RENEWABLE ENERGY SOURCES

Subject Code : (MT831OE/ME853PE)
Regulations : R16 - JNTUH
Class : IV Year B.Tech EEE II Semester

Department of Electrical and Electronics and Engineering

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

RENEWABLE ENERGY SOURCES (MT831OE/ME853PE)
COURSE PLANNER

I. COURSE PURPOSE:

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:

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.

- 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	**L2: Understanding**
CO2.	Knowledge of working principle of various energy systems	**L2: Understanding**
CO3.	Capability to carry out basic design of renewable energy systems	**L2: Understanding**

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignment/ Exam
PO2	**Problem analysis**: 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	**Design/development of solutions**: 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	**Conduct investigations of complex problems**: 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	**Modern tool usage**: 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.	1	Assignment/Exams
PO6	**The engineer and society**: 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	**Environment and sustainability**: 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	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	Assignment/Exams
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Assignment/Exams
PO10	**Communication**: 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	**Project management and finance**: 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	**Life-long learning**: 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's	Program Outcomes (PO's)												PSO ATTAINMENT		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1.	3	2	2	2	2	1	1	1	3	1	--	3	3	2	2
CO2.	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 Nonrenewable 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.

SUGGESTED BOOKS:

TEXT BOOK:

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986

REFERENCES:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

NPTEL WEBSITES

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

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

GATE SYLLABUS: NOT APPLICABLE

IES SYLLABUS: NOT APPLICABLE

IX. COURSE PLAN:

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

LESSON PLAN ACADEMIC YEAR 2020-2021 II SEM

Course Instructor :Mr.V Sampath Kumar/Ms.S.Marlin **Class: EEE-IV-A/B**

Subject: Renewable Energy Sources **WEF :26/03/2021**

LNo.	WEEK No.	Topics	Link for PDF	Link for PPT	Link for Small Projects/ Numericals(if any)	COURSE LEARNING OUTCOMES	TEACHING METHODOLOGY	REFERENCES
1	1	**Global and National Energy Scenario:** Role and potential of new and renewable source,	https://drive.google.com/file/d/1JnD73p3MC5DI7bML4_jVkV-qXSKph0gs/view?usp=sharing	https://drive.google.com/file/d/1KcFb3M7K3XHqICTNQiPSc2YTFGB8af_S/view?usp=sharing	https://drive.google.com/file/d/1RAvK7b3nDDCVX64wbnNpJmDvDOEEh4Ru/view?usp=sharing	Explain	PPT	Text book 1
2		**Student Presentations**	Student Presentations			Student Presentations		
3		Types of Renewable energy sources and needs , physics of the Sun, the solar constant,	https://drive.google.com/file/d/1fFbdnmh8mctQ5QeRsXuRBjBShMGjB8hu/view?usp=sharing	https://drive.google.com/file/d/1KcFb3M7K3XHqICTNQiPSc2YTFGB8af_S/view?usp=sharing	https://drive.google.com/file/d/14Zw5rhbDXNKmTSpgLm819uEO3DkTsbkn/view?usp=sharing	Explain	PPT	
4	2	Extra - terrestrial and terrestrial solar radiation,	https://drive.google.com/file/d/1kMDLlOxl-2DNIS2aLWVlTQAY1kCotjwz/view?usp=sharing	https://drive.google.com/file/d/1ePFz9SRSyjH0AYzrdxA7oGXgszeh8QIM/view?usp=sharing	https://drive.google.com/file/d/1clGrWaDmGLgSZ_p5sOyXwF08znKaVVpn/view?usp=sharing	Understand	PPT	Text book 1
5		Solar radiation on tilted surface, Instrument for measuring solar radiation and sun shine, solar radiation data.	https://drive.google.com/file/d/1w4grHJKgNpHln_oSfl6Pj5Om-jOSvOru/view?usp=sharing	https://drive.google.com/file/d/1KcFb3M7K3XHqICTNQiPSc2YTFGB8af_S/view?usp=sharing	https://drive.google.com/file/d/1RAvK7b3nDDCVX64wbnNpJmDvDOEEh4Ru/view?usp=sharing	Understand	PPT	Text book 1
6		**Student Presentations**	Student Presentations			Student Presentations		

7		**Mock 1**	-	-		Explain	PPT	Text book 1
8	3	**SOLAR ENERGY COLLECTION:** Flat plate collectors, Flat plate & concentrating collectors	https://drive.google.com/file/d/1gxs4Uszud_IzhMtDteJT3gs3cw1EJOXn/view?usp=sharing	https://drive.google.com/file/d/1DwNQ7q-KK20ZugAe-R0qQ0fw5_UV3xtP/view?usp=sharing	https://drive.google.com/file/d/1_rv8QnW2XFF9CdBVisV9MKLPRZgmoEb4/view?usp=sharing	Explain	PPT	Text book 1
9		Classification of concentrating collectors, orientation and thermal analysis	https://drive.google.com/file/d/1_X3edXbKVpTsZD-mC1bFveCkpDcR_cHQ/view?usp=sharing	https://drive.google.com/file/d/10nevqd4l1Q2pnnMAeBbvVrM8_Z4espMY/view?usp=sharing		Understand	PPT	Text book 1
10		SOLAR ENERGY STORAGE AND APPLICATIONS: sensible, latent heat and stratified storage	https://drive.google.com/file/d/1mk-6t0QS0vTELwnvJ87iMgvoovRSGyvH/view?usp=sharing	https://drive.google.com/file/d/13G6urQOKKUdyPQCJX_DlmWup0ys2ISwo/view?usp=sharing		Understand	PPT	Text book 1
11		**Student Presentations**	Student Presentations			Student Presentations		
12	4	Solar ponds, Solar Applications - Solar heating / cooling technique, solar Distillation and drying, Photo voltaic energy conversion	https://drive.google.com/file/d/1femfpcvMqo3YMZZ4U-Pjr_R2Jn34SzpV/view?usp=sharing	https://drive.google.com/file/d/1Iuzfdi-WPmnvK6wMJrtYi1veZYJv_1K_/view?usp=sharing		Understand	PPT	Text book 1, 2
13		Revision	-	-		Explain	PPT	Text book 1, 2
14		**Student Presentations**	Student Presentations			Student Presentations		
15	4	**WIND ENERGY:** Sources and potentials, Horizontal and vertical axis wind mills	https://drive.google.com/file/d/11MVHG-qjF0pDs9th9mFvLYTq21KyJgp0/view?usp=sharing	https://drive.google.com/file/d/1qeuduZTnw3WDwbezFcdqWV5Tsxvi7n3_/view?usp=sharing	https://drive.google.com/file/d/1_rv8QnW2XFF9CdBVisV9MKLPRZgmoEb4/view?usp=sharing	Study	PPT	Text book 1, 2
16	5	Design of Horizontal and vertical axis wind mills,	https://drive.google.com/file/d/1XpUl5i8MWstXpSDe-6IxYTEg8apFLy0C/view?usp=sharing	https://drive.google.com/file/d/1vzoHyajRYxqGruyVFPos5HfbClx06mw1/view?usp=sharing		Explain	PPT	Text book 1
17		Performance characteristics, Benz Criteria	https://drive.google.com/file/d/1aVge-ZqPMqrGBe	https://drive.google.com/file/d/1QZM-9pP10o4ynzSu		Application	PPT	Text book 1

			UWWgNYQcNY4vIbAIBr/view?usp=sharing	0Pu6OJnR1YoOc8By/view?usp=sharing				
18		**Student Presentations**	Student Presentations			Student Presentations		
19		BIO-MASS :Principles of Bio conversion	https://drive.google.com/file/d/1vRhuBJ7CoKfbcOWi4ti1GJTKi2q4RWna/view?usp=sharing	https://drive.google.com/file/d/1k9Zulbu8iS-Ur90cDun_Jk6u-PZL09Kx/view?usp=sharing		Application	PPT	Text book 1
20	6	Anaerobic and aerobic digestion. Types of Bio gas digesters	https://drive.google.com/file/d/10kT6ogT9U18yo4Qy9iL1cwEXIiq73yYz/view?usp=sharing	https://drive.google.com/file/d/1R37445AVMvhD5ok4hXV1qGeitGaNNa2T/view?usp=sharing		Explain	PPT	Reference 1
21		IC engine operation and economic aspects	https://drive.google.com/file/d/1XEMxuYFcXz77F4r2zaFma2O8jpd_TYue/view?usp=sharing	https://drive.google.com/file/d/1F2MiGZwadw-Kz6hQPjLhCMkjxMlwbxOP/view?usp=sharing		Explain	PPT	Text book 1
22		**Student Presentations**	Student Presentations			Student Presentations		
23		Revision	-	-		Explain	PPT	Text book 1
24	7	**GEO THERMAL ENERGY :** Resources	https://drive.google.com/file/d/1EDNdIstXcTw8GKTlylpIwd16WNGLgvaf/view?usp=sharing	https://drive.google.com/file/d/17aR1h7mQvDFpbeRTNxFgsduj31XQUSwp/view?usp=sharing	https://drive.google.com/file/d/1_rv8QnW2XFF9CdBVisV9MKLPRZgmoEb4/view?usp=sharing	Application	PPT	Text book 1
25		Types of wells, methods of harnessing the Energy, Potential in India	https://drive.google.com/file/d/1FR2GxH4_1AUFm3U824od6eCNpchacj73/view?usp=sharing	https://drive.google.com/file/d/1FR2GxH4_1AUFm3U824od6eCNpchacj73/view?usp=sharing		Application	PPT	Text book 1
26		**Student Presentations**	Student Presentations			Student Presentations		
27		OCEAN ENERGY : OTEC, Principles of utilization, setting of OTEC plants,	https://drive.google.com/file/d/1WPyx_rqKhZGL662xDyj5hqM91IcvNnMW/view?usp=sharing	https://drive.google.com/file/d/1sxWB3EQBWQj3OdweI86j_nIIKhrDwemd/view?usp=sharing		Application	PPT	Text book 1,2

28		Thermodynamic cycles, Tidal and wave energy	https://drive.google.com/file/d/128l4UJi9qbJvCs5F54DgrvxvUz0tJJiB/view?usp=sharing	https://drive.google.com/file/d/1jwmyWSZNIpqZ9KANxwODKWBS1vlf9Uxl/view?usp=sharing		study	PPT	Text book 1,2
29	8	Potential and conversion techniques, Mini Hydel Power plants and their economics	https://drive.google.com/file/d/1rqaNu8tXD_yu2Xs0IAzyo55FNuZVrLsy/view?usp=sharing	https://drive.google.com/file/d/18lvfnvbUhfXR70ygasVbrmbzfCEpFNfI/view?usp=sharing		Explain	PPT	Text book 1,2
30		**Student Presentations**	Student Presentations			Student Presentations		
31		**Mock 2**	-	-		Explain	PPT	Reference 1
32	9	**DIRECT ENERGY CONVERSION :** Need for DEC, Carnot cycle, limitations	https://drive.google.com/file/d/1-039k7KlKKc2Pc_HiRW32z8TDGPwTWrV/view?usp=sharing	https://drive.google.com/file/d/1tAZIsABklrP5PfXvW8scTmIzRK2zVHWR/view?usp=sharing	https://drive.google.com/file/d/1G9RGYVbwlSSs2KfcJXlp8-vQ-1r8H8Cr/view?usp=sharing	Explain	PPT	Text book 1,2
33		Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects	https://drive.google.com/file/d/1FR2GxH4_1AUFm3U824od6eCNpchacj73/view?usp=sharing	https://drive.google.com/file/d/123nOalIBnGQAYbXe_oA6IqAjIFiwvC4P/view?usp=sharing		Explain	PPT	Text book 1,2
34	10	**Student Presentations**	Student Presentations			Student Presentations		
35		Figure of Merit, materials, applications, MHD generators, principles, dissociation and ionization	https://drive.google.com/file/d/1v6g3gtEYQE_YVyZT9Cwwr4exXnU70lew/view?usp=sharing	https://drive.google.com/file/d/123nOalIBnGQAYbXe_oA6IqAjIFiwvC4P/view?usp=sharing		Study	PPT	Text book 1,2
36		Hall effect, Magnetic Flux, MHD accelerator, MHD engine	https://drive.google.com/file/d/1DNxxX3yfSPlFrzhln-MSm4WWLIQj5i2f/view?usp=sharing	https://drive.google.com/file/d/1TPdLX3nOZbHdvCfSZLD2nCCsNXc2tQj2/view?usp=sharing		Illustrate	PPT	Text book 1,2
37	11	MHD engine, power generation systems, electro gas dynamic conversion, economic aspects, Fuel cells, principles, Faraday's laws	https://drive.google.com/file/d/1cPiBUvma6Kq8wv5U0cPCQ_6uR7VgI54I/view?usp=sharing	https://drive.google.com/file/d/10qdLjF0rvRV2w5EFKDUnlOWyvImPjK0k/view?usp=sharing		Explain	PPT	Text book 1,2

38		**Student Presentations**	Student Presentations			Student Presentations	
39		thermodynamic aspects, selection of fuels and operating conditions	https://drive.google.com/file/d/1-039k7KlKKc2Pc_HiRW32z8TDGPwTWrV/view?usp=sharing	https://drive.google.com/file/d/19x7I02Hyira65nqs5tMur9Aj8oV7Zk9W/view?usp=sharing		Explain	PPT	Text book 1,2

SUGGESTED BOOKS:

TEXT BOOK:

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986

REFERENCES:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

NPTEL WEBSITES

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

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

GATE SYLLABUS: NOT APPLICABLE

IES SYLLABUS: NOT APPLICABLE

X. QUESTION BANK: (JNTUH)

DESCRIPTIVE QUESTIONS:

UNIT-I

Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	What are conventional & renewable energy sources?	**L2**	**CO 1**
2	Explain types of renewable energy systems?	**L2**	**CO 2**
3	What is Future of Energy Use?	**L2**	**CO 1**
4	What is Global and Indian Energy scenario?	**L2**	**CO 2**
5	What is the concept of Hybrid systems?	**L2**	**CO 1**

Long Answer Questions-

1	Explain need & development of renewable energy sources?	**L2**	**CO 2**
2	Explain types of renewable energy systems?	**L2**	**CO 1**
3	Explain Renewable and Nonrenewable Energy sources?	**L2**	**CO 2**
4	Explain in brief Energy for sustainable development, Potential of renewable energy sources?	**L2**	**CO 1**
5	Explain in detail about renewable electricity and key elements?	**L2**	**CO 2**
6	Explain the Global climate change, CO2 reduction potential of renewable energy	**L2**	**CO 2**

UNIT-II

Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	What is the standard value of solar constant?	**L2**	**CO 1**
2	Classify focusing type collectors.	**L2**	**CO2**
3	What is the role and potential of renewable source?	**L2**	**CO 1**

4	State the principle of solar radiation.	**L2**	**CO 2**
5	State the environmental impact of solar power.	**L2**	**CO 2**

Long Answer Questions-

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

UNIT-III

Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain Wind Energy Conversion?	**L2**	**CO 2**
2	Explain Nature of the wind?	**L2**	**CO 1**
3	What is energy wheeling, and energy banking concepts?	**L2**	**CO 2**
4	Explain the – Hybrid systems of wind energy?	**L2**	**CO 1**
5	What is meant by Betz limit?	**L2**	**CO 2**

Long Answer Questions-

1	Write short notes on: i Wind Energy Conversion, Potential ii. Wind energy potential measurement?	**L2**	**CO 2**
2	Explain about types of wind turbines?	**L2**	**CO 1**
3	Explain Wind farms, wind Generation and Control?	**L2**	**CO 2**
4	Explain wind speed monitoring, classification of wind and its characteristics?	**L2**	**CO 1**
5	List out and explain Safety and environmental aspects, wind energy potential and installation in India?	**L2**	**CO 2**
6	Enumerate applications of wind turbines, offshore wind energy?	**L2**	**CO 2**
7	Explain site selection, wind energy conversion devices?	**L2**	**CO 1**
8	Explain Wind mill component design, economics and demand side management?	**L2**	**CO 2**

UNIT-IV

Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	Explain Calorific value and composition of Biogas?	**L2**	**CO 1**
2	How do you get biogas from plant wastes?	**L2**	**CO 2**
3	What are the most favorable sites for installing of wind turbines?	**L2**	**CO 1**
4	State the merits and demerits of Horizontal and Vertical	**L2**	**CO 2**

	windmills.		
5	What are the various advantages of anaerobic digestion?	**L2**	**CO 1**

Long Answer Questions-

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

UNIT-V

Short Answer Questions-

Sl.No	Question	Blooms Taxonomy Level	Course Outcome
1	State the fundamental principle of tidal energy generation.	**L2**	**CO 1**
2	What is small hydel development?	**L2**	**CO 2**
3	What is the fundamental principle in energy conversion from ocean waves?	**L2**	**CO 1**
4	What are the civil works design considerations for mini and micro hydel power plants?	**L2**	**CO 2**
5	Classify small hydel power stations?	**L2**	**CO 1**

Long Answer Questions-

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

OBJECTIVE QUESTIONS:

JNTUH:

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 (θ_z) and solar altitude (α) angles is _____.
(a) $\theta_z + \alpha = 60^0$ (b) $\theta_z + \alpha = 90^0$ (c) $\theta_z + \alpha = -90^0$ (d) $\theta_z + \alpha = 0^0$.

UNIT-2

1. On September 22nd, 2001, the declination angle will be _____.
(a) zero (b) $+23.45^0$ (c) -23.45^0 (d) $+180^0$
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) $(\text{velocity of stream})^2$
(c) $(\text{velocity of stream})^3$ (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 (Cp) 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 30^0, 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 _____.

XI. WEBSITES:

1. www.power-eng.com
2. www.rwe.com
3. www.iaea.org
4. www.powerplantengineering.com
5. www.nae.edu
6. www.power-gen.com

XII. EXPERT DETAILS:

1. Dr B.Sudheer Prem Kumar, Professor & HOD (Mech), JNTU, Hyderabad
2. Dr AVSSK Gupta, Professor (Mech), JNTU, Hyderabad
3. Dr E.Ramjee, Professor (Mech), JNTU, Hyderabad
4. Dr M.V Ramana Murthy, Associate Professor (Mech), OU, Hyderabad
5. Dr Raja Banerjeee, Associate Professor, IIT Hyderabad

XIII. JOURNALS:

1. International Journal of Energy Engineering

Nuclear Engineering and Design

International Journal of Energy Engineering

XIV. 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

CASE STUDIES / SMALL PROJECTS:

1. Preparing an automobile using solar energy

COLLEGE TRANSPORT FACILITY

The institute not only aspires for good academics but also cares for the safety, comfort & convenience of the students; which are the prerequisites for their good academic performance.

Hence for the students' convenience along with many other facilities, college offers transportation to all the students with its fleet of new, neat & clean buses. The college transport facility offers many advantages to the students such as

1. Reaching on time to college and hence punctual in attending the classes.
2. Comfortable journey with an assured seat in the bus.
3. Less strain during the journey, hence better performance in academic activities.
4. Safety of their belongings.
5. Presence of at least 2 faculty incharges in the bus ensures discipline & risk free travel (Especially for girl students).
6. Returning home promptly after the completion of the college.
7. No scope of ragging due to the presence of faculty incharges in the bus.
8. Fleet of 40 buses covering all possible route in twin cities.

Note: We are ready to add few more routes to our coverage if at least 10 students from new areas are registering for the transport facility.

COLLEGE BUS ROUTE SCHEDULE

Route No	Starting Point	Areas Covered
1	**Dilsukhnagar**	Dilsukhnagar (foot-over bridge and Opp. To Sai baba temple Arch), Kothapet Fruit Market, AstaLaxmi Temple Kaman, White House, Sagar Ring Road, Omkar Nagar, Hasthinapuram, BN Reddy
3	**Chaitanyapuri (Women Special)**	Chaitanyapuri, White house, AstaLaxmi Temple Kaman, RR Dist Court, L B Nagar D Mart, Omkar Nagar, Hasthinapuram, BD Reddy Garden, BN Reddy
4	**Kothapet (Women Special)**	Mohan Nagar Andhra Bank ATM, Kothapet, Bakers Q Kothapet, AstaLaxmi Temple Kaman, BN Reddy
5	**Malaysian Township / Shilparamam**	Shilparamam, BIO Diversity, Rayadurgam Police Station, Gachibowli Y Junction, Shaikpet (Darga and Naryanamma College), Tolichowki, Tolichowki X Roads,RethiBowli, Attapur Pillar No 143, Upparpalli X Road, Rajendra Nagar Pillar No: 216, Shivrampally Pillar No: 296, Barkas, Shahin Nagar, PahadiShareef, Tukkuguda
7	**Hayathnagar**	Laxma Reddy Palem, Hayathnagar, Panama, Bhagyalatha Hospital, Hanuman Temple, Shanthi Nagar, Kamala Nagar - Bus Stop, Raithu Bazar, NGO's Colony, Vanasthanlipuram.
8	**Block 1**	Vidhyanagar, Tilaknagar Rly Gate, Shankar Matt, Nallakunta, Tilak Nagar - Signal, Shivam Road - Bakers Q, 6 No. Signal Amberpet, Sri Ramana - Near Temple, Amberpet - Darga, Ramanthpur (TV Studio & HPS)
9	**Himayathnagar**	Indira Park, Himayathnagar (Liberty, Stanza & Minerva Hotel), Barkatpura X Road, Tilaknagar Bus Stop, Street No:6, Moosrambagh (More Super Market)
10	**VST**	Musheerabad, VST Signal, Ramnagar x Roads, RamnagarGundu, VidyanagarSpencers (Adikmet), Amberpet (Police Line), Saroornagar (Lake, Gandhi Statue &Laxmi Vilas Bank), Karmanghat
11	**Darushifa**	Darushifa, City College, Afzalgunj, Puranapool, Bahadurpura, Zoo Park, Shivarampally, Aramgarh, Katedan Signal, CRPF , Banlaguda, Hashmabad, Chandryangutta Flyover, Rakshapuram, Gayatrinagar
12	**Shaadan college**	Shaadan College, Lungerhouse, Mehdipatnam Military Gate, NMDC, Masabtank, Lakdikapool, Nampally (Public gardens, Care hospital), Monza Market, ChadharghatNaigara Hotel, Champapet
13	**RTC X Road**	RTC x Road, Chilkalguda, Kachiguda Tourist Hotel, Kumar Theater, Nimboliadda, SN Reddy Gardens, Green Park Colony, Byramalguda, BD Reddy Garden, BN Reddy
14	**Moula – Ali (Andhra Bank)**	Moulali, HB colony (E-seva, NTR Statue), Mallapur (Bus Stop), Nacharam (Bus Stop, PS), HMT Nagar, Kamineni Hospital, LB Nagar, Omkar Nagar, Hasthinapuram
15	**Bolarum**	Bolarum, Alwal, Lothukunta, Tirumalgiri X Roads, Monda Market, Diamond Point, JBS, Patny-YMCA, Secunderabad, Sangeeth Theater, Mettuguda, Uppal X Road, BN Reddy
16	**Neredmet X Road**	Neredment x Road, Krupa Complex, Vinayak Nagar, East Anandbagh, ZTC, Tarnaka St 'Anns, Uppal Ring Road, Nagole, Kamineni Hospital
18	**Hayathnagar**	Kamala Nagar, Raithu Bazar, Red Tank, NGO’s Colony, Vaidehi Nagar, Yamjal, Ragannaguda
20	**Hyder Nagar**	Hydernagar Temple, Nizampet, JNTU, Vivekananda Nagar, Kukatpally BJP Office, Balanagar, Shobhana Theatre, Ferozguda, Bowenpally, Gilf Bakery, Paradise.

21	**Shalibanda**	Chatrinaka, Laldarwaza, Shalibanda, Chandryangutta, Babanagar, Rakshapuram, Midhani, Balapur X Road, Badangper, Nadargul.
22	**Malakpet**	MalakpetYashoda Hospital, Super bazar, TV Tower , Moosarambagh X Roads, GaddiAnnaram, Shiva Ganga Theater, Saroornagar Lake, Sharada Talkies, Karmanghat x Road, Tapovan
23	**Borabanda**	Motinagar, Rahmathnagar, YusufgudaBasti, Krishna Nagar, Indira Nagar, Sri Nagar Colony, PunjaGutta, Khairatabad, Lakdika Pool, Abids, Koti SBI, Nalgonda X Road, Chanchalguda Jail, Saidabad Signal, Bharat Garden, Byramalguda, Kharmanghat, BN Reddy
24	**Sainikpuri X Road Officer's Colony**	Sainikpuri X Roads, Officers Colony, AS Rao Nagar, Radhika x Roads, ECIL X Roads, SP Nagar Petrol Pump, Lalapet Bridge, Habsiguda, Omkar Nagar, Hasthinapuram
25	**SAHARA**	Mansoorabad, Sahara Estates, M E Reddy Funtion Hall, Sushma Theater, RR School Gautam Nagar, Shiva Sindhu, Vanasthalipuram
26	**Chintalkunta**	Chintalkunta (Check Post & Toyota), Panama, Ganesh Temple, Government Area Hospital, Vanasthalipuram, BN Reddy
27	**Golconda X Road**	Golconda X Road, Raja deluxe Opp, Musheerabad X Roads , Bhoiguda, Padmarao Nagar, Bhoiguda, Chilkalaguda X Roads, Mylargadda, Seethaphalmandi, Tarnaka, Nagole
29	**Jillelguda**	Balapur X Road, Jillellaguda Lake, Meerpet Kaman, Almasguda Kaman, Badangpet, Prasanti Hills, RC Road, Gurramguda
31	**Dilsukhnagar**	DilsukhnagarChandana Bros, Chaitanyapuri, LB Nagar, BN Reddy
32	**Narayanaguda**	Naryanaguda, YMCA, Kachiguda X Roads, Koti Women's College, Govt. Press, Saidabad Colony, Karmanghat, Bharat Gardens, Yamjal, BN Reddy
33	**Uppal Depot**	Medipally, Boduppla (MRF Showroom, NTR Statue & Kaman), Peerjadhiguda, Uppal Bus Stop, Uppal Gandhi Statue
34	**LB Nagar (Women special)**	LB Nagar, Sagar X Road,Omkar Nagar, Hasthinapuram (Central, South), BN Reddy Nagar, Sagar Complex, Injapur, Yamjal
37	**Chaitanyapuri (Geetha Hospital)**	Chaitanyapuri (Geetha Hospital),Ramalayam 2nd Bus stop, Old Maruthinagar, Jain Mandir, Mohan Nagar, Andhra Bank ATM, RK PuramSaibaba Temple, Alkapuri X Road, BN Reddy, Injapur
38	**Safilguda**	Safilguda X Road, Anandbagh X Road, MalkajgiriAnutex , Tukaramgate, Mettuguda, TarnakaSudharshan Sweets, Habsiguda X Road, Uppal X Road.
39	**I S Sadan**	IS Sadan,Yadagiri Theater, Maruthi Nagar Road, Champapet X Road, MandaMallama, Gayatrinagar, TKR Arch, Sagar X Road, Omkar Nagar, Hasthinapurm