Sri Krishna Institute of Technology, Bangalore

COURSE PLAN

Academic Year 2019

Program:	BE-Electrical and Electronics Engineering
Semester:	5
Course Code:	17EE563
Course Title:	Renewable Energy Resources
Credit/L-T-P:	3/3-0-0
Total Contact Hours:	40
Course plan Author:	Chaitra A S

Academic Evaluation and Monitoring Cell

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Table of Contents

17EE563 : Renewable Energy Resources

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Year / Semester :	2019/5	Academic Year:	2019
Course Title:	RENEWABLE ENERGY RESOURCES	Course Code:	17EE563
Credit / L-T-P:	3-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	40	SEE Marks:	60 Marks
CIA Marks:	40	Assignment	1 / Module
Course Plan Author	CHAITRA A S	Sign	Dt:
Checked By:		Sign	Dt:

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	**Introduction:** Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. **Energy from Sun:** Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications.	8	Energy Resources Solar Energy	L2, L3
2	**Solar Thermal Energy Collectors:** Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond. **Solar Cells:** Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems**.**	8	Solar Energy Collection Solar Cell	L3,L4
3	**Hydrogen Energy:** Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. **Wind Energy:** Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. **Geothermal Energy:** Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects. **Solid waste and Agricultural Refuse:** Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics.	8	Hydrogen Production Technologies Wind Resources Energy production from Geothermal and from waste.	L2, L2,L4
4	**Biomass Energy:**Biomass Production, Energy Plantation,Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers,	8	Energy Production from biogas and biomass	L4,L3

	Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers. **Biogas Energy:** Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics. **Tidal Energy:**Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy.		Tidal Power generation	
5	**Sea Wave Energy:**Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. **Ocean Thermal Energy:** Introduction,Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC.	8	Wave Energy Ocean Thermal Energy conversion.	L3,L2

3. Course Material

Module	Details	Available
1	Text books	
	Non conventional Energy Resources, ShobhNath Singh, Pearson 1 st Edition, 2015	In Lib
2	Reference books	
	Non conventional Energy Resources,B.H. Khan,McGraw Hill 3 rd Edition.	In dept
	Renewable Energy Power for a sustainable Future,Godfrey Boyle,Oxford,3 rd Edition, 2012.	
	Renewable Energy Sources: Their Impact on global Warming and Pollution, TasneemAbbasi S.A. Abbasi,PHI, 1 st Edition, 2011	1
3	Others (Web, Video, Simulation, Notes etc.)	
		Not Available

4. Course Prerequisites

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	15EE42	Power Generation and Economics	Operation of hydroelectric, steam, diesel, gas turbine and nuclear power plants.	4		L2

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

#	COs	Teach.	Concept	Instr	Assessmen	Blooms'

		Hours		Method	t Method	Level
17EE563.1	Understanding the various renewable energy resources, availability,its applications and conversion methods.	04	Energy Resources	Lecture	unit Test and Assignment	L2
17EE563.2	Explain about the basics of solar energy. Derive and analyze the solar angles used in power calculations to maximize photo voltaic power generation	04	Solar Energy	Lecture	unit Test and Assignment	L3
17EE563.3	Comparing the various collectors used in power generation and analyzing the strength and weakness of solar thermal energy conversion.	7	Solar Energy Collection	Lecture	unit Test and Assignment	L4
17EE563.4	Understanding about the solar cell system, equivalent circuit model and calculation of output power and efficiency and analyzing the characteristics.	05	Solar Cell	Lecture / PPT	unit Test and Assignment	L3
17EE563.5	Describing about the hydrogen production technologies and storage methods.	06	Hydrogen Production Technologies	Lecture	unit Test and Assignment	L2
17EE563.6	Discuss about the technologies used for power generation and how to reuse and reduce the waste.	06	Energy production from Geothermal and from waste	Lecture / PPT	unit Test and Assignment	L2
17EE563.7	Analyzing the mathematical model for extraction of energy from wind and discussing about the Wind energy scenario,site selection and classification.	05	Wind Resources	Lecture	unit Test and Assignment	L4
17EE563.8	Explaining about the types of biogas plants and biomass gasifiers and applications.	06	Energy Production from biogas and biomass	Lecture	unit Test and Assignment	L4
17EE563.9	Understanding about the tidal power generation and calculation of tidal power and harnessing the tidal energy	05	Tidal Power Generation	Lecture	unit Test and Assignment	L3
17EE563.10	Understanding about the devices used foe harnessing wave energy and deriving an expression for power.	05	Wave Energy	Lecture	unit Test and Assignment	L3
17EE563.11	Understanding about the principles of ocean thermal energy conversion and production of electricity	05	Ocean Thermal energy	Lecture / PPT	unit Test and Assignment	L2
-	**Total**	**58**	-	-	-	-

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Generating electricity, hot water heating, solar cooling, crop drying and a variety of commercial and industrial uses.	CO1	L2
2	Solar thermal energy applications – space heating, domestic and industrial hot water, pool heating, solar cooking, crop drying	CO2	L3
3	Solar Water heating systems, solar dryers, crop dryers, solar cookers,solar space heating systems	CO3	L4

4	Solar Water pumps, solar vehicle, solar panels, remote lightning systems, rural electrification , electric fences, water treatment systems etc	CO4	L3
5	At home sector, work sector, transport and industrial sectors.	CO5	L2
6	Geothermal energy is used in industries, agriculture, food processing and providing heat for residential use. Waste- Reducing or eliminating adverse impacts on the environment through reducing, reusing and recycling, and minimizing resource extraction can result in improved air and water quality and help in the reduction of greenhouse gas emissions.	CO6	L2
7	Wind energy can be used to generate electricity,which can be used: To pump water to higher level, To lift the load, To lighting purpose, For many other purposes.	CO7	L4
8	Gasifier products are used to provide shaft power to industrial and agricultural equipment and machinery such as water pumps, running of high efficiency stirling engines, tractors, power generation, drying of agricultural crop, and food products. Biogas can be used for any heating purpose, such as cooking. It can also be used for electricity generation.	CO8	L4
9	Tidal power, also called tidal energy, is a form of hydro power that converts the energy of tides into useful forms of power	CO9	L3
10	Sea Wave energy technologies can have applications across desalination, coastal erosion and power generation.	CO10	L3
11	Ocean thermal energy conversion plant is used for production of electricity, hydrogen production,Aquaculture, air conditioning.	CO11	L2

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	Level
17EE563.1	Understanding the various renewable energy resources, availability,its applications and conversion methods.	2	3				2	2		2				L2
17EE563.2	Explain about the basics of solar energy. Derive and analyze the solar angles used in power calculations to maximize photo voltaic power generation	2	3				2	2		3				L3
17EE563.3	Comparing the various collectors used in power generation and analyzing the strength and weakness of solar thermal energy conversion.	2	2											L4
15EE56.4	Understanding about the solar cell system, equivalent circuit model and calculation of output power and efficiency and analyzing the characteristics.	2	2				2	3		2				L3
15EE56.5	Describing about the hydrogen production technologies and storage methods.	2	2											L2
15EE56.6	Discuss about the technologies used for power generation and how to reuse and reduce the waste.	2	2											L2
15EE56.7	Analyzing the mathematical model for extraction of energy from wind and discussing about the Wind energy scenario,site selection and classification.	2	2											L4
15EE56.8	Explaining about the types of	2	2				2	3						L4

	biogas plants and biomass gasifiers and applications.													
15EE56.9	Understanding about the tidal power generation and calculation of tidal power and harnessing the tidal energy	2	2											L3
15EE56.10	Understanding about the devices used foe harnessing wave energy and deriving an expression for power.	2	2				3	2						L3
15EE56.11	Understanding about the principles of ocean thermal energy conversion and production of electricity	2	2				2	2						L2
CS501PC.	Average													
Note: Mention the mapping strength as 1, 2, or 3														

4. Mapping Justification

Mapping		Justification	Mapping Level
CO	**PO**	**-**	**-**
CO1	PO1	Knowledge on the energy resources and conversion methods for production of electricity	L2
CO1	PO2	Identify the conversion methods and analyze the working of conversion methods for production of electricity	L2
CO1	PO6	Non conventional energy resources from sun, earth and sea have risen to the challenge of meeting the increasing energy demands of the present and future generations.	L2
CO1	PO7	Non conventional energy resources from sun, earth and sea have risen to the challenge of meeting the increasing energy demands of the present and future generations.	L2
CO1	PO9	Projects or internship on Solar Power Generation Based on Light Intensity	L2
CO2	PO1	Knowledge on the basics of solar energy	L2
CO2	PO2	Analyze the solar angles which is used in power calculations to maximize photo voltaic power generation.	L3
CO2	PO6	As global demand for energy is increasing and conventional energy resources becoming costly to extract, imparting knowledge to make use of the energy obtained from sun as it is renewable energy.	L3
CO2	PO7	As global demand for energy is increasing and conventional energy resources becoming costly to extract, imparting knowledge to make use of the energy obtained from sun as it is renewable energy.	L3
CO2	PO9	Projects or internship on Solar Power Generation Based on Light Intensity	L3
CO3	PO1	Knowledge on various solar collectors that are being marketed to utilize thermal energy from sun.	L4
CO3	PO2	Identify the types of solar collectors that can be used in variety of applications like space heating, space cooling, water heating, solar electricity generation and analyze the strength and weakness of solar thermal energy conversion.	L4
CO4	PO1	Knowledge on the basics of solar Cell	L3
CO4	PO2	Analyzing the important factors that need careful attention in the design of solar cell and analyzing the performance of solar cell.	L3
CO4	PO6	Photo voltaic panels convert sunlight to electricity that can be used to supplement or replace the electricity supplied by the utility grid.	L3
CO4	PO7	Photo voltaic panels convert sunlight to electricity that can be used to supplement or replace the electricity supplied by the utility grid.	L3
CO4	PO9	Projects or internship on Solar Power Generation Based on Light	L3

		Intensity	
CO5	PO1	Knowledge on hydrogen energy	L2
CO5	PO2	Identifying the techniques for hydrogen production and analyzing the processes for producing hydrogen	L2
CO6	PO1	Knowledge on geothermal energy and resource utilization	L2
CO6	PO2	Identifying the techniques for electric power generation and analyzing the operation of geothermal plants	L2
CO7	PO1	Knowledge on wind energy	L2
CO7	PO2	Analyzing the guidelines to be followed for site selection for installation of wind turbine.	L2
CO8	PO1	Knowledge on biomass energy	L4
CO8	PO2	Identifying the different methods for biomass production and analyzing the process of gasification.	L4
CO8	PO6	Biomass is used for heating, electric power generation, and combined heat and power.	L4
CO8	PO7	Biomass is used for heating, electric power generation, and combined heat and power.	
CO9	PO1	Knowledge on tidal energy resources	L3
CO9	PO2	Analyzing the tidal basin systems for harnessing the tidal energy	L3
CO10	PO1	Knowledge on sea wave energy	L3
CO10	PO2	Identifying the basic technologies for converting wave energy to electricity and analyzing the operation of devices used for harnessing wave energy	L3
CO10	PO6	Sea waves have high energy densities and provide consistent stream of electricity generation.	L3
CO10	PO7	Clean source of renewable energy, no greenhouse gas emissions.	L3
CO11	PO1	Knowledge on ocean thermal energy conversion	L2
CO11	PO2	Analyzing the working of different types of Ocean thermal energy conversion power plants	L2
CO11	PO6	OTEC is fuel free, low environment impact, supply pure water for both drinking and agriculture and can provide a coastal community with reliable energy etc	L2
CO11	PO7	Clean, renewable energy resource available in plenty and has no environment problem and green house effects. Good source of freshwater and portable water	L2

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Mod	Title	Teaching	No. of question in Exam	CO	Levels

ule #		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction Energy from Sun	8	2	-	-	1	1	2	CO1, CO2	L2, L3
2	Solar Thermal Energy Collectors Solar Cells	12	2	-	-	1	1	2	CO3, CO4	L4 L3
3	Hydrogen Energy Wind Energy Geothermal Energy Solid waste and Agricultural Refuse	17	-	2	-	1	1	2	CO5, CO6, CO7	L2, L2 L4
4	Biomass Energy Biogas Energy Tidal Energy	11	-	2	-	1	1	2	CO8, Co9	L4 L3
5	Sea Wave Energy Ocean Thermal Energy	10	-	-	4	1	1	2	CO10, CO11	L3,L2
-	**Total**	**58**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	30	CO1, CO2, CO3, CO4	L2, L3, L4 L3
CIA Exam – 2	30	CO5, CO6, CO7, C08,C09	L2, L2 L4 L4,L3
CIA Exam – 3	30	CO10,CO11	L3 L2
Assignment - 1	05	CO1, CO2, CO3, CO4	L2, L3, L4 L3
Assignment - 2	05	CO5, CO6, CO7, C08,C09	L2, L2 L4 L4,L3
Assignment - 3	05	CO9, CO10	L3 L2
Final CIA Marks	**40**	**-**	**-**

Note : Blooms Level in last column shall match with A.2 above.

D1. TEACHING PLAN - 1

Module - 1

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understanding the various renewable energy resources, availability,its applications and conversion methods.	CO1	L2
2	Explain about the basics of solar energy. Derive and analyze the solar angles used in power calculations to maximize photo voltaic power generation	CO2	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Causes of Energy Scarcity, Solution to Energy Scarcity,	C01	L2
2	Energy Resources and Classification	C01	L2
3	Renewable Energy – Worldwide Renewable Energy Availability	C01	L2
4	Renewable Energy in India. Factors Affecting Energy Resource Development	C01	L2
5	Sun- earth Geometric Relationship, Layer of the Sun	CO2	L3
6	Earth – Sun Angles and their Relationships,	CO2	L3
7	Solar Energy Reaching the Earth's Surface,	CO2	L3
8	Solar Thermal Energy Applications.	CO2	L3
c	**Application Areas**	**CO**	**Level**
1	Generating electricity, hot water heating, solar cooling, crop drying and a variety of commercial and industrial uses.	CO1	L2

2	Solar thermal energy applications – space heating, domestic and industrial hot water, pool heating, solar cooking, crop drying.	CO2	L3
d	**Review Questions**	-	-
1	Discuss the causes of energy scarcity futher mention factors to be considered for solving energy crunch problems	CO1	L2
2	Define and explain the term energy resources. Discuss different ways of there classifications. Mention atleast two energy resources in each category	CO1	L2
3	Discuss about the renewable energy availability in world wide and INDIA.	CO1	L2
4	Explain the factors affecting energy resource development.	CO1	L2
5	How much energy actually reaches the earth surface from the sun	CO2	L3
6	With a neat diagram explain the layers of sun	CO2	L3
7	Classify the methods of solar energy storage.	CO2	L3
8	Explain basic Rankine cycle used with solar thermal power plant	CO2	L3
9	Define the following terms; altitude angle, incident angle, zenith angle, solar azimuth angle, latitude angle, declination angle and hour angle	CO2	L3
10	State and explain the terms solar time and solar insulation	CO2	L3
11	Write a short notes on beam and diffuse radiation, solar constant.	CO1	L3
e	**Experiences**	-	-
1		CO1	L2
2			

Module – 2

Title:	Divide and Conquer	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Comparing the various collectors used in power generation and analyzing the strength and weakness of solar thermal energy conversion.	CO3	L4
2	Understanding about the solar cell system, equivalent circuit model and calculation of output power and efficiency and analyzing the characteristics.	CO4	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
9	Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors,	CO3	L4
10	Concentrating Collectors	CO3	L4
11	Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine	CO3	L4
12	Solar Collector Systems into Building Services, Solar Water Heating Systems,Passive Solar Water	CO3	L4

	Heating Systems,		
13	Applications of Solar Water Heating Systems,Active Solar Space Cooling, Solar Air Heating	CO3	L4
14	Active Solar Space Cooling, Solar Air Heating,Solar Dryers, Crop Drying, Space Cooing.	CO3	L4
15	Solar Cookers, Solar pond.	CO3	L4
16	Components of Solar Cell System, Elements of Silicon Solar Cell,	CO4	L3
17	Solar Cell materials, Practical Solar Cells,	CO4	L3
18	Equivalent Circuit, I – V Characteristics of Solar Cells,	CO4	L4
19	Efficiency of Solar Cells, Photo-voltaic Panels, Problems	CO4	L4
20	Applications of Solar Cell Systems.	CO4	L3
c	**Application Areas**	**CO**	**Level**
1	Solar Water heating systems, solar dryers, crop dryers, solar cookers,solar space heating systems	CO3	L4
2	Solar Water pumps, solar vehicle, solar panels, remote lightning systems, rural electrification , electric fences, water treatment systems etc	CO4	L3
d	**Review Questions**	-	-
12	What are solar collectors. Give there classifications and compare them based on the construction and area of applications	CO3	L4
13	With neat sketches discuss important parts of any flat plate solar collectors. Futher discuss the material aspects of individual parts	CO3	L4
14	With a neat sketch explain how the solar energy is harnest through solar ponds	CO3	L4
15	Discuss the different methods of sun tracking	CO3	L4
16	Explain the working of heliostat electric generating plant with a neat sketch	CO3	L4
17	Discuss about the solar water heating systems	CO3	L4
18	State applications of solar Photo-voltaic systems	CO4	L3
19	What are the main elements of Photo-voltaic systems	CO4	L3
20	Draw and explain electrical equivalent circuit model of a solar cell. Starting with the assumptions made, if any, derive and draw I-V characteristic of solar cell. Further, obtain an expression for the external load voltage that gives maximum cell output power.	CO4	L4
21	Explain the term fill factor and its importance as a performance parameter for a solar cell	CO4	L4
22	Explain the factors limiting the efficiency of solar cell	CO4	L3
23	Discuss about the photo voltaic panels.	CO4	L3
e	**Experiences**	-	-
1		CO1	L2
2			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	17EE563	Sem:	5	Marks:	30	Time:	75 minutes		
Course:	Renewable energy resources								
-	**-**	**Note: Answer any 3 questions, each carry equal marks.**					**Marks**	**CO**	**Level**
1	a	Discuss the causes of energy scarcity futher mention factors to be considered for solving energy crunch problems.					7	CO1	L2
	b	For a typical photovoltaic cell. The following performance parameeerts are obtained from the I-V characteristics open circuit voltage= 0.611, short circuit curent= 2.75, voltage corresponding to cell maximum power output=0.5, current corresponding to cell maximum power output=2.59, calcuate fill factor of the cell					8	CO4	L3
2	a	With neat sketches discuss important parts of any flat plate solar collectors. Futher discuss the material aspects of individual parts					7	CO3	L2
	b	Draw and explain electrical equivalent circuit model of a solar cell. Starting with the assumptions made, if any, derive and draw I-V characteristic of solar cell. Further, obtain an expression for the external load voltage that gives maximum cell output power.					8	CO4	L4
3	a	With a neat sketch explain how the solar energy is harnessed through solar ponds.					7	CO3	L2
	b	With a neat diagram explain the layers of sun.					8	CO4	L2
4	a	Discuss about the solar water heating systems.					7	CO3	L2
	b	Classify the methods of solar energy storage.					8	CO3	L2

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions									
Crs Code:	17EE563	Sem:	I	Marks:	5 / 10	Time:	90 – 120 minutes		
Course:	Renewable Energy Resources								
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.									
SNo	**USN**	**Assignment Description**					**Marks**	**CO**	**Level**
1	1KT16EE001 1KT14EE030	Discuss about the renewable energy availability in world wide and INDIA.					5	CO1	L2
2	1KT16EE001 1KT14EE030	Discuss the process of energy scarcity futher mention factors to be considered for solving energy crunch problems					5	CO2	L3
3	1KT16EE003	Define and explain the term energy resources. Discuss different ways of there classifications. Mention atleast two energy resources in each category					5	CO2	L4
4	1KT16EE003	How much energy actually reaches the earth surface from the sun.					5	CO1	L3
5	1KT16EE004	State and explain the terms solar time and solar constant					5	CO2	L3
6	1KT16EE004 1KT14EE034	Write a short notes on beam and diffuse radiation					5	CO2	L3
7	1KT16EE006 1KT14EE034	Define the following terms; altitude angle, incident angle, zenith angle					5	CO2	L3
8	1KT16EE006 1KT15EE011	Define the following terms:solar azimuth angle, latitude angle, declination angle and hour angle					5	CO2	L3
9	1KT16EE007 1KT15EE011	Explain basic Rankine cycle used with solar thermal power plant					5	CO2	L3
10	1KT16EE007	Classify the methods of solar energy storage.					5	CO2	L3

	1KT15EE013				
11	1KT16EE011 1KT15EE013	With a neat diagram explain the layers of sun	5	CO2	L3
12	1KT16EE011 1KT15EE015	What are solar collectors. Give there classifications and compare them based on the construction and area of applications	5	CO3	L4
13	1KT16EE013 1KT15EE015	With neat sketches discuss important parts of any flat plate solar collectors. Futher discuss the material aspects of individual parts	5	CO3	L4
14	1KT16EE013	With a neat sketch explain how the solar energy is harnessed through solar ponds	5	CO3	L4
15	1KT16EE014 1KT15EE017	Discuss the different methods of sun tracking	5	CO3	L4
16	1KT16EE014 1KT15EE017	Explain the working of heliostat electric generating plant with a neat sketch.	5	CO3	L4
17	1KT16EE016	Discuss about the solar water heating systems.	5	CO3	L4
18	1KT16EE016	With a neat sketch explain active solar space cooling	5	CO3	L4
19	1KT16EE017	With a neat sketches explain rice solar and rock bed dryers		CO3	L4
20	1KT16EE017 1KT16EE402	Discuss different types of solar cookers.	5	CO3	L4
21	1KT16EE020 1KT16EE402	State applications of solar PV systems	5	CO4	L3
22	1KT16EE020 1KT16EE404	What are the main elements of PV systems	5	CO4	L3
23	1KT16EE021 1KT16EE404	Draw and explain electrical equivalent circuit model of a solar cell. Starting with the assumptions made, if any, derive and draw I-V characteristic of solar cell. Further, obtain an expression for tge external load voltage that gives maximum cell output power.	5	CO4	L3
24	1KT16EE021 1KT16EE410	Explain the term fill factor and its importance as a performance parameter for a solar cell	5	CO4	L3
25	1KT16EE023	Explain the factors limiting the efficiency of solar cell	5	CO4	L3
26	1KT16EE023	Discuss about the photo voltaic panels.	5	CO4	L3
27	1KT16EE025	Write a short notes on efficiency of solar cell		CO4	L3
28	1KT16EE025	Discuss about the configurations of practical solar thermal collectors	5	CO3	L4
29	1KT16EE026	With a neat sketch explain fresnel solar thermal collector	5	CO3	L4
30	1KT16EE005	With a neat sketch explain parabolic dish systems	5	CO3	L4
31	1KT16EE005	With a neat sketch explain heliostat field solar collector	5	CO3	L4
32	1KT16EE019	Explain parabolic dish stirling engine system	5	CO3	L4
33	1KT16EE019	With a neat sketch explain working of stirling or brayton heat engine	5	CO3	L4

D2. TEACHING PLAN - 2

Module – 3

Title:	Divide and Conquer	Appr Time:	16 Hrs

a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Describing about the hydrogen production technologies and storage methods.	CO5	L2
2	Discuss about the technologies used for power generation and how to reuse and reduce the waste.	CO6	L3
3	Analyzing the mathematical model for extraction of energy from wind and discussing about the Wind energy scenario,site selection and classification.	C07	L4
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
21	Hydrogen Energy Benefits of Hydrogen Energy, Hydrogen Production Technologies.	CO5	L2
22	Hydrogen Production Technologies	CO5	L2
23	Hydrogen Production Technologies	CO5	L2
24	Hydrogen Energy Storage	CO5	L2
25	Use of Hydrogen Energy,Advantages and Disadvantages of Hydrogen Energy	CO5	L2
26	Problems Associated with Hydrogen Energy, Applications.	CO5	L2
27	Geothermal Systems, Classifications	CO6	L2
28	Geothermal Resource Utilization, Resource Exploration	CO6	L2
29	Geothermal Based Electric Power Generation	CO6	L2
30	Geothermal Based Electric Power Generation	CO6	L2
31	Associated Problems and environmental effects	CO6	L2
32	Waste is Wealth,	CO6	L2
33	Key Issues, Waste Recovery Management Scheme, Sources and Types of Waste	CO6	L2
34	Advantages and Disadvantages of Waste Recycling,	CO6	L2
35	Recycling of Plastics.	CO6	L2
36	Wind Resources, Energy availability in the wind	CO7	L4
37	Site Selection,Guidelines, Classifications and description of wind machines	CO7	L4
		CO7	L4
c	**Application Areas**	**CO**	**Level**
1	At home sector, work sector, transport and industrial sectors.	CO5	L2
2	Geothermal energy is used in industries, agriculture, food processing and providing heat for residential use. Waste- Reducing or eliminating adverse impacts on the environment through reducing, reusing and recycling, and minimizing resource extraction can result in improved air and water quality and help in the reduction of greenhouse gas emissions.	CO6	L2
3	Wind energy can be used to generate electricity,which can be used: To pump water to higher level, To lift the load, To lighting purpose, For many other purposes.	CO7	L4
d	**Review Questions**	-	-
1	What is hydrogen energy?	CO5	L2
2	Dicuss the benefits of hydrogen energy	CO5	L2
3	State and explain methods of hydrogen production technologies	CO5	L2
4	Discuss the applications, advantages and disadvantages of hydrogen energy	CO5	L2
5	Mention the problems associated with the development and application	CO5	L2

	of hydrogen energy		
6	With a neat sketch explain single flash geothermal steam electric power plant.	CO6	L2
7	Discuss about the extensive use of geothermal energy	CO6	L2
8	With a neat sketch explain binary cycle based geothermal electric power plant	CO6	L2
9	Briefly discuss the environmental effects of geothermal energy	CO6	L2
10	Explain the role of incineration, pyrolysis, and composting in solid waste management.	CO6	L2
11	What are solid wastes? Also discuss main sources of solid wastes.	CO6	L2
12	State the advantages and disadvantages of waste recycling	CO6	L2
13	Derive the expression for power developed due to wind	CO7	L4
14	Describe the main considerations in selecting a site for wind generators	CO7	L4
15	Describe a darrieus rotot wind turbine generator unit	CO7	L4
16	Mathematical model of extraction of energy from the wind.	CO7	L4
e	**Experiences**	-	-
1		CO1	L2
2			

Module – 4

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Explaining about the types of biogas plants and biomass gasifiers and applications.	CO8	L4
2	Understanding about the tidal power generation and calculation of tidal power and harnessing the tidal energy	CO9	L3
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
38	Biomass Production, Energy Plantation,Biomass Gasification.	CO8	L4
39	Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification	CO8	L4
40	Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification	CO8	L4
41	Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.	CO8	L4
42	Introduction, Biogas and its Composition, Anaerobic Digestion	CO8	L4
43	Biogas Production, Benefits of Biogas	CO8	L4
44	Factors Affecting the Selection of a Particular Model of a Biogas Plant,	CO8	L4

	Biogas Plant Feeds and their Characteristics.		
45	Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation.	CO9	L3
46	Tidal Power Basin, Problems	CO9	L3
47	Turbines for Tidal Power	CO9	L3
48	Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy,Energy Availability in Tides.	CO9	L3
c	**Application Areas**	**CO**	**Level**
1	Gasifier products are used to provide shaft power to industrial and agricultural equipment and machinery such as water pumps, running of high efficiency stirling engines, tractors, power generation, drying of agricultural crop, and food products. Biogas can be used for any heating purpose, such as cooking. It can also be used for electricity generation.	CO8	L4
2	Tidal power, also called tidal energy, is a form of hydro power that converts the energy of tides into useful forms of power	CO9	L3
d	**Review Questions**	-	-
1	Classify and explain the methods of obtaining energy from biomass	CO8	L4
2	Define biomass gasification	CO8	L4
3	Explain the working of updraft, downdraft, cross draft and fluidized bed gasifer with schematic representation	CO8	L4
4	State the applications of biomass gasifiers.	CO8	L4
5	Explain the meaning of anaerobic digestion and discuss the process involved during anaerobic digestion.	CO8	L4
6	Describe the construction and working of biogas plant	CO8	L4
7	Explain the advantages and limitations of biogas plants	CO8	L4
8	Explain the types of biogas plants with a neat sketch	CO8	L4
9	Explain the single basin and two basin systems for tidal power harnessing. Further, discuss their advantages and limitations.	CO9	L3
10	Explain the problems faced in exploiting tidal energy	CO9	L3
11	State the advantages and disadvantages of tidal power	CO9	L3
12	Discuss about the energy availability in tides.	CO9	L3
e	**Experiences**	-	-
1		CO7	L2
2			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	17EE563	Sem:	5	Marks:	30	Time:	75 minutes

Course:		Renewable energy resources.			
-	**-**	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Explain the working of updraft and fluidized bed gasifer with schematic representation	7	CO8	L4
	b	Explain biomass production	8	CO8	L4
2	a	Explain the meaning of anaerobic digestion and discuss the process involved during anaerobic digestion.	7	CO7	L2
	b	With a neat sketch explain fixed dome type biogas plant	8	CO8	L4
3	a	Explain the single basin system for tidal power harnessing. Further, discuss the advantages and disadvantages of tidal power	7	CO9	L3
	b	With a neat sketch explain single flash geothermal steam electric power	8	CO6	L2
4	a	Discuss the problems faced in exploiting tidal energy	7	CO9	L3
	b	Discuss the methods of hydrogen energy storage	8	CO5	L2

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	17EE563	Sem:	5	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Renewable energy resources.						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT16EE001 1KT15EE017	Explain biomass production.	5	CO8	L4
2	1KT16EE001 1KT16EE402	Explain biomass gasification.	5	CO8	L4
3	1KT16EE003 1KT16EE402	Discuss about the classification of gasifier.		CO8	L4
4	1KT16EE003 1KT16EE404	Explain the working of updraft gasifer with schematic representation	5	CO8	L4
5	1KT16EE004 1KT16EE404	Explain the working of downdraft bed gasifer with schematic representation	5	CO8	L4
6	1KT16EE004 1KT16EE410	Explain the working of cross draft gasifer with schematic representation	5	CO8	L4
7	1KT16EE0061 KT16EE410	Explain the working of fluidized bed gasifer with schematic representation	5	CO8	L4
8	1KT16EE006	Discuss about the gasifier feed characteristics.	5	CO8	L4
9	1KT16EE007	State the applications of biomass gasifiers	5	CO8	L4
10	1KT16EE007	Explain the meaning of anaerobic digestion and discuss the process involved during anaerobic digestion.	5	CO8	L4
11	1KT16EE011	Define biogas and explain its composition		CO8	L4
12	1KT16EE011	Explain biogas production.	5	CO8	L4
13	1KT16EE013	Describe the construction and working of biogas plant	5	CO8	L4
14	1KT16EE013	With a neat sketch explain fixed dome type biogas plant	5	CO8	L4

15	1KT16EE014	With a neat sketch explain floating dome type biogas plant.		CO8	L4
16	1KT16EE014	Discuss the benefits of biogas.	5	CO8	L4
17	1KT16EE016	Explain the factors affecting the selection of a particular model of biogas plant	5	CO8	L4
18	1KT16EE016	Explain the two basin system for tidal power harnessing.	5	CO9	L3
19	1KT16EE017	Discuss the advantages and limitations of tidal energy.	5	CO9	L3
20	1KT16EE017	Discuss about the energy availability in tides.	5	CO9	L3
21	1KT16EE020	Discuss about the biogas plant feeds and characteristics.	5	CO8	L4
22	1KT16EE020	Explain the advantages and limitations of biogas plants	5	CO8	L4
23	1KT16EE021	Explain the advantages and limitations of biogas plants		CO8	L4
24	1KT16EE021	Explain the single basin system for tidal power harnessing.	5	CO9	L3
25	1KT16EE023	Explain the turbines for tidal power	5	CO9	L3
26	1KT16EE023	What is hydrogen energy	5	CO5	L2
27	1KT16EE025	Dicuss the benefits of hydrogen energy	5	CO5	L2
28	1KT16EE025	Explain thermochemical production technology	5	CO5	L2
29	1KT16EE026	Explain hydrogen electrolytic production technology	5	CO5	L2
30	1KT16EE026	Explain photolytic production technology	5	CO5	L2
31	1KT16EE005	Discuss the methods of hydrogen energy storage		CO5	L2
32	1KT16EE005	Discuss the applications of hydrogen energy	5	CO5	L2
33	1KT16EE019	Mention the problems associated with the development and application of hydrogen energy.	5	CO5	L2
34	1KT16EE019	With a neat sketch explain single flash geothermal steam electric power plant.	5	CO6	L2
35	1KT14EE030	Discuss about the extensive use of geothermal energy	5	CO6	L2
36	1KT14EE030	With a neat sketch explain binary cycle based geothermal electric power plant	5	CO6	L2
37	1KT14EE034	Briefly discuss the environmental effects of geothermal energy	5	CO6	L2
38	1KT14EE034	Explain the role of incineration, pyrolysis, and composting in solid waste management.	5	CO6	L2
39	1KT15EE011	What are solid wastes? Also discuss main sources of solid wastes.	5	CO6	L2
40	1KT15EE011	State the advantages and disadvantages of waste recycling	5	CO6	L2
41	1KT15EE013	Derive the expression for power developed due to wind	5	CO7	L4
42	1KT15EE013	Describe the main considerations in selecting a site for wind generators	5	CO7	L4
43	1KT15EE015	Describe a darrieus rotot wind turbine generator unit		CO7	L4
44	1KT15EE015	Mathematical model of extraction of energy from the wind.	5	CO7	L4
45	1KT15EE017	With a neat sketch explain double flash geothermal steam electric power plant.	5	CO6	L2

D3. TEACHING PLAN - 3

Module – 5

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understanding about the devices used foe harnessing wave energy and deriving an expression for power.	CO10	L3
2	Understanding about the principles of ocean thermal energy conversion	CO11	L2

	and production of electricity		
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
49	Introduction, Motion in the sea Waves, Power Associated with Sea Waves	CO10	L3
50	Wave Energy Availability	CO10	L3
51	Devices for Harnessing Wave Energy	CO10	L3
52	Devices for Harnessing Wave Energy	CO10	L3
53	Advantages and Disadvantages of Wave Power.	CO10	L3
54	Introduction,Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants.	CO11	L2
55	Ocean Thermal Energy Conversion plants.	CO11	L2
56	Basic Rankine Cycle and its Working, Closed Cycle,	CO11	L2
57	Open Cycle and Hybrid Cycle, Carnot Cycle,	CO11	L2
58	Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC.	CO11	L2
c	**Application Areas**	**CO**	**Level**
1	Sea Wave energy technologies can have applications across desalination, coastal erosion and power generation.	CO10	L3
2	Ocean thermal energy conversion plant is used for production of electricity, hydrogen production,Aquaculture, air conditioning.	CO11	L2
d	**Review Questions**	-	-
1	Discuss the principle and working of sea wave energy conversion systems.	CO10	L3
2	With a neat sketch explain salter's duck system.	CO10	L3
3	With a neat sketch explain oscillating water column device for harnessing wave energy	CO10	L3
4	State the expression for energy and power in ocean waves	CO11	L2
5	Explain the difference between land based and floating based ocean energy conversion plants	CO11	L2
6	With a neat sketch explain the working of basic rankine cycle.	CO11	L2
7	Describe the closed cycle OTEC systems. Write the advantages over open cycle systems.	CO11	L2
8	Explain carnot efficiency for an OTEC plant wuth the help of thermodynamic cycle.	CO11	L2
9	With a neat sketch explain land based OTEC power plant	CO11	L2
10	With a neat sketch explain floating based OTEC power plant	CO11	L2
11	With a neat sketch explain Open Cycle OTEC plant.	CO11	L2
12	With a neat sketch explain hybrid Cycle OTEC plant.	CO11	L2
13	With a neat sketch explain Carnot Cycle OTEC plant.	CO11	L2
14	Discuss about the wave energy availability	CO10	L3
15	Discuss about the devices used for harnessing wave energy	CO10	L3
e	**Experiences**	-	-
1		CO10	L2

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	17EE563	Sem:	5	Marks:	30	Time:	75 minutes
Course:	Renewable Energy Resources						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	With a neat sketch explain the working of basic rankine cycle.	7	CO10	L3
	b	State the expression for energy and power in sea waves	8	CO11	L2

2	a	Explain the difference between land based and floating based ocean energy conversion plants	7	CO11	L2
	b	Describe the closed cycle OTEC systems. Write the advantages over open cycle systems.	8	CO11	L2
3	a	With a neat sketch explain floating based OTEC power plant	6	CO11	L2
	b	With a neat sketch explain Open Cycle OTEC plant.	9	CO11	L2
4	a	With a neat sketch explain oscillating water column device for harnessing wave energy	7	CO10	L3
	b	Explain carnot efficiency for an OTEC plant wuth the help of thermodynamic cycle.	8	CO11	L2

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions

Crs Code:	17EE563	Sem:	5	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Renewable energy resources						

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT16EE001 1KT16EE014 1KT16EE019 1KT16EE404	Discuss the principle and working of sea wave energy conversion systems.	5	CO10	L3
2	1KT16EE001 1KT16EE016 1KT14EE030 1KT16EE404	With a neat sketch explain salter's duck system.	5	CO10	L3
3	1KT16EE003 1KT16EE016 1KT14EE030 1KT16EE410	With a neat sketch explain oscillating water column device for harnessing wave energy	5	CO10	L3
4	1KT16EE003 1KT16EE017 1KT14EE034 1KT16EE410	State the expression for energy and power in sea waves	5	CO10	L3
5	1KT16EE004 1KT16EE020 1KT14EE034	Explain the difference between land based and floating based ocean energy conversion plants	5	CO11	L2
6	1KT16EE004 1KT16EE021 1KT15EE011	With a neat sketch explain the working of basic rankine cycle.	5	CO11	L2
7	1KT16EE006 1KT16EE023 1KT15EE011	Describe the closed cycle OTEC systems. Write the advantages over open cycle systems.	5	CO11	L2
8	1KT16EE006 1KT16EE023 1KT15EE013	Explain carnot efficiency for an OTEC plant wuth the help of thermodynamic cycle.	5	CO11	L2
9	1KT16EE007 1KT16EE025 1KT15EE013	With a neat sketch explain land based OTEC power plant	5	CO11	L2
10	1KT16EE007 1KT16EE025 1KT15EE015	With a neat sketch explain floating based OTEC power plant	5	CO11	L2
11	1KT16EE011 1KT16EE026 1KT15EE015	With a neat sketch explain Open Cycle OTEC plant.	5	CO11	L2
12	1KT16EE011 1KT16EE026	With a neat sketch explain hybrid Cycle OTEC plant.	5	CO11	L2

	1KT15EE017				
13	1KT16EE013 1KT16EE005 1KT15EE017	With a neat sketch explain Carnot Cycle OTEC plant.	5	CO11	L2
14	1KT16EE013 1KT16EE005 1KT16EE402	Discuss about the wave energy availability	5	CO10	L3
15	1KT16EE014 1KT16EE019 1KT16EE402	Discuss about the devices used for harnessing wave energy	5	CO10	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:		RENEWABLE ENERGY RESOURCES					Month / Year	May /2018	
Crs Code:		17EE563	Sem:	5	Marks:	100	Time:	180 minutes	
-	**Note**	Answer all FIVE full questions. All questions carry equal marks.					**Marks**	**CO**	**Level**
1	a	Define the term energy resources. Discuss different ways of there classifications with examples in each category					6	CO1	L2
	b	Define the following terms:- solar azimuth angle, latitude angle, declination angle.					7	CO2	L3
	c	Calculate hour angle when it is 3h after solar noon.					3	CO2	L3
	OR								
-	a	Mention factors to be considered for solving energy crunch problems					6	CO1	L2
	b	Write a short notes on layers on sun.					6	CO2	L2
	c	List solar thermal energy applications					6	CO2	L2
2	a	For a typical photovoltaic cell. The following performance parameerts are obtained from the I-V characteristics open circuit voltage= 0.611, short circuit curent= 2.75, voltage corresponding to cell maximum power output=0.5, current corresponding to cell maximum power output=2.59, calcuate fill factor of the cell					8	C04	L3
	b	With a neat sketch explain how the solar energy is harnessed through solar ponds.					7	CO3	L4
	OR								
-	a	Draw and explain electrical equivalent circuit model of a solar cell. Starting with the assumptions made, if any, derive and draw I-V characteristic of solar cell. Further, obtain an expression for the external load voltage that gives maximum cell output power.					8	CO4	L3
	b	Discuss about the solar water heating systems.					7	CO3	L4
3	a	Mention the problems associated with the development and application of hydrogen energy					5	CO5	L2
	b	With a neat sketch explain binary cycle based geothermal electric power plant					6	CO6	L2
	c	Discuss about wind characterstics					5	CO7	L4
	OR								
-	a	Discuss the applications, advantages and disadvantages of hydrogen energy					5	CO5	L2
	b	Explain the role of incineration, pyrolysis, and composting in solid waste					5	CO6	L2

		management.			
	c	Discuss about the factors or guidelines for wind turbine site selection	6	CO7	L4
4	a	Explain the problems faced in exploiting tidal energy	5	CO9	L3
	b	With a neat sketch explain floating dome type biogas plant	5	CO8	L4
	c	Explain the working of fluidized bed gasifer with schematic representation	6	C08	L4
	OR				
-	a	Explain the factors affecting the selection of a particular model of biogas plant	5	CO8	L4
	b	Explain the two basin system for tidal power harnessing.	5	CO9	L3
	c	Discuss the advantages and limitations of tidal energy.	6	CO9	L3
5	a	With a neat sketch explain the working of basic rankine cycle.	6	CO10	L3
	b	State the expression for energy and power in sea waves	6	CO10	L3
	OR				
	a	List the applications of ocean thermal energy conversion plants	3	CO11	L2
	b	With a neat sketch explain floating based ocean thermal energy conversion power plant	7	CO11	L2
	c	Discuss about the devices used for harnessing the sea wave energy	6	C010	L3

2. SEE Important Questions

Course:	RENEWABLE ENERGY RESOURCES					Month / Year	May /2018
Crs Code:	17EE563	Sem:	5	Marks:	100	Time:	180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-
Module	Qno.	Important Question				**Marks**	**CO**	**Year**
1	1	Discuss the causes of energy scarcity futher mention factors to be considered for solving energy crunch problems				8	CO1	2018
	2	Define and explain the term energy resources. Discuss different ways of there classifications. Mention atleast two energy resources in each category				8	CO1	
	3	With a neat diagram explain the layers of sun				8	CO2	
	4	Define the following terms; altitude angle, incident angle, zenith angle, solar azimuth angle, latitude angle, declination angle and hour angle				8	CO2	
	5	Classify the methods of solar energy storage				8	CO2	2018
2	1	What are solar collectors. Give there classifications and compare them based on the construction and area of applications				8	CO3	
	2	With neat sketches discuss important parts of any flat plate solar collectors. Futher discuss the material aspects of individual parts				8	CO3	2018
	3	With a neat sketch explain how the solar energy is harnessed through solar ponds				8	CO3	
	4	Discuss about the solar water heating systems				8	CO3	
	5	Draw and explain electrical equivalent circuit model of a solar cell. Starting with the assumptions made, if any, derive and draw I-V characteristic of solar cell. Further, obtain an expression for the external				8	CO4	

		load voltage that gives maximum cell output power.			
3	1	Dicuss the benefits of hydrogen energy	8	CO5	2018
	2	State and explain methods of hydrogen production technologies	8	CO5	
	3	With a neat sketch explain single flash geothermal steam electric power plant.	8	CO6	
	4	Explain the role of incineration, pyrolysis, and composting in solid waste management.	8	CO6	
	5	Discuss about the factors or guidelines for wind turbine site selection	8	CO7	
4	1	Explain the working of updraft, downdraft, cross draft and fluidized bed gasifer with schematic representation	8	CO8	
	2	Explain the problems faced in exploiting tidal energy	8	CO9	
	3	Explain the meaning of anaerobic digestion and discuss the process involved during anaerobic digestion.	8	CO8	
	4	Explain the types of biogas plants with a neat sketch	8	CO8	
	5	Explain the single basin and two basin systems for tidal power harnessing. Further, discuss their advantages and limitations.	8	CO9	
5	1	With a neat sketch explain the working of basic rankine cycle.	8	CO10	
	2	Describe the closed cycle OTEC systems. Write the advantages over open cycle systems.	8	CO11	
	3	Explain carnot efficiency for an OTEC plant wuth the help of thermodynamic cycle.	8	CO11	
	4	With a neat sketch explain land based OTEC power plant	8	CO11	
	5	Discuss about the devices used for harnessing wave energy	8	CO10	