MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Physics

Name of the Subject	Renewable Energy Source	Name of the handling Faculty	Dr. S. Vadivelan
Subject Code	OR0551	Year / Sem	III Year / V Sem
Acad Year	2022 - 2023	Batch	2020 - 2024

Course Objective

To get exposure on solar radiation and its environmental impact to power. To know about the various collectors used for storing solar energy.To know about the various applications in solar energy. To learn about the wind energy and biomass and its economic aspects.To know about geothermal energy with other energy sources

Course Outcome

At the end of the course, the students will able to,

CO1 - Gain knowledge to understanding the physics of solar radiation.

CO2 - Acquire knowledge to classify the solar energy collectors and methodologies of storing solar energy

CO3 - Get knowledge in applying solar energy in a useful way.

CO4 - Have the necessary understanding in wind energy and biomass with its economic aspects.

CO5 - Understand the basics in capturing and applying other forms of energy sources like wind, biogas and geothermal Energies.

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I - PRINCIPLES OF SOLAR RADIATION							
1	Introduction	T1 / R2	1	BB	L1	CO1	
2	Role and Potential of new renewable source	T1 / R2	1	BB	L2	CO1	
3	environmental impact of solar power	T1 / R2	1	BB	L2	CO1	
4	physics for sun	T1 / R2	1	BB	L2	CO1	
5	solar constant	T1 / R2	1	BB	L5	CO1	
6	extra terrestrial solar radiation	T1 / R2	1	BB	L3	CO1	
7	terrestrial solar radiation	T1 / R2	1	BB	L3	CO1	
8	solar radiation on tilted surface	T1 / R2	1	BB	L5	CO1	
9	instruments for measuring solar radiation and Sunshine	T1 / R2	1	BB	L5	CO1	
10	solar energy data	T1 / R2	1	BB	L5	CO1	
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any QUIZ							
Evaluation method Marks out of 10							
UNIT II - SOLAR ENERGY COLLECTION							
11	Introduction	T1 / R2	1	PPT	L5	CO2	
12	Flat Plate Collectors	T1 / R2	1	BB	L5	CO2	
13	Concentrating Collectors and its types	T1 / R2	1	BB	L5	CO2	
14	Types of Collectors	T1 / R2	1	BB	L5	CO2	
15	classification of collectors	T1 / R2	1	BB	L4	CO2	
16	Orientation and Thermal Analysis	T1 / R2	1	PPT	L4	CO2	
17	Advanced Collectors	T1 / R2	1	PPT	L2	CO2	
18	Advanced Collectors	T1 / R2	1	PPT	L3	CO2	
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any QUIZ							

Evaluation method Marks out of 10							
UNIT III - SOLAR ENERGY STORAGE AND APPLICATIONS							
19	Introduction, Different methods	T1 / R2	1	PPT	L2	CO3	
20	sennsible, latent heat and startified storage	T1 / R2	1	PPT	L2	CO3	
21	solar ponds	T1 / R2	1	BB	L3	CO3	
22	solar heating techniques	T1 / R2	1	BB	L3	CO3	
23	solar cooling techniques	T1 / R2	1	BB	L3	CO3	
24	solar distillation and drying	T1 / R2	1	BB	L3	CO3	
25	Photovoltaic energy conversion	T1 / R2	1	BB	L5	CO3	
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Assignment							
Evaluation method Marks out of 10							
UNIT IV - WIND ENERGY							
26	Sources and potentials	T1 / R2	1	BB	L1	CO4	
27	Horizontal axis windmills	T1 / R2	1	BB	L3	CO4	
28	performance characteristics	T1 / R2	1	PPT	L5	CO4	
29	vertical axis windmills, types	T1 / R2	1	PPT	L3	CO4	
30	performance characteristics, Betz Criteria	T1 / R2	1	PPT	L5	CO4	
31	BIO_MASS: Principles of Bio-Conversion,	T1 / R2	1	PPT	L1	CO4	
32	Anaerobic/ aerobic digestion, Types of Bio-gas Digesters,	T1 / R2	1	BB	L2	CO4	
33	Gas yield, Combustion, Utilization	T1 / R2	1	PPT	L4	CO4	
34	I.C. Engine Operation	T1 / R2	1	BB	L3	CO4	
35	Economic aspects	T1 / R2	1	BB	L5	CO4	
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any **MODEL DEVELOPED**							
Evaluation method Marks out of 10							
UNIT V - GEOTHERMAL ENERGY							
36	Resources, Types of Wells,	T1 / R2	1	PPT	L1	CO5	
37	Methods of Harnessing, Potential	T1 / R2	1	PPT	L2	CO5	
38	OCEAN ENERGY: OTEC	T1 / R2	1	BB	L1	CO5	
39	Principles, Utilization	T1 / R2	1	BB	L4	CO5	
40	Settings, thermodynamic cycles.	T1 / R2	1	PPT	L3	CO5	
41	TIDAL AND WAVE ENERGY: Potential and Conveersion Techniques	T1 / R2	1	PPT	L2	CO5	
42	Mini- Hydel Power plants	T1 / R2	1	PPT	L3	CO5	
43	economics	T1 / R2	1	PPT	L5	CO5	
44	DIRECT ENERGY CONVERSION: Need for DEC, Carnot Cycle	T1 / R2	1	PPT	L3	CO5	
45	Limitations, Principles of DEC	T1 / R2	1	PPT	L5	CO5	
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Assignment							
Evaluation method Marks out of 10							
Content Beyond the Syllabus Planned							
1	Solar Cookers						

2	Solar heaters, Solar dryers

Text Books

1	Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2	Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

Reference Books

1	Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007
2	Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2004
3	Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003
4	Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010

Website / URL References

1	https://nptel.ac.in/courses/112/105/112105051/
2	https://nptel.ac.in/courses/115/103/115103123/
3	https://www.youtube.com/watch?v=sh4ZjiVlRC4
4	https://www.youtube.com/watch?v=qn5DZ2CQQEs
5	https://www.youtube.com/watch?v=Xsf6RujEB8o

Blooms Level

Level 1 (L1) : Remembering **Level 2 (L2) : Understanding** **Level 3 (L3) : Applying**	Lower Order Thinking	Fixed Hour Exams	**Level 4 (L4) : Analysing** **Level 5 (L5) : Evaluating** **Level 6 (L6) : Creating**	Higher Order Thinking	Projects / Mini Projects

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	PRINCIPLES OF SOLAR RADIATION	1	3	2	-	4	-	6	4	10
Unit 2	SOLAR ENERGY COLLECTION	-	1	1	2	4	-	2	6	8
Unit 3	SOLAR ENERGY STORAGE AND ITS APPLICATIONS	-	2	4	-	1	-	6	1	7
Unit 4	WIND ENERGY	2	1	3	1	3	-	6	4	10
Unit 5	GEOTHERMAL ENERGY	2	2	3	1	2	-	7	3	10
Total		5	9	13	4	14	0	27	18	45
Total Percentage		11.11	20.00	28.89	8.89	31.11	0.00	60.00	40.00	100.00

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	2	-	1	-	-	-	-	2	-	-
CO2	3	3	3	-	2	-	2	-	-	-	-	2	-	-
CO3	3	3	3	-	1	-	2	-	-	-	-	1	-	-
CO4	3	3	2	-	2	-	-	-	-	-	-	2	-	-
CO5	3	3	2	-	2	-	1	-	-	-	-	1	-	-
Avg	3	3	3	-	2	-	2	-	-	-	-	2	-	-

Justification for CO-PO mapping

CO1	Applying the concepts of renewable energy sources strongly (PO1) helps to analyze the potential strongly (PO2). This will help in design and development of solution to some extent (PO3). This may help to know the modern tool usage moderately (PO5). (PO7) gives the knowledge of engineering solutions in society and environment weakly and (PO12) recognizes the need for life-long learning to some extent.
CO2	Applying the fundamentals and applications of solar radiation in Engineering field strongly (PO1) helps in problem analysis to greater extent (PO2). This may help in design and development of solutions strongly (PO3). PO5 attributes to the usage of modern tools to some extent and to assess the health and safety of society as well as environment and sustainable development moderately (PO7). solar radiation collectors may be of some use to know the life-long technological changes in renewable energy devices (PO12).
CO3	Concepts of various solar energy storage and its application attribute to strong Engineering knowledge (PO1). This will help in problem solving (PO2) as well as design and development of solution (PO3) to a greater extent. Developing simple model helps to learn the techniques (PO5) weakly. PO7 helps to understand the impact of solar energy storage to environment to some extent and PO12 recognizes the need for life-long learning weakly.
CO4	While understanding the nature, properties and application of wind energy and biomass energy to strong Engineering knowledge (PO1) is developed. This will help in problem solving (PO2) strongly and design and development of solution (PO3) to some extent. HAWT help in applying appropriate techniques and tools with an understanding of the limitations (PO5) moderately. Bio mass energy may be of some use to know the life-long technological changes (PO12).

CO5	Understand the basics of OTEC, GEOTHERMAL and their applications attributes to strong Engineering knowledge (PO1). This will help in problem solving (PO2) as well as design and development of solution (PO3) to a greater extent. Selecting suitable algorithm helps in learning the commercial (PO5) to some extent. PO7 gives the knowledge of engineering solutions in society and environment moderately. PO12 recognizes the need for life-long learning to some extent.

3	**High level**	**2**	**Moderate level**	**1**	Low level

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Format No :231