Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

जा.क्र./शि.वि/अं.म./ 608 दिनांक:— ०७/१०/२०२५

प्रति,

१. मा. संचालक / प्राचार्य,
सर्व संलग्नीत अभियांत्रीकी महाविद्यालये,
शिवाजी विद्यापीठ, कोल्हापूर

२.प्र. संचालक,
स्कुल ऑफ इंजिनिअरींग ॲण्ड टेक्नॉलॉजी,
शिवाजी विद्यापीठ, कोल्हापूर

३.प्र. संचालक,
यशवंतराव चव्हाण स्कुल ऑफ रुरल डेव्हलपमेंट,
शिवाजी विद्यापीठ, कोल्हापूर

विषय:— एम. टेक अभ्यासक्रमातील किरकोळ दुरुस्तीबाबत.

संदर्भ:— १.एसयु/बीओएस/सायन्स&टेक/३१७ व ५३४ दि.२३/५/२०२५ व दि.४/९/२०२५
२.एसयु/बीओएस/सायन्स&टेक/५३९ दि.०८/०९/२०२५

महोदय,

उपरोक्त संदर्भिय विषयास अनुसररुन आपणास आदेशान्वये कळविण्यात येते की, शैक्षणिक वर्ष २०२५—२६ पासून लागू करण्यात आलेल्या खालील **एम.टेक** अभ्यासक्रमामध्ये किरकोळ दुरुस्ती करण्यात आलेली आहे.

Sr.	Course/Syllabus	Sr.	Course/Syllabus
1	Enargy Technology (ON)	6	Rural Technology (ON)
2	Computer Science and Technology (ON)	7	Computer Science and Engineering (OFF)
3	Electronics and Telecommunication (ON)	8	Mechanical (CAD/CAM/CAE) (OFF)
4	Environmental Science and Technology (ON)	9	Electronics and Telecommunication Engineering (OFF)
5	Food Technology (ON)		

सोबत सदर अभ्यासक्रमाची प्रत जोडली आहे. तसेच विद्यापीठाच्या https://www.unishivaji.ac.in (NEP-2020@suk/ Online syllabus) या संकेस्थळावर ठेवण्यात आला आहे. सदर दुरुस्ती ही शैक्षणिक वर्ष २०२५—२६ पासून लागू राहील.

सदर अभ्यासक्रम सर्व संबधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावेत ही विनंती.

कळावे.

आपला विश्वासू,

डॉ. एस. एम. कुबल
उपकुलसचिव

सोबत — अभ्यासक्रमाची प्रत,

प्रत :— **माहितीसाठी व पुढील योग्यत्या कार्यवाहीसाठी**

मा. संचालक, परीक्षा व मुल्यमापन मंडळ	प्र. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा
अध्यक्ष, संबंधित अभ्यास /अस्थायी मंडळ	इतर परिक्षा ४ विभागास.
परीक्षक नियुक्ती ए व बी विभागास.	संलग्नता टी. १ व टी. २ विभागास
पीजी प्रवेश विभागास	पीजी सेमिनार विभागास
संगणक केंद्र / आयटी सेल	पात्रता विभागास

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

M. Tech. (Energy Technology) Curriculum

2025-26 onwards

School of Engineering and Technology,
Shivaji University
M.Tech. Energy Technology

Vision:

To be a leader in engineering and technology education, a research center of global standards to provide valuable resources for industry and society through development of competent technical human resources.

Mission:

1. To undertake collaborative research projects that offer opportunities for consistent interaction with industries.
2. To organize teaching learning programs to facilitate the development of competent and committed professionals for practice, research and academics
3. To develop technocrats of national & international stature committed to the task of nation building.

Program Outcomes (POs):

1. Scholarship of Knowledge: The ability to acquire and synthesize in-depth, specialized knowledge, including a global perspective, to enhance one's understanding of the discipline.

2. Critical Thinking: The ability to critically analyse complex engineering problems and apply independent judgment to make intellectual and creative advances in a broader theoretical, practical, and policy context.

3. Problem Solving: The ability to think laterally and originally to solve engineering problems. This involves evaluating a wide range of solutions, while considering public health and safety, societal, and environmental factors.

4. Research Skill: The ability to use literature surveys and experiments to extract information, apply appropriate methodologies and tools, and analyze data to contribute to scientific and technological knowledge.

5. Usage of Modern Tools: The ability to select and apply modern engineering and IT tools, including modelling and prediction, with an understanding of their limitations.

6. Collaborative and Multidisciplinary Work: A knowledge of group dynamics and the capacity for self-management, teamwork, and decision-making to contribute positively to multidisciplinary research and achieve common goals.

7. Project Management and Finance: The ability to apply engineering and management principles to manage projects efficiently in a multidisciplinary environment, considering financial and economic factors.

8. Communication: The ability to communicate complex engineering activities confidently and effectively with both the engineering community and society. This includes writing reports, giving presentations, and giving clear instructions.

9. Life-long Learning: A recognition of the need for, and the ability to engage in, independent and continuous life-long learning to improve competence.

10. Ethical Practices and Social Responsibility: Professional and intellectual integrity, a commitment to a code of conduct and ethics of research, and an understanding of the impact of research outcomes on the community and sustainable development

Program Specific Outcomes (PSOs):

1. Able to apply the knowledge gained during the program in general and all energy technology courses in particular to identify, formulate and solve real life problems faced in industries and/or during research work.
2. Able to provide socially acceptable technical solutions to complex energy sector problems with the application of modern and appropriate techniques for sustainable development.

……

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

M. Tech. (Energy Technology)

Curriculum Structure

w.e.f 2025-26 onwards

SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology
First Year M. Tech. (Energy Technology) Semester - I
w. e. f. Academic Year 2025-26

Sr. No	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	ETAC1	Research Methodology	2	-	-	2	---	---	IOE	50
2	ETC11	Sustainable Power Generation Systems	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
3	ETC12	Bioenergy	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
4	ETC13	Solar Photovoltaic Energy Conversion	3		-	3	ISE	40	--------	-------
							ESE	60	--------	-------
5	ETE1	Elective-I	3		-	3	ISE	40	--------	-------
							ESE	60	--------	-------
6	ETOE1	Elective- II (Open Elective)	3	-	-	3	ISE	40	--------	-------
							ESE	60		
7	ETC14	Seminar - I	-	-	2	1	--------	-------	IOE	50
8	ETC15	Sustainable Power Generation Systems Lab	-	-	2	1	--------	-------	IOE	50
9	ETC16	Solar Photovoltaic Energy Conversion Lab	-	-	2	1	--------	-------	IOE	50
Total			**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week =23*										

Elective – I
ETE 11. Wind Energy and Small hydropower systems
ETE 12. Energy storage systems
ETE 13. Waste to Energy Conversion

Elective II (Open Elective): choose from list on next page

*** Students from M. Tech any branch of Department of Technology Can opt for this Elective.**

Semester –I (Open Elective*)

Sr. No.	Elective-II (Open Elective*)	Branch
1	Advanced Communication System	Electronics Technology
2	Reconfigurable Computing	
3	VLSI Testing & Testability	
4	FTE-21:Advances in processing of dairy Technology	Food Technology
5	FTE-22: Food Trade Management	
6	FTE-23: Advances in Grain Science and Technology	
7	ETOE11: Electric Vehicles and Renewable Energy	Energy Technology
8	ETOE12: Energy Efficient Buildings	
9	ETOE13: Computational Fluid Dynamics	
10	ESTE-21 Environmental Biotechnology	Environmental Science and Technology
11	ESTE-22 Energy Efficient Building	
12	ESTE-23 Operational Health and Safety Management	
13	CSTEOE1: Advanced Operating Systems	Computer Science and Technology
14	CSTOE2: Internet of Things	
15	CSTOE3: Data Analytics	

SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology
First Year M. Tech. (Energy Technology) Semester - II
w. e. f. Academic Year 2025-26

Sr. No	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
	ETAC2	Intellectual Property Rights	2	-	-	2	---	---	IOE	50
1	ETC21	Solar Thermal Energy Conversion	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
2	ETC22	Energy Management and Audit	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
3	ETC23	Energy efficiency in thermal and electrical Utilities	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
4	ETE2	Elective-III	3	-	-	3	ISE	40	--------	-------
							ESE	60	--------	-------
5	ETOE2	Elective- IV (Open Elective)	3	-	-	3	ISE	40	--------	-------
							ESE	60		
6	ETC24	Seminar-II	-	-	2	1	--------	-------	IOE	50
7	ETC25	Solar Thermal Energy Conversion Lab	-	-	2	1	--------	-------	IOE	50
8	ETC26	Energy efficiency in thermal and electrical utilities Lab	-	-	2	1	--------	-------	IOE	50
Total			**17**	**-**	**6**	**20**		**500**		**200**
Total Contact hours per week =23*										

Elective - III
ETE 21. Hydrogen Energy and Fuel Cell Technology
ETE 22. Power Plant System Engineering
ETE 23. Energy Resources, Economics, and Sustainability

Elective IV (Open Elective): choose from list on next page

*** Students from M. Tech any branch of Department of Technology Can opt for this Elective.**

Semester –II (Open Elective*)

Sr. No.	Elective-IV (Open Elective*)	Branch
1	METCOE21: MIMO Systems	Electronics Technology
2	METCOE22: Satellite Communication	
3	METCOE23:Smart and Phased Array Antenna Design	
4	FTE-41: Recent developments in processing of plantation crops	Food Technology
5	FTE-42: Project Management for Food Processing Industries	
6	FTE-43: Sustainable Food Process Engineering	
7	ETOE21 : Energy Modeling and Project Management	Energy Technology
8	ETOE22 : Artificial Intelligence in Energy Systems	
9	ETOE23 : Design and Optimization of Energy Systems	
10	ESTE-41 Operation and Maintenance of Environmental Facilities	Environmental Science and Technology
11	ESTE-42 Rural Water Supply and Sanitation	
12	ESTE-43 Environmental Biotechnology	
13	CSTOE21: Geographical Information Systems	Computer Science and Technology
14	CSTOE22: Natural Language Processing	
15	CSTOE23: Blockchain Technology	

SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology
Second Year M. Tech. (Energy Technology) Semester - III
w. e. f. Academic Year 2026-27

Sr. No	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	ETC31	Industrial Training	-	-	2*	5**	--------	-------	IOE	50
									EOE	50
2	ETC32	Dissertation Phase-I	-	-	2*	15	--------	-------	IOE	100
									EOE	100
Total			**-**	**-**	**4**	**20**				**300**
Total Contact hours per week =4*										

*Students are expected to do self-study for two hours as per the guidance given by the Project Guide and report to the department once in a week. Hence contact hours to be taken as two for the calculation of contact hours.

** Industrial Training of Eight weeks at the end of First Year
OR
Industrial training will be split in two slots of four weeks during semester III

Evaluation at end of III semester on the basis given report and Presentation to concern Guide.

SHIVAJI UNIVERSITY, KOLHAPUR
Department of Technology
Second Year M. Tech. (Energy Technology) Semester - IV
w. e. f. Academic Year 2026-27

Sr. No.	Subject Code	Subject Title	Teaching Scheme (Hours/week)				Examination Scheme			
							Theory		Practical	
			L	T	P	Credits	Scheme	Max. marks	Scheme	Max. marks
1	ETC41	Dissertation Phase-II	-	-	4*	20	--------	-------	IOE	100
									EOE	200
Total			**-**	**-**	**4**	**20**	--------	-------		**300**
Total Contact hours per week =4*										

*Students are expected to do self-study for two hours as per the guidance given by the project Guide and report to the department once in a week. Hence contact hours to be taken as two for the calculation of contact hours.

Note:

$: Minimum 40% marks required in ESE as passing head.

• Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

ISE – In Semester Examination, ESE –End Semester Examination,

IPE – Internal Practical Evaluation, EPE–External Practical Examination,

IOE– Internal Oral Evaluation, EOE–External Oral Examination

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

M. Tech. (Energy Technology) Curriculum

2025-26 onwards

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Research Methodology			***Course Code*:**	:	ETAC1
Teaching Scheme (Hours)	:	Lecture :	02 Hrs./week		***Total Credits***	:	02
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	:	IOE=50	ESE = Nil	Grand Total=50	***Duration of SEE***	:	–
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	The student should be familiarize with basic of research.					
Course Domain	:	Audit Course					

Course Rationale:
This course aims to lay a foundation for your research. The goal is to help you to design and develop your future research projects.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Familiarize students with basic of research and the research process.	1.	To understand basic concepts of research and its methodologies
2.	Familiarize Research Design.	2.	To select and define appropriate research problem and parameters
3.	Introduce measurement and scaling techniques in research.	3.	To apply Measurement and Scaling Techniques
4.	Familiarize methods of data collection and analysis	4.	To use Methods of Data Collection and Analysis
5.	Introduce techniques of hypotheses, parametric or standard tests	5.	To apply techniques of hypotheses, parametric or standard tests
6.	Help to analyze variance and co-variance	6.	Present and defend research ideas using Analysis of Variance and Co-variance

Curriculum Content	**Hours**
Unit I- Research Methodology: An Introduction: Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem	(5 h)
Unit II- Research Design: Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling	(5 h)
Unit III - Measurement and Scaling Techniques: Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.	(4 h)
Unit IV - Methods of Data Collection and Analysis: Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation	(4 h)
Unit V - Techniques of Hypotheses, Parametric or Standard Tests: Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parameteric Test, Conversion of Chi to Phi, Caution in using Chi-square test	(4 h)
Unit VI - Analysis of Variance and Co-variance: ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis	(5 h)

Suggested Text Books:	
1.	"Research Methodology", C.R. Kothari, Wiley Eastern.
Suggested Reference Books:	
1.	"Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Hymalaya Publication, Bombay.
2.	"Research in Education", John W Best and V. Kahn, PHI Publication.
3.	"Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson Education
4.	"Management Research Methodology-Integration of principles, methods and Techniques", K.N. Krishnaswami and others, Pearson Education.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc22
2.	https://onlinecourses.nptel.ac.in/noc23
3.	https://onlinecourses.swayam2.ac.in/cec20

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	1	0	1	2	2	2	1
CO2	2	3	2	3	2	1	2	1	2	2	3	2
CO3	2	2	2	3	2	1	0	1	2	2	2	2
CO4	2	3	2	3	3	2	1	2	2	2	3	2
CO5	2	3	2	3	2	1	0	2	2	3	2	2
CO6	2	3	2	3	2	2	1	3	2	3	2	2

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Sustainable Power Generation Systems			***Course Code*:**	:	ETC 11
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total =100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Mechanical Engineering					
Course Domain	:	Professional core course					

Course Rationale:

This course broadly gives an overview of various energy resources, their availability and use pattern. It also gives an exposure about environmental effects of energy usage. The world scenario of conventional energy sources, various renewable energy sources and their applications are discussed in depth. The energy conversion processes, fuels and their characteristics and environmental impacts of energy conversion are also discussed.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the different forms of energy, and explain the second law of thermodynamics.	1.	Demonstrate an understanding of the origin and time scale of fossil fuels and the concept of renewable energy resources
2.	Explain the concept of renewable energy resources, and the role of energy in economic development and social transformation	2.	Identify the role of energy in economic development and social transformation
3.	Summarize the impact of growing energy consumption on the global and Indian economy	3.	Evaluate the impact of rising energy consumption on the global and Indian economy
4.	Illustrate the ecological and environmental impacts of power plants	4.	Analyze the environmental degradation caused by energy production and utilization

Curriculum Content	**Hours**
Unit I - Introduction to Energy: Definition and units of energy and power, forms of energy, conversion of energy, second law of thermodynamics, origin of fossil fuels, time scale of fossil fuels, renewable energy resources, role of energy in economic development and social transformation, Human Development Index of UNO.	(6 h)
Unit II - Global Scenario : Energy resources - coal, oil, natural gas, uranium and hydroelectricity, energy resources and their geographical distribution, energy consumption in various sectors, projected energy consumption for the twenty first century, impact of rise in energy consumption on global economy, large power plants, energy consumption in some important countries, energy exports, future energy options, role in brief, of International Atomic Energy Agency.	(10 h)
Unit III - Indian Scenario: Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time, energy resources available in urban and rural sector, nuclear energy - promise and future, energy as a factor limiting growth, need for use of renewable energy resources, state wise energy utilization, energy independence, large power projects.	(10 h)

Unit IV - Environmental Impact : Environmental degradation due to energy production and utilization, primary and secondary pollution-air, thermal and water, depletion of ozone layer, global warming, biological damage due to environmental degradation, pollution due to thermal power stations and their control, pollution due to nuclear power generation, radioactive waste management, effect of hydro-electric power stations on ecology and environment, global warming and its effects - summary of UNFCCC studies.	(10 h)

Suggested Text Books:	
1.	G.D. Rai, Non-conventional energy sources, Khanna publication
2.	S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi
3.	O.P. Gupta, Energy Technology, Khanna Book Publishing House
Suggested Reference Books and links:	
1.	International Energy Outlook' -EIA annual Publication
2.	Ministry of Power - Govt. of India - Energy Statistics - latest edition
3.	Kishore V.V.N., "Renewable Energy Engineering and Technology", Teri Press, New Delhi, 2012
4.	Kreith F. and Kreider J.F., "Principles of Solar Engineering", McGraw-Hill, 1978.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc23_ge47/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ch27
3.	https://nptel.ac.in/courses/103103206
4.	https://onlinecourses.nptel.ac.in/noc19_ch26
5.	https://mnre.gov.in/
6.	https://powermin.gov.in/

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	1	0	1	2	2	2	3
CO2	2	3	2	2	1	2	2	2	2	2	3	3
CO3	2	3	2	2	1	1	2	2	2	3	2	3
CO4	2	3	2	2	1	1	1	2	2	3	2	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	**:**	Bioenergy			***Course Code*:**	**:**	ETE 12
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs./week		***Total Credits***	**:**	03
		Tutorial :	0 Hrs./week				
Evaluation Scheme (Marks)	**:**	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	**:**	03 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Basic Science courses					
Course Domain	**:**	Professional core course					

Course Rationale:

Bioenergy plays a crucial role in sustainable energy systems by utilizing biomass resources to generate heat, electricity, and biofuels. This course provides an in-depth understanding of biomass conversion technologies, their economic viability, and environmental impacts. With increasing global energy demands and climate change concerns, bioenergy offers a renewable alternative to fossil fuels.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To provide an understanding of biomass resources, their classification, and assessment techniques.	1.	Understand the classification and assessment of biomass resources.
2.	To explore various thermo-chemical and biological conversion processes for bioenergy production.	2.	Analyze different bioenergy conversion technologies and their applications.
3.	To study chemical conversion methods and their applications in biofuels and chemicals.	3.	Design and evaluate bioenergy systems for sustainable power generation.
4.	To examine biomass-based power generation technologies and their practical implementations.	4.	Interpret government policies, regulations, and economic aspects of bioenergy.

Curriculum Content	**Hours**
Unit- 01: Introduction to Bioenergy Origin of Biomass and its role in energy production, Classification and characteristics of biomass resources, Techniques for biomass assessment, Application of remote sensing in forest assessment, Biomass estimation methods.	(6 h)
Unit- 02: Thermo-chemical Conversion Direct combustion, incineration, pyrolysis, gasification, and liquefaction, Economics of thermo-chemical conversion processes, Biomass processing: Briquetting and palletization, Biomass stoves and biomass carbonization, Production of syngas from biomass.	(6 h)
Unit-03: Biological Conversion Biodegradation and biodegradability of substrates, Biochemistry and process parameters of bio-methanation, Biogas digester types, design, and utilization, Chemical kinetics and mathematical modeling of bio-methanation, Economics and socio-environmental impacts of biogas plants, Bioconversion of substrates: Alcohol (methanol & ethanol), organic acids, solvents, amino acids, antibiotics, Activated sludge process, plug flow reactors, anaerobic fixed film reactors, UASB reactor, anaerobic fluidized bed reactor, Estimation of methane yield, anaerobic digestion systems for MSW, vermi-composting.	(6 h)
Unit- 04: Chemical Conversion Hydrolysis and hydrogenation, Solvent extraction of hydrocarbons, Solvolysis of wood, Bio-crude and biodiesel production, Biogas to green vehicle fuel (Bio-CNG), Biogas opportunities: Landfill gas, agricultural and industrial wastewater, additional methane sources.	(6 h)

Unit No 05: Power Generation Utilization of gasifiers for electricity generation, Operation of spark ignition and compression ignition engines with wood gas, methanol, ethanol, and biogas, Biomass-integrated gasification and combined cycle (BIGCC) systems.	(6 h)
Unit No 06: Biomass Productivity, Policies, and Economics Energy plantation and power programs, Biomass renewable energy programs of the Central and State Governments, Regulations and policies on bioenergy, Feed-in tariff policies and grid injection, Hybrid bioenergy systems and cost economics.	(6 h)

Suggested Text Books:	
1.	Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson , Kenneth L. Starcher
2.	Bioenergy: Biomass to Biofuels by by Anju Dahiya
3.	Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal
Suggested Reference Books:	
1.	Bioenergy by Judy D. Wall and Caroline S. Harwood
2.	Bioenergy: Sustainable Perspectives by Ted Weyland
3.	Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York
4.	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc19_bt16/preview
2.	https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-bt03/
3.	https://archive.nptel.ac.in/courses/103/103/103103207/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	1	1	0	1	2	2	3	2
CO2	2	3	3	2	2	1	1	1	2	2	3	3
CO3	2	3	3	2	2	2	2	2	2	3	3	3
CO4	2	3	2	1	1	1	3	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Solar Photovoltaic Energy Conversion			***Course Code*:**	:	ETC 13
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	0 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Fundamental Physics					
Course Domain	:	Professional core course					

Course Rationale:
The course aims to equip students with the knowledge and skills necessary to understand, design, and evaluate solar PV systems. It also addresses the market and economic aspects of solar energy, enabling students to assess the viability and potential of solar energy projects in various contexts.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss solar energy and its applications	1.	Summarize the knowledge of Solar PV system.
2.	Impart the skills to analyze and design solar photovoltaic (PV) systems	2.	Acquire the skills to analyze and design solar photovoltaic (PV) systems
3.	Develop the ability to evaluate the performance of solar PV systems	3.	gain knowledge about solar PV system component standards and testing procedures
4.	Illustrate the market dynamics and economics related to solar PV systems	4.	Understand the Market Analysis & Techno-economical feasibility of Solar PV System

Curriculum Content	**Hours**
Unit I - Introductions to Solar Energy: Solar Spectrum, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram; Shadow angle protractor; Solar Radiation: Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces; Measurement of Solar radiation. Analysis of Indian solar radiation data and applications.	(6 h)
Unit II - Photovoltaic Principles: Solar Cell Physics: p-n junction: homo and heterojunctions, Metal-semiconductor interface; The Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells, various types of solar cells.	(8 h)
Unit III - Solar Photovoltaic System Design: Solar cell array system analysis and performance prediction; Shadow analysis: Reliability; Solar cell array design concepts; PV system design; Design process and optimization; Detailed array design; Storage autonomy; Voltage regulation; Maximum tracking; Use of computers in array design; Quick sizing method; Array protection and trouble shooting.	(8 h)
Unit IV - Performance evaluation of SPV systems: Plant load factor, PV array efficiency evaluation, Inverter efficiency tests, balance of material (BOM), energy loss calculations, system efficiency loss calculations, solar PV system component standards and testing standards	(8 h)
Unit V - Market analysis and economics of SPV system: Various business models for sale of PV electricity, Feed in tariff, regulatory provisions and central/ states solar PV policy, The Recent developments in Solar cells, Role of nano-technology in Solar cells.	(6 h)

Suggested Text Books:	
1.	Chetan Singh Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.
2.	Sukhatme S.P.,. Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008
3.	Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000
Suggested Reference Books:	
1.	Solar Energy Engineering: Processes and Systems by Prof. Soteris Kalogirou
2.	Solar Electricity Handbook-2015 Edition, by Michael Boxwell, Greenstream Publishing Ltd.
3.	Solar Photovoltaic Basics by Sean White
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc21_ph25/preview
2.	https://onlinecourses.nptel.ac.in/noc22_ee71/preview
3.	https://nptel.ac.in/courses/113104084

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	1	0	1	2	2	3	2
CO2	2	3	3	2	3	2	2	2	2	2	3	3
CO3	2	2	2	3	3	1	1	1	2	2	3	2
CO4	2	3	2	2	2	2	3	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Wind Energy and Small hydropower systems			***Course Code*:**	:	ETE 11
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	0 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Mechanical Engineering					
Course Domain	:	Program Specific Elective					

Course Rationale:

The course aims to equip students with the knowledge and skills necessary to understand the principles of wind energy conversion, design efficient wind energy systems, assess wind resources, evaluate project feasibility, and analyze the economic and environmental aspects of wind energy utilization and small hydropower systems.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the types and classification of wind energy conversion systems and SHP	1.	Identify the types and classification of wind energy conversion systems (WECS) and SHP.
2.	Elaborate the considerations and methodology for wind turbine design	2.	Demonstrate the skills to design efficient wind energy conversion systems
3.	Illustrate the performance, design concepts, and testing of wind pumps	3.	Interpret the performance, design concepts, and testing of wind systems
4.	Summarize the knowledge of the economics of wind energy utilization	4.	Analyze Techno-economic feasibility of WESH System

Curriculum Content	**Hours**
Unit I - Introduction: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics, Wind resource map of India, screening probable sites and various indicators involved, instrumentation, wind speed measurement, Micrositing of wind turbines, site identification, wind mast installation, Annual Energy Output estimation Uncertainties in estimation, Probabilities of Estimation	(6 h)
Unit II - WECS Design: Aerodynamic design principles, Aerodynamic theories; (2-D, 3-D aerodynamics), Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss correction.	(3h)
Unit III - Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.	(6 h)
Unit IV - Wind Energy Application: Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy utilization; Wind energy in India; Case studies, Environmental Impacts of Wind Farms.	(6 h)
Unit V - Wind Power Project Planning and Structuring: Bank ability of Projects, Promoters, Financing, Balance Sheet, Non-Recourse or Project Finance, Leasing, Taxation Issues Electricity Off Take Arrangements & Structures; PPA with utility, Captive, Group Captive, Open Access & Merchant Sale and concerned government regulations and policies	(6 h)

Unit VI - Project Contracts: Wind Turbine Supply Contracts, Works Contracts, E&C Contract, O&M Contract, Introduction to WASP, Wind Farmer.	(3h)
Unit VII -Small Hydropower Systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works; Speed and voltage regulation; Investment issues load management and tariff collection; Distribution and marketing issues, case studies.	(6 h)

Suggested Text Books:	
1.	Non-conventional energy sources by G.D. Rai, Khanna Publishers
2.	Freris L.L., "Wind Energy Conversion Systems", Prentice Hall, 1990
3.	John D Sorensen and Jens N Sorensen, "Wind Energy Systems", Woodhead Publishing Ltd, 2011.
4.	Kaldellis J.K., "Stand – alone and Hybrid Wind Energy Systems", CRC Press, 2010.
Suggested Reference Books:	
1.	Wind Energy Engineering, Pramod Jain, The McGraw-Hill Companies, Inc.
2.	Advanced Renewable Energy Sources, By G. N. Tiwari, Rajeev Kumar Mishra
3.	Renewable Energy Engineering and Technology: principles and practice edited by V. V. N. Kishore
4.	C-Wet : Wind Energy Resources Survey in India VI
Useful links:	
1.	https://nptel.ac.in/courses/103103206
2.	https://nptel.ac.in/courses/108108078
3.	https://nptel.ac.in/courses/103107157

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	1	2	1	1	0	1	2	2	3	2
CO2	2	3	3	2	3	2	2	2	2	2	3	3
CO3	2	2	2	3	3	1	1	1	2	2	3	2
CO4	2	3	2	2	2	2	3	2	2	3	2	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	**:**	Energy storage systems			***Course Code*:**	**:**	ETE 12
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs./week		***Total Credits***	**:**	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	**:**	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	**:**	03 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Basic Mechanical Engineering ,Basic Electrical Engineering					
Course Domain	**:**	Program Specific Elective					

Course Rationale:
The main objective of this course is to offer a comprehensive and integrated understanding of different energy systems. The course will cover an extensive range of energy storage systems, including both conventional and emerging technologies. It will explore the principles behind their operation, energy efficiency, and the significant challenges.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the relevance and current scenario of energy storage systems.	1.	Demonstrate knowledge and understanding of current scenario of energy storage systems.
2.	Summarize the various applications of energy storage systems.	2.	Identify and analyze the criteria for energy storage systems.
3.	Conduct a detailed analysis of each type, assessing their advantages and drawbacks.	3.	Performance evaluation of various electrical & thermal energy storage systems.
4.	Introduce emerging advances and technologies in the field.	4.	Perform the selection based on techno-economic viewpoint.

Curriculum Content	**Hours**
Unit I - Introduction to Energy Storage: Relevance and scenario. Perspective on development of Energy storage systems. Energy storage criteria, General concepts. Conventional batteries – fundamentals and applications. Grid connected and Off grid energy storage systems and requirements.	(6 h)
Unit II - Thermal storage: Thermal properties of materials, Principle of operations, Efficiency factors, large scale and Medium scale operations, Pros and Cons. Advances in thermal storage.	(6 h)
Unit III - Mechanical Storage: Types of systems, Principle of operations, Emerging advances and Technologies. case study : Flywheel	(6 h)
Unit IV - Electrochemical Storage: Materials, Principle of Operation, Challenges and research survey, Positive electrode materials, negative electrode materials, electrolytes.	(6 h)
Unit V - Fuel Cells and Hydrogen storage: History of Fuel cell, Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantage and drawback of each type.	(6 h)
Unit VI - Supercapacitors: Principle of operation, device fabrication, challenges and technical review	(6 h)

Suggested Text Books:	
1.	Ibrahim Dincer and Mark A. Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons 2002
2.	Energy Storage: Fundamentals, Materials and Applications 2nd ed. 2016 Edition by Robert Huggins
3.	James Larminie and Andrew Dicks,"Fuel cell systems Explained", Wiley publications, 2003.
Suggested Reference Books:	
1.	Thermal Energy Storage Technologies for Sustainability: Systems Design by S. Kalaiselvam, R. Parameshwaran
2.	Hybrid Hydrogen Systems: Stationary and Transportation Applications by Said Al-Hallaj, Kristofer Kiszynski
3.	Energy Storage – Technologies and applications by Ahmed Faheem Zobaa
4.	Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion) by Yuping Wu (Editor)
5.	Storing Energy: with Special Reference to Renewable Energy Sources by Trevor M. Letcher
Useful links:	
1.	https://nptel.ac.in/courses/113105102
2.	https://nptel.ac.in/courses/112107283
3.	https://onlinecourses.nptel.ac.in/noc21_mm23/preview

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	1	0	1	2	2	3	2
CO2	2	3	2	2	2	1	1	1	2	2	3	3
CO3	2	3	3	3	3	2	1	1	2	2	3	3
CO4	2	3	2	2	2	2	3	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Waste to Energy Conversion			***Course Code*:**	:	ETE 13
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Mechanical Engineering ,					
Course Domain	:	Program Specific Elective					

Course Rationale:

Waste management and energy production are crucial for environmental sustainability. This course focuses on the scientific and technological aspects of converting waste into usable energy, addressing solid waste management, waste treatment, and energy recovery techniques. By exploring biochemical, thermochemical, and mechanical conversion processes, students will gain expertise in sustainable waste-to-energy strategies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand the sources, classification, and properties of solid waste.	1.	Understand solid waste properties and management strategies.
2.	To study waste treatment and disposal techniques, including composting and incineration.	2.	Analyze different waste-to-energy conversion technologies and applications.
3.	To explore landfill design, leachate management, and gas control systems.	3.	Evaluate landfill design and environmental control measures.
4.	To analyze biochemical and thermochemical waste-to-energy conversion methods.	4.	Assess economic and environmental impacts of waste-to-energy processes.

Curriculum Content	**Hours**
Unit I - Solid Waste Definitions, sources, types, and composition of solid waste, Properties of solid waste, Municipal solid waste management.	(6 h)
Unit II - Waste Collection, Minimization & Recycling Physical, chemical, and biological properties of waste, Collection and transfer stations, Waste minimization strategies and municipal waste recycling.	(6 h)
Unit III - Waste Treatment & Disposal Size reduction and aerobic composting, Incineration: Furnace types, designs, and medical/pharmaceutical waste incineration, Environmental impacts and mitigation measures for incineration, Landfill method of solid waste disposal: Classification, types, methods, and site selection.	(6 h)
Unit IV - Landfill Design & Environmental Monitoring Layout and preliminary design of landfills, Composition, characteristics, and generation of landfill leachate and gases, Movement and control of landfill gases, Environmental monitoring systems for landfill emissions.	(6 h)
Unit V - Energy Generation from Waste Biochemical conversion: Energy generation from industrial waste and agro residues, Anaerobic digestion and biogas production, Types of biogas plants and community biogas plants, Thermo-chemical conversion: Gasification and gasifier types, Industrial applications and environmental benefits of waste-to-energy processes, Briquetting and its utilization.	(6 h)
Unit VI - Bio-Diesel & Alternative Fuels History and production methods of bio-diesel, Transesterification process and fuel quality standards, Properties and raw material availability for bio-diesel, Bio-diesel applications and potential in India.	(6 h)

Suggested Text Books:	
1.	Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store.
2.	Young G.C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons.
3.	Harker, J.H. and Backhusrt, J.R., "Fuel and Energy", Academic Press Inc.
Suggested Reference Books:	
1.	Energy Conversion by D. Yogi Goswami, Frank Kreith.
2.	Waste to Energy Conversion Technology by Klinghoffer & Castaldi
3.	EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc20_ch16/preview

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	1	0	1	2	2	3	2
CO2	2	3	3	2	2	1	1	1	2	2	3	3
CO3	2	3	2	3	2	1	1	1	2	3	2	3
CO4	2	3	2	2	2	2	3	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Electric Vehicles and Renewable Energy			***Course Code*:**	:	ETOE 11
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Electrical Engineering					
Course Domain	:	Professional Elective course					

Course Rationale:

The transition to electric vehicles (EVs) and renewable energy is essential for sustainable transportation and energy security. This course provides a comprehensive understanding of EV technology, vehicle dynamics, powertrain systems, battery storage, and charging infrastructure. It also explores decentralized renewable energy generation and storage solutions, ensuring students gain practical and theoretical knowledge to contribute to the growing EV and renewable energy sectors.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand the current landscape of electric vehicles in India and their impact.	1.	Understand the fundamentals of EV technology and its integration with renewable energy.
2.	To analyze vehicle dynamics and subsystems, including powertrain and battery technology.	2.	Analyze EV powertrain components, battery storage, and charging technologies.
3.	To explore EV motor design, controllers, and vehicle accessories.	3.	Evaluate motor and controller design for optimized performance.
4.	To examine battery storage, charging, swapping, and energy management.	4.	Assess the feasibility of decentralized renewable energy generation for EV charging.

Curriculum Content	**Hours**
Unit- 01: Overview of Electric Vehicles in India Introduction to electric vehicles (EVs), Growth and adoption of EVs in India, Government policies, incentives, and regulatory framework, Environmental benefits and challenges of EV adoption.	(6 h)
Unit- 02: Vehicle Dynamics Fundamentals of vehicle motion and performance, Aerodynamic forces and power requirements, Regenerative braking and energy recovery, Driving cycles and range estimation.	(6 h)
Unit-03: Vehicle Subsystems – EV Powertrain EV powertrain components and architecture, Energy flow and efficiency considerations, Transmission systems and integration with electric motors, Comparison between conventional and electric powertrains.	(6 h)
Unit- 04: Storage for EVs and Battery Pack Design Types of energy storage systems for EVs, Lithium-ion and alternative battery technologies. Fundamentals of EV battery pack design, Battery management systems (BMS) and safety considerations.	(6 h)
Unit No 05: EV Motors and Controllers – Fundamentals and Design Types of electric motors used in EVs (Induction, BLDC, PMSM, etc.), Design considerations and performance characteristics, Motor controllers and power electronics, Efficiency and thermal management of EV motors.	(6 h)
Unit No 06: Charging Infrastructure and Renewable Energy Integration Battery charging technologies: Slow, fast, and ultra-fast charging, Battery swapping technology and infrastructure requirements, Decentralized solar energy generation and its role in EV charging, Energy storage solutions for renewable energy-powered EV charging stations.	(6 h)

Suggested Text Books:	
1.	Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication
2.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Mehrdad Ehsani, CRC Press,2004
3.	Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, Taylor & Francis Group, 2015.
4.	Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003, 2nd Edition.
Suggested Reference Books:	
1.	Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc21_ee112/preview
2.	https://archive.nptel.ac.in/courses/108/102/108102121/
3.	https://archive.nptel.ac.in/courses/108/106/108106170/
4.	https://archive.nptel.ac.in/courses/108/103/108103009/

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	1	2	2	1	0	1	2	2	3	2
CO2	2	3	3	3	3	2	1	2	2	2	3	2
CO3	2	3	3	3	3	2	1	2	2	2	3	2
CO4	2	3	2	2	2	2	3	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Energy Efficient Buildings			***Course Code*:**	:	ETOE 12
Teaching Scheme (Hours)	:	Lecture : 03 Hrs./week Tutorial : 00 Hrs./week			***Total Credits***	:	03
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Nil					
Course Domain	:	Professional Elective course					

Course Rationale:

The Energy-Efficient Buildings course covers sustainable design principles, focusing on building energy efficiency. It begins with basics like energy requirements and heat transfer, progressing to psychometrics and passive design strategies. Students learn about passive solar heating, ventilation, mechanical controls, and natural ventilation

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Explain the significance of building science, in the context of energy management concepts.	1.	Demonstrate understanding of the fundamental principles of architecture for sustainable construction
2.	Describe thermal comfort criteria and various parameters and its importance in designing energy-efficient buildings	2.	Analyze solar radiation calculations, considering building orientation and design of shading devices
3.	Summarize the significance of passive cooling and heating concepts	3.	Apply appropriate passive design concepts for different climatic zones in India
4.	Utilize building simulation software to design energy-efficient buildings and assess their performance	4.	Comprehend the use of building simulation software to evaluate the effectiveness of different energy conservation techniques

Curriculum Content	**Hours**
Unit I - Introduction : Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building	(6 h)
Unit II - Thermal Analysis and Design For Human Comfort : Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation; Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems	(6 h)
Unit III - Passive Cooling and Heating Concepts : Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces; Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel, Introduction to green campus, Solar cities and smart cities	(6 h)
Unit IV - Heat Transmission in Buildings : Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.	(6 h)

Unit V - Bioclimatic Classification : Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.	(6 h)
Unit VI - Simulation soft wares : Building performance modelling and simulation tools: Software packages and coding, Energy efficient building standards: National and International Codes, Case studies	(6 h)

Suggested Text Books:	
1.	Energy conscious building by J.K. Nayak ,J.A. Prajapati
2.	Energy conservation Building Codes 2006; Bureau of Energy Efficiency
3.	Solar Passive Building, Science and Design by M. S. Sodha, N. K,.Bansal, P. K. Bansal, A. Kumar and M. A. S. Malik , Pergamon Press, 1986.
4.	Majumdar, M. (Ed), Energy efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2002.
Suggested Reference Books:	
1.	Solar Energy – fundamentals, technology and systems by K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman ,Delft University of Technology, 2014
2.	Passive solar architecture :Heating,cooling,ventilation,day lighting and more using natural flows – David Bainbridge, Ken Haggard
3.	The solar house: Passive heating and cooling – Daniel D Chiras
4.	Solar energy fundaments and modeling techniques – Zekai sen
5.	Energy performance of buildings – George Baird
Useful links:	
1.	https://onlinecourses.swayam2.ac.in/nou24_ge85/preview
2.	https://onlinecourses.nptel.ac.in/noc23_ar16/preview
3.	https://onlinecourses.nptel.ac.in/noc20_ph14/preview
4.	https://archive.nptel.ac.in/courses/112/105/112105050/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	1	1	1	1	2	3	2	3
CO2	2	3	3	3	2	1	1	2	2	3	3	3
CO3	2	3	3	3	2	1	1	2	2	3	3	3
CO4	2	2	2	3	3	2	1	2	2	3	3	3

lass, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	**:**	Computational Fluid Dynamics			***Course Code*:**	**:**	ETOE 13
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs./week		***Total Credits***	**:**	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	**:**	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	**:**	03 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Basic Fluid Dynamics					
Course Domain	**:**	Professional Elective course					

Course Rationale:

The course on Computational Fluid Dynamics provides a rational approach to understanding the conservation laws and governing equations for fluid flow, including the continuity equation and momentum equation. It provides a solid foundation in mathematical modeling of fluid flow, equips students with computational methods for solving fluid flow problems, and explores solutions for laminar and turbulent flow scenarios.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the conservation laws and governing equations for fluid flow	1.	Demonstrate the knowledge and understanding of governing equations to different fluid flow problems
2.	Summarize the methods of discretization in computational fluid dynamics (CFD)	2.	Define and setup flow problem properly within CFD context.
3.	Demonstrate the skills for solving laminar flow problems	3.	Gain knowledge and skills in solving laminar flow problems.
4.	Illustrate examples and practice solving turbulent flow problems using appropriate turbulence models	4.	Use CFD software to model relevant engineering flow problems and analyze the CFD results.

Curriculum Content	**Hours**
UNIT I - Mathematical Modelling of Fluid Flow: Conservation laws & governing equations for fluid flow: Continuity equation, Momentum equation etc. and their derivations, General form of conservation equations, Boundary conditions, Classification of equations, Mathematical modeling practices of basic fluid flow problems and its solution, Methods of flow visualization.	(9h)
Unit II - Methods of Discretization: Introduction to Computational methods, Components and properties of computational methods, Various methods of discretization; Illustration of Finite volume method (FVM) for generalized form of conservation equations, Solution of steady & unsteady diffusion equations, Solution of convection-diffusion equation with illustration of various differencing schemes.	(9h)
Unit III - Solution of Laminar Flow Problems: Basic equations for Laminar flow cases, Calculation of flow field variables, Difficulties involved in solution of momentum equations, Staggard grid, Navier-Stokes solvers, SIMPLE algorithm & its variants, Solution of simple viscous laminar flow problems as Couette flow, Poiseuille flow, boundary layer flows, etc., Implementation of various boundary conditions, Numerical techniques for solution of algebraic equations.	(9h)

Unit IV - Introductory Solution of Turbulent Flow Problems: Important features of turbulent flow, Reynolds average Navier-stoke (RANS) equation, Necessity of turbulence modeling, Different types of turbulence model, Illustrative example and practice.	(9h)

Suggested Text Books:	
1.	An Introduction to Computational Fluid Dynamics: The finite volume Method, Versteeg, H.K., and Malalasekera, W.
2.	Computational fluid dynamics – The basics with applications, Anderson, J.D
3.	Computational Methods for Fluid dynamics, Ferziger and Peric
Suggested Reference Books:	
1.	Numerical heat transfer and fluid flow, Patankar, S. V., Hemisphere Publishing Corporation, 2004.
2.	Turbulent flows, Pope S. B., Cambridge university press.
3.	Computer simulation of flow and heat transfer, Ghoshdastidar, P. S., Tata McGraw Hill Publishing Company Ltd., 1998.
4.	Anderson, "Computational Fluid Mechanics and Heat Transfer", McGraw Hill. 1984
Useful links:	
1.	https://nptel.ac.in/courses/112105045
2.	https://onlinecourses.nptel.ac.in/noc21_me126/preview
3.	https://onlinecourses.nptel.ac.in/noc23_ch10/preview
4.	https://onlinecourses.nptel.ac.in/noc20_ae11/preview

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	1	1	0	1	2	2	3	2
CO2	2	3	3	3	2	1	1	2	2	2	3	2
CO3	2	3	3	3	2	1	0	2	2	2	3	2
CO4	2	2	3	3	3	2	1	2	2	2	3	3

Class, Part & Semester	**:**	**Second Year M. Tech (Energy Technology), Part I , Sem-I**					
Course Title	**:**	Seminar - I			***Course Code*:**	**:**	ETC 14
Teaching Scheme (Hours)	**:**	Practical :	2 Hrs./week		***Total Credits***	**:**	01
Evaluation Scheme (Marks)	**:**	IPE=Nil	IOE= 50	Total=50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Soft Skills					
Course Domain	**:**	Management					

Course Rationale:

The course aims to emphasize the value and significance of the seminar in the M.Tech program, illustrating its contribution to the overall learning experience and the professional growth of the students.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study.	1.	Acquire a comprehensive understanding of the seminar topic, its theoretical foundations, and its practical applications within their field of study.
2.	Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem solving.	2.	Develop improved research skills, including the ability to critically analyze existing literature, design experiments or investigations, collect and analyze data, and draw meaningful conclusions.
3.	Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience.	3.	Effectively present and communicate their research findings, ideas, and arguments through oral presentations and written reports.
4.	Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations.	4.	Gain knowledge on latest developments, trends, and challenges within their field, enabling them to contribute to the advancement of knowledge and industry practices.

Curriculum Content

The seminar should focus on the student's dissertation topic or related area, demonstrating a clear understanding of the concepts using modern presentation methods. It aims to conduct an in-depth literature review, prepare a critical analysis, and enhance the student's confidence in delivering the material. The seminar will be evaluated by a Department Committee, considering a submitted report and a viva-voce session at the end of the semester. A hard copy of the well-formatted report (25 to 30 pages, A4 size, 12 fonts, Times New Roman, single-spaced, both sides printed, preferably in IEEE format) must be submitted to the Department before the seminar, and a soft copy in PDF form should also be provided to the guide, along with other relevant details.

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	1	1	0	2	2	2	3	2
CO2	2	3	3	3	2	2	1	2	2	2	3	2
CO3	2	2	2	2	2	2	1	3	2	2	3	2
CO4	2	2	2	3	2	2	1	2	2	3	3	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	**:**	Sustainable Power Generation Systems Lab			***Course Code*:**	**:**	ETC 15
Teaching Scheme (Hours)	**:**	Practical :	02Hrs/week		***Total Credits***	**:**	01
Evaluation Scheme (Marks)	**:**	IOE=50	EPE/EOE=Nil	Total=50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Nil					
Course Domain	**:**	Laboratory course					

Course Rationale:
This course's rationale is to equip students with a comprehensive knowledge of energy systems, their environmental implications, and the importance of sustainable energy practices. By studying global and Indian energy scenarios and conducting laboratory experiments, students will gain the necessary insights to contribute to the development and implementation of clean energy solutions in society.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Familiarize students with various forms of energy and their significance in the context of energy flow on Earth.	1.	Demonstrate a comprehensive understanding of various forms of energy
2.	Develop an understanding of the role of energy in economic development and social transformation.	2.	Analyze the role of energy in economic development and social transformation,
3.	Conduct experiments using a pyranometer to estimate solar radiation and a sunshine recorder to determine sunshine hours.	3.	Gain hands-on experience in measuring and assessing solar energy parameters
4.	Provide practical experience and enhance students' skills in renewable energy assessment and data interpretation.	4.	Identify the environmental challenges, and propose sustainable solutions for the future.

Sr. No.	***List of Experiments***
1.	Study of various forms of energy and energy flow diagram to earth.
2.	Study of role of energy in economic development and social transformation
3.	Study of global energy consumption in various sectors and various energy resources.
4.	Study of Indian energy scenario.
5.	Study of air and water pollution due to power plants.
6.	Study of various pollution related issues.
7.	Experiment on pyranometer to estimate solar radiation
8.	Experiment on sunshine recorder to estimate sunshine hours

Suggested Text Books/ Reference Books/Manual

1.	G.D. Rai, Non-conventional energy sources, Khanna publication
2.	S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	1	0	1	2	2	3	2
CO2	2	3	2	2	1	2	1	2	2	3	2	3
CO3	2	2	3	3	3	2	1	2	2	2	3	2
CO4	2	3	2	2	2	2	1	2	2	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Solar Photovoltaic Energy Conversion Lab			***Course Code*:**	:	ETC 16
Teaching Scheme (Hours)	:	Practical :	02Hrs/week		***Total Credits***	:	01
Evaluation Scheme (Marks)	:	IOE=50	EPE/EOE=Nil	Total=50	***Duration of EPE***	:	—
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Nil					
Course Domain	:	Laboratory course					

Course Rationale:

The rationale for the lab work is to provide students with hands-on experience and practical knowledge in the field of photovoltaic (PV) systems. By conducting various experiments and calculations, students will develop a deep understanding of the characteristics, behavior, and performance of PV modules and associated components.

	Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to
1.	Equip students with the practical skills and knowledge required to understand and analyze the performance of PV modules	1.	Understand the impact of module configurations on the overall performance and power output of a PV system.
2.	Develop proficiency in power flow calculations, shading analysis, and system optimization	2.	Develop proficiency in performing power flow calculations for standalone PV systems
3.	Illustrate the design and operation of efficient and sustainable PV systems	3.	Acquire the skills to draw charging and discharging characteristics of batteries used in PV systems.
4.	Develop the ability to analyze and optimize the performance of PV modules and associated components	4.	Acquire practical skills and knowledge that can be applied in the design, analysis, and optimization of PV systems

Sr. No.	***List of Experiments***
1.	To demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level
2.	To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
3.	To show the effect of variation in tilt angle on PV module power
4.	To demonstrate the effect of shading on module output power
5.	To demonstrate the working of diode as Bypass diode and blocking diode
6.	Workout power flow calculations of standalone PV system of DC load with battery.
7.	Workout power flow calculations of standalone PV system of AC load with battery..
8.	Workout power flow calculations of standalone PV system of DC and AC load with battery.
9.	To draw the charging and discharging characteristics of battery

Suggested Text Books/ Reference Books/Manual

1. Solar Photovoltaics – Fundamentals, Technologies and Applications by Chetan Singh Solanki, PHI Learning Private limited, 2011.
2. Solar Energy –Principle of Thermal Storage and collection by Sukhatme S.P., Nayak.J.P , Tata McGraw Hill, 2008

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	1	0	1	2	2	3	2
CO2	2	3	3	3	2	1	1	2	2	2	3	2
CO3	2	2	2	3	3	2	1	2	2	2	3	2
CO4	3	3	3	3	3	2	1	2	2	3	3	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	**:**	Intellectual Property Rights			***Course Code*:**	**:**	ETAC2
Teaching Scheme (Hours)	**:**	Lecture : 2 Hrs/week Tutorial : -- Hrs/week			***Total Credits***	**:**	2
Evaluation Scheme (Marks)	**:**	IOE=50	ESE = NIL	Grand Total =50	***Duration of SEE***	**:**	--
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites *(if any)*	**:**	Basic Legal Awareness, Digital Literacy					
Course Domain	**:**	Audit Course					

Course Rationale:

The course on Intellectual Property Rights (IPR) is designed to provide students with an in-depth understanding of the importance of intellectual property in fostering innovation, creativity, and economic development. As the global economy becomes increasingly knowledge-driven, protecting and managing intellectual property is critical for individuals, organizations, and nations.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide a comprehensive understanding of the concept, origin, and types of Intellectual Property Rights (IPR) and their significance in the global context.	**1.**	Explain the fundamental concepts, origin, and significance of various types of Intellectual Property Rights (IPRs) in protecting innovations and creations.
2.	Introduce the legal framework of IPR, including the TRIPS agreement and its relationship with the WTO.	**2.**	Apply the knowledge of patent laws, registration procedures, and infringement remedies in the protection of inventions and technologies.
3.	Familiarize students with the processes and laws related to patents, copyrights, and trademarks, along with their infringements and remedies.	**3.**	Demonstrate an understanding of copyright laws, including software copyrights, piracy issues, and the remedies for infringement.
4.	Understand the significance of designs, geographical indications, and layout designs, as well as their protection under international and national laws.	**4.**	Analyze and manage issues related to trademarks, including registration, infringement, and offenses in cyberspace, such as domain name disputes.
5.	Explore the legal provisions and ethical considerations related to the Information Technology Act, 2000, including cybercrime, e-commerce, and digital signatures.	**5.**	Evaluate the legal framework for design protection, including the Semiconductor Integrated Circuits Layout Design Act and international conventions.
6.	Develop the ability to identify, register, and manage intellectual property rights in various domains, including traditional knowledge and modern technologies.	**6.**	Assess the implications of the Information Technology Act, 2000, particularly in the areas of e-governance, e-commerce, digital signatures, and combating cybercrime.

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	1	1	2	2	3	3	2
CO2	3	3	3	2	2	1	2	2	2	3	3	3
CO3	3	2	2	2	1	1	1	2	2	3	3	2
CO4	3	3	3	2	2	2	2	2	2	3	3	3
CO5	3	3	2	2	1	1	2	2	2	3	3	2
CO6	3	3	3	2	2	2	2	2	2	3	3	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	**:**	Solar Thermal Energy Conversion			***Course Code*:**	**:**	ETC 21
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs./week		***Total Credits***	**:**	03
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	**:**	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	**:**	03 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Engineering Thermodynamics					
Course Domain	**:**	Professional core course					

Course Rationale:
This course aims to equip students with a solid foundation in solar energy systems, their design, performance evaluation, and applications in various domains. Students will be prepared to contribute to the development and implementation of sustainable solar energy solutions and emerging technologies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the radiative properties and characteristics of materials.	1.	Analyze the behavior of reflecting surfaces and transparent materials.
2.	Explore the knowledge of flat-plate collectors, including the energy balance, thermal analysis	2.	Acquire the knowledge of testing methods and be able to differentiate between different types of flat-plate collectors
3.	Summarize the Concentrating collector designs, including classification, design principles, performance parameters.	3.	Compare and evaluate the performance and effectiveness of different collectors.
4.	Exercise the ASHRAE code and implementing modeling and simulation techniques for solar thermal system.	4.	Acquire skills to analyze, design, and optimize solar thermal systems

Curriculum Content	**Hours**
Unit I - Radiative Properties and Characteristics of Materials: Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials.	(6h)
Unit II - Flat-plate Collectors: Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors-Thermal analysis; Evacuated tubular collectors.	(6h)
Unit III - Concentrating Collector Designs: Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.	(6h)
Unit IV - Performances of solar collectors: ASHRAE code; Modeling of solar thermal system components and simulation; Design and sizing of solar heating systems: f – chart method and utilizability methods of solar thermal system evaluation; Development of computer package for solar heating and cooling applications.	(6h)

Unit V - Solar Energy for Industrial Process Heat: Industrial process heat: Temperature requirements, consumption pattern; Applications of solar flat plate water heater & air heater for industrial process heat; Designing thermal storage; Transport of energy.	(6h)
Unit VI - Solar Thermal Energy Systems: Types- Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage system. , Solar still; Solar cooker: Solar pond; Greenhouse technology, Fundamentals, design, modeling and applications, Emerging technologies: Linear Fresnel reflector, Solar chimney, Application of softwares.	(6h)

Suggested Text Books:	
1.	Principles of Solar Energy by D.Yogi Goswami
2.	Solar Energy by S.P. Sukhatme
3.	Solar Energy by H.P.Garg
Suggested Reference Books:	
1.	Kreith F. and Kreider J.F., "Principles of Solar Engineering", McGraw-Hill, 1978.
2.	Passive solar Energy Book by Mazria,E
3.	Fundamentals of solar energy conversion: by E.E. Anderson.
Useful links:	
1.	https://nptel.ac.in/courses/115103123
2.	https://archive.nptel.ac.in/courses/112/105/112105051/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	2	1	2	1	1	2	3	2
CO2	3	2	2	2	2	1	1	1	1	2	3	2
CO3	3	3	3	2	2	1	2	2	1	2	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Energy Management and Audit			***Course Code*:**	:	ETC 22
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Nil					
Course Domain	:	Professional core course					

Course Rationale:

This course aims to equip students with a comprehensive understanding of energy conservation principles, management strategies, and practical skills in energy auditing, monitoring, and targeting. Students will be prepared to contribute to the development and implementation of energy conservation practices in various sectors, promoting sustainable energy use and sustainable environmental management

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the importance of energy conservation and its role in sustainable development.	1.	Develop an understanding of energy conservation and its importance in achieving sustainable development.
2.	Illustrate the knowledge of energy management	2.	Acquire knowledge of energy management principles
3.	Expose the practical skills required for conducting energy audits and implementing effective energy conservation measures	3.	To conduct energy audits, and the expertise to develop and implement effective energy conservation measures
4.	Contribute to the development and implementation of sustainable energy practices	4.	To address energy-related challenges and contribute to sustainable energy practices, both at the organizational and societal levels.

Curriculum Content	**Hours**
Unit I - Energy Conservation : Energy Conservation and its Importance; Energy Strategy for the Future; The Energy Conservation Act, 2001 and its Features.	(6 h)
Unit II - Energy Management : Definition & Objectives of Energy Management; Importance; Indian need of Energy Management; Duties and responsibilities of energy managers. Introduction to ISO 50001-2011 Energy Management System (EnMS).	(6 h)
Unit III - Energy Audit : Energy Audit: Types and Methodology; Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximizing System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors.	(6 h)
Unit IV - Material and Energy Balance : Basic Principles; The Sankey Diagram and its Use; Material Balances; Energy Balances; Method for Preparing Process Flow Chart; Facility as an Energy System; How to Carryout Material and Energy (M & E) Balance. Energy Action Planning Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy management, top management support, managerial function, accountability; Motivation of employees: Information system designing barriers, strategies; Marketing and communicating: Training and planning.	(6 h)

Unit V - Energy Monitoring and Targeting : Definition; Elements of Monitoring & Targeting System; A Rationale for Monitoring, Targeting and Reporting; Data and Information Analysis; Relating Energy Consumption and Production; CUSUM; Case Study.	(6 h)
Unit VI - Electrical and Thermal Energy Management : Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors. Building energy management, energy management commissioning. Energy conservation with respect to IAQ and IEQ. Thermal energy Management Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management, building thermal performance.	(6 h)

Suggested Text Books:	
1.	Energy Audit Professional by Dheungel
2.	Handbook on Energy Efficiency, TERI, New Delhi, 2001.
3.	Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)
Suggested Reference Books:	
1.	Energy Management, Audit and Conservation (Kindle Edition) Barun Kumar De
2.	Energy management handbook / by Wayne C. Turner & Steve Doty
3.	NPC energy audit manual and reports
4.	Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council
5.	Handbook of Energy Audits, Ninth Edition Hardcover – by Albert Thumann , Terry Niehus, William J. Younger
Useful links:	
1.	https://nptel.ac.in/courses/112105221
2.	https://nptel.ac.in/courses/109106161
3.	https://beeindia.gov.in/sites/default/files/1Ch3.pdf

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	3	2	1	2	3	3
CO2	3	3	2	2	2	2	2	2	1	2	3	3
CO3	3	3	3	3	3	2	3	2	2	3	3	3
CO4	3	3	3	2	2	3	3	3	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Energy efficiency in thermal and electrical Utilities			***Course Code*:**	:	ETC 23
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Engineering Thermodynamics , Basic Electrical Engineering					
Course Domain	:	Professional core course					

Course Rationale:

This course provides a comprehensive understanding of energy systems, focusing on topics such as boilers, furnaces, FBC boilers, waste heat recovery, electric motors, compressed air systems, HVAC and refrigeration, fans and blowers, pumps and pumping systems, cooling towers, DG set systems, and energy-efficient technologies in electrical systems. Through case studies and practical examples, students will gain insights into energy conservation opportunities and strategies for efficient operation in various industrial applications.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the fundamental concepts and principles of boilers, including their types, classifications, and components	1.	Characterize various thermal and electrical utilities and their function
2.	Explain the case studies to apply the acquired knowledge	2.	Demonstrate performance evaluation of various components of energy system.
3.	Summarize the opportunities for energy savings in thermal and electrical utilities	3.	Determine potential of energy conservations for various utilities
4.	Develop the necessary skills to evaluate system performance in various industrial applications.	4.	Demonstrate best practices in thermal and electrical utilities.

Curriculum Content	**Hours**
Unit I - Boilers : Introduction; Boiler Systems; Boiler Types and Classifications; Performance Evaluation of Boilers; Boiler Blowdown; Boiler Water Treatment; Energy Conservation Opportunities; Case Study. Steam System Introduction; Properties of Steam; Steam Distribution; Steam Pipe Sizing and Design; Proper Selection, Operation and Maintenance of Steam Traps; Performance Assessment Methods for Steam Traps; Energy Saving Opportunities Mechanism of Fluidized Bed Combustion; Retrofitting of FBC Systems to Conventional Boilers; Advantages of Fluidized Bed Combustion Boilers.	(6 h)
Unit II - Furnaces : Types and Classification of Different Furnaces; Performance Evaluation of a Typical Furnace General Fuel Economy Measures in Furnaces; Case Study. Insulation and Refractories Purpose of Insulation; Types and Application; Calculation of Insulation Thickness; Economic Thickness of Insulation(ETI); Simplified Formula for Heat Loss Calculation; Refractories; Properties of Refractories; Classification of Refractories; Typical Refractories in Industrial Use; Selection of Refractories; Heat Losses from Furnace Walls.	(6 h)

Unit III - Waste Heat Recovery : Introduction; Classification and Application; Benefits of Waste Heat Recovery; Development of Waste Heat Recovery System; Commercial Waste Heat Recovery Devices. **Cooling Towers :** Introduction; Cooling Tower Performance; Efficient System Operation; Flow Control Strategies; Energy Saving Opportunities in Cooling Towers.	(4 h)
Unit IV - HVAC And Refrigeration System Introduction : Types of Refrigeration System; Common Refrigerants and Properties; Compressor Types and Application; Selection of a Suitable Refrigeration System; Performance Assessment of Refrigeration Plants; Factors Affecting Performance and Energy Efficiency of Refrigeration Plants; Energy Savings Opportunities.	(4 h)
Unit V - Electric Motors : Introduction; Motor Types; Motor Characteristics; Motor Efficiency; Motor Selection; Energy Efficient Motors; Factors Affecting Energy Efficiency and Minimizing Motor Losses in Operation; Rewinding Effects on Energy Efficiency; Speed Control of AC Induction Motors; Motor Load Survey: Methodology. **Compressed Air System :** Introduction; Compressor Types; Compressor Performance; Compressed Air System Components; Efficient Operation of Compressed Air Systems; Compressor Capacity Assessment; Checklist for Energy Efficiency in Compressed Air System. Energy Efficient Technologies In Electrical Systems Maximum Demand Controllers; Automatic Power Factor Controllers; Energy Efficient Motors; Soft Starter; Variable Speed Drives; Energy Efficient Transformers; Electronic Ballasts; Energy Efficient Lighting Controls.	(8 h)
Unit VI - FANS AND BLOWERS Introduction : Fan Types; Fan Performance Evaluation and Efficient System Operation; Fan Design and Selection Criteria; Flow Control Strategies; Fan Performance Assessment; Energy Saving Opportunities. **Pumps And Pumping System :** Pump Types; System Characteristics; Pump Curves; Factors Affecting Pump Performance; Efficient Pumping System Operation; Flow Control Strategies; Energy Conservation Opportunities in Pumping Systems.	(4 h)
Unit VII - DG Set System : Introduction; Selection and Installation Factors; Operational Factors; Energy Performance Assessment of DG Sets; Energy Savings Measures for DG Sets.	(4 h)

Suggested Text Books:	
1.	Energy Conservation Guidebook by Patrick, Fordo
2.	Energy Efficiency in Thermal Utilities by Bureau of Energy Efficiency
3.	Energy Efficiency in Electrical Utilities by Bureau of Energy Efficiency
Suggested Reference Books:	
1.	Handbook Of Energy Engineering by Thumann & Mehta
2.	Introduction To Heat Transfer by Incropera, Dewitt
3.	Energy Systems Engineering by Pistikopoulos
4.	Energy Efficiency in Electrical Motors by Modi
5.	Energy Audit Professionals by Dheungel
Useful links:	
1.	https://nptel.ac.in/courses/112105221

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	1	2	3	3
CO2	3	3	3	3	3	2	2	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	2	3	3	3	3	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Hydrogen Energy and Fuel Cell Technology			***Course Code*:**	:	ETE 21
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total =100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Science Courses					
.Course Domain	:	Program Specific Elective					

Course Rationale:

Hydrogen energy and fuel cell technology are at the forefront of the transition to a sustainable energy future. This course provides an in-depth understanding of hydrogen as a fuel, its production, storage, and fuel cell technologies. Students will explore different fuel cell types, their applications, and ongoing research in hydrogen energy.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand the advantages and applications of hydrogen as a fuel.	1.	Understand the significance of hydrogen as a clean energy source.
2.	To analyze different hydrogen production methods and their efficiency.	2.	Analyze different hydrogen production and storage techniques.
3.	To study various hydrogen storage techniques, including advanced materials.	3.	Evaluate the working principles, performance, and challenges of fuel cells.
4.	To explore fuel cell principles, components, and operational characteristics.	4.	Identify the applications and commercial viability of fuel cell technology.

Curriculum Content	**Hours**
Unit I - Hydrogen Energy Introduction to hydrogen as an energy carrier, Merits of hydrogen as a fuel, Applications of hydrogen in energy and transportation sectors.	(6 h)
Unit II - Hydrogen Production Methods Hydrogen production from fossil fuels, Electrolysis of water, Thermal decomposition methods, Photochemical and photocatalytic production, Hybrid hydrogen production techniques.	(6 h)
Unit III - Hydrogen Storage Methods Hydrogen storage principles and challenges, Metal hydrides and metallic alloy hydrides, Carbon nanotube-based hydrogen storage, The ocean as a source of deuterium.	(6 h)
Unit IV - Fuel Cell Basics Definition and working principle of fuel cells, Difference between batteries and fuel cells, History and development of fuel cells, Fuel cell components and stack design, Performance characteristics and efficiency analysis, Fuel cell power plants: fuel processor, power section, and power conditioner, Advantages and limitations of fuel cells.	(6 h)
Unit V - Types of Fuel Cells Alkaline fuel cells (AFC), Polymer electrolyte fuel cells (PEFC), Phosphoric acid fuel cells (PAFC), Molten carbonate fuel cells (MCFC), Solid oxide fuel cells (SOFC) – planar, tubular, high-temperature, and intermediate-temperature, Single-chamber solid oxide fuel cells, Challenges and applications of fuel cells, Overview of commercially available fuel cell stacks, Global research trends in fuel cell technology.	(6 h)

Unit VI - Research and Development in Fuel Cells Fuel cell research and development in India, Government policies and initiatives for hydrogen and fuel cells, Industrial and academic advancements in fuel cell technology, Future prospects and commercialization of hydrogen energy in India.		(6 h)
Suggested Text Books:		
1.	Hydrogen Generation, Storage and Utilization, Zhang, J. Z., Li, J., Li, Y., Zhao, Y., John Wiley & Sons, 2014	
2.	Sustainable Hydrogen Production, Dinçer, I., Zamfirescu, C., Elsevier, 2016.	
3.	Fuel Cell Technology Hand Book, Hoogers G., CRC Press, 2003	
4.	Fuel Cell Engines, Mathew M. Mench, Wiley, 2008.	
Suggested Reference Books:		
1.	Hydrogen Fuel: Production, Transport, and Storage, Gupta, R. B., CRC press, 2008.	
2.	Materials for Hydrogen Production, Conversion, and Storage, Altalhi, T. A., Adnan, S. M., Amin, M. A., John Wiley & Sons, 2023.	
3.	Hydrogen as an Energy Carrier: Technologies, Systems, Economy, Winter, C. J., Nitsch, J. Springer Science & Business Media, 2012.	
4.	Handbook of Hydrogen Energy, Sherif, S. A., Goswami, D. Y., Stefanakos, E. L., Steinfeld, A., CRC press, 2014.	
5.	Fuel Cell Fundamentals, O'Hayre, R. P., Cha, S., Colella, W., Prinz, F. B., Wiley, 2006.	
6.	Fuel Cell Science and Engineering – Materials, Processes, Systems and Technology, Detlef Stolten, Bernd Emonts, Vol-1, Wiley-VCH, 2012.	
Useful links:		
1.	https://onlinecourses.nptel.ac.in/noc22_ch66/preview	
2.	https://nptel.ac.in/courses/103/102/103102015/	

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	3	2	1	2	3	3
CO2	3	3	3	3	3	2	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	2	3	3	3	3	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Power Plant System Engineering			***Course Code*:**	:	ETC 22
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	-- Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total =100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic Mechanical Engineering					
.Course Domain	:	Program Specific Elective					

Course Rationale:
This course aims to equip students with knowledge and understanding of different power generation technologies, their operational characteristics, and the economic considerations associated with electricity generation.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1	Discuss the principles, components, and operational characteristics of various power generation technologies	1	Demonstrate knowledge and understanding of different power generation technologies
2	Summarize the efficiency, performance, and economic aspects of different power generation technologies	2	Analyze the efficiency and performance characteristics of power generation systems
3	Illustrate solutions for efficient power generation, including cogeneration, renewable energy resources.	3	Evaluate the advantages and disadvantages of different power generation technologies
4	Compare various electricity-producing energy resources based on capital costs, running costs, plant life, capacity factor, etc.	4	Explore creative solutions for efficient power generation

Curriculum Content	**Hours**
Unit I - Introduction: Overview of Indian power sector, Choice of power generation; load & load duration curves; load factor; diversity factor; load deviation curve; load management; number and size of generating units, combustion of fuels.	(6 h)
Unit II - Steam Power Plants: Basics of typical power plant utilities, Boilers, Nozzles, Turbines, Condensers, Cooling Towers, Water Treatment and Piping system, Rankine Cycle – thermodynamic analysis, Cycle improvements – Superheat, Reheat, Regeneration	(6 h)
Unit III - Diesel and Gas Turbine Power Plants: I.C Engine Cycles - Otto, Diesel & Dual ,Typical diesel power plant – Types – Components - Layout - Performance analysis and improvement , Combustion in CI engines - E.C cycles – Gas turbine & Stirling - Gas turbine cycles , thermodynamic analysis, cycle improvements , Intercoolers, Re heaters, regenerators.	(6 h)
Unit IV - Advanced Power Cycles: Cogeneration systems, topping & bottoming cycles, Performance indices of cogeneration systems, Heat to power ratio - Thermodynamic performance of steam turbine cogeneration systems, gas turbine cogeneration systems, reciprocating IC engines cogeneration systems, Binary Cycle, Combined cycle – IGCC – AFBC / PFBC cycles, Thermionic steam power plant. MHD – Open cycle and closed cycle- Hybrid MHD & steam power plants	(6 h)

Unit V - Hydroelectric & Nuclear Power Plants: Hydroelectric Power plants – classifications , essential elements , pumped storage systems , micro and mini hydel power plants, General aspects of Nuclear Engineering , Components of nuclear power plants - Nuclear reactors & types – PWR, BWR, CANDU, Gas Cooled, Liquid Metal Cooled and Breeder reactor - nuclear safety – Environmental issues	(6 h)
Unit VI - Economics of Electricity Generation: Electricity generation from renewable energy resources, comparison of various electricity producing energy resources including capital cost, running cost, plant life, capacity factor, construction time, taxes etc.	(6 h)

Suggested Text Books:	
1.	A Text Book of Power Plant Engineering, R.K. Rajput, Laxmi Publications
2.	A Course in Power Plant Engineering, Arora, Domkundwar, Dhanpat Rai & Co.
3.	Power Plant Engineering, 2nd edition, P.K. Nag, Tata McGraw-Hill Pub. Com., New Delhi.
Suggested Reference Books:	
1.	'International Energy Outlook' -EIA annual Publication
2.	Ministry of Power - Govt. of India - Energy Statistics - latest edition
3.	Power Plant Engineering, A K Raja, Amit Prakash Shrivastava, Manish Dwivedi, New Age International Publishers
4.	Power Plant Engineering, P.C. Sharma, S.K. Kataria & Sons.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc20_me10/preview
2.	https://archive.nptel.ac.in/courses/108/105/108105058/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	2	2	2	3	2	1	2	3	3
CO2	3	3	3	3	3	2	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	2	3	3	3	3	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-I**					
Course Title	:	Energy Resources, Economics, and Sustainability			***Course Code*:**	:	ETE 23
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Sustainable Power Generation Systems					
Course Domain	:	Program Specific Elective					

Course Rationale:

The course aims to explain the present global energy demand, the environmental effects of energy use, and what can be accomplished to alleviate the environmental effects of energy use and ensure an adequate energy supply. This course provides insights into the energy landscape, economic decision-making in energy investments, environmental concerns, and sustainability strategies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To understand the global and Indian energy scenario, including demand and supply trends.	1.	Understand global and national energy trends and economic linkages.
2.	To analyze economic principles and financial decision-making in energy projects.	2.	Apply financial analysis techniques to energy investment decisions.
3.	To study the environmental impacts of energy production and strategies for mitigation.	3.	Evaluate environmental impacts and sustainability strategies in energy systems.
4.	To explore global climate policies and agreements related to energy sustainability.	4.	Analyze international climate policies and their implications.

Curriculum Content	**Hours**
UNIT I - Global and Indian Energy Scenario Overview of the world energy scenario, Primary energy demand and supply trends, Fossil fuel reserves and resource estimates, Comparative analysis of India's energy scenario with other countries, Energy use patterns and Sankey diagram formulation.	(6 h)
Unit II - Energy Economics and Development Relationship between energy and economic development, Energy pricing mechanisms, economic and political influences, Energy chains and primary energy analysis, Net energy analysis with practical examples.	(6 h)
Unit III - Investment Appraisal and Financial Analysis Fundamental concepts of economics related to energy, Decision-making processes in energy investments, Investment appraisal methods: net present value, annual worth method, payback period, internal rate of return, profitability index, Financial analysis of renewable energy projects, Government incentives, disincentives, and project financing, Case studies: wind energy, green hydrogen, and electric vehicles.	(6 h)
Unit IV - Environmental Impacts of Energy Production Environmental consequences of energy production and utilization, Success stories in reducing acid rain, lead emissions, and ozone depletion, Climate change challenges and solutions, The energy-water nexus: interdependence of energy and water resources.	(6 h)
Unit V - Climate Policies and Agreements Kyoto Protocol, Paris Agreement, and Kigali Agreement, Myths and realities of global climate change, Nuclear waste management and thermal pollution issues, Policy interventions for mitigating climate change.	(6 h)
Unit VI - Life Cycle Assessment (LCA) in Energy Systems Introduction to life cycle assessment (LCA) and its role in environmental decision-making,	(6 h)

LCA framework, methods, and international standards, Mass flow analysis, data estimation, and impact categories, Multi-functionality, mid-point and end-point indicators in LCA, Case studies: LCA of different energy systems.	
Suggested Text Books:	
1.	Energy, the Environment, and Sustainability, Efstathios E. Michaelides, CRC Press, 2018.
2.	The Age of Sustainable Development, Jeffrey D. Sachs, Ki-moon Ban, Columbia University Press, 2015
3.	Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, Mary Ann Curran, Wiley, 2012.
Suggested Reference Books:	
1.	Energy Economics, Subhes C. Bhattacharyya, Springer London, 2011.
2.	Energy Economics: Concepts, Issues, Markets and Governance, Bhattacharyya, S. C., Springer Nature, 2019, 2nd Edition
3.	Sustainable Energy Choosing Among Options, Tester J. W., Drake E. M., Driscoll M. J., Golay, M. W, Peters, W. A., PHI Learning Private Limited, New Delhi, 2009.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc24_hs77/preview
2.	https://onlinecourses.nptel.ac.in/noc22_hs43/preview
3.	https://archive.nptel.ac.in/courses/109/101/109101171/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	1	1	1	2	2	2	3	2
CO2	2	2	3	2	3	1	3	2	2	1	3	2
CO3	2	3	3	2	2	2	2	2	3	3	2	3
CO4	2	3	2	2	2	2	2	2	3	3	2	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Energy Modeling and Project Management			***Course Code*:**	:	ETOE 21
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Nil					
Course Domain	:	Professional Elective courses					

Course Rationale:

This course covers the basic concepts of econometrics and statistical analysis, regression models, and tests of regression coefficients applied to energy analysis and forecasting using real-world case studies from India. The course also focuses on simulation and forecasting of future energy demand in India, integrated resource planning, energy pricing, and project evaluation and management techniques, including financial analysis, risk analysis, and network analysis for project planning and implementation using relevant case studies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Explain the basic concepts of econometrics and statistical analysis	1.	Describe econometrics & model useful for energy sector & analyze & simulate types of energy models.
2.	Describe the interdependence between energy, economy, and environment, and its significance in energy modeling.	2.	Gain knowledge of Input-Output Analysis and its relevance to energy policy.
3.	Review network analysis methods, such as PERT, CPM, and CERT, for effective project planning, estimation.	3.	Apply network analysis methods for effective project planning, estimation, and evaluation.
4.	Elaborate the social cost-benefit analysis of energy projects and the importance of project planning.	4.	Analyze and interpret performance indices for effective project management and monitoring.

Curriculum Content	**Hours**
Unit I - Introduction : Basic concept of econometrics and statistical analysis; variable regression model; multiple regression model; Tests of regression coefficients and regression equation; Econometric techniques used for energy analysis and forecasting with case studies from India; Operation of computer package.	(6 h)
Unit II - Input – Output Analysis : Basic concept of Input-output analysis; concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy; Energy and environmental Input - Output analyses using I-O model.	(6 h)
Unit III - Energy Modeling : Interdependence of energy-economy-environment; Modeling concept, and application, Methodology of energy demand analysis; Methodology for energy forecasting; Sectoral energy demand forecasting; Interfuel substitution models; SIMA model, and I-O model for energy policy analysis.	(6 h)
Unit IV - Simulation and forecasting : Simulation and forecasting of future energy demand consistent with macroeconomic parameters in India; Energy Economics and Policies: National and Sectoral energy planning; integrated resource planning; Energy pricing.	(6 h)

Unit V - Project Evaluation & Management : Financial analysis: Project cash flows, time value of money, life cycle approach & analysis, conception, definition, planning, feasibility and analysis; Project appraisal criteria; Risk analysis; Project planning matrix; Aims oriented project planning; Social cost benefit analysis.	(6 h)
Unit VI - Network analysis for project management : Time estimation; Critical path determination; PERT, CPM and CERT; Fuzzy logic analysis; Stochastic based formulations; Project evaluation techniques; Funds planning; Project material management, evaluation & analysis; Implementation and monitoring; Performance indices; Case studies.	(6 h)

Suggested Text Books:	
1.	Energy Management, Audit and Conservation" by Barun Kumar De
2.	Guide to Energy Management" by Barney L
3.	Energy Engineering & Management, Chakrabarti A, PHI
4.	Energy Audit and Management, Teri Press
Suggested Reference Books:	
1.	Energy policy: B.V. Desai (Weiley Eastern)
2.	Modeling approach to long term demand and energy implication: J. K. Parikh
3.	Energy Modeling And Computations in the Building Envelope by Alexander V. Dimitrov
4.	Energy Conservation in Buildings, Khanna Publications by O.P Jahkar
5.	Handbook on Energy Audit and Environment Management by Y P Abbi and Shashank Jain, TERI
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2.	https://onlinecourses.nptel.ac.in/noc22_hs43/preview
3.	https://nptel.ac.in/courses/110107081

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	3	2	2	2	2	2	3	3
CO2	3	3	2	2	2	2	2	2	2	2	3	3
CO3	2	2	3	2	3	2	3	2	2	1	3	2
CO4	2	2	3	2	2	2	3	2	2	2	2	2

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Artificial Intelligence in Energy Systems			***Course Code*:**	:	ETOE 22
Teaching Scheme (Hours)	:	Lecture :	03 Hrs./week		***Total Credits***	:	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	:	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	:	03 Hrs.
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Basic knowledge of energy systems, programming, and mathematics (linear algebra, probability).					
Course Domain	:	Professional Elective courses					

Course Rationale:
Artificial Intelligence (AI) is transforming the energy sector by enabling intelligent decision-making, optimizing energy management, and improving system efficiency. This course equips students with AI techniques to model, predict, and optimize energy systems, addressing challenges in grid stability, renewable energy integration, and demand forecasting.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To introduce artificial intelligence (AI) techniques and their applications in energy systems.	1.	Understand AI techniques relevant to energy systems.
2.	To develop skills for modeling, prediction, and optimization of energy systems using AI tools.	2.	Develop AI-based models for energy forecasting, optimization, and control.
3.	To explore the role of AI in improving energy efficiency, grid management, and renewable energy integration.	3.	Apply machine learning and deep learning tools to energy problems.
4.	To provide hands-on experience with AI tools and frameworks for solving energy-related challenges.	4.	Analyze case studies of AI implementation in real-world energy applications.

Curriculum Content	**Hours**
Unit- 01: Introduction to Artificial Intelligence in Energy Systems Overview of energy systems and AI, Role of AI in renewable energy, energy storage, and grid management, Key AI techniques: machine learning (ML), deep learning (DL), and reinforcement learning (RL), AI frameworks and tools (e.g., Python, TensorFlow, Scikit-learn).	(7 h)
Unit- 02: Machine Learning for Energy Systems Supervised Learning, Regression techniques for energy demand forecasting, Classification techniques for energy efficiency, Unsupervised Learning, Clustering for energy consumption patterns, Dimensionality reduction for complex energy datasets. Hands-on: Implementing ML models for energy demand prediction.	(8 h)
Unit-03: Deep Learning and Neural Networks Fundamentals of artificial neural networks (ANNs), Deep learning models (CNNs, RNNs) for energy systems, Applications of DL in: Solar energy prediction and optimization, Wind energy forecasting, Fault detection in energy systems, Hands-on: Developing a DL model for renewable energy prediction.	(7 h)

Unit- 04: Optimization and Reinforcement Learning in Energy Systems AI-driven optimization techniques: Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Reinforcement learning for energy management systems:Demand response, Smart grid optimization, Battery storage control.	(7 h)
Unit No 05: Case Studies and Future Trends in AI for Energy Systems AI in energy efficiency and conservation, AI for microgrid and hybrid energy system optimization, Digital twins for predictive maintenance in energy systems, Challenges and ethical considerations in AI adoption for energy systems, Discussion on cutting-edge research and future directions in AI for energy.	(7h)

Suggested Text Books:	
1.	Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2.	Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.
3.	Ian GoodFellow, Yoshua Bengio & Aaron Courville, Deep Learning, MIT Press (2016).
Suggested Reference Books:	
1.	Machine Learning, Tom M. Mitchell, Mc Graw Hill Education, 2017
2.	Pattern Recognition and Machine Learning, Bishop, C. M., Springer Link, 2006
3.	Artificial Intelligence, Kevin Knight, Elaine Rich, Nair, B., McGraw Hill, 2017, 3rd Edition.
Useful links:	
1.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2.	https://nptel.ac.in/courses/106102220
3.	https://nptel.ac.in/courses/106105077

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	3	2	2	2	2	2	3	3
CO2	3	3	3	2	3	2	3	2	2	2	3	3
CO3	3	3	3	2	3	2	2	2	2	2	3	3
CO4	2	3	3	2	2	2	2	3	2	2	3	3

Class, Part & Semester	**:**	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	**:**	Design and Optimization of Energy Systems			***Course Code*:**	**:**	ETOE 23
Teaching Scheme (Hours)	**:**	Lecture :	03 Hrs./week		***Total Credits***	**:**	03
		Tutorial :	00 Hrs./week				
Evaluation Scheme (Marks)	**:**	ISE =40	ESE = 60	Grand Total=100	***Duration of SEE***	**:**	03 Hrs.
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Thermodynamics. Fluid Mechanics. Heat Transfer					
Course Domain	**:**	Professional Elective courses					

Course Rationale:
The design and optimization of energy systems are critical for improving efficiency, reducing costs, and ensuring sustainable energy utilization. This course provides students with an in-depth understanding of energy system modeling, simulation, regression techniques, and optimization strategies.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	To introduce the fundamentals of system design and optimization techniques in energy systems.	1.	Understand the fundamentals of energy system design and optimization.
2.	To equip students with mathematical and computational tools for system simulation and analysis.	2.	Apply simulation techniques to analyze energy systems.
3.	To develop proficiency in regression and curve fitting for system modeling.	3.	Utilize regression and curve fitting methods for energy modeling.
4.	To explore various optimization techniques for energy system performance improvement.	4.	Implement various optimization techniques to improve energy efficiency.

Curriculum Content	**Hours**
Unit- 01: Introduction to Energy System Design Introduction to design and system design principles, Morphology of design with flow chart representation, Market analysis, profitability, and time value of money, Discounted cash flow techniques with examples, Concept of workable design and case studies on optimal system design.	(6 h)
Unit- 02: System Simulation Classification of simulation techniques, Successive substitution method with examples, Newton-Raphson method: single and multiple unknowns, Gauss-Seidel method for solving nonlinear equations, Introduction to finite difference methods for partial differential equations.	(6 h)
Unit-03: Regression and Curve Fitting Importance of regression in simulation and optimization, Concept of best fit and exact fit, Lagrange interpolation and Newton's divided difference method, Least square regression: linear regression with single and multiple variables, Power law forms and Gauss-Newton method for nonlinear regression.	(6 h)

Unit- 04: Optimization Techniques Introduction to optimization and problem formulation, Calculus-based optimization: Lagrange multiplier method, Search methods: Interval of uncertainty, exhaustive search, dichotomous search, Fibonacci search and Golden section search, Steepest ascent/descent and conjugate gradient methods	(6 h)
Unit No 05: Applications of Optimization in Energy Systems Optimization techniques applied to renewable and non-renewable energy systems, Economic optimization of power plants and energy networks, Energy dispatch optimization in microgrids and smart grids, Case studies on energy system design and performance improvement	(6 h)
Unit No 06: Advanced Topics in Energy System Optimization Multi-objective optimization in energy systems, Artificial intelligence and machine learning applications in energy optimization, Sensitivity analysis and uncertainty modeling, Decision support systems for energy system planning, Future trends and research opportunities in energy system optimization.	(6 h)

Suggested Text Books:	
1.	Modeling, assessment, and optimization of Energy Systems, Sayyaadi, H., Academic Press, 2020.
2.	Modeling, analysis and optimization of process and energy systems, Knopf, F. C., John Wiley & Sons, 2011.
3.	Essentials of Thermal System Design and Optimization, Prof. C.Balaji, Aue Books, New Delhi in India and CRC Press in the rest of the world.
Suggested Reference Books:	
1.	Energy Systems Engineering: Evaluation and Implementation, Vanek, F. M., Albright,
2.	Introduction to Applied Mathematics, Gilbert Strang, Wellesley Cambridge Press. 2009
3.	Linear Algebra and Its Applications, Gilbert Strang, Wellesley Cambridge Press, 2009, 4 th Edition.
Useful links:	
1.	https://nptel.ac.in/courses/112106064
2.	https://home.iitk.ac.in/~dasgupta/teaching/optim/

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	2	2	3	3
CO2	3	3	3	2	3	2	2	2	2	2	3	3
CO3	3	3	3	2	3	2	2	2	2	2	3	3
CO4	3	3	3	2	3	2	3	2	2	2	3	3

Class, Part & Semester	**:**	**Second Year M. Tech (Energy Technology), Part I , Sem-II**					
Course Title	**:**	Seminar -II			***Course Code*:**	**:**	ETC 24
Teaching Scheme (Hours)	**:**	Practical :	2 Hrs./week		***Total Credits***	**:**	01
Evaluation Scheme (Marks)	**:**	IOE= 50	EPE/EOE=Nil	Total=50	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2025
Pre-requisites	**:**	Soft Skills					
Course Domain	**:**	Management					

Course Rationale:

The course aims to emphasize the value and significance of the seminar in the M.Tech program, illustrating its contribution to the overall learning experience and the professional growth of the students.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Provide students with in-depth knowledge and understanding of a specific subject or research area within their field of study.	1.	Acquire a comprehensive understanding of the seminar topic, its theoretical foundations, and its practical applications within their field of study.
2.	Enhance students' research skills, including critical analysis, literature review, data collection and analysis, experimental design, and problem solving.	2.	Develop improved research skills, including the ability to critically analyze existing literature, design experiments or investigations, collect and analyze data, and draw meaningful conclusions.
3.	Help to improve students' ability to present technical information effectively, both orally and in writing, to an academic audience.	3.	Effectively present and communicate their research findings, ideas, and arguments through oral presentations and written reports.
4.	Promote collaboration and networking among students, faculty members, and experts in the field, fostering interdisciplinary discussions and potential research collaborations.	4.	Gain knowledge on latest developments, trends, and challenges within their field, enabling them to contribute to the advancement of knowledge and industry practices.

Curriculum Content

The seminar should focus on the student's dissertation topic or related area, demonstrating a clear understanding of the concepts using modern presentation methods. It aims to conduct an in-depth literature review, prepare a critical analysis, and enhance the student's confidence in delivering the material. The seminar will be evaluated by a Department Committee, considering a submitted report and a viva-voce session at the end of the semester. A hard copy of the well-formatted report (25 to 30 pages, A4 size, 12 fonts, Times New Roman, single-spaced, both sides printed, preferably in IEEE format) must be submitted to the Department before the seminar, and a soft copy in PDF form should also be provided to the guide, along with other relevant details.

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	1	0	2	2	2	3	2
CO2	2	3	3	3	2	2	1	2	2	2	3	2
CO3	2	2	2	2	2	2	1	3	2	2	3	2
CO4	2	2	2	3	2	2	1	2	2	3	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Solar Thermal Energy Conversion Lab			***Course Code*:**	:	ETC 25
Teaching Scheme (Hours)	:	Practical :	02Hrs/week		***Total Credits***	:	01
Evaluation Scheme (Marks)	:	IOE= 50	EPE/EOE=Nil	Total=50	***Duration of EPE***	:	----
Revision:	:	Fourth			***Month***	:	July 2023
Pre-requisites	:	Nil					
Course Domain	:	Lab work					

Course Rationale:

This lab work focuses on conducting performance trials of various solar collectors, including Solar Flat Plate Collector, Solar Evacuated Tube Collector, Solar Air Heater, and Solar Concentrating Collector. Additionally, students will gain practical experience in evaluating the performance of a Solar Distillation Plant.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Discuss the principles and working mechanisms of various solar collectors.	1.	Acquire a comprehensive understanding of the functioning and operational principles of various solar collectors.
2.	Examine and compare the performance trial results of different solar collectors.	2.	Gain practical skills in conducting performance trials and hydraulic pressure testing on Solar Flat Plate Collectors.
3.	Demonstrate hydraulic pressure testing techniques for assessments of the Solar Flat Plate Collector.	3.	Interpret the results to identify key performance parameters, strengths, and limitations of each technology.
4.	Verify the effectiveness and efficiency of each solar collector.	4.	Enhance the efficiency and overall performance in harnessing solar energy.

Sr. No.	***List of Experiments***
1.	Performance trial on Solar Flat Plate Collector
2.	Performance trial on Solar Evacuated Tube Collector
3.	Performance trial on Solar Air Heater
4.	Performance trial on Solar Concentrating Collector
5.	Performance trial on Solar Distillation Plant
6.	Trial on hydraulic pressure testing of Solar Flat Plate Collector

Suggested Text Books/ Reference Books/Manual

1.	Principles of Solar Energy by D.Yogi Goswami
2.	Solar Energy by S.P. Sukhatme
3.	Solar Energy by H.P.Garg

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	2	2	2	2	2	3	3
CO2	3	3	3	2	3	2	2	2	2	2	3	3
CO3	3	3	3	2	3	2	2	2	2	2	3	3
CO4	3	3	3	2	3	2	3	2	2	2	3	3

Class, Part & Semester	:	**First Year M. Tech (Energy Technology), Part I, Sem-II**					
Course Title	:	Energy efficiency in thermal and electrical Utilities Lab			***Course Code*:**	:	ETC 26
Teaching Scheme (Hours)	:	Practical :	02Hrs/week		***Total Credits***	:	01
Evaluation Scheme (Marks)	:	IOE= 50	EPE/EOE=NIL	Total=50	***Duration of EPE***	:	----
Revision:	:	Fourth			***Month***	:	July 2025
Pre-requisites	:	Nil					
Course Domain	:	Lab work					

Course Rationale:

This lab course aims to provide students with practical training and hands-on experience in evaluating the performance of various engineering systems. The course will foster critical thinking and analytical skills, empowering students to propose energy conservation opportunities for optimizing the performance and energy efficiency of different equipment in real-world applications.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Explain the fundamental concepts and principles related to the performance evaluation of boilers, furnaces, etc.	1.	Apply theoretical knowledge to effectively evaluate the performance of various engineering systems
2.	Demonstrate the methodologies and techniques used to assess various systems.	2.	Assess the efficiency, losses, capacity, and flow control strategies of different equipment.
3.	Help students gain practical experience in real-world scenarios	3.	Demonstrate the skills needed to conduct performance evaluations of systems
4.	Illustrate the problem-solving skills in the field of energy engineering.	4.	Explore energy conservation opportunities for enhancing the performance and energy efficiency of various engineering systems.

Sr. No.	***List of Experiments***
1.	Assignment on performance evaluation of boiler
2.	Assignment on performance evolution of furnace.
3.	Assignment on economic thickness of insulation (ETI).
4.	Assignment on retrofitting of FBC
5.	Assignment on electrical motors characterization, efficiency calculation, loss calculation, speed control of IMS and load surveys.
6.	Assignment on performance of compressor and capacity assessment
7.	Assignment on performance of refrigeration and AC plants and EC opportunities
8.	Assignment on performance a pump, pump characteristics, flow control strategies.
9.	Assignment on performance of cooling tower and energy conservation opportunities
10.	Assignment on performance and heat balance sheet of DG sets.
11.	Experiment on performance of Induction Motor
12.	Experiment on performance of heat exchanger.
Suggested Text Books/ Reference Books/Manual	
1.	Energy Efficiency in Thermal Utilities by Bureau of Energy Efficiency
2.	Energy Efficiency in Electrical Utilities by Bureau of Energy Efficiency

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	3	2	3	2	1	2	1	2	3	2
CO2	3	3	3	2	3	2	1	1	1	2	2	3
CO3	3	3	3	2	3	1	2	1	2	2	3	3
CO4	3	3	3	2	3	1	2	2	2	1	2	3

Class, Part & Semester	:	**Second Year M. Tech (Energy Technology), Part II , Sem-III**					
Course Title	:	Industrial Training			***Course Code*:**	:	ETC31
Teaching Scheme (Hours)	:	Practical :	2 Hrs./week		***Total Credits***	:	5
Evaluation Scheme (Marks)	:	IOE= 50	EOE= 50	Total= 100	***Duration of EPE***	:	----
Revision:	:	Fourth			***Month***	:	July 2026
Pre-requisites	:	Technical Knowledge and Skills, Communication and Interpersonal Skills					
Course Domain	:	Core					

Course Rationale:

By incorporating industrial training into the curriculum, students can acquire practical experience, industry exposure, and relevant skills that will equip them for successful careers in their chosen field. Industrial training enhances their employability, fosters networking opportunities, and cultivates the essential attributes for professional growth and development.

	Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to
1.	Provide students with an opportunity to apply the theoretical knowledge gained during their coursework to a real-world engineering project	1.	Apply the theoretical concepts and skills learned during their training to develop a engineering project
2.	Offer students hands-on experience in various aspects of Energy Technology	2.	Gain hands-on experience in various aspects of Energy Technology
3.	Develop students' collaborative and professional skills	3.	Learn to collaborate effectively with team members, communicate their ideas, and participate in project discussions
4.	Enhance students' problem-solving abilities by exposing them to complex real-world problems	4.	Analyze complex problems, break them down into manageable tasks, and develop innovative solutions
5	Enhance students' technical writing and presentation skills	5.	Submit a comprehensive report of their development work

Curriculum Content

The student shall undertake Energy Technology related project at any of the industry/research organization/software company under the guidance of internal guide and a suitable Co-guide from that industry/research organization/software company for duration of eight weeks at the end of first year (during summer).

The report of the development work is to be submitted to the University in the first week of semester III. (Student is expected to submit report in Latex/Microsoft word in the standard format style file available in the department).

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	2	3	2	2	2	3	3
CO2	3	2	3	2	3	2	2	2	2	2	3	3
CO3	2	2	2	1	2	3	2	3	2	2	2	3
CO4	3	3	3	2	3	2	2	2	2	2	3	3
CO5	2	2	2	2	2	2	2	3	2	2	2	2

Class, Part & Semester	**:**	**Second Year M. Tech (Energy Technology), Part II , Sem-III**					
Course Title	**:**	Dissertation Phase-I			***Course Code*:**	**:**	ETC32
Teaching Scheme (Hours)	**:**	Practical :	2 Hrs./week		***Total Credits***	**:**	15
Evaluation Scheme (Marks)	**:**	IOE= 100	EOE= 100	Total= 200	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2026
Pre-requisites	**:**	Research Skills and Methodology, Domain-Specific Knowledge					
Course Domain	**:**	Dissertation					

Course Rationale:

This course develop essential research skills, demonstrate their ability to formulate research questions and proposals, and gain a comprehensive understanding of the research process. The rationale behind this course is to prepare students for the subsequent stages of their dissertation, ensuring they have the necessary knowledge, skills, and tools to undertake rigorous and meaningful research.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Develop students' research competence by providing them with the opportunity to engage in independent research.	1.	Develop research skills through conducting a literature survey, critically analyzing existing literature, identifying research gaps, and proposing a dissertation topic.
2.	Enable students to prepare and deliver effective research proposals.	2.	Gain proficiency in preparing and delivering a presentation to propose a dissertation title.
3.	Equip students with project planning and execution skills.	3.	Demonstrate the ability to plan and execute a research project by preparing a synopsis, outlining research objectives, methodology, and expected outcomes
4.	Enhance students' research presentation and communication skills.	4.	Develop effective presentation and communication skills by delivering an end-of-semester presentation summarizing the progress of their dissertation work
5	Assess students' research work and their ability to defend their findings.	5.	Gain valuable research experience, contribute to their chosen field of study, and develop essential skills for future academic and professional pursuits.

Curriculum Content

The dissertation title should be determined based on the literature survey, and a presentation must be delivered. Subsequently, the synopsis of the dissertation should be prepared and submitted to the University for approval. The student shall carry work related to the dissertation with the consent of the guide. This work shall include related design/working model/sponsored projects/ assignments, fieldwork (if required) as decided by the guide. The student shall submit monthly progress report to the department and shall deliver a presentation at the end of Semester III submitting the progress of the work done. The work is to be jointly assessed for oral examinations by internal (guide) and external examiners appointed by the University.

(Student is expected to submit seminar report in Latex/Microsoft word in the standard format style file available in the department)

Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	3	3	3	2	2	2	2	3	2	3	3
CO2	2	2	2	1	1	2	1	3	2	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2	3	3
CO4	2	2	2	1	1	2	1	3	2	2	2	2
CO5	3	3	3	3	2	2	2	2	3	3	3	3

Class, Part & Semester	**:**	**Second Year M. Tech (Energy Technology), Part II , Sem-IV**					
Course Title	**:**	Dissertation Phase-II			***Course Code*:**	**:**	ETC41
Teaching Scheme (Hours)	**:**	Practical :	4 Hrs./week		***Total Credits***	**:**	20
Evaluation Scheme (Marks)	**:**	IOE= 100	EOE= 200	Total= 300	***Duration of EPE***	**:**	----
Revision:	**:**	Fourth			***Month***	**:**	July 2026
Pre-requisites	**:**	Research Skills and Methodology, Domain-Specific Knowledge Research Ethics, Research Methods or Analysis					
Course Domain	**:**	Dissertation					

Course Rationale:

The course rationale is to provide students with a comprehensive learning experience that combines theoretical knowledge with practical application, enabling them to become proficient researchers capable of conducting rigorous research, producing high-quality academic writing, delivering effective presentations, and publishing their work in reputable outlets.

Course Objectives: The Course teacher will		***Course Outcomes:*** Students will be able to	
1.	Enable students to acquire the necessary skills and knowledge to conduct high-quality research in their chosen field of study.	1.	Develop research skills by conducting a comprehensive study, collecting relevant data, and analyzing findings to contribute to the field of study.
2.	Foster the ability to produce well-structured and coherent written reports, including monthly progress reports.	2.	Enhance presentation skills by delivering a comprehensive presentation of the dissertation work at the end of Semester IV
3.	Help to develop effective oral communication and presentation skills.	3.	Gain experience in publishing research work by submitting a paper on the thesis work to either National or International Conference proceedings
4.	Encourage students to contribute to the academic community by publishing their thesis work in conference proceedings.	4.	Develop proficiency to create dissertation reports in the standard format style file provided by the department.

Curriculum Content

The student shall submit monthly progress report to the department and shall deliver a presentation of the work at the end of Semester IV submitting the report on the dissertation work.

A publication of a paper on the thesis work in a National/International Conference proceedings with presentation certificate or a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of 4th semester is mandatory.

A pair of referees, as appointed by the University, one of which will be the guide and the other external examiner will access the dissertation work during the oral examination.

(The student is expected to submit a seminar report in either Latex or Microsoft Word, adhering to the standard format style file provided by the department.)

Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	2	2	2	3	2	3	3
CO2	2	2	2	1	1	2	1	3	2	2	2	2
CO3	3	3	3	2	2	2	2	3	2	3	3	3
CO4	2	2	2	1	2	1	1	2	2	2	2	2