Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Mechanical Engineering
BGE002- WIND AND SOLAR ENERGY
Sixth Semester, 2015-16 (EvenSemester)

Course (catalog) description

To equip students with adequate knowledge on the need for alternate energy sources, potential of solar and wind options.

Compulsory/Elective course : Elective for Mechanical students

Credit& contact hours : 3 & 45

Course Coordinator : Dr.Shanmuganandh

Instructors : Karthikeyan S

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Karthikeyan S	VI Sem Mech	Seminar Hall		Karthikeyans.mech@ bharathuniv.ac.in	Karthikeyan S

Relationship to other courses:

Pre –requisites : Basic Mechanical Engineering
Assumed knowledge : By gaining knowledge about alternate energy fuels, students will be able to gain a brief insight into the future and work towards it.
Following courses : Energy Engineering & Management

Syllabus Contents

UNIT I : Wind rotor and its modeling **9 Hours**

Scope of wind power, wind turbine design- Approach elementary aerodynamic models for rotors, Ranking Fronde actuator disc theory- Wake rotation ,two dimensional air foil theory, Glauert momentum vortex theory-Optimal rotor – Modification, Experimental verification of aero dynamic model.

UNIT II : Wind rotor design and performance estimation **9 Hours**

Wind model rotor sizing- Rotor specification, Rotor design – Number of blades, blade design. Performance estimation, sitting economics of wind power.

UNIT III : **9 Hours**

General requirements, synchronous generators, Induction generators-Squirrel cage-Variable speed-Wound rotor-Resistance controlled-with cyclone converter-practical aspects. Speed control-Stall and Pitch control, Electronic control, power control, Electrical cut-in.

UNIT IV : SOLAR ENERGY **9 Hours**

Principle of conversion of solar radiation into heat, types of solar thermal collectors-Flat plate and concentrating collectors (parabolic, trough, Minor,strip, Fresnel lens and compound parabolic concentrator),compression of collectors selective absorber coating, solar thermal power plant.

UNIT V : SOLAR ENERGY STORAGE AND APPLICATIONS **9 Hours**

Solar energy storage systems-Thermal, Electrical, Chemical, Mechanical and Electro-magnetic, Solar pond. Applications of solar energy-Solar thermo electric conversion-Solar photo voltaic, Solar heating and cooling of buildings, Solar distillation, Solar pumping and terrestrial application. System of solar cell power plant, direct grid connection through electronic control devices.

Total : 45 Hours

TEXTBOOKS:

Rai G.D. , Non – Conventional sources of energy, Khanna Publications, 4th edition, 2004.

REFERENCES:

1. David M. Eggleston and Forrest S.Stoddard, Wind Turbine Engineering Designing – Van Noustrand 1987.
2. Le Gouries D, Wind Power Plants, Theory and Design - Permagon Press, 1982.
3. Putnam Palmer C., Power from Wind – Van Noustrand, 1984.
4. www.global-greenhouse-warming.com/renewable-energy-eBooks.htm

Computer usage:

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100 %

Broad area: Renewable Energy

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

Learning about alternate energy and its potential for the future generation.	Correlates to program outcome		
	H	**M**	**L**
Student learns about modelling of wind rotor	a		
Student learns the wind rotor design	c,i		e,k
Student learns the speed control	a	f	
Student learns the use of solar energy in the far future	c	g	e,l
Student learns the installation methods for solar panel	i		
Student understands the use of voltaic cell	a	e,l	

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem Solving (Yes/No)	Text/Chapter
Unit I: Wind Rotor and its Modelling			
1	Introduction, Need for alternate fuels	No	[T1] Chapter 1,3 [R1]
2	Scope of wind power and working of a wind mill	No	
3	Aerodynamic models and turbine design	No	
4	Introduction to theories that help design rotors	No	
5	Ranking-Fronde actuator - a brief insight	No	
6	Wake rotation ,two dimensional air foil theory	No	
7	Glauert momentum vortex theory-Optimal rotor	No	

8	Modifications - rotors	No	
9	Recap, Verification of models	Yes	
UNIT II : WIND ROTOR DESIGN AND PERFORMANCE ESTIMATION			
10	Rotor Sizing and specification	No	[T1] Chapter 3,4 [R1],[R2]
11	Design of a rotor	No	
12	Parameters that decide a rotor performance	No	
13	Design of blade-I	No	
14	Design of blade-II & Types	Yes	
15	Estimation of performance	No	
16	Wind power: Economics	Yes	
17	Comparison with conventional power sources	No	
18	Performance of different designs	No	
UNIT III :			
19	Generators Intro & Working	No	
20	Generator types & it's working principle	No	
21	Differences between various types	No	
22	Need for converter and its working	No	
23	Practical aspects of converters	No	
24	Need for controllers	No	
25	Electronic, power and cut-in	No	
26	Less commonly used controller types	No	
27	Complete layout of power generation	No	
UNIT IV : SOLAR ENERGY			
28	Brief intro into solar, advantages and limitations	No	[T1] Chapter 4,5
29	Types of solar machines, Intro to thermal & PV	No	
30	Solar thermal collectors - types & working	No	
31	Limitations and differences of each solar collector	No	
32	Fresnel lens and concentrators	No	
33	Coatings used to increase heat content in system	No	
34	Efficiency comparison thermal vs PV	Yes	
35	Solar power plant - deep insight	No	
36	Scope of solar in residential homes	Yes	
UNIT V : SOLAR ENERGY STORAGE AND APPLICATIONS			
37	Solar Energy storage systems & need for storage	No	[T1] Chapter 4,5
38	Methods of storing energy in various forms	No	
39	Solar pond, industrial storage systems	No	
40	Applications of solar energy	No	
41	Solar thermo electric, photo voltaic	No	
42	Solar heating and cooling of buildings	No	
43	Solar distillation, Solar pumping	No	
44	Solar cell power plant & Grid connection	No	
45	Questionnaire	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by Karthikeyan S

Addendum

<u>ABET Outcomes expected of graduates of B.Tech / MECH / program by the time that they graduate:</u>

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.
b) The ability to identify, formulate and solve engineering problems.
c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d) The ability to design and conduct experiments, as well as to analyze and interpret data
e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
f) The ability to apply reasoning informed by the knowledge of contemporary issues.
g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
h) The ability to understand professional and ethical responsibility and apply them in engineering practices.
i) The ability to function on multidisciplinary teams.
j) The ability to communicate effectively with the engineering community and with society at large.
k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:

Mechanical Engineering graduatesare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:

Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:

Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:

Mechanical Engineering graduates became skilled to afford training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:

Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

Course Teacher	Signature
Karthikeyan S	

Course Coordinator
Dr.Shanmuganandh

HOD/MECH