SEMESTER S6

ENERGY SYSTEMS

Course Code	**PERAT637**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. Introduces various types of renewable energy sources
2. Various means of generating and storing energy and the importance of renewable energy

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Energy Scenario:** Indian Energy Scenario, World Energy Scenario, Indian Energy Sector Reforms, Energy and Environment, Energy Security, Energy conservation act **Energy Efficient Systems:** Reducing pollution and improving efficiency in buildings, Green Building Standards, Types of lamps and their efficiencies	**9**
2	**Renewable Energy Resources:** Solar Thermal System-Working Principle-Block diagram, Solar Photovoltaic System- Working Principle-Block diagram, Solar cell efficiency calculation, Wind Energy Systems- Working Principle-Block diagram, wind power equation, Energy from Waves and tides- Working Principle-Block diagram, Ocean Thermal Energy System-Working Principle-Block diagram, Energy from Biomass	**9**
3	**Energy Storage:** Importance of Energy Storage- Means of Storing Energy-Principle of operation and performance comparison. Compressed air storage, Fly wheel Energy Storage, Battery Storage-Battery: Specification, Charging/Discharging rate, Primary and secondary cells-Dry cell, lead acid, lithium ion, Lithium air, Nickel Cadmium, Nickel Metal Hydride Fuel Cell: Working Principle, efficiency	**9**

4	**Energy Standards** – International Energy Standards-ISO50001, Bureau of Energy Efficiency, star rating **Energy Management:** Significance and general principles of Energy Management, Energy audit-types and procedure, Energy audit report, Instruments for energy auditing **Energy Economics:** Traditional Types of Rates - Single-Part Rates - Two-Part Rates - ThreePart Rates – Numerical problems	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

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End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Indian and global energy scenario	**K2**
CO2	Elaborate different conventional and non-conventional energy generation schemes and the economics of generation	**K2**
CO3	Analyse principle of operation and performance comparison of various energy storage schemes	**K4**
CO4	Identify major Global and Indian standards for Energy Management	**K2**
CO5	Appraise various aspects of energy economics	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2
CO5	3	3										2

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Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Energy Storage for Power Systems	A.G.Ter-Gazarian	The Institution of Engineering and Technology (IET) Publication, UK	Second Edition
2	Guide to Energy Management	Barney L. Capehart, Wayne C. Turner and William J. Kennedy	The Fairmont Press Inc., 2012	Seventh Edition
3	Electric Power Systems Planning	S. Pabla	Mac Millan India Ltd	First Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Renewable Energy Sources and Emerging Technology	K.C. Kothari, D.P.Ranjan, Rakeshsingal	PHI	2nd Revised edition
2	Energy Resources: Conventional & Non-Conventional	M.V.R. Koteswara Rao	BS Publications/BSP Books (2017)	First Edition
3	Efficient Lighting Applications & Case Studies	Albert Thumann, Scott Dunning	The Fairmont Press, Inc.	First Edition
4	Energy Economics-Concepts, Issues, Markets and Governance	Subhes C. Bhattacharyya	Springer	First Edition

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=hMtZl4Op5VQ
2	https://archive.nptel.ac.in/courses/121/106/121106014/
3	https://onlinecourses.nptel.ac.in/noc21_mm34/preview
4	https://onlinecourses.nptel.ac.in/noc20_hs68/preview

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