

**COURSE NAME : ELECTRICAL POWER SYSTEM**  
**COURSE CODE : EP**  
**SEMESTER : SIXTH**  
**SUBJECT TITLE : RENEWABLE ENERGY SOURCES (Elective for EP)**  
**SUBJECT CODE :**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

# - External

@ - Internal

\* On Line Examination

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)

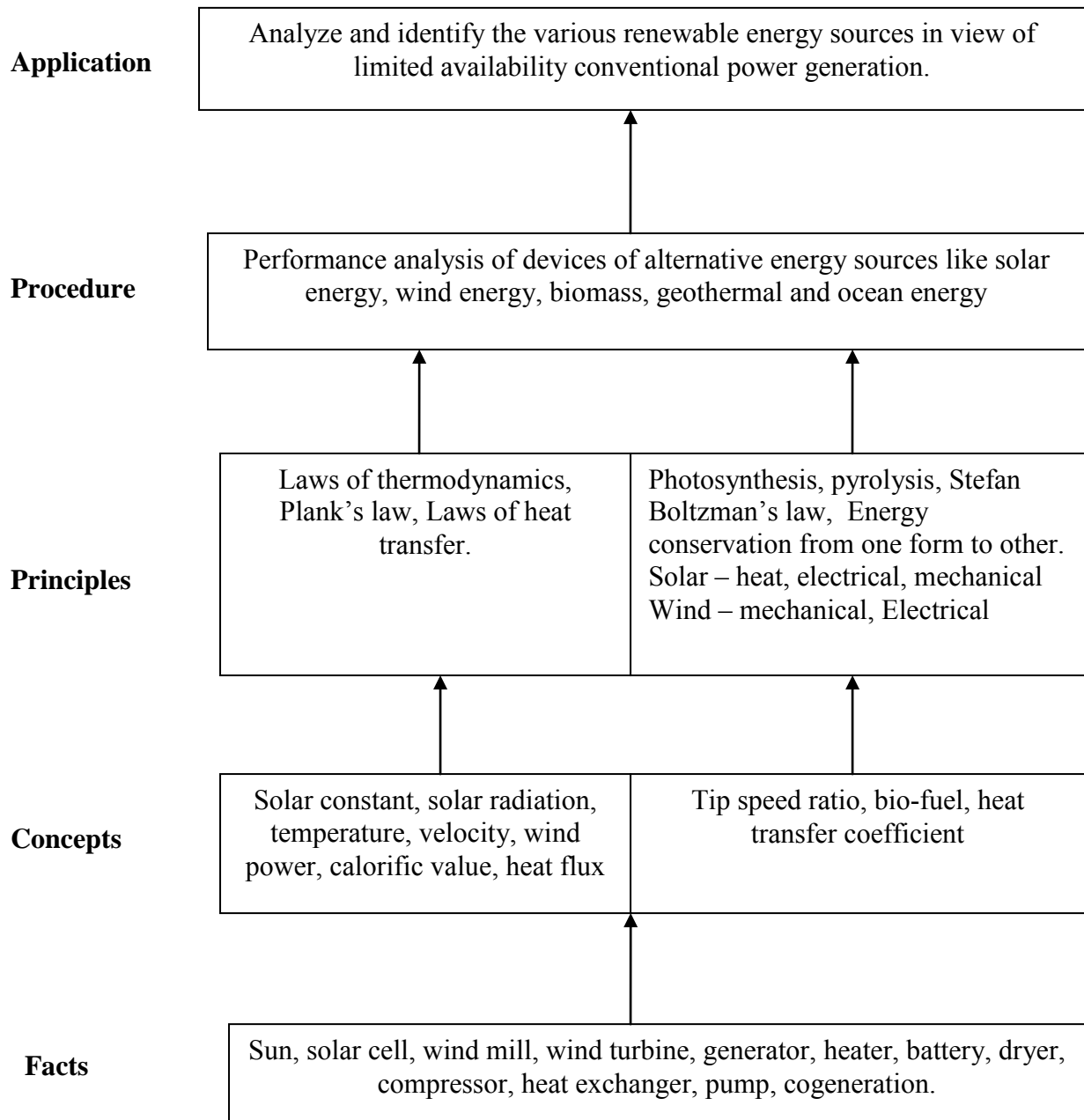
**Rationale:**

Energy is an important aspect in all sectors of country's economy. The energy crisis is mainly caused due to increased population, enhanced standard of living, life style, rapid urbanization. The conventional energy sources are insufficient to meet these demands and causing deleterious effects on human health and natural environment. Hence, alternative energy sources which are eco-friendly are used for fulfilling the energy demands. This subject helps the engineers to develop, operate and maintain these systems.

**General Objectives:**

1. Develop awareness for effective utilization of renewable energy sources.
2. Understand sustainability problem of present energy system and its potential solution.
3. Identify different components of all renewable energy devices.

**Learning Structure:**



**Theory:**

Topic and Contents	Hours	Marks
<p><b><u>Topic 1: Introduction to Energy Sources</u></b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Prospects of alternate energy sources.</li> <li>➤ Need for alternate energy sources.</li> </ul> <p><b>Contents:</b></p> <p>1.1 Types of Energy sources (Primary, Secondary, Supplementary).</p> <p>1.2 Energy scenario in India (Energy consumption, Energy production, various sources and Their limitations).</p> <p>1.3 Necessity of alternate energy sources.</p> <p>1.4 Renewable Energy Sources Definition and examples</p> <p>1.5 Environmental aspects of energy and sustainable development</p>	04	08
<p><b><u>Topics 2: Basics of Solar Energy</u></b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Identify instruments used for measurement of solar radiation.</li> <li>➤ Understand methods of solar radiation measurement</li> </ul> <p><b>Contents:</b></p> <p>2.1 Solar Radiation</p> <ul style="list-style-type: none"> <li>• Solar radiation at the earth's surface: Spectral Distribution of Extra Terrestrial Solar Radiation</li> <li>• Schematic representation of Distribution of Solar energy as direct, diffused, total radiation.</li> <li>• Solar constant: definition and formula (No numerical)</li> </ul> <p>2.2 Radiation Geometry</p> <ul style="list-style-type: none"> <li>• Definition and concept of latitude of location,</li> <li>• Declination, hour angle,</li> <li>• Solar azimuth angle, zenith angle, incident angle</li> </ul> <p>2.3 Solar Radiation Measurements: Construction, working and limitations of :</p> <ul style="list-style-type: none"> <li>• Pyrheliometer for measurement of beam radiation.</li> <li>• Pyranometer for measurement of total radiation or global radiation.</li> </ul> <p>2.4 Solar radiation on tilted surface:</p> <ul style="list-style-type: none"> <li>• Definition of tilt factor for beam radiation,</li> <li>• Diffused radiation</li> <li>• Deflected radiation stating empirical formula. (Simple numerical)</li> </ul>	06	10
<p><b><u>Topic 3: Solar Thermal and PV Systems</u></b></p> <ul style="list-style-type: none"> <li>➤ Select different types of solar energy collectors, storage devices</li> <li>➤ Decide the rating of PV cell.</li> <li>➤ List limitations of Solar Power Generation.</li> </ul> <p><b>Contents:</b></p>		



<p>frequency system.</p> <ul style="list-style-type: none"> <li>• Variable speed constant frequency system.</li> <li>• Variable speed variable frequency system.</li> <li>• Salient features and characteristics of synchronous generator and induction generators used in wind mills.</li> </ul> <p>4.7 Area of applications of wind energy.</p>		
<p><b><u>Topic 5 : Energy from Biomass</u></b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Identify different bio-energy sources.</li> <li>➤ Select type of biomass plant depending upon availability of waste.</li> <li>➤ Identify different biogas plant.</li> </ul> <p><b>Contents:</b></p> <p>5.1 Bio-energy sources.</p> <ul style="list-style-type: none"> <li>• Energy crops (woody crops, agriculture crops).</li> <li>• Wastes (wood residues, animal waste, municipal waste).</li> </ul> <p>5.2 Methods of obtaining energy from biomass.</p> <ul style="list-style-type: none"> <li>• Combustion</li> <li>• Anarobic Digestion</li> <li>• Pyrolysis</li> <li>• Gasification</li> <li>• Fermentation</li> </ul> <p>(Definition and brief description of each method).</p> <p>5.3 Thermal classification of biomass.</p> <p>5.4 Classification of biomass Gasifiers (schematic diagram and working of)</p> <ul style="list-style-type: none"> <li>• Fixed bed gasifier</li> <li>• Fluidized bed gasifier</li> </ul> <p>5.5 Classification of biomass plants.</p> <ul style="list-style-type: none"> <li>• Continuous and batch type</li> <li>• Dome and Drum type</li> <li>• Different variations in Drum type</li> <li>• Advantages and disadvantages of Drum and dome type plants.</li> </ul> <p>( Brief description of working with schematic diagram).</p>	10	12
<p><b><u>Topic 6 : Other Energy Sources</u></b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Identify different geothermal energy and geothermal sources.</li> <li>➤ Identify different methods of Ocean Thermal Electric Power Generation</li> <li>➤ List advantages and disadvantages of Tidal Power Plant</li> <li>➤ Understand the operation of fuel cell and hydrogen energy</li> </ul> <p><b>Contents:</b></p> <p>6.1 Concept of geothermal energy and geothermal sources</p> <ul style="list-style-type: none"> <li>• Hydrothermal, geopressured, petrothermal, magma volcano: Diagram showing typical geothermal field</li> <li>• Operation of geothermal power plant with schematic diagram</li> <li>• Advantages and disadvantages of geothermal energy.</li> </ul>	06	10

<ul style="list-style-type: none"> <li>• Application of Geothermal energy.</li> </ul> <p>6.2 Ocean Thermal Electric Power Generation:</p> <ul style="list-style-type: none"> <li>• Construction and operation of the plant with diagram of Closed cycle / Anderson cycle, Open cycle / Claud cycle</li> <li>• Site selection for Ocean Thermal Electric Power Plant</li> </ul> <p>6.3 Energy from Tides</p> <ul style="list-style-type: none"> <li>• Principles of Tidal Power Generation</li> <li>• Components and their functions: Dams( Barrage), Gates and Locks, Power House</li> <li>• Operation method of utilization of Tidal Energy: Single basin arrangement , Double basin arrangement</li> <li>• Site requirement</li> <li>• Advantages and limitations</li> </ul> <p>6.4 Emerging technologies</p> <ul style="list-style-type: none"> <li>• Fuel Cell: Principle, construction, operation, applications</li> <li>• Hydrogen Energy: Principle, applications, advantages, limitations</li> </ul>		
<b>Total</b>	<b>64</b>	<b>100</b>

### List of Assignments:

1. Measurement of solar radiation by solar measurement kit.
2. Determine the capacity of solar water heater depending upon quantity of water to be heated .State the procedure for erection
3. Collect information about PV cells: compare them on the basis of ratings, cost, application and life.
4. Search on different areas for economic applications of solar energy.
5. Collect information about different types of wind mills in Maharashtra state: Installed capacity, location, type and company.
6. Visit to any solar and Wind power plant and prepare a report mentioning, generating capacity, and specification, type of generator and wind mill used.
7. Collect the case studies of biomass generation and Municipal Solid waste projects in Maharashtra and write a report on it.
8. Collect information of potential of geothermal energy, tidal energy and wave energy in India form internet, journals and magazines
9. Collect information of design, operation and applications of fuel cells
10. Collect information from journals, magazines, and from internet related to “Recent trends in renewable energy sources”. Present the seminar on the same.
11. Prepare a report on implementation of renewable energy for Rural electrification in India

### Learning Resources:

#### 1. Books:

Sr. No.	Author	Title	Publisher
1	G. D. Rai	Non-Conventional Energy Sources	Khanna Publications

2	S. P. Sukhatme	Solar Energy	Tata McGraw Hill
3	Abbasi	Renewable energy sources: Their impact on global warming and pollution .	PHI
4	Dr. H. S. Mukund	Understanding Clean Energy and Fuels from Biomass	Wiley India
5	Kothari, Singal & Rajan	Renewable Energy Sources and Emerging Technologies	PHI
6	Boyle	Renewable Energy Power for Sustainable Future: Second edition	Oxford University press

**Websites:**

1. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)
2. [www.solardyne.com](http://www.solardyne.com)
3. [www.otherpower.com](http://www.otherpower.com)
4. [www.solarenergy.com](http://www.solarenergy.com)
5. [www.windpower.org](http://www.windpower.org)
6. [www.alternativesourcesofenergy.net](http://www.alternativesourcesofenergy.net)
7. [www.mnre.gov.in](http://www.mnre.gov.in)
8. [www.howstuffworks.com](http://www.howstuffworks.com)
9. [www.mahaurja.org/com](http://www.mahaurja.org/com)