



## University of Kerala

Discipline	<b>PHYSICS</b>				
Course Code	<b>UK1MDCPHY102</b>				
Course Title	<b>GREEN ENERGY</b>				
Type of Course	<b>MDC</b>				
Semester	<b>I</b>				
Academic Level	<b>100 - 199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	<p>The course provides a comprehensive understanding of work, energy, and power fundamentals. It includes various forms of energy such as renewable and conventional systems like coal, oil and natural gas. It explores the impact of non-conventional energy sources on global warming and examines approaches to energy conservation and governmental policies. Moreover, this course also covers specific renewable energy sources like solar, wind, hydro, tidal, and wave energy. The course touches upon other energy sources, storage methods and provides a broad overview of energy systems and technologies.</p>				

### BOOKS FOR STUDY:

1. Energy Technology: S. Rao and Dr. B.B. Parulekar, Third edition, 2009.
2. Alternative Energy Resources, Green Energy and Technology, Efsthios E. (Stathis) Michaelides, Springer, 2012, DOI 10.1007/978-3-642-20951-2.
3. Non-Conventional Energy Sources, Sri. Shali Habibulla, State Institute of Vocational Education Directorate of Intermediate Education Govt. of Andhra Pradesh, Hyderabad, 2005.

4. Non-Conventional Energy Resources: G. D. Rai, Khanna Publishers, 2008.
5. Solar Energy Fundamentals and application: H.P. Garg and J. Prakash, Tata McGraw - Hill Publishing company Ltd., 1997.

**BOOKS FOR REFERENCE:**

1. Power Plant Technology: A. K. Wahil. 1993.
2. Solar energy: S. P. Sukhatme, Tata McGraw- Hill Publishing company Ltd.,1997.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 2004, Oxford University Press, in association with The Open University.
4. Solar Energy: Resource Assessment Handbook, Dr. P Jayakumar, 2009.
5. Wave and Tidal Energy Editor(s): Deborah Greaves, Gregorio Iglesias, First published:23 March 2018, DOI:10.1002/9781119014492, 2018 John Wiley & Sons Ltd.
6. Renewable Energy Resources: John Twidell and Tony Weir, Routledge Publishers ISBN: 978-1138782841.
7. Solar energy: G.D. Rai, Fifth edition, 1995.
8. Renewable Energy: Sources and Methods, Anne Elizabeth Maczulak, 2010.

**DETAILED SYLLABUS: THEORY**

Module	Unit	Content	Hrs	CO No
<b>I</b>	<b>INTRODUCTION</b> (Book 1 Chapter 2, Book 2 Chapter 1, Book 3, Chapter 1)		<b>9</b>	
	1	Fundamentals of Work, Energy and Power	1	1
	2	Various Forms of Energy - Renewable and Conventional energy Systems - Comparison - Coal, Oil and Natural Gas – Availability - Applications – Merits and demerits	2	1
	3	Impact Due to Non-Conventional Energy Sources – Global Warming	3	1
	4	Approaches to Energy Conservation - Energy Conservation Policies of Different Governmental Bodies	3	1
<b>II</b>	<b>SOLAR ENERGY</b> (Book 1 Chapter 4, Book 3 Chapter 2)		<b>9</b>	
	5	Solar Radiation Measurements (qualitative only), Solar Energy Collector, Principles of the Conversion of Solar Radiation into Heat	3	2

	6	Classification of Different Types of Solar Energy Collectors (qualitative ideas only) - Merits and Demerits	3	2
	7	Solar Energy Storage, Solar Heaters, Solar Cookers, Solar Green Houses	1	2
	8	Merits and Demerits of Solar Energy, Solar Cell Technology (basic principle only)	2	2
	<b>WIND ENERGY</b> <b>(Book 1 Chapter 8,9, Book 2 Chapter 8, Book 3 Chapter 3)</b>		<b>9</b>	
<b>III</b>	9	Basic Principles of Wind Energy Conversion, Merits and Demerits	3	3
	10	Basic Components of Wind Energy Conversion System	3	3
	11	Policies Related to Wind Energy in India, Applications of Wind Energy.	3	3
	<b>HYDRO, TIDAL AND WAVE ENERGY</b> <b>(Book 1 Chapter 18, Book 3 Chapter 5)</b>		<b>9</b>	
<b>IV</b>	12	Hydro-Resources, Hydro-Project- Types and Hydro-Conversion Technologies	2	4
	13	Tidal Resource, Tidal Power Conversion	3	4
	14	Wave Resource, Wave Energy Conversion	3	4
	15	Challenges to Sustainability	1	4
	<b>OTHER SOURCES OF ENERGY AND STORAGE</b> <b>(Book 1 Chapter 19, 20, Book 2 Chapter 12)</b>		<b>9</b>	
<b>V*</b>	16	Piezoelectric Energy Harvesting – Physics and Characteristics of Piezoelectric Effect, Piezoelectric Energy Applications	2	5
	17	Electromagnetic Energy Harvesting	2	5
	18	Oceans and Chemical Energy Resources	2	5
	19	Energy Storages - Primary and Secondary Cells –Fuel Cells (basics)	3	5

**COURSE OUTCOMES**

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identifying various forms of energy and the impacts of Non-Conventional Energy Sources	R, U	PSO-3,4,7
CO-2	Explain the principles conversion of solar energy into heat and classify various types of solar energy collectors	R, U	PSO-3,4,7
CO-3	Explain the principles of wind energy conversion and discuss the policies related to wind energy in India	R,U	PSO-3,4,7
CO-4	Explain the fundamental principles hydro resources and challenges to sustainability	R, U	PSO-3,4,7
CO-5	Differentiate between piezoelectric and electromagnetic energy harvesting methods	R,U	PSO-3,4,7

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: GREEN ENERGY**

**Credits: 3:0:0 (Lecture: Tutorial: Practical)**

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identifying various forms of energy and the impacts of Non-Conventional Energy Sources	PO-1,2 /PSO-3,4,7	R, U	F, C	L	-
CO-2	Explain the principles conversion of solar energy into heat and classify various types of solar energy collectors	PO-1,2 /PSO-3,4,7	U	C	L	-

CO-3	Explain the principles of wind energy conversion and discuss the policies related to wind energy in India	PO-1,2 /PSO-3,4,7	U	C	L	-
CO-4	Explain the fundamental principles hydro resources and challenges to sustainability	PO-1,2 /PSO-3,4,7	R, U	F, C	L	-
CO-5	Differentiate between piezoelectric and electromagnetic energy harvesting methods	PO-1,2 /PSO-3,4,7	U	F, C	L	-

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs :**

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-2	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-3	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-4	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-5	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-

**Correlation Levels:**

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	-	-	-	✓
CO-3	✓	✓	-	✓
CO-4	-	-	-	✓
CO-5	✓	✓	-	-