

RENEWABLE ENERGY SOURCES			
Course Code:	22ETS15C/25C	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours	Credits	03
Course objectives <ul style="list-style-type: none"> ▮ To understand energy scenario, energy sources and their utilization. ▮ To explore society's present needs and future energy demands. ▮ To Study the principles of renewable energy conversion systems. ▮ To exposed to energy conservation methods. 			
Teaching-Learning Process These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective <ol style="list-style-type: none"> 1. Use pie chart showing distribution of renewable energy sources 2. Use wind turbine models 3. Use sun path diagrams 			
Module-1 (08 hours)			
Introduction: INTRODUCTION: Principles of renewable energy and there types. energy and sustainable development,– Environmental Aspects of Energy Utilization– Renewable Energy Scenario in India and around the World and Potentials – Achievements / Applications			
Module-2 (08 hours)			
SOLAR ENERGY: Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors - Fundamentals of Solar Photo Voltaic Conversion – Solar PV Power Generation – Solar energy Applications			
Module-3 (08 hours)			
WIND ENERGY: Wind Data and Energy Estimation – Wind Energy Conversion Systems – Performance – Site Selection— Safety and Environmental Aspects.			
BIOMASS ENERGY: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome and floating type; Urban waste to energy conversion. Biomass Applications.			
Module-4 (08 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, advantages and disadvantage with OTEC.			
Module-5 (08 hours)			
Green Energy: Introduction, Fuel cells: Classification of fuel cells – H ₂ ; 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.			
Geothermal Energy. Introduction-, geothermal filed and its applications. Small Hydro-power generation.			

Course outcome (Course Skill Set)

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

CO1	Describe the environmental aspects of renewable energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
CO2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation.
CO3	Understand the conversion principles of wind and tidal energy
CO4	Understand the concept of biomass energy resources and green energy.
CO5	Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):**Two Unit Tests each of 20 Marks (duration 01 hour)**

- First test after the completion of 30-40 % of the syllabus
- Second test after completion of 80-90% of the syllabus

One Improvement test before the closing of the academic term may be conducted if necessary. However best two tests out of three shall be taken into consideration.

Two assignments each of 10 Marks

The teacher has to plan the assignments and get them completed by the students well before the closing of the term so that marks entry in the examination portal shall be done in time. Formative (Successive) Assessments include Assignments/Quizzes/Seminars/ Course projects/Field surveys/ Case studies/ Hands-on practice (experiments)/Group Discussions/ others.. The Teachers shall choose the types of assignments depending on the requirement of the course and plan to attain the Cos and POs. (to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). CIE methods /test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

The sum of two tests, two assignments, will be out of 60 marks and will be scaled down to 30 marks

CIE for the practical component of the Integrated Course

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and **scaled down to 15 marks**.

- ▮ The laboratory test (**duration 02/03 hours**) at the end of the 14th /15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and **scaled down to 05 marks**.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- ▮ The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- ▮ The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks**.
- ▮ There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

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.Solar energy, Subhas P Sukhatme, TataMcGraw Hill, 2nd Edition,1996.

Reference Books:

1. Principles of Energy conversion, A. W. Culp Jr.,, McGraw Hill, 1996
2. Non-Convention EnergyResources, Shobh Nath Singh, Pearson, 2018

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

- Poster presentation on the theme of renewable energy sources
- Industry Visit