

RENEWABLE ENERGY RESOURCES(Open Elective) B.E., V Semester, Electrical and Electronics Engineering [As per Choice Based Credit System (CBCS) scheme]			
Course Code	17EE563	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40	Exam Hours	03
Credits - 03			
Course objectives:			
<ul style="list-style-type: none"> • To discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. • To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships • To discuss about solar energy reaching the Earth’s surface and solar thermal energy applications. • To discuss types of solar collectors, their configurations and their applications • To explain the components of a solar cell system, equivalent circuit of a solar cell, its characteristics and applications. • To discuss benefits of hydrogen energy, production of hydrogen energy, storage its advantages and disadvantages. • To discuss wind turbines, wind resources, site selection for wind turbine • To discuss geothermal systems, their classification and geothermal based electric power generation • To discuss waste recovery management systems, advantages and disadvantages • To discuss biomass production, types of biomass gasifiers, properties of producer gas. • To discuss biogas, its composition, production, benefits. • To discuss tidal energy resources, energy availability, power generation. • To explain motion in the sea wave, power associated with sea wave and energy availability and the devices for harnessing wave energy. • To discuss principles of ocean thermal energy conversion and production of electricity. ■ 			
Module-1			Teaching Hours
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. ■			08
Revised Bloom’s Taxonomy Level	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying.		
Module-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 Cooling, 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. ■			08
Revised Bloom’s Taxonomy Level	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.		
Module-3			

<p>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.</p> <p>Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.</p> <p>Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects.</p>	08
--	-----------

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE) CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER - V	
17EE563 RENEWABLE ENERGY RESOURCES(Open Elective) (continued)	
Module-3 (continued)	Teaching Hours
<p>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. ■</p>	
<p>Revised Bloom's Taxonomy Level</p>	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.
Module-4	
<p>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, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.</p> <p>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.</p> <p>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.</p>	08
<p>Revised Bloom's Taxonomy Level</p>	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.
Module-5	
<p>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.</p> <p>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. ■</p>	08
<p>Revised Bloom's Taxonomy Level</p>	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying.
Course outcomes:	
<p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> • Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. • Discuss energy from sun, energy reaching the Earth's surface and solar thermal energy applications. • Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications. • Discuss generation of energy from hydrogen, wind, geothermal system, solid waste and agriculturerefuse. • Discuss production of energy from biomass, biogas. • Discuss tidal energy resources, energy availability and power generation. 	

- Discuss power generation sea wave energy and ocean thermal energy. ■

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Modern tool usage, Ethics.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE)
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER - V**

17EE563 RENEWABLE ENERGY RESOURCES(Open Elective) (continued)

Textbook

1	Nonconventional Energy Resources	ShobhNath Singh	Pearson	1 st Edition, 2015
---	----------------------------------	-----------------	---------	-------------------------------

Reference Books

1	Nonconventional Energy Resources	B.H. Khan	McGraw Hill	3 rd Edition,
2	Renewable Energy; Power for a sustainable Future	Godfrey Boyle	Oxford	3 rd Edition, 2012
3	Renewable Energy Sources: Their Impact on global Warming and Pollution	TasneemAbbasi S.A. Abbasi	PHI	1 st Edition, 2011