III B.Tech – I Semester
(20EE5315) HYBRID ENERGY SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisites: Power Systems-I

Course Objectives

- Introduce the fundamental concepts of global and national energy scenario, Solar, Wind, Hydel, Tidal, Bio-Mass, Geo-thermal, Ocean, Integrated and hybrid Energy Systems.
- Develop a thorough understanding of the key elements and principals of Solar, Wind, Hydel, Tidal, Bio-Mass, Geo-thermal, Ocean, Integrated and hybrid Energy Systems.
- Understand the structure, functions, policies and performance of Solar, Wind, Hydel, Tidal, Bio-Mass, Geo-thermal, Ocean, Integrated and hybrid Energy Systems.

UNIT-I: Global and National Energy Scenario

Overview of conventional & renewable energy sources, need, potential & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, Global climate change, - concept of Hybrid systems

UNIT-II: Solar Energy, Wind Energy, Fuel Cell Technology

General Solar Photo Voltaic (SPV) system, Different configurations, SPV system components and their characteristics, MPPT Techniques, Stand-Alone and Grid Connected SPV systems.
Wind Energy Conversion, Potential, Nature of the wind, Wind Data and Energy Estimation, Site selection, Wind Generation and Control, classification of wind, characteristics, offshore wind energy – Hybrid systems
Introduction – working and types of fuel cell, applications, Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, kinetic performance

UNIT-III: Hydel & Thermal Power Systems

Basic working principle, Classification of hydel systems: Large, small, micro – measurement of head and flow – Energy equation – Types of turbines –Tidal power – Basics – Kinetic energy equation – Wave power – Basics – Kinetic energy equation.

UNIT-IV: Biomass, Geo-Thermal & Ocean Energy

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C Engine operation and economic aspects. Resources, types of wells, methods of harnessing the energy, potential in India.OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles

UNIT-V: Integrated Energy Systems & Characteristics

Introduction, Integrated Smart infrastructure, Integrated Energy system Modeling, Various Integrated energy schemes, their cost benefits.

Course Outcomes:

After successful completion of the course, the students will be able to:

S.No	Course Outcome	BTL
1.	Demonstrate the impact of Solar, Wind, Hydel, Tidel, Bio-Mass, Geo-thermal, Ocean energies on power generation.	L3
2.	Outline the structures of various renewable and non conventional methods (Solar, Wind, Hydel, Tidel, Bio-Mass, Geo-thermal, Ocean energies) used in power generation.	L1
3.	Develop the theoretical models of various renewable and non conventional methods (Solar, Wind, Hydel, Tidel, Bio-Mass, Geo-thermal, Ocean energies) used in power generation.	L5
4.	Assess the performance of various renewable and non conventional methods (Solar, Wind, Hydel, Tidel, Bio-Mass, Geo-thermal, Ocean energies) used in power generation.	L6

Correlation of COs with POs& PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3			2	3					1	3	2
CO2			3			2	3					1	3	2
CO3			3			2	3					1	3	2
CO4			3			2	3					1	3	2
CO5			3			2	3					1	3	2

Text Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rdEdition
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013.
3. Non-Conventional Energy Sources /G.D. Rai, Khanna Publishers

Reference Books:

1. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore
2. Renewable Energy Technologies /Ramesh & Kumar/Narosa.
3. Hybrid Energy systems /Bahman Zohurialaxy Advanced Engineering Inc., Department of Electrical and Computer Engineering University of New Mexico Albuquerque USA
4. Non- Conventional energy sources by G.D.Rai published by Khanna Publishers