GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM

Course Title: Non Conventional Energy Sources
(Code: 3346302)

Diploma Programmes in which this course is offered	Semester in which offered
Agriculture Engineering	**Fourth Semester**

1. RATIONALE

Energy is an important input in all sectors of country's economy. Standards of living of a country can be directly judged by per capita consumption of energy. Energy sources in general can be broadly ategorized as –
(i) Conventional sources of energy — like fossil fuels such as coal, oil, gas, atomic and hydroelectric energy and
(ii) Non-conventional sources of energy — such as solar, wind, ocean, geothermal, and bio-mass etc

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency:

i. Use of different types of non conventional energy sources and appliances.
ii. For having basic knowledge of renewable energy sources and its uses along with its agricultural as well as domestic applications.

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; C – Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment.

4. DETAILED COURSE CONTENTS:

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I **Conventional and Non conventional sources of energy**	1a. State the different types of conventional and non conventional energy sources 1b. State the comparison between Conventional and Non conventional sources of energy. 1c. Explain the Need, importance and scope of non conventional and alternate energy resources.	1.1. Conventional energy sources. 1.2. Non conventional energy sources. 1.3. Need of non conventional energy sources. 1.4. Renewable Sources of Energy such as Hydro, Solar, Wind, Bio-mass, Tidal and Geothermal - their availability and limitations.
Unit – II **Bio-mass Energy**	2a. Describe Bio-mass energy 2b. Explain different Types of bio gas plant 2c. Explain the concept of Energy plantation 2d. Compare different Types of Biogas plants. 2e. Explain design of different types of bio gas plants. 2f. State the Applications of biogas plant	2.1. Introduction to biomass and farm residue, management and briquetting. 2.2. Bio-gas as a source of energy. Benefits of bio-gas. 2.3. Technology of biogas. 2.4. Principles, feedstock, types an design of biogas plants. 2.5. Comparison of plant designs. 2.6. Main parts of biogas plants, digester, gas holder, pressure gauge, gas controlling cocks and meter. 2.7. Selection of biogas model and size. Site selection of biogas plants. 2.8. Appliances of biogas plant - burner, heating plate, lamps. 2.9. Operation, trouble shooting and maintenance of biogas plant. 2.10Safety measures in biogas plant. Biomass Gasification, Different types of biomass gasifiers.
Unit– III **Wind Energy Technology**	3a. Describe the scope of wind energy 3b. Explain different types of wind mills. 3c. List out data required for wind mill installation. 3d. Explain the factors to be consider while site selection of wind mill.	3.1. windmill - vertical and horizontal axis. 3.2. Data required for windmill installation such as meteorological data, geohydrological, agricultural and socio- economic data. 3.3. Site selection of windmill. 3.4. Installation, operation and maintenance of windmill.

Unit– IV **Solar Energy Technology**	4a. Describe Solar Energy Technology in different Areas 4b. Explain Flat type solar collector. 4c. Explain concentration or focusing type solar collectors.	4.1. Introduction, significance of solar energy, solar spectral and green house effect 4.2. Principles of thermal collection and storage. 4.3. Classification of solar collectors -flat type collector and concentration or focusing type collectors , and their comparision. 4.4. Introduction to Spy module, its principle and applications.
Unit– V **Solar Thermal Systems**	5a. Explain the constructional details of different types of solar appliances. 5b. Explain the operation of different types of solar appliances. 5c. Explain the maintenance of different types of solar appliances.	5.1. Constructional details, operation and maintenance of solar cooker. 5.2. Operation, constructional details and maintenance of solar water heater. 5.3. Operation, constructional details and maintenance of solar still. 5.4. Operation, constructional details and maintenance of solar water pumping system. 5.5. Operation, constructional details and maintenance of SPV system. 5.6. Operation, constructional details and maintenance of solar crop dryers.
Unit– VI **Energy Conservation**	6a. Understand the concept of energy Conservation 6b. Explain the energy conservation in domestic appliances. 6b. Explain the traditional cooking stoves and improved cooking stoves.	6.1. Principles of energy conservation. 6.2. Familiarization with the different energy conservation appliances and practices. 6.3. Improved cooking stoves. 6.4. Benefits of improved cooking stoves over the traditional cooking stoves.

				Distribution of Theory Marks			
Unit No.	**Unit Title**	**Teaching Hours**		**(Duration – …..Hours)**			
			R Level	**U Level**	**A Level**		**Total**
1.	Conventional and Non conventional sources of energy	06	3	4	1		08
2.	Bio-mass Energy	08	5	5	4		14
3.	Wind Energy Technology	07	3	5	4		12
4.	Solar Energy Technology	07	3	5	4		12
5.	Solar Thermal Systems	07	2	3	7		12
6.	Energy Conservation	07	3	7	2		12
	Total	**42**	**20**	**29**	**21**		**70**
Legends:							

R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

6. SUGGESTED LIST OF EXPERIMENTS/PRACTICALS

The experiments/practicals sho*u*ld be properly designed and implemented to develop different types of skills leading to achieve expected competency in the subject

Sr No.	Unit No.	List of Experiments	Teaching Hours
1	I.	Demonstration/study of solar cooker	2
2	II.	Demonstration/study of solar water distillation	2
3	III.	Demonstration/study of solar water heater	2
4	IV.	Demonstration/study of solar photovoltaic lighting system	2
5	V.	Demonstration/study of solar water pumping system	2
6	VI.	Visit to biogas plants, domestic community/institution for study and demonstration of biogas plants	2
7	VII.	Demonstration/study of the working of a windmill	2
8	VIII.	Study of energy saving appliances and their applications	2

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

I. Visit to wind farm and learn actual energy generated per area
II. Study about all types of biogas plant and their power generation plant
III. Visit to places where solar energy is produced in farm for the use of water pumping

8. SUGGESTED LEARNING SOURCES:

A. List of Books

S.No.	Author	Title of Books	Publication/Year
1	O.P.Chawla	Advance in Biogas Technology	1 CAR, New Delhi.
2	S.P.Sukhatme	Solar Energy	Tata McGraw-hill Publishing Co. Ltd., New Delhi.
3	G.D.Rai	Solar Energy Utilization	Khanna Publishers, New Delhi.
4	K.C.Khandelwal & S.S. Mahdi	Bio Gas Technology	Tata McGraw-hill Publishing Co. Ltd., New Delhi.
5	OECD	Biomass Energy	Oxford & **IBH** Publication Co.
6	Srivastava	Wind Energy For water Pumping	Oxford & IBH Publication Co.
7	N.S.Grewal	Cook Stoves For Masses	PAD Ludhiana.
8	ISAE	Energy in Agricultural Engineering	Jain Brothers, Delhi.
9	G.D.Rai	Non Conventional Energy Sources	Khanna Publishers,New Delhi.
10	S. Rao	Renewable & Conventional Energy	Khanna Publishers,New Delhi.

B. List of Major Equipment/ Instrument

i. Monitoring Experiment Equipment
ii. Thermometer
iii. Solar collector
iv. Wind Power Generation Experimental Equipment
v. Dual-Axis Tracker Experiment Equipment
vi. Solar water pumping system
vii. Solar water distillation unit
viii. Solar cookers
ix. Gasifier unit
x. Solar water heater

C. List of Software/Learning Websites:

i. https://en.wikipedia.org/wiki/Biogas
ii. https://en.wikipedia.org/wiki/Solar_energy
iii. https://en.wikipedia.org/wiki/Wind_power
iv. https://en.wikipedia.org/wiki/Wind_farm
v. https://en.wikipedia.org/wiki/Biomass

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE