

Program : Diploma in Electrical and Electronics Engineering	
Course Code : 5033A	Course Title: Renewable Energy Power Plants
Semester : 5	Credits: 4
Course Category: Program Core	
Periods per week: 4 (L:3 T:1 P:0)	Periods per semester: 60

Course Objectives:

- To motivate students to rely on renewable energy sources as future energy sources.
- To categorize variable renewable energy sources and their applications.
- To organize an outline for extracting power from renewable energy sources and the operation of various types of renewable energy power plants

Course Prerequisites:

Topic	Course code	Course Name	Semester
Power and energy		Fundamentals of Electrical & Electronics Engineering	2

Course Outcomes:

On completion of the course, the students will be able to:

CO _n	Description	Duration (hours)	Cognitive Level
CO1	Classify various methods of harnessing energy from renewable sources.	14	Understanding
CO2	Explain electric power generation from solar energy and select number of solar panels for stand alone systems.	17	Applying
CO3	Illustrate electric power generation from wind energy.	14	Understanding
CO4	Explain the methods of power generation using ocean energy, Fuel cells and MHD system.	13	Understanding
	Series Test	2	

CO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7
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Outcomes							
CO1	2				3		
CO2	3				3		
CO3	2				3		
CO4	2				3		

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline

Module Outcome	Description	Duration (Hours)	Cognitive Level
CO1	Classify various methods of harnessing energy from renewable sources.		
M1.01	Summarize the need of non-conventional method of generation of electrical energy	4	Understanding
M1.02	Illustrate the power generation by small hydel power plants	3	Understanding
M1.03	Outline the concept of geothermal power generation	3	Understanding
M1.04	Explain the concept of energy from bio resources	4	Understanding
<p>Contents:</p> <p>Energy sources -Classification of energy sources with examples- -conventional -non conventional-need of renewable energy -advantages</p> <p>Small Hydel Power Plants-overview of hydro power plants- classifications - based on head - based on capacity - small hydro power plants- schematic diagram-- turbines-types(explanation with diagram)- advantages -disadvantages-applications-criterion for selection of sites</p> <p>Geothermal Energy-introduction- resources-advantages- disadvantages- methods of generation-schematic diagrams -Flash stream-Binary cycle-Vapour dominated</p> <p>Bio Energy -Biomass-Definition- resources -examples - different processes -Pyrolysis-Gasification</p> <p>Bio gas- Definition-list the constituents -applications - process-Anaerobic digestion - biogas plants-types -construction - working-dome type - drum type.</p>			

CO2	Explain electric power generation from solar energy and select number of solar panels for stand alone systems.		
M2.01	Illustrate various solar collectors	4	Understanding
M2.02	Classify concentrated solar power plants	4	Understanding
M2.03	Explain the operation of solar photovoltaic power plants	4	Understanding
M2.04	Identify various steps to determine the rating of solar PV systems	5	Applying
	Series Test – I	1	

Contents:

Solar energy -basic principle--advantages- disadvantages- applications.-definitions -solar radiation- solar irradiation- solar insolation.

Solar collectors-types-diagrams- concentrated(parabolic, trough,mirror strip and Fresnel lens)- non concentrated(Flat plate and evacuated tubes)

Concentrated Solar Power (CSP) plants- classifications-based on temperature- block diagrams- solar pond - Flat plate-Line focusing parabolic trough-parabolic dish - power tower

Solar cell- working principle (photovoltaic effect)- basic construction - definitions -cells-modules-panels-array- definition- megawatt peak(MWp)

V/I characteristics of pv module-definitions –maximum power point- fill factor-important factors considered for installing a solar panel -direction -tilt -shading - temperature-solar pv system-advantages- disadvantages-applications -basic concepts-Roof top - building integrated -Solar power satellite

Solar cell power plant- Classifications- block diagrams-Standalone-Grid connected Power converters in PV system- Buck converter - Boost converter Charge controller-block diagram-MPPT

Sizing of solar system-Selection of number of solar panels, battery and inverter for a given backup time-simple problems

CO3	Illustrate electric power generation from wind energy.		
M3.01	Summarize the principle of wind energy conversion	4	Understanding
M3.02	Classify wind energy conversion systems and wind turbines	3	Understanding
M3.03	Illustrate the block diagram of of wind power plants	3	Understanding
M3.04	Explain various schemes for wind electric power generation	4	Understanding

Contents:

Principles of wind energy conversions- introduction-advantages- disadvantages - applications-criterion for selection of sites

Wind energy conversion system-block diagram-basic components -turbines-

classifications- schematic diagrams -horizontal axis - vertical axis - comparison between horizontal axis and vertical axis machines

Wind power plant-block diagrams- standalone - grid interactive -power output from a wind turbine (equation only) - simple problems.

Schemes for electric generation-principle of induction generators-block diagrams - schemes for electric power generation- constant speed constant frequency - variable speed constant frequency- variable speed variable frequency

CO4	Explain the methods of power generation using ocean energy, Fuel cells and MHD system.		
M4.01	Illustrate the generation of electrical energy from tides and waves	3	Understanding
M4.02	Explain the principle of operation of Ocean thermal energy conversion systems	3	Understanding
M4.03	Summarize the working of fuel cells	4	Understanding
M4.04	Outline the principle of operation of MHD system.	3	Understanding
	Series Test – II	1	

Contents:

Ocean energy conversion systems- introduction

Tidal Power-Basic concepts-advantages-disadvantages-tidal power plants-single basin system- double basin system

Ocean Wave energy- Basic systems - Float system(buoys) - Oscillating water column (brief idea only)

Ocean Thermal Energy Conversion Systems -principle of operation- block diagrams- Open cycle- closed cycle

Fuel cells - features - -principle of operation - hydrogen and oxygen fuel cells-advantages - disadvantages-applications- differences between battery and fuel cells.

MHD system-generation of electric power -principle of operation - block diagram

Text /Reference:

T/ R	BookTitle/Author
R1	Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
R2	David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
R3	Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
R4	B.H Khan-“Non- Conventional Energy Resources”,McGraw Hill Education(India)Private Limited.ISBN:978-93-5260-189-9
R5	4. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043
R6	Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
R7	Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
R8	Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.
R9	O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-9386173-683)
R10	G.D.Rai, “Non conventional Energy sources” Khanna Publishing House, New Delhi (ISBN: 81-7409-073-8)

Online resources

Sl.No	Website Link
1	https://www.swayam.gov.in/
2	https://nptel.ac.in/
3	https://www.teriin.org/
4	https://www.youtube.com/
5	https://mnre.gov.in/
6	https://www.anert.gov.in/