SEMESTER: S8

ENERGY TECHNOLOGY

Course Code	PEPOT 868	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2Hr. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. Understand Energy Fundamentals and Global Energy Dynamics.
2. Explore Advanced Energy Storage Systems
3. Investigate Hydrogen and Fuel Cell Technologies

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Introduction to Energy:** Definition and units of energy, power, Forms of energy, Conservation of energy, Energy flow diagram to the earth. Origin of fossil fuels, time scale of fossil fuels, Renewable Energy Resources, Role of energy in economic development and social transformation. **Global Energy Scene** Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.	9
2	**Energy Storage Systems**	9

	Electrochemical Energy Storage Systems: Batteries- Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes in electrodes. Magnetic and Electric Energy Storage Systems: Superconducting Magnet Energy Storage (SMES) systems; Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.	
3	**Hydrogen Technology and Fuel Cell Technology** Hydrogen Production Methods: Production from fossil fuels, electrolysis, thermal decomposition, photochemical, photocatalytic, hybrid. Hydrogen Storage Methods: Metal hydrides, Metallic alloy hydrides, Carbon nano-tubes; Sea as the source of Deuterium, Its merit as a fuel and Applications Fuel Cell: Basics Fuel cell definition, difference between batteries and fuel cells, components of fuel cells, principle of working of fuel cell, performance characteristics of fuel cells, efficiency of fuel cell, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages of fuel cell power plant.	**9**
4	**The New Energy Technologies** Introduction:Development in the field of superconductivity, Basic parameters of superconductivity, Types of superconductors, BCS theory, Meissner Effect, Josephson effect in Superconductors. High Tc Superconductors: Cuprate Superconductors; La, Y, Bi, Tl and Hg based superconductors, Intermetallic MgB2superconductor crystal structure and superconducting properties, Applications of Superconductors in Energy.	**9**

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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

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

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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	Explain the fundamental concepts of energy, including its forms, units, and conservation principles, and analyze global energy consumption patterns and their economic impact	**K4**
CO2	Describe various renewable and non-renewable energy resources, their origins, and their roles in economic and social development.	**K2**
CO3	Evaluate different electrochemical, magnetic, and electric energy storage systems, including advanced batteries and supercapacitors, in terms of their principles, performance, and applications.	**K5**
CO4	Explain the methods of hydrogen production and storage, and differentiate between batteries and fuel cells in terms of components, working principles, and efficiency.	**K4**
CO5	Assess the developments and applications of superconductors in energy technology, including their basic parameters, types, and specific properties.	**K5**

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

CO-PO Mapping Table:

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

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Energy Technology: Non-Conventional, Renewable and Conventional	S. Rao, B. B. Parulekar	Khanna Publishers	4th Edition, 2005
2	Renewable Energy Resources	John Twidell, Tony Weir	Routledge	3rd Edition, 2015
3	Energy Systems Engineering: Evaluation and Implementation	Francis Vanek, Louis Albright, Largus Angenent	McGraw-Hill	3rd Edition, 2016
4	Fuel Cell Technology Handbook	Gregor Hoogers	CRC Press	1st Edition, 2003

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Energy Storage Systems	A. G. Ter-Gazarian	Institution of Engineering and Technology	1st Edition, 1994
2	Hydrogen and Fuel Cells: Emerging Technologies and Applications	Bent Sørensen	Academic Press	1st Edition, 2005
3	Superconductivity: Physics and Applications	P. G. de Gennes, J. B. Goodenough	Springer	1st Edition, 1999
4	Modern Batteries: An Introduction to Electrochemical Power Sources	Colin A. Vincent, Bruno Scrosati	Butterworth-Heinemann	2nd Edition, 1997

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Link: "https://nptel.ac.in/courses/112/101/112101104/"
2	Link: "https://nptel.ac.in/courses/108/108/108108034/"
3	Link: "https://nptel.ac.in/courses/103/106/103106176/"
4	Link: "https://nptel.ac.in/courses/115/108/115108121/"

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