INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION

Course Title	**RENEWABLE ENERGY SOURCES**			
Course Code	**A80234**			
Regulation	**R13**			
Course Structure	**Lectures**	**Tutorials**	**Practical's**	**Credits**
	4	**1**	**-**	**3**
Course Coordinator	**Dr. P Mallikarjuna Sharma, Professor, EEE**			
Team of Instructors	**Dr. P Mallikarjuna Sharma, Professor, EEE**			

I. COURSE OVERVIEW:

The course introduces alternative energy sources and explains solar energy radiation, collection, storage, and application. It also introduces Wind Energy, Biomass Energy, Geothermal Energy and Ocean Energy as alternative, energy Sources

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Power Systems

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session Marks	University End Exam Marks	Total Marks
There shall be two midterm examinations. Each midterm exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after	75	100

completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part-B. Where part A consists of short answer questions carrying total marks of 25 and part-B consists of 10 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.		

IV. EVALUATION SCHEME:

S.No	Component	Duration	Marks
1	I Mid Examination	80 minutes	20
2	I Assignment	--	05
3	II Mid Examination	80 minutes	20
4	II Assignment	--	05
5	External Examination	3 hours	75

V. COURSE OBJECTIVE:

This course enables the students to:

I. Understand the various types of renewable energy sources.
II. Analyze the principle and operation of direct energy conversion.
III. Understand and analyze the hybrid energy systems.
IV. Apply the renewable energy sources to real world electrical and electronics problems.
V. Apply the renewable energy sources to real world electrical and electronics applications

VI. COURSE OUTCOMES:

After completing this course, the student can:

1. Understand the need of utilization of alternate energy resources.
2. Describe the solar energy and solar radiation.
3. Discuss the collection of solar energy, storage of solar energy and its applications.
4. Understand the potential of wind energy as a renewable source.
5. Illustrate the potential of bio mass as a renewable source.
6. Understand the potential of geothermal energy as a renewable source.
7. Analyze the potential of ocean energy as a renewable source.
8. Identify and explain the hydel power plants.
9. Discuss the direct energy conversion systems.
10. Explain the operation and working of Carnot cycle.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		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.	H	Assignments
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	H	Exercises
PO3	**Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	N	-----
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.	N	-------
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.	N	-------
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.	H	Seminars
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.	H	Seminars, Discussions
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	-----
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	-----
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.	N	-----

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.	H	Workshops
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.	S	Seminar, Discussions

N= None **S=Supportive** **H=highly related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency Assessed By
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	S	Lectures, Assignments
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting-edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	N	------
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test, maintain power system and applications.	S	Guest Lectures

N – None **S – Supportive** **H - Highly Related**

IX. SYLLABUS:

UNIT I:

Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data

UNIT II:

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar Energy Storage and Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion

UNIT III:

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance

characteristics, Betz criteria

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects

UNIT IV:

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India

Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT-V:

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, principles of DEC

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	Learning Objectives	Topics to be Covered	Reference
1	To learn solar energy as a renewable source	solar energy as a renewable source	T1
2	To learn Role and potential of Solar energy	Role and potential of Solar energy	T1
3,4	To learn environmental impact of solar power	environmental impact of solar power	T1
5	To learn physics of the sun	physics of the sun	T1
6	To understand the solar constant, extra-terrestrial and terrestrial solar radiation	the solar constant, extra-terrestrial and terrestrial solar radiation	T1
7	Seminar on recent trends in solar energy development	Seminar on recent trends in solar energy development	T1
8	To learn solar radiations	solar radiations	T1
9	To understand instruments used for measuring solar radiation and sun shine	instruments used for measuring solar radiation and sun shine	T1
10	To learn solar energy as a renewable source	solar energy as a renewable source	T1
11,12	To learn about different types of collectors	different types of collectors	T2
13	To learn classification of concentrating collectors	classification of concentrating collectors	T2
14	To learn orientation and thermal analysis	orientation and thermal analysis	T2
15	To learn advanced collectors	advanced collectors	T2
16,17	Discussion on solar collectors	solar collectors	T2
18	To learn methods of solar energy storage	methods of solar energy storage	T2
19	To learn storage	Storage	T2

20	To learn solar ponds	solar ponds	T2
21	To learn Solar Applications	Solar Applications	T1
22	To learn solar heating/cooling technique	solar heating/cooling technique	T1
23	To learn solar distillation and drying,	solar distillation and drying,	T1
24	To learn photovoltaic energy conversion	photovoltaic energy conversion	T1
25	Discussion on Solar Applications	Solar Applications	T1
26	To understand Potential of wind energy sources	Potential of wind energy sources	T1
27,28	To understand the types of windmills	types of windmills	T1
29	To understand performance characteristics	performance characteristics	T1
30	To understand Betz criteria	Betz criteria	T1
31,32	To lean schemes of electric generation and control	schemes of electric generation and control	T1
33	To lean application of wind energy	application of wind energy	T1
34,35	Seminar on recent trends in wind energy development	Seminar on recent trends in wind energy development	T1
36	To understand principles of Bio-Conversion	principles of Bio-Conversion	T2
37,38	To understand anaerobic/aerobic digestion	Anaerobic/aerobic digestion	T1
39,40	To understand types of Bio-gas digesters	types of Bio-gas digesters	T1
41	To understand combustion characteristics of bio-gas	combustion characteristics of bio-gas	T1
42,43	To understand the advantages and disadvantages of plants	the advantages and disadvantages of plants	T1
44	To understand Pyrolisis	Pyrolisis	T1
45	To understand I.C.Engine operation and economic aspects.	I.C.Engine operation and economic aspects.	T1
46,47	To understand I.C.Engine operation and economic aspects.	I.C.Engine operation and economic aspects.	T2
48,49	To understand combustion characteristics of bio-gas	combustion characteristics of bio-gas	T2, R2
50	To learn Geothermal Energy Resources	Geothermal energy Resources	T2,R2,R4
51,52	To learn Geothermal Energy Resources	Geothermal energy Resources	T2, R2
53, 54	To learn Types of wells	Types of wells	T2, R2
55,56	To learn Methods of harnessing the energy	Methods of harnessing the energy	T2, R2

57,58	To learn Methods of harnessing the energy	Methods of harnessing the energy	T2, R2
59	To learn Potential in India	Potential in India	T2, R2
60	To understand Ocean Thermal Energy Conversion	Ocean Thermal Energy Conversion	T2, R2
61	To understand Thermodynamic cycles	Thermodynamic cycles	T2, R2
62	To understand tidal and wave energy	tidal and wave energy	T1
63	To understand Mini-hydel power plants	Mini-hydel power plants	T2
64	To understand need for DEC	need for DEC	T2, R2
65	To learn Carnot cycle, limitations	Carnot cycle, limitations	T2,R2,R4
66	To understand principles of DEC	principles of DEC	T2, R2
67	Revision	Revision	

TEXT BOOKS:

1. Non-Conventional Energy Sources /G.D. Rai, khanna publications
2. Renewable Energy Sources /Twidell&Weir CRC Press

REFERENCES:

1. Renewable Energy resources /Tiwari and Ghosal/Narosa
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa
3. Non-Conventional Energy Systems / K Mittal /Wheeler
4. Renewable Energy sources and emerging technologies by D.P. Kothari, K.C. Singhal, P.H.I

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H		-	-	-	H	-	S	-	-	H	S	S	-	-
II	H	H	-	-	-	S	H	S	-	-	H	S	S	-	-
III	H	S	-	-	-	H	S	H	-	-	S	H	-	-	S
IV	S	S	-	-	-	S	-	H	-	-	-	S	S	-	S
V	H	S	-	-	-	S	-	S	-	-	S	S	S	-	S

N – None S – Supportive H - Highly Related

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAMOUTCOME:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H	-	-	-	H	H	S	-	-	H	S	S	-	-
II	S	S	-	-	-	H	S	S	-	-	S	-	-	-	S
III	H	H	-	-	-	H	H	S	-	-	H	S	S	-	-
IV	H	S	-	-	-	H	S	H	-	-	S	H	-	-	S
V	S	S	-	-	-	S	-	H	-	-	-	S	S	-	S
VI	H	S	-	-	-	S	-	S	-	-	S	S	S	-	-
VII	S	S	-	-	-	H	S	S	-	-	S	-	-	-	-
VIII	H	S	-	-	-	H	S	H	-	-	S	H	-	-	S
IX	H	S	-	-	-	S	-	S	-	-	S	S	S	-	S
X	H	S	-	-	-	S	-	S	-	-	S	S	S	-	-

N – NoneS – Supportive H - Highly Related

Prepared by:

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