GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Master of Technology	Branch/Spec.	Chemical Engineering
Semester	I	Version	1.0.0.0
Effective from Academic Year	2026-27	Effective for the batch Admitted in	July 2026
Subject code	**3CH1102**	Subject Name	**Advanced Energy Engineering**

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture (DT)		Practical (Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	0	0	3	Theory	40	60	100
Hours	3	0	0	0	3	Practical	0	0	0

Pre-requisites:

Basic knowledge of Thermodynamics, Heat Transfer, Material and Energy Balance

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	Explain global and national energy scenarios using thermodynamic and sustainability concepts.
CO2	Analyze fossil fuel–based energy technologies and their efficiency and emission control methods.
CO3	Evaluate alternative energy systems including hydrogen and fuel cells for industrial applications.
CO4	Apply energy storage and integration techniques to design sustainable energy systems

Theory syllabus

Unit	Content	Hrs
1	**Energy scenario and advanced thermodynamics:** Global and national energy scenario. World energy demand and supply trends. Indian energy scenario: fossil fuels, renewable energy resources, and future outlook. Energy security, sustainability, and climate change concerns. Review of First and Second Laws of Thermodynamics. Exergy analysis and irreversibility. Energy efficiency versus exergy efficiency. Availability analysis of chemical and thermal processes. Energy balance in process industries. Introduction to energy auditing and benchmarking.	11
2	**Fossil fuel based advanced energy technologies:** Advanced combustion systems. High-efficiency boilers and furnaces. Fluidized bed combustion systems (AFBC, CFBC, PFBC). Oxy-fuel combustion. Thermal power generation systems. Supercritical and ultra-supercritical power plants. Combined cycle power plants (CCPP). Co-generation and trigeneration systems. Emission control technologies for NO_x, SO_x, and particulates. Waste heat recovery systems. Basics of carbon capture, utilization, and storage (CCUS).	12
3	**Renewable and Alternative Energy Technologies:** Solar thermal collectors and concentrators. Solar power tower and parabolic trough systems. Solar energy storage systems (thermal and chemical). Wind energy conversion systems. Biomass gasification and pyrolysis. Biogas production and biofuels such as bioethanol and biodiesel. Hydrogen production methods including steam methane reforming, electrolysis, and biomass routes. Hydrogen storage techniques. Fuel cell types and their applications.	11
4	**Energy storage, efficiency, and sustainable energy systems:** Energy storage technologies: thermal energy storage, electrochemical storage (batteries and flow batteries), mechanical storage (compressed air and flywheel). Energy efficiency in chemical industries. Pinch technology for heat integration. Energy-efficient separation processes. Smart grids and energy management systems. Life cycle assessment (LCA) of energy systems. Future trends including net-zero energy systems and circular economy.	11

Text Books

1	Moran, M. J., Shapiro, H. N., *Fundamentals of Engineering Thermodynamics*, Wiley.
2	Twidell, J., Weir, T., *Renewable Energy Resources*, Routledge.
3.	Kalogirou, S., *Solar Energy Engineering*, Academic Press.
4.	Larminie, J., Dicks, A., *Fuel Cell Systems Explained*, Wiley.
Reference Books	
1	Boyle, G., *Renewable Energy: Power for a Sustainable Future*, Oxford University Press.
2	Smith, R., *Chemical Process Design and Integration*, Wiley.
3	Sorensen, B., *Renewable Energy Systems*, Elsevier.
ICT/MOOCs references	
NPTEL: Energy Engineering & Renewable Energy Systems SWAYAM: Sustainable Energy Technologies IEA and MNRE technical reports	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	3	-	-	-	1	2	-	2
CO2	3	3	2	1	1	2	3	-	-	-	1	3	2	2
CO3	3	3	2	1	1	2	3	-	-	-	1	3	2	2
CO4	3	2	3	1	2	3	3	-	-	1	2	3	3	3