

DEPARTMENT OF PHYSICS				CLASS: I M.Sc. Physics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Major-Elective-I	21P1PME1	PHYSICS OF NON-CONVENTIONAL ENERGY RESOURCES	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented			Entrepreneurship oriented	

Course Objectives:

1. To develop the human resources in non conventional Energy resources is needed.
2. To create the people who will teach the science of non conventional Energy resources, this will be also helpful for the promotion of Research in this field.
3. To create several self-employment opportunities in renewable energy and energy efficiency sectors for modestly-trained and self-trained human resources exist in all geographic locations of the country.
4. It will help to develop the skills required in renewable energy and energy management fields.

Unit	Description	Hours	K-level	CLO
I	Energy Sources: Introduction- Energy resources and their availability- classification –conventional energy sources- non-conventional sources. Solar energy- Electricity from solar energy-world renewable energy sources - Solar radiation geometry. Theory of solar cell, solar cell material, limitations-Solar radiation at the earth's surface.	15	Up to K2	1
II	Solar Thermal energy: Solar Thermal Energy: Introduction- flat plate collectors –solar air heaters-application-advantages-solar energy storage-introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage-latent heat storage-application of solar energy-introduction-solar heating-active based heating system- Solar cooling-absorption air conditioning-LiBr-H ₂ O system-solar heating-passive heating system- Solar cooling-NH ₃ -H ₂ O coolers-Advantages and disadvantages of concentrating collectors over flat plate types collectors.	15	Up to K4	2

III	Wind Energy: Introduction-The power of the Wind - site selection consideration-wind energy conversion systems. Classification of WEC systems-advantages and disadvantages of WECS-Performance of wind machines-Application of wind energy.	15	Up to K3	3
IV	Geothermal Energy Introduction- Geothermal sources-hydrothermal resources-Interconnection of geothermal fossil systems-Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy-application of geothermal energy-Magneto-hydrodynamics (MHD): Principle of working of MHD system-Advantage of MHD systems- Estimates of geothermal power-advantages of geothermal field-Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displacement machines.	15	Up to K4	4
V	Bio-Mass and ocean Energy Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion (OTEC): Introduction-methods of Ocean thermal electricity power generation-open cycle OTEC system. Wave and Tidal Wave: Basic Principle of Tidal power-operation methods of utilization of tidal enegy-advantage and limitation of tidal power generation-utilization of biogas, OTEC Utilization, component of tidal power-Hybrid cycle, prospects of OTEC, Prospects of tidal energy.	15	Up to K4	5

BOOKS FOR STUDY:

1. Non-Conventional Energy Sources – G.D.Rai- Khanna publication(reprint-2018)

Sections:

UNIT I: Chapter-1: 1.4, 1.6, pg(30-31)

Chapter-2:2.4

UNIT II: Chapter-3:3.3,(B) pg(63-67)

Chapter-4:4.1,4.2pg(97-100)

Chapter-5:5.1,5.2,5.3pg(120-122),5.4(126-128)

UNIT III: Chapter-6:6.2,6.2.2,6.4,6.5,6.6,6.7

UNIT IV: Chapter-8:8.1,8.4,8.5,8.5.1,8.10,pg(354-356),8.11,8.11.3,8.12,8.13

Chapter-12:12.1,12.2.12.5

UNIT V: Chapter-7:7.2

Chapter-9:9.2,9.2.1,9.3.1,9.3.2,9.3.4,9.3.9

BOOKS FOR REFERENCE:

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications, 2006.
2. Energy Resources: Conventional & Non-Conventional -M.V.R. KoteswaraRao, BSP Publications, 2006.
3. Non-conventional Energy Resources -D.S. Chauhan, New Age International.
4. Renewal Energy Technologies: A Practical Guide for Beginners, C.S. Solanki-PHI Learning.

Web Resources:

1. <https://www.pveducation.org/pvcdrom/properties-of-sunlight/solar-radiation-at-the-earths-surface>.
2. <https://hal-mines-paristech.archives-ouvertes.fr/hal-01676634/document>.
3. <https://public.wmo.int/en/sun%E2%80%99s-impact-earth>.
4. <https://alteredenergy.com/types-of-concentrated-solar-collectors-and-their-advantages-disadvantages/>.
5. <https://askinglot.com/which-is-a-disadvantage-of-concentrating-solar-thermal-systems>.
6. <https://www.sciencedirect.com/topics/engineering/geothermal-power-plant>.
7. <https://www.osti.gov/servlets/purl/6125875>.
8. https://www.najah.edu/media/cms_page_media/759/Wind_Energy.pdf.
9. <https://www.e-education.psu.edu/eme807/node/713>.
10. https://www.researchgate.net/publication/339985429_Prospects_of_ocean-based_renewable_energy_for_West_Africa's_sustainable_energy_future.
11. https://en.wikipedia.org/wiki/Ocean_thermal_energy_conversion.

Rationale for Nature of the course

This course is mainly occupational skill and essential for many work in the renewable energy are delivered.

Activities having direct bearing on skill development/ Employability / Entrepreneurship

The activity is mainly efficient knowledge to work and go in to the further learning of energy resources.

Pedagogy: Chalk and talk, materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Designers:

1. Dr.M.Kavitha
2. Dr.J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Energy resources and their availability	3	PPT, Chalk and talk, Quiz and assignment
	Non-conventional sources. Solar energy	3	
	Electricity from solar energy-world renewable energy sources	3	
	Classification –conventional energy sources- non-conventional sources.	4	
	Solar radiation geometry, solar cell material.	2	
Unit II	Solar Thermal Energy: Introduction- flat plate collectors	3	Chalk and talk, Quiz and assignment
	solar air heaters-application-advantages- solar energy storage	3	
	Introduction-thermal storage system-sensible heat storage-water storage-packed bed exchanger storage	3	
	latent heat storage-application of solar energy-introduction-solar heating	2	
	Active based heating system- Solar cooling-absorption air conditioning-LiBr-H ₂ O system.	4	
Unit III	Introduction, The power of the Wind energy	4	Chalk and talk, Quiz, assignment and seminar
	wind energy conversion systems	2	
	Classification of WEC systems-advantages and disadvantages of WECS.	4	
	Performance of wind machines, Application of wind energy.	3	
	Wind energy, site selection consideration	2	
Unit IV	Geothermal Energy, Introduction, Geothermal sources	3	Chalk and talk, quiz, Group discussion
	hydrothermal resources-Interconnection of geothermal fossil systems	2	
	Geothermal energy conversion- impulse machine-Advantage and disadvantage of geothermal energy	4	
	hydrodynamics (MHD): Principle of working of MHD system- Advantage of MHD systems	2	
	Hydrothermal resources-vapour dominated systems-geothermal energy conversion-positive displacement machines	4	
Unit V	Bio-mass: bio-mass conversion technology. Ocean Thermal Energy Conversion	4	PPT, Chalk and talk, Quiz and Interaction
	(OTEC): Introduction-methods of Ocean thermal electricity power generation	2	
	open cycle OTEC system. Wave and Tidal Wave	3	
	Basic Principle of Tidal power-operation methods of utilization of tidal energy-advantage and limitation of tidal power generation.	4	
	utilization of biogas,OTEC Utilization, component of tidal power.	2	

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Discuss about the energy system and resources available in the world	Up to K2
CLO 2	Categorize the thermal storage collection and its application	Up to K4
CLO 3	Apply the real life application and study its uniqueness of wind energy	Up to K3
CLO 4	classify sustainable geothermal application	Up to K4
CLO 5	Compare the design and working principle of the wind, wave and ocean energies	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	2	2	2
CLO2	3		2	3	2
CLO3	3	2	2	3	
CLO4	3		2	2	2
CLO5	3	2	2	3	2

Advance application –3, Intermediate level –2, Basic level–1

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K4	2	K2 & K3	1	K3	2 (K4&K4)	1 (K3)
3	CLO 3	Up to K3	2	K3 & K4	1	K1	2 (K2&K2)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00