AC 29/4/13
Item no. 4.97

UNIVERSITY OF MUMBAI

Syllabus
for
Sem V & VI
Program: B.Sc.
Course:
Solar and Applied Energy Resources (Applied Component)

(Credit Based Semester and Grading System with effect from the academic year 2013–2014)

SEMESTER V

Theory

USACSE501	**Fundamentals of Energy and Solar Energy**		**No of Credits**	**Lectures/Week**
Units	**I**	**Fundamental of Energy – Science and Technology, Energy Conversion, energy storage**	**2**	**4**
	II	**Solar Energy-Basic**		
	III	**Solar Thermal System**		
	IV	**Solar Photovoltaic System**		

Practicals

USACSE5P1	SAEP-I	**2**	**4**

SEMESTER VI

Theory

USACSE601	**Applied Energy Resources**		**No of Credits**	**Lectures/Week**
Units	**I**	**Wind Energy**	**2**	**4**
	II	**Biomass Energy**		
	III	**Geothermal Energy**		
	IV	**Small Hydro Resources, Emerging Technologies, Miscellaneous Non-Conventional Technologies**		

Practicals

USACSE6P1	SAEP-II	**2**	**4**

The revised syllabus under the credit based grading system in the subject of **Solar and Applied Energy Resources** (Applied Component) for Third Year B.Sc. Physics (Single/Twin major subject) will be implemented from the academic Year 2013-14.

The scheme of examination in the subject of **Solar and Applied Energy Resources** (Applied Component) will be as follows:

Semester V & VI : Theory

Course Code: USACSE501 & USACSE601

(A) Internal Examination: 40 marks

Sr. No	Particulars	Marks
1	One Class Test/case study/online examination to be conducted in the given semester	20
2	One assignment based on the curriculum to be assessed by the teacher concerned	10
3	Active Participation in routine class instructional deliveries.	05
4	Overall conduct as a responsible learner, communication and leadership qualities in organizing related academic activities	05

(B) External Examination : 60 marks

- Duration of each Theory paper will be of two and half hours.
- Each theory paper shall consist of five questions, one from each unit and the fifth question will be from all the units. All questions are compulsory and will have internal choice.

Semester V & VI : Practical

Course Code: USACESE5P1 & USASE6P1

There will not be any internal examination for practical. The External examination will be conducted as per the following scheme by the respective colleges and the marks will be forwarded to the University:

Sr. No	Particulars of External Practical Examination	Marks
1	Laboratory Work	Eighty
2	Journal	10
3	Viva	10
	TOTAL	100

Total Marks in each semester :

- Duration of each Practical paper will be of 3 Hours per semester.
- A certified Journal of **Solar and Applied Energy Resources** must contain a minimum of **EIGHT** Experiments in each semester
- Every candidate will be required to perform **ONE** experiment at the semester end practical examination.
- A candidate will be allowed to appear for the Practical Examination only if the candidate submits his/her certified Journal or a certificate from the Head of the Department of Physics stating that the candidate has completed the practical Course of Electronic Instrumentation of the respective semester as per requirements.

Note:

- The problems related to the Units should be solved as illustrations of the concern topics.

Semester V

Course Code: USACEI501

Title: Fundamental of Energy and Solar Energy

Unit 1: ***(15 Lectures)***

Fundamental of Energy – Science and Technology: Classification of Energy Resources, Importance of Non-Conventional Energy Sources, Advantages and disadvantages of conventional Energy Sources, Environmental Aspects of Energy, World Energy status, Energy scenario in India.
Energy conversion: Salient Features of Energy Conversion Act 2001, Various Aspects of Energy Conversation, Principle of Energy Conversion, General Electrical Energy Conversion Opportunities, Combined Cycle Plants.
Energy storage: Necessity of Energy Storage, Energy Storage methods
Ref-BHK: Chapter 1: 1.3, 1.5, 1.8, 1.10, 1.13, 1.14; **Chapter 2:** 2.1, 2.2, 2.3, 2.4, 2.5, **Chapter 3:** 3.1, 3.2

Unit -II **(L-15)**
Solar Energy-Basic: The sun as a Source of Energy, The Earth, Sun, Earth Radiation Spectrum, Extraterrestrial and Terrestrial radiations, Spectral energy distribution of Solar Radiation, Depletion of Solar Radiation, Measurements of Solar Radiation, Solar Radiation Data, Solar Time, Solar Radiation geometry, Solar Day Length, Empirical Equation for Estimating Solar Radiation, Hourly Global , Diffusion and Beam Radiation on Horizontal surface under cloudless Skies, Solar Radiation on Inclined plane Surface.
Ref-BHK: Chapter 4: 4.1, to 4.14,

Unit- III **(L-15)**
Solar Thermal System: Solar collectors, Solar Water Heater, Solar Passive Space-Heating and Cooling Systems, Solar Industrial Heating Systems, Solar Refrigeration and Air-Conditioning Systems, Solar Cookers, Solar Furnaces, Solar Green House, Solar Dryers, Solar Distillation, 5.11 Solar Thermo-Mechanical Systems.
Ref-BHK: Chapter 5: 5.1 to 5.11

Unit-IV **(L-15)**
Solar Photovoltaic System: Solar cell Fundamentals, Solar Cell Characteristics, Solar cell Classification, Solar Cell Module Panel and Array Construction, Maximum the Solar PV Output and Local Matching, Maximum Power Point Tracker, Balance of System Components, Solar PV System, Solar PV Applications.
Ref-BHK: Chapter6: 6.1 to 6.9

PRACTICALS (Semester V)

Course Code: USACSE5P1

1. Study of solar cell: Solar radiation measurement using Lux meter
2. Study of effect of intensity variation on efficiency of solar cell
3. Spectral response of solar cell
4. Solar dryer: Construction and performance
5. Thermal efficiency of parabolic collector/ Reflector
6. Flat plate collector: Construction and Thermal collection
7. Photovoltaic Cell: I-V characteristics, O/P variation with temperature
8. Scheffler Disc (Reflector)
9. Study of various energy units and their conversions.
10. Study of charging and discharging of chemical storage batteries.
11. Use and study of solar cooker
12. Solar cell array construction

Optional:

Projects:

1. Solar radiation and local time
2. Solar distillation plant
3. Solar power incident on earth surface with respect to sun ray
4. Sun tracking

Field visits:

1. Visit to Thermal power / Hydro power stations
2. Visit to thermal cooking station Shirdi / Mount Abu
3. Demonstrations of the experiments related to the topics are encouraged.

Main References

1. **BHK:** B H Khan- Non-Conventional Energy Resources (Second Edition)
   Publisher: Tata McGraw-Hill Education Pvt Ltd New Delhi
   Year 2009
2. RM: R Morgan R B Murry- Energy Resources J T MacMillan
3. HPG H P Garg - Solar Energy, Fundamental and Application, Tata McGraw Hill New Delhi
4. Sukhatme S.P. and Nayak J K – Solar energy-Principles of Thermal and Collection and Storage, Tata McGraw Hill

Practical:

1. Chetan Singh Solanki- Renewable energy Technologies (A Practical Guide for Beginners) PHI Learning Pvt Ltd New Delhi

Semester VI

Course Code: USACEI601

Title: Applied Energy Resources

Unit-I **(L-15)**

Wind Energy: Origin of Winds, Nature of Winds, Wind Turbine Sitting, Major Applications of Wind Powers, Basics of Fluid Mechanics, Wind Turbine Aerodynamics, Wind Turbine type and Their Conversion, Wind Energy Conversion Systems, Wind- diesel Hybrid System, Effects of Wind Speed and Grid Condition, Wind-Energy storage, Environmental Aspects, Wind-Energy Programme in India.
Ref-BHK: Chapter 7: 7.1 to 7.13

Unit-II **(L-15)**

Biomass Energy: Photosynthesis Process, Usable Forms of Biomass their Composition, Biomass Resources, Biomass Conversion Technology, Urban Waste to Energy Conversion, Biomass Gasification, Biomass Liquefaction, Biomass to Ethanol Production, Biogas Production from Waste Biomass, Energy Farming, Biomass Energy Programme in India.
Ref-BHK: Chapter 8: 8.1 to 8.11

Unit -III **(L-15)**

Geothermal Energy: Applications, Origin and Distribution of geothermal Energy, Types of Geothermal Resources, Analysis of Geothermal Resources, Exploration and Development of Geothermal Resources, Environmental Consideration, Geothermal Energy in India.
Ocean Energy: Tidal Wave, Wave Energy, Ocean Thermal Energy
Ref-BHK: Chapter 9: 9.1 to 9.7; **Chapter 10**: 10.1 to 10.3

Unit- IV **(L-15)**

Small Hydro Resources: Advantage and Disadvantage of Small Hydro Schemes, Layout of Macro Hydro schemes, Water Turbines, Turbine Classification, Characteristics and Selection, Generations, Present status .
Emerging Technologies: Fuel Cell, Hydrogen Energy.
Miscellaneous Non-Conventional Technologies: Magneto Hydrodynamics, Thermo-electrical Power Conversions, Thermionic Power Conversions.
Ref-BHK: Chapter 11: 11.1 to11.6; **Chapter 12**: 12.1 to 12.2; **Chapter 13**: 13.1 to 13.3

Main References

1. **BHK:** B H Khan- Non-Conventional Energy Resources (Second Edition)
Publisher: Tata McGraw-Hill Education Pvt Ltd New Delhi Year 2009
2. RM: R Morgan R B Murry- Energy Resources J T MacMillan
3. HPG H P Garg - Solar Energy, Fundamental and Application, Tata McGraw Hill New Delhi

PRACTICALS (Semester VI)

Course Code: USACSE6P1

1. Wind data measurement and analysis (power)

2. Measurement of wind velocity (Air Blower, Anemometer)
3. Caloric values of fuel (coal, coke wood and charcoal)
4. Study of heat storage: construction and calibration
5. Wind mill models: Construction and comparison of their efficiency
6. Low cost Anemometers: Construction and calibration
7. Measurement of solar radiation (Lux meter)
8. Determination of thermal energy of hot water system
9. Construction and Study of different small scale wind turbine blades for angular velocity, power conversion efficiency, inertia, cost of construction etc.
10. Study of DC motor/generator.
11. Calorific value of various biomasses.
12. Study of potential energy of water storage with reference to height and amount of storage.

Optional:

Projects:

1 Study of Biogas plant
2 Study of energy cycle on earth
3 Financial Economical Evaluation- Use of PC (Chapter-14 B H Khan)

Field visits:

1. Visit to the wind farm
2. Visit to the energy village / School of energy studies
3. Demonstrations of the experiments related to the topics are encouraged.

Ref: Practical:

1. Chetan Singh Solanki- Renewable energy Technologies (A Practical Guide for Beginners) PHI Learning Pvt Ltd New Delhi