GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: PG
Branch: Energy Engineering
Course / Subject Code:
Course / Subject Name: Energy Conversion Systems

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite :	Basic knowledge of Energy sources and Thermodynamics
Rationale:	The course provides understanding of conventional energy conversion systems

Course Outcome: After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
CO-1	Explain different terminology related to energy conversion.	Understand
CO-2	Analyze energy conversion cycles.	Analyze
CO-3	Apply stoichiometric equations related to combustion of fuels.	Apply
CO-4	Evaluate performance of energy conversion systems.	Evaluate
CO-5	Compare various energy conversion systems.	Analyze

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Fundamentals of Energy Conversion:** Various forms of energy, thermodynamics of energy conversion, energy sources, primary energy sources, conversion of primary into secondary energy sources such as electricity, thermal or steam	2	5
2	**Fuel Combustion and Gasification:** Fuel composition and heating value, combustion stoichiometry and calculation, gaseous product combustion, coal gasification, gasification process and gasifiers	5	10

3	**Thermal Energy:** Steam and gas power plant cycle, Rankine and Brayton cycles, efficiency enhancement through reheat, regenerative and intercooling, supercritical cycle, steam generators and boilers - types, performance evaluation of boilers, boiler water treatment and blow down, introduction to FBC boilers, mechanism and operational features of FBC, retrofitting FBC system to conventional boilers, steam turbines: classification, impulse turbine, reaction turbine, compound turbine, performance evolution, energy losses in turbine and governing, turbine auxiliary system, advances in thermal energy	18	40
4	**Nuclear Energy:** Energy conversion through fission and fusion, nuclear reactor: PWR, BWR, GCR, HTRG, HWR, LMFBR, advances in nuclear energy	7	15
5	**Co-generation, Tri-generation & Waste Energy Recovery:** Co-generation Tri-generation: Definition, need, application, advantages, classification, saving potential, Waste heat recovery: Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices	13	30
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**30**	**20**	**30**	**20**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Advance Energy Systems by Nikolai V. Khartchenko, Taylor and Francis Publishing
2. Power Plant Technology by M. M. El-Wakil, McGraw Hill Publication
3. Steam Turbine by Rajmohan Gupta, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Power Plant Engineering by P. K. Nag, McGraw Hill Publications
5. Gas Turbine by V. Ganeshan, McGraw Hill Publication
6. Gas Turbine Engineering Handbook by Meherwan P. Boyce, Gulf Professional Publishing
7. BEE Reference book: no.1/2/3/4
8. Practical Heat Recovery by Boyen J.L. John Wiley, New York, USA

(b) Open-source software and website:

1. www.nptel.iitm.ac.in/courses/;
2. https://www.coursera.org/;
3. https://www.edx.org/;
4. Power Plant Simulator Software

Practical List:

1. Characterization of Fuel
2. Determination of Calorific Value of fuels
3. Combustion product analysis
4. Determination of boiler efficiency
5. Evaluation of performance parameters of steam power cycle
6. Evaluation of performance parameters of gas power cycle
7. Study of nuclear power generation
8. Study of combined, cogeneration and tri-generation systems
9. Study of waste heat recovery systems

List of Laboratory/Learning Resources Required: Bomb Calorimeter, Junker's Calorimeter, Flash & Fire Point Apparatus, Carbon Residue Apparatus, Automatic Proximate Analyzer, Pressure gauges, Thermometers, Liquid level gauges, Flow meters, Gas analyzers, Steam Turbine Power Plant system (Rankine Cycle Simulator), Gas Turbine Power Plant System, Gasifier

Suggested Project List: Industrial visit of one of the power plants viz. Kakrapar Atomic Power Project, Wanakbori Thermal Power Plant, Ukai Thermal Power Plant may be arranged

Suggested Activities for Students: Student can make Interactive Models for different boiler, reactor.

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