# Course-Plan

**School of Engineering**
**Department of Mechanical Engineering**
**Course Code: ME 552**
**Course Name: Renewable Thermal Power Technology**
**Instructor: Prof. Partha. P. Dutta**

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1. **Abstract**: Solar energy is the fundamental source of renewable energy. Utilization of solar radiation into useful heat and power through the different devices and techniques like flat plate collectors, concentrating collectors, evacuated collector are attractive options for partial application of green energy. Design of sensible and latent heat storage system for solar thermal power plants and economic analysis are related with energy conservation and efficiency. Combustion, gasification, pyrolysis, liquification of biomass (another form of solar energy) are attractive options for both renewable thermal and electrical power generation. Effective techno-management of biomethenation technology, biodiesel, improved wood stove, bio-hydrogen generation, are the needs of hour.

2. **Prerequisites of the course**: None

3. **Course objectives:**

   1. To introduce students on solar science and utilization of solar thermal energy by the flat plate collectors, concentrating collectors, evacuated collector, design of various types of solar collectors, performance of solar collectors, ASHRAE standards for design and testing.
   2. To understand and analysis solar desalination technology, solar drying, industrial process heating applications, solar thermal power plant, economics of solar thermal processes.
   3. To train students on types of solar thermal energy storage; design of sensible and latent heat storage systems for solar thermal power plants and economic analysis and issues related to sensible and latent heat storage systems.
   4. To orient students on combustion, gasification, pyrolysis, liquification, biomass pre-treatment and processing, bio-methenation technology.
   5. To introduce and to analyse on biodiesel production and utilization, improved wood stove, bio-hydrogen generation, dual fuel engine and purely producer gas fired technology, engine modifications for electrical power generation cooling and cleaning methods of gas produced from gasifier.
   6. To orient student for preliminary design and analysis on renewable energy-based system through the final year project work.

**4. Textbooks**:

1. Nayak, J. K. and Sukhatme, S. P. *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw Hill, New Delhi, 2006.
2. Mukunda, H. S. *Understanding Clean Energy and Fuels from Biomass*, Wiley India, 2011

**5. References**:

3. Duffie J. A. and Beckman W. A. *Solar Engineering of Thermal Processes*, John Wiley, 2006

4. Goswami D. Y. Kreith F. and Kreider J. F. *Principles of Solar Eng*ineering, Taylor and Francis, 1999.

5. Garg H. P. and Prakash S. (1997); *Solar Energy: Fundamental and Application*, Tata McGraw Hill, 1997

6. Kishore V. V. N. *Renewable Energy Engineering and Technology*, TERI, 2009

7. Tiwari G. N. *Solar Energy: Fundamentals, Design, Modelling and Applications*, Narosa, 2002

8. Basu P. *Biomass Gasification and Pyrolysis: Practical Design and Theory*, Academic Press, New York, 2010

9. Loo S. V. and Koppejan J. *The Handbook of Biomass Combustion and Co-firing*, Earthscan, London, 2008

**6. (a) Time-Plan:**

**Theory Classes**

| Topic | No. of theory classes |
|---|---|
| Introduction to solar science, environment, and estimations of different angles. | 4 |
| Methodologies for Solar thermal conversion system, Solar thermal conversion devices coating technology | 4 |
| General description of solar thermal collectors – Flat plate collectors, improved design of solar thermal collector for enhanced heat transfer, concentrating collectors, evacuated collector, Design of various types of Solar collectors, Performance of solar collectors. | 4 |
| ASHRAE codes, Solar active and passive heating; Solar cooling; Conversion to mechanical energy; Solar desalination, Solar drying, Industrial application, Solar thermal power plant, Economics of solar processes. | 5 |
| Modeling of solar thermal systems, Components, and simulation; Design and sizing of solar heating systems. | 5 |
| Types of thermal energy storage; – Design of sensible and latent heat storage system for solar thermal power plants and economic analysis. Issues related to sensible and latent heat storage systems. | 8 |
| Biomass resource assessment, properties of biomass and its analysis, different energy conversion methods – combustion, gasification, pyrolysis, liquification, biomass pre-treatment and processing, Biomethenation technology, biodiesel, improved wood stove, bio-hydrogen generation, electricity generation from biomass gasifier, cooling and cleaning methods of gas produced from gasifier, engine systems, petrol, diesel, and dual fuel engine and purely producer gas fired technology. | 10 |
| Total | 40 |

**6. (b) Evaluation plan**: Evaluation would be based upon the following:

| **Component** | **Marks** |
|---|---|
| Sessional Test I | 10 |
| Mid Semester Examination | 30 |
| Sessional Test II | 10 |
| End Semester Examination | 50 |
| **Total** | **100** |

**7. Pedagogy:** Introduction and detailed renewable thermal energy resources and technology will be explained. Solar science, application of different solar thermal energy conversion devices will be explained. Renewable energy-based power generation system like biomass gasifier, biodiesel production and engine application units will be demonstrated.

**8. Expected outcomes:**

1. The students will understand solar science and utilization of solar thermal energy on flat plate, concentrating collectors, evacuated collector, design of various types of solar collectors, performance of solar collectors; ASHRAE standards.
2. The students will be able to perform mathematical analysis for solar desalination technology, solar drying, process hating industrial applications, solar thermal power plant, and economics of solar thermal technology.
3. The students will be able to perform analysis on solar thermal energy storage, design of sensible and latent heat storage systems for solar thermal power plants and economics.
4. The students will be able to perform mathematical and practical analysis on combustion, gasification, pyrolysis, liquefaction, biomass pre-treatment and processing, bio-methenation technology.
5. Students will be able to perform experiments on biodiesel, improved wood stove, bio-hydrogen generation, purely producer gas fired technology, engine modifications for electrical power generation, cooling and cleaning methods of gas produced from gasifier.
6. Students will be able to perform experimental and computational M.Tech thesis work on renewable thermal energy components / systems.