

Minor Area – Cogeneration and Energy Efficiency

The importance of energy efficiency in the present scenario has grown tremendously. With overwhelming awareness of increased energy consumption present scenario demands everyone to be energy efficient. Professionals having knowledge of efficient utilization of various resources of energy are highly regarded in present day industries.

Cogeneration and energy efficiency minor area is focussed on building future energy efficient technocrats who will have a holistic knowledge of efficient utilization of energy in power sector. This minor area will create awareness among the students regarding the significance of cogeneration systems that simultaneously produce electricity and heat which may otherwise be wasted in the production of electricity.

Following are the courses offered under the minor area of Cogeneration and Energy Efficiency–

Core–

1. Energy analysis – ESL 785
2. Cogeneration and energy efficiency – ESL 784
3. Economics of energy conservation – New course

Electives–

1. Industrial energy and environmental analysis – ESL 776
2. Alternative fuels for transportation – ESL 875
3. Integrated energy systems – ESL 722
4. Power generation, transmission and distribution – ESL 718
5. Electrical power plant engineering – ESL 714
6. Exergy Analysis – New course
7. Waste heat recovery – New course

COURSE TEMPLATE

1. **Department/Centre** : Centre for Energy Studies
2. **Course Title** : Exergy Analysis
3. **L-T-P structure** : 3-0-0
4. **Credits** : 3
5. **Course number** : New course
6. **Status**

(category for program) : Minor areas

7.	Pre-requisites (course no./title)	Nil
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8.	Overlap of contents with any (give course number/title)
8.1	Existing UG course(s) of the Department/Centre
8.2	Proposed UG course(s) of the Department/Centre
8.3	Approved PG course(s) of the Department/Centre
8.4	UG/PG course(s) from other Department/Centre
8.5	Equivalent course(s) from existing UG course(s)

9.	Not allowed for (indicate program names)	Nil
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10.	Frequency of offering	Either semester
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11.	Faculty who will teach the course	Prof. S. C. Kaushik, Dr Dibakar Rakshit
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12.	Will the course require any visiting faculty?	Yes
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13.	Course objective (about 50 words)	Primary objective of the course is to introduce students the basis of the Exergy Analysis which is an emerging area in the field of energy science and engineering. Emphasis will be placed on developing theoretical basis along with numerical examples for understanding the exergetic evaluation of thermal energy systems, components, devices and thermal power plants and refrigeration/ Heat pump/ Air conditioning Plants. The course is mainly planned for BTech/ Mtech students in thermal engineering and energy studies. The students need to have
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		basic background of thermal science and thermodynamics. Students other than thermal science background should consult the instructors before registering this course.
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14.	Course contents (about 100 words)/(include laboratory/design activities): 1. Thermodynamic basis of available energy, exergy and entropy 2. Exergy balance equations for closed and open flow systems under steady state and unsteady state conditions 3. Exergetic efficiency definition for various devices, components including heat exchangers, mixing chamber and drying process 4. Exergy analysis of thermal energy systems including thermal power plants, refrigeration and heat pump/ air-conditioning plants 5. Exergy analysis of solar energy systems, solar cooker/ dryer/ collector/ concentrator/ solar still/ solar pond/ thermal storage systems and solar thermal power generation, solar photo voltaic system 6. Economics based on exergy analysis of thermal energy systems.
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15. Lecture Outline (with topics and number of lectures)

Module No.	Topic	No. of hours
1	Introduction and basic thermodynamic concepts	4
2	Exergy balance equations development	6
3	Exergetic efficiency definitions and different forms	6
4	Exergy analysis of thermal energy systems	8
5	Exergy analysis of solar energy systems	8
6	Numerical examples and exergoeconomics	8
7	Conclusions from exergy analysis	2
	Course total	42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Module No	Experiment description	No. of hours
1	Nil	
	COURSE TOTAL	Nil

18. Suggested texts and reference materials

1. Design and management for energy conservation By Paul., W.O. Callaghan, Pergamon, UK
2. Industrial Energy management and utilization By Larry C. Witte, Phillip S. Schmidt and David R. Brown, Hemisphere Publishing Corporation (USA)
3. Thermodynamics: An Engineering Approach by Yunus. A. Cengel and Michael A, McGraw Hill Book Company (USA)
4. Heat Engineering by I. Shvets et al. Mir Publishers (Moscow)

19. Resources required for the course (itemized & student access requirements, if any)

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom Infrastructure	LCD Projector, OHP and Black Board
19.7	Site visits	

20. Design content of the course (percent of student time with examples, if possible)

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	Some typical examples

Date:

(Signature of the Head of the Department / Centre)

COURSE TEMPLATE

1. **Department/Centre** : Centre for Energy Studies
2. **Course Title** : Waste heat recovery
3. **L-T-P structure** : 3-0-0
4. **Credits** : 3
5. **Course number** :
6. **Status**

(category for program) :

7.	Pre-requisites (course no./title)	Nil
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8.	Overlap of contents with any (give course number/title)
8.1	Existing UG course(s) of the Department/Centre
8.2	Proposed UG course(s) of the Department/Centre
8.3	Approved PG course(s) of the Department/Centre
8.4	UG/PG course(s) from other Department/Centre
8.5	Equivalent course(s) from existing UG course(s)

9.	Not allowed for (indicate program names)	Nil
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10.	Frequency of offering	1 st Semester of Every Year
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11.	Faculty who will teach the course	Dr Dibakar Rakshit, Prof. S. C. Kaushik
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (about 50 words)	To provide comprehensive understanding of industrial waste heat recovery and its further utilization in HVAC system and building. The course is mainly planned for BTech/ Mtech students in thermal engineering and energy studies. The students need to have basic background of thermodynamics and heat transfer. Students other than thermal science background should consult the instructors before registering this course.
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14.	Course contents <i>(about 100 words)/(include laboratory/design activities):</i> Introduction to Waste heat recovery, Classifications, Principles, Utilizations, Strategy of using waste heat recovery, Basic Heat Exchanger Design Concepts, Heat Exchanger equipment classifications, Steam generation equipment, Power plant heat recovery systems, Commercial waste heat recovery systems with detailed study of Recuperators, Radiation/Convective Hybrid Recuperator, Ceramic Regenerator, Introduction to efficient building design
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15. Lecture Outline *(with topics and number of lectures)*

Module No.	Topic	No. of hours
1	Introduction to waste heat utilization	1
2	Classifications, Principles of Heat Transfer, Heat Exchanger design systems	15
3	Different type of waste heat exchangers	10
4	Power plant waste heat recovery	7
5	Commercial waste heat recovery	5
6	Building waste heat recovery	4
	Course Total	42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Module No	Experiment description	No. of hours
1	Nil	
	COURSE TOTAL	Nil

18. Suggested texts and reference materials

5.	Utilization of Reject Heat By Mitchell Olszewski
6.	Waste Energy Utilization Technique By Yen-Hsiung Kiang
7.	Industrial boilers and heat recovery generators By V Ganapathy
8.	Heating and cooling of buildings- Design for Efficiency By Jan F. Kreider, Peter S. Curtiss, Ari Rabi

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	

19.4	Laboratory	
19.5	Equipment	
19.6	Classroom Infrastructure	LCD Projector, OHP and Black Board
19.7	Site visits	

20. Design content of the course *(percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	Some typical examples

Date:

(Signature of the Head of the Department / Centre)