ENERGY, ENVIRONMENT AND SOCIAL ENGINEERING
ENEX 417

Lecture : 3 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 0

Course Objectives:

This course gives computer engineering students a comprehensive understanding of energy systems, green energy technologies, and their environmental impacts. It emphasizes energy efficiency, conservation, and sustainability and introduces solar PV system design, energy storage, and energy computation for ICT infrastructure. Students will critically examine global energy trends, hazards, and ethical responsibilities to contribute responsibly to sustainable engineering and societal advancement.

1 Technology and Development (4 hours)

1.1. Introduction to technology and its evolution
1.2. Role of technology in social transformation
1.3. Importance and mechanisms of technology transfer
1.4. Positive and negative impacts of emerging technologies

2 Energy Basics (7 hours)

2.1. Fundamentals of energy and energy calculations
2.2. Classification of energy sources
2.3. Energy's relation to Maslow's hierarchy of needs
2.4. Correlation between Human Development Index (HDI) and energy consumption
2.5. Energy needs and strategies for reducing GHG emission
2.6. Global and local trends: supply, demand and issues
2.7. Energy conservation, energy efficiency, energy mix, energy star ratings, and green economy
2.8. Sustainable Development Goals (SDG 7: Affordable and Clean Energy)

3 Green Energy Sources (8 hours)

3.1. Solar Energy
  3.1.1. Solar Radiation
  3.1.2. Solar Thermal Energy
  3.1.3. Solar Photovoltaic(PV)
3.2. Hydropower
  3.2.1. Water sources and Power
  3.2.2. Water Turbines and Hydroelectric Plants
  3.2.3. Hydropower Plant Classification(pico, micro, small, medium, large)
3.3. Wind Energy
  3.3.1. Availability of Wind Energy Sources
  3.3.2. Wind turbines, wind parks and power control
3.4. Hydrogen Energy and Fuel Cell
  3.4.1. Hydrogen energy, production and storage

3.4.2. Basics of electrochemistry
3.4.3. Polymer membrane electrolyte(PEM) fuel cells
3.4.4. Solid oxide fuel cells(SOFCs)

4 Energy Storage (4 hours)

4.1. Forms of energy storage
4.2. Hybrid vehicles
4.3. Grid-to-Vehicle(G2V) and Vehicle-to-Grid(V2G) system
4.4. Smart grid systems and demand side management
4.5. Battery technologies
4.6. Super-capacitors

5 Design of Solar PV System (8 hours)

5.1. Basic Principles of Solar Photo-Voltaic Effect
5.2. Solar Cells, Modules and Arrays
5.3. Components of a Solar PV System
5.4. Design of Solar PV System for different applications (telecommunication, home automation, water pumping, switching system etc)

6 Energy computation for ICT infrastructure (5 hours)

6.1. Energy auditing for data centers and ICT infrastructure
6.2. Thermal management and cooling requirements
6.3. ICT energy system design and power distribution
6.4. Energy aware algorithm design, energy complexity, green computing

7 Environmental and Safety aspects of Energy Sources (4 hours)

7.1. Emission hazard and atmospheric impacts
7.2. Battery hazard
7.3. Chemical hazard
7.4. Nuclear hazard
7.5. Electric shock (AC, DC)
7.6. Human safety and first aid

8 Social Engineering (5 hours)

8.1. Understanding human behavior
8.2. Engineer's role as an agent of social change
8.3. Public accountability and ethical citizenship
8.4. Balancing technical and social expectations
8.5. Contribution to SDGs (Sustainable Development Goals)
8.6. Legal issues and practices
8.7. Conflict identification and resolution in engineering projects

Evaluation Scheme:

There will be questions covering all the chapters in the syllabus. The evaluation scheme for the question will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	4	6
2	7	10
3	8	8
4	4	4
5	8	12
6	5	8

7	4	5
8	5	7
Total	**45**	**60**

*There may be minor deviation in marks distribution

References

1. Boyle, G. (2012). Renewable Energy: Power for a Sustainable Future. Oxford: Oxford University Press.
2. Garg, H., & Prakash, J. (2010). Solar Energy Fundamentals and Applications. New Delhi: Tata McGraw Hill Education Pvt. Ltd.
3. Rai, G. (2010). Non-Conventional Sources of Energy. New Delhi: Khanna Publishers.
4. Rosa, A. V., & Ordonez, J. C. (2021). Fundamentals of Renewable Energy Processes. Elsevier.
5. Sharma, D. K., & Shakya, S. R. (2011). Training Manual for Engineers on Solar PV System. Lalitpur: Alternative Energy Promotion Centre.