & Advantages Of Various Collectors, Selective Absorber Coatings, Solar Energy Storage Systems (Thermal, Electrical, Chemical & Mechanical), Solar Pond.	6	11
6.	Energy From Biomass: Introduction, Energy Plantation, Biomass Conversion Technologies, Photosynthesis, Biogas Generation, Factors Affecting Biogas Generation, Classification Of Biogas Plants & Their Comparisons, Types Of Biogas Plants (Including Those Used In India), Community Plants & Site Selection, Digester Design Considerations, Properties & Utilisation Of Biogas.	6	11
7.	Fuel Cell: Introduction, Hydrogen – Oxygen Fuel Cell, Ion Exchange Membrane Cell, Fossil Fuel Cell, Molten Carbonate Cell, Advantages & Disadvantages, Polarisation, Type Of Electrodes, Applications Of Fuel Cells.	6	11
8.	Hydrogen : Properties Of Hydrogen, Production Of Hydrogen, Thermo chemical Methods, Fossil Fuel Methods, Solar Methods, Storage & Transportation, Safety & Management.	5	9
9.	Magneto Hydro-Dynamic (MHD) Power Generation: Principle, MHD System, Open Cycle System, Closed Cycle System, Design Problems & Developments, Advantages, Materials For MHD Generators, Magnetic Field & Super Conductivity.	6	11
10.	Nuclear Energy: Fission, Fusion, Fuel For Nuclear Fission Reactor (Exploration, Mining, Milling, Concentrating, Refining, Enrichment, Fuel Fabrication, Fuel Use, Reprocessing, Waste Disposal), Storage & Transportation, Fast & Slow Neutrons, Multiplication Factors & Reactor Control, Uranium Enrichment Process.	6	12

Reference Books:

1. Energy Sources 2nd Ed. by G. D. Rai, Khanna Publications, New Delhi
2. Fuels & combustion by Samir Sarkar, Orient Longmans(1974)
3. Solar Energy by Sukatame, Tata McGraw Hill, New Delhi
4. Energy Technology by Rao & Parulaker, Khanna Publications (2009), New Delhi
5. World Energy Resources : Charles E. Brown, Springer2002.

Course Outcome:

After learning the course the students should be able to understand different non conventional energy sources and apply his knowledge to improve the efficiency of the existing processes and solve various technical obstacles to the effective and large scale application of these energy sources.

List of Experiments and Open Ended Projects:

Minimum **5** practicals to be performed and remaining time should be allotted to open-ended projects / study reports / latest outcomes in technology study:-

1. In the beginning of the academic term, faculties will have to allot their students at least one Open-ended Project / Study Report / Latest outcome in technology.
2. Literature survey including patents and research papers of fundamental process
 - Design based small project **or**
 - Study report based on latest scientific development **or**
 - Technology study report/ modeling/ simulation/collection report **or**
 - Computer based simulation/ web based application/ analysis presentations of basic concept field which may help them in chemical engineering.
3. These can be done in a group containing maximum **three** students in each.
4. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
5. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to study the design module of given task.
6. In the semester student should perform **minimum 5** set of experiments and complete **one small open ended dedicated project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER.**

List of Experiments (Any five)

Sr. No.	List of Experiment
1	Measurement of Solar Radiation
2	Design Calculation For Flat Plate Collector.
3	Study Of Solar Still And Solar Ponds
4	To Carry Out Performance Test On Solar Water Heating
5	To Study And Design Calculation Of Bio-Gas Plant.
6	To Carry Performance Test On Solar Air Heating System
7	Design Calculation Of Bio Gas Plant
8	To Carry Out Trial On Windmill
9	To Study The MHD Power Generation And MHD Power Cycle

Open Ended Problem:

Technology Engineering applications to define project. Some suggested projects are listed below:

- Carry out projects on solar collectors
- Designing of various fuel cell experiments set up.
- Projects on Energy from Biomass etc.
- Carry out projects on wind energy.

Major Equipments:

1. Solar Collector
2. Wind mill generator set
3. Biogas plant modules

List of Open Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL lecture series.

- Students can refer to the CDs available with some reference books for the solution of problems using software's/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.

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