

<b>Course Title:</b> Conventional and Renewable Energy Resources				
<b>Course Code:</b> UES 207	<b>No. of Credits:</b> 3	<b>L-T-P:</b> 33-12-0	<b>Learning Hours:</b> 45	
<b>Pre-requisite Course Code and Title (if any):</b> None				
<b>Department:</b> Natural and Applied Sciences				
<b>Course Coordinator:</b>		<b>Course Instructor:</b>		
<b>Contact Details:</b>				
<b>Course Type:</b> Minor		<b>Course Offered In:</b> Semester 3		
<b>Course Description</b> This course provides an understanding of conventional and renewable energy sources, including their technologies, applications, environmental impacts, and socio-economic considerations. Through lectures, discussions, and tutorial sessions, students will gain insights into the role of these energy sources in addressing energy challenges and transitioning towards sustainable energy systems.				
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• To introduce students to the fundamentals of conventional and renewable energy sources.</li> <li>• To explore the technological advancements, applications, and limitations of different energy sources.</li> <li>• To examine the environmental and socio-economic considerations associated with conventional and renewable energy systems.</li> <li>• To foster critical thinking and problem-solving skills in addressing energy-related challenges.</li> </ul>				
<b>Course Content</b>				
<b>Module</b>	<b>Topic</b>	<b>L</b>	<b>T</b>	<b>P</b>
1	<b>Introduction to Energy Sources</b>			
	This module focuses on introductory knowledge about energy sources, their classifications, production/consumption trends, concepts of energy efficiency and security, and environmental-social-economic considerations related to energy, thus setting the context for the next modules.			
	Status of World and Indian Energy scenario, overview of energy sources and their classification; patterns and trends in energy production and consumption; concepts of energy efficiency and energy security; environmental implications of energy use: CO <sub>2</sub> emissions in developed and developing countries; socio-economic considerations.	3	1	
2	<b>Conventional Energy Sources</b>			
	This module provides an understanding of conventional energy sources and fossil fuels. Students will explore the technologies, extraction methods, and environmental impacts associated with these energy sources.			
	Introduction to conventional energy sources, history of fossil fuels, classification, fundamental definitions and physio-chemical properties.	3	1	
	<b>Solid Fossil Fuel:</b> Coal – classification, formation, and composition; coal mining techniques: surface mining, underground mining; coal combustion, gasification, liquefaction.	3	1	
	<b>Liquid and Gaseous Fossil Fuels:</b> Petroleum – formation, oil exploration, extraction, and refining processes and products. Natural gas – exploration, extraction; producer gas, water gas, hydrogen gas.	4	2	
	Environmental impacts of fossil fuels.	2		
3	<b>Nuclear Energy</b>			
	This module provides a basic introduction to nuclear energy processes, nuclear radiation hazards, and nuclear waste management.			
	Nuclear fission and fusion processes, nuclear reactors, nuclear fuels, nuclear energy	3	1	

	safety and waste management: radiation hazards and nuclear waste disposal.			
4	<b>Renewable Energy Sources</b>			
	This module offers an exploration of renewable energy sources, including solar, wind, hydro, biomass, geothermal, and ocean energy. Through theoretical lectures, tutorials and case studies, students will gain an understanding of the technologies and applications associated with renewable energy.			
	Introduction to renewable energy, types of renewable energy sources, importance of renewable energy in the context of sustainable development.	1		
	<b>Solar Energy:</b> Sun as source of energy, solar radiation, and its spectral characteristics, solar photovoltaic (PV) and solar thermal technologies, applications, challenges, benefits, international solar alliance.	3	1	
	<b>Wind Energy:</b> Wind energy resource assessment and potential; wind turbines: technology, types, and operation; wind farms.	2	1	
	<b>Hydropower and Ocean Energy:</b> Hydropower technologies: principles of generation; types (dams, run-of-river), advantages, and challenges; ocean energy technologies: tidal, wave, and ocean thermal energy conversion (OTEC).	3	1	
	<b>Geothermal Energy:</b> Geothermal resource assessment, exploration techniques, geothermal energy extraction methods and applications.	2	1	
	<b>Biomass Energy:</b> Biomass resources: types, characteristics; biomass conversion technologies: combustion, gasification, anaerobic digestion; waste to energy.	2	1	
5	<b>Challenges and Transitioning towards Sustainable Energy Systems</b>			
	This module will help students identify the issues related to renewable energy integration, grid management, and the need for transitioning towards sustainable energy systems.			
	Challenges and solutions in renewable energy integration and grid management, smart grid technologies and demand-side management, role of energy storage systems in renewable energy integration, energy-climate change linkages and need for transitioning towards sustainable energy systems.	2	1	
		33	12	
<b>Evaluation Criteria</b>				
<ul style="list-style-type: none"> <li>• Tutorials/assignment: 20%</li> <li>• Minor Test 1 (Module 1 and 2): 20%</li> <li>• Minor Test 2 (Module 3 and 4): 20%</li> <li>• Major Test (Entire Syllabus): 40%</li> </ul>				
<b>Learning Outcomes</b>				
Upon completion of the course, the students will be able to:				
<ul style="list-style-type: none"> <li>• develop an introductory understanding of energy sources, patterns in energy production and consumption, and environmental-social-economic considerations associated with energy resources [Module 1, Minor Test 1, Major Test]</li> <li>• gain knowledge of the fundamentals of conventional energy sources, including technologies and extraction methods used in producing conventional energy [Module 2, Minor Test 1, Major Test]</li> <li>• develop an understanding of nuclear energy technologies [Module 3, Minor Test 2, Major Test]</li> <li>• develop an understanding of various renewable energy technologies and their applications [Module 4, Minor Test 2, Major Test]</li> <li>• understand the challenges and solutions related to renewable energy integration, grid management, and the need for transitioning towards sustainable energy systems [Module 5, Major Test]</li> </ul>				
<b>Pedagogical Approach</b>				
<ul style="list-style-type: none"> <li>• The course will be delivered through classroom lectures, class exercises, and tutorials that will be further connected with real-life examples and case studies.</li> <li>• The course will focus on classroom discussions and assignments that will help to make this study more participatory, robust, and productive.</li> </ul>				

**Reading Resources**

1. Hinrichs RA, Kleinbach MH, Wade R (2023). *Energy: Its Use and the Environment*. Sixth Edition, Cengage Learning.
2. Kumar, R. (2013). *Fossil Fuels: Sources, Environmental Concerns and Waste Management Practices*. Nova Science Publishers.
3. Murray, R., & Holbert, K.E. (2019). *Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes*. Butterworth-Heinemann.
4. Boyle, G. (2012). *Renewable Energy: Power for a Sustainable Future*. Oxford University Press.
5. Nelson, V.C., & Starcher, K.L. (2016). *Introduction to Renewable Energy*. CRC Press.
6. Kishore, V.V.N. (2008). *Renewable Energy Engineering and Technology—A Knowledge Compendium*. TERI Press, New Delhi.
7. Stephen, A. (2021). *Fundamentals and applications of renewable energy*. States Academic Press, New York.
8. Rajput, R.K. (2014). *Non-conventional energy sources and utilisation*. Sultan Chand, New Delhi.
9. Maisie, W. (2017). *Renewable energy: power for a sustainable future*. Larsen & Keller, New York.
10. Twidell, J., & Weir, T. (2015). *Renewable energy resources*. Routledge.

**Student Responsibilities**

The students must come prepared with readings suggested during the classes and ensure timely submissions of tutorials and assignments. They are also expected to attend classes regularly, participate, and contribute to classroom discussions to strengthen their understanding further. Their other responsibilities include feedback and discipline.

**Course Designed by:**

- Dr Anand Madhukar, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

**Course Reviewers:**

The course is reviewed by following reviewers:

- Dr Atul Sharma, Professor, Rajiv Gandhi Institute of Petroleum Technology, Jais, Amethi.
- Dr. Ram Narayan Singh, Professor, School of Energy & Environmental Studies, Devi Ahilya Vishwavidyalaya, Indore.