

BMEE205E	Renewable Energy Systems	L	T	P	C
		2	0	2	3
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To help students gain essential knowledge on the importance of various renewable energy sources. 2. To familiarize the students with principles of energy conversion for various renewable energy sources. 3. To understand the method for assessment of various input energy resources for meeting specific requirements. 4. To know limitations in renewable energy conversion techniques. 5. To do practical experiments for energy resource performance under different operating conditions. 					
Course Outcomes					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> 1. Outline the current energy scenario and its needs towards the renewable energy sector. 2. Demonstrate the various components of solar thermal energy systems. 3. Analyse the nuances of solar PV systems to assess their performance. 4. Analyse the wind, hydel, ocean and geothermal energy systems to assess their performance. 5. Perform the design and analysis of various bio-energy systems. 6. Summarize various hybrid energy systems to solve real world problems. 7. Conduct experiments, interpret the data, and analyse the performance of various renewable energy systems. 					
Module:1	Energy Source and its Scenario	3 hours			
Energy chain and common forms of usable energy - Present energy scenario - World and Indian energy status - Introduction to renewable energy resources – Need for Renewable energy sources – Renewable energy potentials – Indian and global renewable energy scenario. Energy Trilemma index of the World Energy Council.					
Module:2	Solar Thermal Energy Systems	5 hours			
Introduction to thermal systems and applications - Solar thermal collectors - Flat plate collectors - Evacuated tube collectors - Compound parabolic collectors - Solar air heaters - Solar dryers -solar cookers - solar stills - Solar ponds - Concentrating collectors – Thermal energy storage – Phase change materials.					
Module:3	Solar Photovoltaic Systems	5 hours			
Introduction to Solar Energy - Spectral distribution of Solar radiation – Resource assessments -Instruments for measurement of solar radiation - Solar radiation data analysis - Physics of solar cells - Cell and module – third generation solar cells - Manufacturing and fabrication Process– Characteristics of cells and module - Performance parameters – Balance of systems- PV System applications - Stand-alone - Grid connected systems – integrated PV systems – High performance solar cells – Energy storage systems – Battery Analysis.					
Module:4	Wind Energy Systems	4 hours			
Fundamentals of wind energy – Resource assessment - measurement of wind energy parameters – types of wind turbines - selection of components - blade materials - power regulation - various methods of control - wind farms - site selection - offshore wind farms - Solar Wind Hybrid energy systems.					
Module:5	Hydel, Ocean, Geothermal Energy Systems	4 hours			
Small hydro systems – Introduction – Resource Assessment – Estimation of Power potential – Types – Components – Performance. Ocean Energy Systems - Introduction - Resource Assessment - Power generation through					

OTEC systems - Energy through waves and tides – Geothermal energy systems.			
Module:6	Bio Energy Systems	4 hours	
Need of Bio Energy - Resource Assessment - Fermentation - Gasification - Pyrolysis – Power generation technique - Biofuels Production.			
Module:7	Hybrid Energy Systems	3 hours	
Energy systems for processes and power applications – solar – wind – Biomass hybrid technologies, Solar – Fuel cell hybrid systems – Hydrogen generation technologies.			
Module:8	Contemporary Issues	2 hours	
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Fang Lin You, Hong ye, Renewable Energy Systems, 2017, 3 rd Edition, Advanced conversion technologies and applications, CRC Press, ISBN: 978-1138077584.		
2.	BH Khan, Non-conventional Energy Sources, 2017, 3 rd Edition, Tata- Mc. Graw Hill Publications. ISBN-13:978-0070142763.		
Reference Books			
1.	John Andrews, Nick Jelley Energy Science: Principles, technologies and impacts, 2017, Oxford Universities press. ISBN: 978-0198755814.		
2.	Ziyad Salameh, Renewable Energy Systems Design, 2014, 1 st Edition, Academic Press, ISBN: 978-0123749918.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT.			
Indicative Experiments			
1.	Solar Radiation measurement by Pyranometer, Pyrheliometer, Albedo meter		
2.	I-V curves of a solar PV module for different operating conditions using PV training Kit.		
3.	Performance characteristics of a Solar liquid flat plate collector		
4.	Determination of power curve using Wind Energy Experimental Set up		
5.	Performance Variation of Tip speed ratio v/s Cp of Wind Energy Generator using Wind Energy Generator Experimental Set up.		
6.	Performance of Proton Exchange Fuel Cell by Experimental simulation		
7.	Performance estimation of a household Biomass stove using briquette		
8.	Evaluation of Property measurements of different biofuels.		
9.	Simulation of hybrid energy systems using software tools		
10.	Performance characteristics of a Solar Air heating systems		
11.	Performance characteristics of a Solar stills		
12.	Study experiment based on renewable energy sources.		
			Total Laboratory Hours
			30 hours
Textbook			
Lab Manual prepared by the Faculty member			
Mode of assessment: Continuous assessment, FAT, Oral Examination			
Recommended by Board of Studies		09-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022