

# **RENEWABLE ENERGY SOURCES**

Subject code: **MT831OE**

Regulations: R16-JNTUH

Class: IV Year B. Tech CE II Sem



DEPARTMENT OF CIVIL ENGINEERING  
BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY  
Ibrahimpattam - 501 510, Hyderabad

# **RENEWABLE ENERGY SOURCES (MT831OE)**

## **COURSE PLANNER**

### **I. COURSE OVERVIEW:**

As humanity progresses in the 21st century, it would in future encounter major challenges in terms of ensuring adequate and equitable provision of energy. While the 20th century was characterized by growing dependence on fossil fuels, the current century would have to deal with the depletion of reserves of fossil fuels, growing environmental problems as a result of production and use of these fuels as well as the threat of climate change, which results from the emissions of GHGs (greenhouse gases) due to the combustion of fossil fuels. There are, therefore, several reasons for the world to explore with some urgency alternative sources of energy supply.

Renewable energy is an option that promises a clean and healthy environment for future generations. The use of renewable energy offers countries around the world the chance to improve their energy security and spur economic development. Renewables solve the two-way problem faced by us today in the energy sector - first it solves the problem depleting stock (that is the reason they are called renewable) and secondly, they do not cause any significant pollution.

The module 'Renewable Energy Sources' describes the various renewable energy sources available to us. Also, discusses the current and future prospective, uses, and challenges.

### **SCOPE OF COURSE:**

This course explores each of the principal renewable energy sources in turn. Each technology is examined in terms of the relevant physical principles; the main technologies involved; their costs and environmental impact; the size of the potential renewable resource; and their future prospects.

### **II. PRE REQUISITES:**

Knowledge of thermodynamics, heat transfer, energy engineering, applied thermodynamics and heat cycles.

### **III. COURSE OBJECTIVE:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

#### IV. COURSE OUTCOMES:

Sl.NO	Description	Bloom's Taxonomy level
CO1.	Understanding of renewable energy sources	<b>L2: Understanding</b>
CO2.	Knowledge of working principle of various energy systems	<b>L2: Understanding</b>
CO3	Capability to carry out basic design of renewable energy systems	<b>L3: Apply</b>

#### V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignment/ Exam
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignment/ Exam
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment/ Exam
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Assignment/Exams
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Assignment/Exams
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	Assignment/Exams
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	1	Assignment/Exams

PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	Assignment/Exams
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Assignment/Exams
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Assignment/Exams
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	-
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	Assignment/Exams

#### VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO1	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyze and provide solutions for the problems related to Mechanical engineering and communicate them effectively to the concerned.	3	Lectures, Assignments
PSO2	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	2	Lectures, Assignments
PSO3	The ability to grasp the latest development, methodologies of mechanical engineering and posses competent knowledge of design process, practical proficiencies, skills and knowledge of programme and developing ideas towards research.	2	Lectures, Assignments

**VII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

CO	Program Outcomes (PO's)												PSO ATTAINMENT		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2	1	1	1	3	1	--	3	3	2	2
CO 2	3	2	2	2	2	1	1	1	3	1	-	3	3	2	2
CO 3	3	2	2	2	2	1	1	1	3	1	-	3	3	2	2
AV G	3	2	2	2	2	1	1	1	3	1	-	3	3	2	2

**VIII. JNTUH SYLLABUS**

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind

energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### **UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India

#### **UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy:** Geothermal power plants, various types, hot springs and steam ejection..

#### **TEXT BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

#### **REFERENCES:**

1. Renewable Energy Resources - Tiwari&Ghosal - Narosa Publisher
2. Principles of Solar Energy – Frank Krieth and John K
3. 5.Non-Conventional Energy – Ashok V Desai

#### **IX.NPTEL WEBSITES**

<https://nptel.ac.in/courses/112104225/22>

<https://nptel.ac.in/courses/112104225/1>

#### **X.GATE SYLLABUS: NOT APPLICABLE**

**IES SYLLABUS: NOT APPLICABLE**

**XI. COURSE PLAN:**

Lecture No.	TOPIC	Course Outcomes	Learning	Teaching Methodology	Reference
<b>UNIT - 1</b>					
1	<b>Global and National Energy Scenario:</b> Over view of conventional & renewable energy sources,	<b>Explain Global and National Energy Scenario:</b> Over view of conventional & renewable energy sources,		Chalk & Talk	<b>Book No. 1, 3</b>
2	need & development of renewable energy sources, types of renewable energy systems,	<b>Explain</b> the need & development of renewable energy sources, types of renewable energy systems,		Chalk & Talk	
3	Future of Energy Use, Global and Indian Energy scenario,	<b>Explain</b> the Future of Energy Use, Global and Indian Energy scenario		Chalk & Talk	
4	Renewable and Non-renewable Energy sources,	<b>Explain</b> the Renewable and Non-renewable Energy sources,		Chalk & Talk	
5	Energy for sustainable development	<b>Explain</b> the Energy for sustainable development		Chalk & Talk	
6	Potential of renewable energy sources,	<b>Explain</b> and concept of Potential of renewable energy sources,		Chalk & Talk	
7	renewable electricity and key elements, Global climate change	<b>Explain</b> and concept of renewable electricity and key elements, Global climate change		Chalk & Talk	
8	CO2 reduction potential of renewable energy-	<b>Explain</b> and concept of CO2 reduction		Chalk & Talk	

	concept of Hybrid systems	potential of renewable energy- concept of Hybrid systems		
<b>UNIT – 2</b>				
<b>9</b>	<b>Solar Energy:</b> Solar energy system	<b>Explain</b> and classification of the Solar energy system	Chalk & Talk	<b>Book No. 1, 2, 3</b>
<b>10</b>	Solar Radiation, Availability	<b>Explain</b> and concept of Solar Radiation, Availability	Chalk & Talk	
<b>11</b>	Measurement and Estimation	<b>Explain</b> of the Measurement and Estimation,	Chalk & Talk	
<b>12</b>	Solar Thermal Conversion and Storage Devices	<b>Classification</b> of the Solar Thermal Conversion Devices and Storage,	Chalk & Talk	
<b>13</b>	Applications Solar Photovoltaic Conversion solar photovoltaic	<b>Applications</b> Solar Photovoltaic Conversion solar photovoltaic	Chalk & Talk	
<b>14</b>	solar thermal	<b>Explain</b> the solar thermal applications	Chalk & Talk	
<b>15</b>	applications of solar energy systems	<b>Explain</b> the applications of solar energy systems	Chalk & Talk	
<b>UNIT – 3</b>				
<b>19</b>	<b>Wind Energy:</b> Wind Energy Conversion, Potential	<b>Explain</b> and concept of WIND ENERGY: Sources and potentials	Chalk & Talk	<b>Book No. 2, 5</b>
<b>20</b>	Wind energy potential measurement, Site selection	<b>Understanding</b> of the Horizontal and vertical axis wind mills	Chalk & Talk	



21	Types of wind turbines, Wind farms, wind Generation and Control	<b>Analyze</b> the design of Horizontal and vertical axis wind mills	Chalk & Talk	
22	Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation	<b>Analyze</b> the performance characteristics, Benz Criteria	Chalk & Talk	
23	wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy	<b>Explain</b> of the wind speed monitoring, classification of wind characteristics, applications of wind turbines, offshore wind energy	Chalk & Talk	
24	Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices	<b>Understanding</b> of the Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices	Chalk & Talk	
25	Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts	<b>Understanding</b> of Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts	Chalk & Talk	
26	Safety and environmental aspects, wind energy potential and installation in India.	<b>Understanding</b> of the Safety and environmental aspects, wind energy potential and installation in India	Chalk & Talk	
<b>UNIT – 4</b>				
27	<b>Biogas:</b> Properties of biogas (Calorific value	<b>Understanding</b> of the <b>Biogas:</b> Properties of	Chalk & Talk	<b>Book No. 2,</b>

	and composition), biogas plant technology and status	biogas (Calorific value and composition), biogas plant technology and status		<b>5</b>
<b>28</b>	Bio energy system, design and constructional features	<b>Explain</b> theBio energy system, design and constructional features	Chalk & Talk	
<b>29</b>	Biomass resources and their classification, Biomass conversion processes	<b>Understanding</b> of the Biomass resources and their classification, Biomass conversion processes,	Chalk & Talk	
<b>30</b>	Thermo chemical conversion, direct combustion, biomass gasification	<b>Understanding</b> of the Thermo chemical conversion, direct combustion, biomass gasification	Chalk & Talk	
<b>31</b>	pyrolysis and liquefaction, biochemical conversion, anaerobic digestion,	<b>Understanding</b> of the pyrolysis and liquefaction, biochemical conversion, anaerobic digestion	Chalk & Talk	
<b>32</b>	types of biogas Plants, applications, alcohol production from biomass	<b>Understanding</b> of the types of biogas Plants, applications, alcohol production from biomass,	Chalk & Talk	
<b>33</b>	bio diesel production, Urban waste to energy conversion	<b>Understanding</b> of the bio diesel production, Urban waste to energy conversion	Chalk & Talk	
<b>34</b>	Biomass energy programme in India	<b>Understanding</b> of the Biomass energy programme in India	Chalk & Talk	

**UNIT – 5**

<b>UNIT – 5</b>				
<b>36</b>	<b>Ocean Energy:</b> Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC),	<b>Understanding</b> of the <b>Ocean Energy:</b> Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC)	Chalk & Talk	<b>Book No. 2, 5</b>
<b>37</b>	ocean thermal power plants, tidal energy conversion	<b>Understanding</b> of the ocean thermal power plants, tidal energy conversion	Chalk & Talk	
<b>38</b>	Tidal and wave energy its scope and development,	<b>Understanding</b> of the Tidal and wave energy its scope and development	Chalk & Talk	
<b>39</b>	Scheme of development of tidal energy	<b>Applications</b> of Scheme of development of tidal energy	Chalk & Talk	
<b>40</b>	<b>Small hydro Power Plant:</b>	<b>Understanding</b> of the <b>Small hydro Power Plant</b>	Chalk & Talk	
<b>41</b>	Importance of small hydro power plants and their Elements,	<b>Understanding</b> of the Importance of small hydro power plants and their Elements	Chalk & Talk	
<b>42</b>	types of turbines for small hydro,.	<b>Understanding</b> of the types of turbines for small hydro	Chalk & Talk	
<b>43</b>	estimation of primary and secondary power	<b>Understanding</b> of the estimation of primary and secondary power,	Chalk & Talk	

44	<b>Geothermal Energy:</b> Geothermal power plants, various types	<b>Understanding</b> of the <b>Geothermal Energy:</b> Geothermal power plants, various types,	Chalk & Talk
45	hot springs and steam ejection.	<b>Expalin</b> the hot springs and steam ejection	Chalk & Talk

## XII.QUESTION BANK: DESCRIPTIVE QUESTIONS:

### UNIT-1

#### Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	What is the renewable energy sources?	<b>L2:Understand</b>	<b>CO 1</b>
2	Classify renewable energy systems.	<b>L2:Understand</b>	<b>CO2</b>
3	What is the role and potential of renewable source?	<b>L2:Understand</b>	<b>CO 1</b>
4	State the principle of renewable electricity and key elements.	<b>L2:Understand</b>	<b>CO 2</b>
5	State the environmental impact of Global climate change.	<b>L2:Understand</b>	<b>CO 2</b>

#### Long Answer Questions-

1	Explain the Over view of conventional & renewable energy sources.	<b>L2:Understand</b>	<b>CO 1</b>
2	Explain about need & development of renewable energy sources.	<b>L2:Understand</b>	<b>CO2</b>
3	Write the types of renewable energy systems	<b>L2:Understand</b>	<b>CO 1</b>
4	Explain the Renewable and Non-renewable Energy sources, Energy for sustainable development.	<b>L2:Understand</b>	<b>CO 2</b>
5	Explain the Potential of renewable energy sources, renewable electricity and key elements.	<b>L2:Understand</b>	<b>CO 2</b>

6	What is Global climate change, CO <sub>2</sub> reduction potential of renewable energy- concept of Hybrid systems?	<b>L2:Understand</b>	<b>CO 1</b>
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### UNIT-2

#### Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	What is the standard value of solar constant?	<b>L2:Understand</b>	<b>CO 1</b>
2	Classify focusing type collectors.	<b>L2:Understand</b>	<b>CO2</b>
3	What is the role and potential of renewable source?	<b>L2:Understand</b>	<b>CO 1</b>
4	State the principle of solar radiation.	<b>L2:Understand</b>	<b>CO 2</b>
5	State the environmental impact of solar power.	<b>L2:Understand</b>	<b>CO 2</b>

#### Long Answer Questions-

1	Derive the expression for monthly average of hourly global radiation on a tilted surface.	<b>L2:Understand</b>	<b>CO 1</b>
2	Explain about Beam and Diffuse radiation.	<b>L2:Understand</b>	<b>CO2</b>
3	Define the following: i. Declination ii. Altitude angle iii. Solar Constant.	<b>L2:Understand</b>	<b>CO 1</b>
4	Explain extraterrestrial and terrestrial Radiation.	<b>L2:Understand</b>	<b>CO 2</b>
5	Explain the principle of conversion of solar energy into heat.	<b>L2:Understand</b>	<b>CO 2</b>
6	What features of solar energy make it attractive for use in irrigation water pump?	<b>L2:Understand</b>	<b>CO 1</b>
7	Explain the following terms (a) Flat plate (b) Paraboloidal dish.	<b>L2:Understand</b>	<b>CO2</b>
8	Explain in brief the Environmental impact of solar power.	<b>L2:Understand</b>	<b>CO 1</b>
9	Explain the role and potential of new and renewable energy sources.	<b>L2:Understand</b>	<b>CO 2</b>
10	With neat sketch explain the instrument for measuring	<b>L2:Understand</b>	<b>CO 2</b>

	solar radiation and sun shine.		
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### UNIT-3

#### Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	What is Benz Criteria?	L2:Understand	CO 1
2	How do you get biogas from plant wastes?	L2:Understand	CO 2
3	What are the most favorable sites for installing of wind turbines?	L2:Understand	CO 1
4	State the merits and demerits of Horizontal and Vertical windmills.	L2:Understand	CO 2

#### Long Answer Questions-

1	Describe the main applications of wind energy.	L2:Understand	CO 2
2	Describe with a sketch the working of a wind energy system with main Components.	L2:Understand	CO 1
3	Derive the expression for power developed due to wind.	L2:Understand	CO 2
4	Explain the various classification of wind, characteristics	L2:Understand	CO 1
5	Explain Wind mill component design, economics and demand side management	L2:Understand	CO 2
6	Draw the sketches of Types of wind turbines.	L2:Understand	CO 2
7	Explain with neat sketch energy wheeling, and energy banking concepts.	L2:Understand	CO 1
8	Explain Safety and environmental aspects.	L2:Understand	CO 2
9	Explain the performance characteristics of wind mills.	L2:Understand	CO 1
10	With neat sketch explain the Wind Energy Conversion.	L2:Understand	CO 2

### UNIT-4

#### Short Answer Questions-

Sl.No	Question	Blooms Taxonomy	Course Outcome
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		Level	
1	What is <b>Biogas</b> ?	<b>L2:Understand</b>	<b>CO 1</b>
2	How do you get biogas from plant wastes?	<b>L2:Understand</b>	<b>CO 2</b>
3	What are the most favorable Properties of biogas	<b>L2:Understand</b>	<b>CO 1</b>
4	State the merits and demerits of biogas plant technology	<b>L2:Understand</b>	<b>CO 2</b>
5	What are the various advantages of anaerobic digestion?	<b>L2:Understand</b>	<b>CO 1</b>

### Long Answer Questions-

1	Describe the main applications of Biogas Energy.	<b>L2:Understand</b>	<b>CO 2</b>
2	Describe with a sketch the working of a Biogas energy system with main Components.	<b>L2:Understand</b>	<b>CO 1</b>
3	Derive the expression for power developed due to bio gas.	<b>L2:Understand</b>	<b>CO 2</b>
4	Explain the various factors affecting the generation of biogas.	<b>L2:Understand</b>	<b>CO 1</b>
5	Explain various dry processes of bioenergy conversion in brief.	<b>L2:Understand</b>	<b>CO 2</b>
6	Draw the sketches of Digester suitable for high water table.	<b>L2:Understand</b>	<b>CO 2</b>
7	Explain with neat sketch Absolute segregation of slurry.	<b>L2:Understand</b>	<b>CO 1</b>
8	Explain about two chamber rectangular digester with floating gas holder and water seal.	<b>L2:Understand</b>	<b>CO 2</b>
9	Explain the Urban waste to energy conversion.	<b>L2:Understand</b>	<b>CO 1</b>
10	With neat sketch explain the types of Bio gas digesters.	<b>L2:Understand</b>	<b>CO 2</b>

### UNIT-5

### Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	State the fundamental principle of tidal energy generation.	<b>L2:Understand</b>	<b>CO 1</b>

2	What is small hydel development?	<b>L2:Understand</b>	<b>CO 2</b>
3	What is the fundamental principle in energy conversion from ocean waves?	<b>L2:Understand</b>	<b>CO 1</b>
4	What are the civil works design considerations for mini and micro hydel power plants?	<b>L2:Understand</b>	<b>CO 2</b>
5	Classify small hydel power stations?	<b>L2:Understand</b>	<b>CO 1</b>

**Long Answer Questions-**

1	Explain the difference between geothermal plant and thermal plant.	<b>L2:Understand</b>	<b>CO 2</b>
2	Explain the various methods to extract geothermal energy.	<b>L2:Understand</b>	<b>CO 1</b>
3	Explain the potential of geothermal resources in India.	<b>L2:Understand</b>	<b>CO 2</b>
4	Explain Liquid dominated geothermal power plant with neat sketch.	<b>L2:Understand</b>	<b>CO 1</b>
5	Draw the diagram of geothermal field.	<b>L2:Understand</b>	<b>CO 2</b>
6	Explain the working of Anderson cycle OTEC system with neat sketch.	<b>L2:Understand</b>	<b>CO 2</b>
7	Explain the fundamental principle of tidal energy generation.	<b>L2:Understand</b>	<b>CO 1</b>
8	Explain vapor dominated geothermal power plant with neat sketch.	<b>L2:Understand</b>	<b>CO 2</b>
9	Explain the power generation from single ebb cycle system.	<b>L2:Understand</b>	<b>CO 1</b>
10	Explain the potential of geothermal energy in India.	<b>L2:Understand</b>	<b>CO 2</b>

**OBJECTIVE QUESTIONS:**

**UNIT-1**

1. A photovoltaic cell converts \_\_\_\_\_.
- (a) Heat energy into mechanical energy      (b) Chemical energy into electrical energy
- (c) solar energy into electrical energy      (d) electrical energy into chemical energy



2. The value of solar constant is \_\_\_\_\_.
3. The highest rank of coal in which carbon content is about 90% is \_\_\_\_\_.
4. Non - conventional energy sources are available in form of \_\_\_\_\_.
5. The sun's outer visible layer is called \_\_\_\_\_ and has temperature of about \_\_\_\_\_.
6. An artificial or natural body of water for collecting and absorbing solar radiation energy and storing it as heat is known as \_\_\_\_\_.
7. Solar heat is directly converted into electricity by \_\_\_\_\_ converters.
8. Photovoltaic cell is a device which converts directly sunlight into \_\_\_\_\_.
9. The current and voltage relationship in a solar cell is given by \_\_\_\_\_.
10. The two basic instruments that are employed for solar radiation measurement are \_\_\_\_\_ and \_\_\_\_\_.
11. The relation between zenith ( $\theta_z$ ) and solar altitude ( $\alpha$ ) angles is \_\_\_\_\_.  
 (a)  $\theta_z + \alpha = 60^\circ$     (b)  $\theta_z + \alpha = 90^\circ$  (c)  $\theta_z + \alpha = -90^\circ$     (d)  $\theta_z + \alpha = 0^\circ$ .

### UNIT-2

1. On September 22<sup>nd</sup>, 2001, the declination angle will be \_\_\_\_\_.  
 (a) zero                      (b)  $+23.45^\circ$                       (c)  $-23.45^\circ$                       (d)  $+180^\circ$
2. Darrius type of rotor mill is used for \_\_\_\_\_ velocity wind.
3. The amount of electromagnetic energy incident on a surface per unit time per unit area is known as \_\_\_\_\_.
4. A flat plate collector is used for many applications such as \_\_\_\_\_.
5. The efficiency of a concentrating collector is \_\_\_\_\_.
6. The basic components of solar water heater are \_\_\_\_\_.
7. Which of the following is not a concentrating type of solar collector?  
 (a) Parabolic trough collector                      (b) liquid heating collector  
 (c) Fresnel lens collector                      (d) Mirror strip reflector
8. In a solar pond , the concentration and temperature are nearly constant in  
 (a) Surface convective zone                      (b) non convective zone  
 (c) storage zone                      (d) All the above
9. Which of the following is not a concentrating type of solar collector?  
 (a) Parabolic trough collector                      (b) liquid heating collector  
 (c) Fresnel lens collector                      (d) Mirror strip reflector
10. The collector area is same as absorber area in \_\_\_\_\_.  
 (a) Non concentrating collector                      (b) Flat plate type solar collector  
 (c) Concentrating type solar collector                      (d) both (a) & (b)

### UNIT-3

1. The phenomenon in which a lot of turbulence ensues, the lift decreases and drag increases quite substantially is called \_\_\_\_\_.

2. Wind aero generators of WECS are generally classified as \_\_\_\_\_ and \_\_\_\_\_.
3. The expression for monthly average horizontal solar radiation  $H_{av}$  is given by \_\_\_\_\_.
4. Efficiency of SPV module is typically \_\_\_\_\_%.
5. A fuel cell is an electrochemical device that converts \_\_\_\_\_ into \_\_\_\_\_.
6. The total power of a wind stream is proportional to \_\_\_\_\_.
  - (a) velocity of stream
  - (b) (velocity of stream)<sup>2</sup>
  - (c) (velocity of stream)<sup>3</sup>
  - (d) 1 / velocity of stream
7. The two primary mechanisms for producing forces from the wind are \_\_\_\_\_ and \_\_\_\_\_.
8. The kinetic energy of wind can be changed into \_\_\_\_\_ or \_\_\_\_\_ energy.
9. Bio gas obtained from cattle dung contains methane about \_\_\_\_\_ to \_\_\_\_\_ percent.
10. Kinetic energy of the wind is given by \_\_\_\_\_.
11. Wind speed at which wind energy starts delivering shaft power is called \_\_\_\_\_.
12. Vertical axis Wind machine among the following
  - (a) Sail type wind machine
  - (b) Multi-bladed wind machine
  - (c) Darrius type rotor
  - (d) both (a) & (b)

#### UNIT -4

1. The value of Betz coefficient ( $C_p$ ) for a horizontal axis wind machine is \_\_\_\_\_.
  - (a) 16 / 27
  - (b) 2 / 3
  - (c) 8 / 27
  - (d) None
2. The different types of wells for geo thermal energy are \_\_\_\_\_.
3. The two primary mechanisms for producing forces from the wind are \_\_\_\_\_ and \_\_\_\_\_.
4. Bio gas is known as \_\_\_\_\_.
5. The two types of OTEC systems are \_\_\_\_\_ and \_\_\_\_\_.
6. A limitation of ocean thermal energy power plant is \_\_\_\_\_.
7. The rise and fall of water level follows a \_\_\_\_\_ curve.
8. Total energy and power density can be written as \_\_\_\_\_.
9. The average rate of release of geothermal energy from within the earth is around \_\_\_\_\_  $W/m^2$ .
10. \_\_\_\_\_ is most important fuel as its component is able to release more energy per unit weight.

#### UNIT -5

1. At the altitude angle of  $30^\circ$ , the magnitude of zenith angle will be \_\_\_\_\_.
2. The angle between the direction of wind and direction perpendicular to the plane of blade is called \_\_\_\_\_.
3. HAWT stands for \_\_\_\_\_.
4. Okha wind farm in Gujarat has \_\_\_\_\_ units of \_\_\_\_\_ kw each.
5. Maximum power output of MHD generator is given by \_\_\_\_\_.
6. The main causes of energy crisis are \_\_\_\_\_.
7. Conventional energy sources are available in form of \_\_\_\_\_.
8. Gaseous product consisting of methane and carbon dioxide is known as \_\_\_\_\_.
9. Dissociation and Ionization are the principles for \_\_\_\_\_.
10. The thermodynamic aspect for DEC is \_\_\_\_\_.

## **XII.WEBSITES:**

1. [www.power-eng.com](http://www.power-eng.com)
2. [www.rwe.com](http://www.rwe.com)
3. [www.iaea.org](http://www.iaea.org)
4. [www.powerplantengineering.com](http://www.powerplantengineering.com)
5. [www.nae.edu](http://www.nae.edu)
6. [www.power-gen.com](http://www.power-gen.com)

## **XII.EXPERT DETAILS:**

1. DrB.SudheerPrem Kumar, Professor & HOD (Mech), JNTU, Hyderabad
2. Dr AVSSK Gupta, Professor (Mech), JNTU, Hyderabad
3. DrE.Ramjee, Professor (Mech), JNTU, Hyderabad
4. Dr M.V Ramana Murthy, Associate Professor (Mech), OU, Hyderabad
5. Dr Raja Banerjee, Associate Professor, IIT Hyderabad

## **XIV.JOURNALS:**

1. International Journal of Energy Engineering
2. Nuclear Engineering and Design
3. International Journal of Energy Engineering

## **XV.LIST OF TOPICS FOR STUDENT SEMINARS:**

1. Indian Energy Scenario and World Energy resources
2. Solar Thermal Energy conversion
3. Design of Wind Power Turbines
4. Bio Mass Energy from Municipal Waste
5. Thermo Electric Power Generation
6. Fuel cell Technology

## **XVI.CASE STUDIES / SMALL PROJECTS:**

1. Preparing an automobile using solar energy
2. Preparing an turbine blade model using wind energy