Course Title:	**Renewable Energy Sources**	Semester	I
Course Code:	**BETCK105E/205E**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (ETC-I)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03

Course Learning Objectives

CLO 1 To understand energy scenario, energy sources and their utilization.
CLO 2 To study society's present needs and future energy demands.
CLO 3 To study the principles of renewable energy conservation systems.

Teaching-Learning Process

1. Use pie- chart showing distribution of renewable energy sources
2. Use wind turbine models
3. Use sun path diagrams

Module-1 (8 hours)

Introduction: Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy. **(RBT- L_1, L_2, L_3)**

Module-2 (8 hours)

Solar Energy: Fundamentals; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.**(RBT- L_2, L_3)**

Module-3 (8 hours)

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and Darrieus types. **(RBT- L_2, L_3 L_4)**

Module-4(8 hours)

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world & problems **(RBT- L_2, L_3 L_4)**

Module-5(8 hours)

Green Energy: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy Concepts: Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy**.** **(RBT- L_2, L_3 L_4)**

Course outcome (Indicative)

At the end of the course the student will be able to:

1. Understand the environmental aspects of solar, wind & tidal energy
2. Apply the Concept of Solar photovoltaic systems, Wind energy conversion systems(WECS), Ocean thermal energy conversion systems(OTEC) & Zero Energy.
3. Analyse the Characteristics of Solar Cells, Horizontal Axis Wind Turbine (HAWT), Vertical axis wind turbine(VAWT) & Tidal power.

Course Assessment and Evaluation Details (both CIE and SEE)

Continuous Internal Evaluation: 50 marks		
Theory Assessment Tool	**Marks**	**Reduced marks**
IAT-1	25	25
IAT-2	25	
Assessment -1	25	25
Assessment-2(activity based)	25	
Semester End Examination (SEE) : 50 marks		
SEE	**Marks**	**Reduced marks**
Course end examination (Answer any one question from each unit – Internal choice)	100	50

Suggested Learning Resources:

Text Books:

1. Nonconventional Energy sources, G D Rai, Khanna Publication, Fourth Edition,
2. Energy Technology, S.Rao and Dr. B.B. Parulekar, Khanna Publication
3. Solar energy Subhas P Sukhatme, Tata McGrawHill, 2ndEdition,1996.

Reference Books

1. Principles of Energy conversion, A. W. Culp Jr.,, McGraw Hill, 1996

Web links and Video Lectures (e-Resources):

E-book URL:https://www.pdfdrive.com/non-conventional-energy-sources-e10086374.html
E-book URL:https://www.pdfdrive.com/non-conventional-energy-systems-nptel-d17376903.html
E-book URL: https://www.pdfdrive.com/renewable-energy-sources-and-their-applications- e33423592.html
E-book URL: https://www.pdfdrive.com/lecture-notes-on-renewable-energy-sources-e34339149.html
https://onlinecourses.nptel.ac.in/noc18_ge09/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Industry visit

CO'S	PO's											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	1	1			2	2					
CO2	3	1	1			2	2					
CO3	3	1	1			2	2					

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped