List of New Course(s) Introduced

Department : Chemical Engineering

Programme Name : B.Tech.

Academic Year : 2023-24

List of New Course(s) Introduced

Sr. No.	Course Code	Name of the Course
1	CHUCTK2	Water Treatment and Management
2	CHUDTO1	Energy and Environment
3	CHUDPV1	Mini Project
4	CH408TPE61	Environmental Engineering
5	CH207TOE02	Waste to Energy

Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2023-24

School : Engineering and Technology

Department : Chemical Engineering

Date and Time : 28 June 2023, 11:00 AM

Venue : HoD Room

Minutes of Meeting

The scheduled meeting of members of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (June 28, 2023) in blended mode (online and offline). The agenda of the meeting was as follows:-

1. Approval of Scheme & Syllabus of B.Tech. Final Year (VII & VIII Semester) of Chemical Engineering (w.e.f. Session 2023-24).
2. Approval of Departmental Vision and Mission.
3. Review of COs of B.Tech. Chemical Engineering Subjects, as required.
4. Review of Scheme & Syllabus of M.Tech. (All Semester) of Chemical Engineering (w.e.f. Session 2023-24)

Following members were present in the meeting:

1. Dr. Raghwendra Singh Thakur, Chairman-BoS , Associate Prof. and Head, Dept. of Chemical Engg.
2. Prof. (Mrs) A B Soni, External Expert Member-BoS, Prof., Dept. of Chemical Engg., NIT Raipur
3. Er. Arvind Verma, External Industry Expert, Special Invitee-BoS, Senior Manager-Process, Nu-Vista (NUVOCO Cement), Baloda Bazar
4. Dr. Anil Kumar Chandrakar Member-BoS, Associate Prof., Dept. of Chemical Engg.
5. Dr. Saurabh Meshram, Member-BoS, Assistant Prof., Dept. of Chemical Engg.
6. Dr. Amit Jain, Invited Member, Associate Prof., Dept. of Chemical Engg.
7. Dr. Neeraj Chandraker, Invited Member, Assistant Prof., Dept. of Chemical Engg.
8. Dr. Anuradha N. Joshi, Invited Member, Assistant Prof., Dept. of Chemical Engg
9. Dr. Gautam Prasad Dewangan, Invited Member, Assistant Prof., Dept. of Chemical Engg.
10. Mr. Vishnu Prasad Yadav, Invited Member, Assistant Prof., Dept. of Chemical Engg.
11. Dr. Sandeep Dharmadhikari, Invited Member, Assistant Prof., Dept. of Chemical Engg.
12. Dr. Ghoshna Jyoti, Invited Member, Assistant Prof., Dept. of Chemical Engg.
13. Dr. Pankaj Kumar, Invited Member, Assistant Prof., Dept. of Chemical Engg.

Following decision has been made in the meeting.

1. The committee discussed the scheme and syllabi of B. Tech Fourth year (VII and VIII semesters) at length and after incorporating the changes, as identified by the BoS members, the final scheme and syllabi is to be sent to the external BoS members for their formal consent.

2. Two open elective courses, Waste To Energy (CH207TOE02) in B.Tech. VII Semester and Project Engineering Economics and Management (B.Tech. CH208TOE03) in B.Tech. VIII Semester, are to be offered by the department of chemical engineering.
3. Vision and Mission of the Department was finalized after discussion in the meeting.
4. Discussion was made on M. Tech. Scheme and Syllabus to modify and implement the changes in next BoS likely to be held in August 2023.

Dr. Raghwendra Singh Thakur

Prof. (Mrs) A B Soni

Er. Arvind Verma

Dr. Anil Kumar Chandrakar

Dr. Amt Jain

Dr. Saurabh Meshram,

Dr. Neeraj Chandraker

Dr. Anuradha N. Joshi

Dr. Gautam Prasad Dewanga

Mr. Vishnu Prasad Yadav

Dr. Sandeep Dharmadhikari

Dr. Ghoshna Jyoti

Dr. Pankaj Kumar

Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2023-24

School : Engineering and Technology

Department : Chemical Engineering

Date and Time : 06 October 2023, 11:00 AM

Venue : HoD Room

Minutes of Meeting

The scheduled meeting of member of Board of Studies (BoS) of Department of Chemical Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held today (06/10/2023, Friday), through blended mode in Room no. G-14, to discuss the B.Tech. (Chemical Engineering) Second year (III and IV semesters) scheme and syllabi. Also to review the CO-PO mapping of M.Tech. program.

The following members were present in the meeting

1. Prof. A. B. Soni, External Expert Member-BoS (Prof., Dept. of Chemical Engg., NIT Raipur)
2. Dr. Raghwendra Singh Thakur, Chairman BOS & Head (I/c) (Associate Professor, Dept. of Chemical Engg.)
3. Prof. Anil Kumar Chandrakar, (Professor, Dept. of Chemical Engg.)
4. Dr. Saurabh Meshram, Member-BoS (Associate Professor, Dept. of Chemical Engg.)
5. Er. Arvind Verma, External Industry Expert Member-BoS (Senior Manager (Process), Nu-Vista (NUVOCO Cement), Baloda Bazar (Online)
6. Dr. Gautam Prasad Dewangan, Invited Member (Assistant Professor, Dept. of Chemical Engg.)
7. Dr. Neeraj Chandraker, Invited Member (Assistant Professor, Dept. of Chemical Engg.)
8. Dr. Anuradha N. Joshi, Invited Member (Associate Professor, Dept. of Chemical Engg.)
9. Dr. Amt Jain, Invited Member (Associate Professor, Dept of Chemical Engg.)
10. Mr. Vishnu Prasad Yadav, Invited Member (Assistant Professor, Dept, of Chemical Engg.)
11. Dr. Sandeep Dharmadhikari, Invited Member (Assistant Professor, Dept. of Chemical Engg.)
12. Dr. Ghoshna Jyoti, Invited Member (Assistant Professor, Dept. of Chemical Engg.)
13. Dr. Pankaj Kumar, Invited Member (Assistant Professor, Dept. of Chemical Engg.)

The following agenda was presented and approved.

1. The committee extensively discussed the scheme and syllabi of B. Tech Second year (III and IV semesters). After thorough discussions and incorporation of identified changes, the final scheme and syllabus with CO-PO mapping was approved.
2. The committee acknowledged that subject codes may be changed as per the University notification.
3. The CO-PO mapping of M.Tech. program was approved with some modification.

06/10/23 Soni 06/10/23 6/10/23 06/10/23 06/10/23

Prof. (Mrs) A B Soni
External Expert Member, BoS
Professor, Dept. of Chemical Engg.
NIT Raipur

Dr. Raghwendra Singh Thakur
Head (I/c) & Chairman-BoS
Associate Prof., Chemical Engg., GGV

Prof. Anil Kumar Chandrakar
Professor, Member-BoS,
Chemical Engg. GGV

Er. Arvind Verma
External Industry Expert Member, BoS
Senior Manager, NUVOCO Cement, Baloda Bazar

Dr. Saurabh Meshram
Member, BoS
Associate Prof.,Chemical Engg., GGV

Dr. Anuradha N. Joshi
Invited Member, BoS
Associate Prof., Chemical Engg., GGV

Dr. Gautam Prasad Dewangan
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Dr. Neeraj Chandraker
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Dr. Amt Jain
Invited Member, BoS
Associate Prof., Chemical Engg., GGV

.Mr. Vishnu Prasad Yadav
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Dr. Sandeep Dharmadhikari
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Dr. Ghoshna Jyoti
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Dr. Pankaj Kumar
Invited Member, BoS
Assistant Prof., Chemical Engg., GGV

Scheme and Syllabus

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Ordinance 2009, No. 3 of 2009)

SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

SECOND YEAR, THIRD SEMESTER (NEP)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
	THEORY					Sessional			
			L	T	P	CIA	SEA	TOTAL	
01.	CHUCTT1	Fluid Mechanics	3	1	0	40	60	100	4
02.	CHUCTT2	Chemical Engineering Thermodynamics	3	1	0	40	60	100	4
03.	CHUCTT3	Material & Energy Balances	3	0	0	40	60	100	3
04.	CHUCTK1	Process Utilities & Safety	3	0	0	40	60	100	3
	CHUCTK2	Water Treatment and Management							
05.	AMUCTE1	Mathematics-III	3	0	0	40	60	100	3
06.	CHUCTO1	Engineering Materials	3	0	0	40	60	100	3
	CEUCTO1	Green Buildings							
	MEUCTO1	Introduction to Thermodynamics							
	IPUCTO1	I. C. Engine							
	CSUCTO1	Data Structure With C++							
	ITUCTO1	Computer Organization & Architecture							
	ECUCTO1	Data Communication							
	PRACTICAL								
01.	CHUCLT1	Basic Chemical Engineering Lab	0	0	2	25	25	50	1
02.	CHUCLT2	Fluid Mechanics Lab	0	0	2	25	25	50	1
		Total	18	2	4	290	410	700	22

CIA – Continuous Internal Assessment
SEA – Semester End Assessment

Total Credits – 22
Total Marks – 700
Total Periods / Week - 24

CIA-Shall be two class test (CT) I &II each 15 marks, 05 marks for assignment, surprise test, quiz etc. and 05 marks attendance
CH-Chemical Engineering, CE-Civil Engineering, ME-Mechanical Engineering, IT-Information Technology
IP-Industrial and Mechanical Engineering, CSE-Computer Science & engineering,
EC-Electronics and Communication Engineering

BoS Held on 06-10-2023

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
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SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B. TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

SECOND YEAR, FOURTH SEMESTER (NEP)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	CIA	SEA	TOTAL	
01.	CHUDTT1	Particle and Fluid Particle Operations	3	0	0	40	60	100	3
02.	CHUDTT2	Inorganic Chemical Technology	3	0	0	40	60	100	3
03.	CHUDTT3	Numerical Methods in Chemical Engineering	3	0	0	40	60	100	3
04.	CHUDTK1	Process Instrumentation	3	0	0	40	60	100	3
	CHUDTK2	Fluidization Engineering							
05.	CHUDTO1	Energy and Environment	3	0	0	40	60	100	3
	CEUDTO1	Remote Sensing & GIS							
	MEUDTO1	Introduction to Fluid Mechanics							
	IPUDTO1	Automobile Engineering							
	CSUDTO1	Introduction to Information Science							
	ITUDTO1	Computer Network							
	ITUDTO2	Fundamentals of Python Programming							
	ECUDTO1	Introduction to Electronic Devices & Circuits							
	ESUDTO1	Effective Technical Communication							
	PRACTICAL								
01.	CHUDLT1	Particle and Fluid Particle Operations Lab	0	0	2	25	25	50	1
02.	CHUDLT2	Numerical Methods in Chemical Engineering Lab	0	0	2	25	25	50	1
03.	CHUDPV1	Mini Project	0	0	4	50	50	100	2
		Total	15	0	8	300	400	700	19

CIA – Continuous Internal Assessment SEA – Semester End Assessment	Total Credits – 19 Total Marks – 700	Total Periods / Week - 23

CIA-Shall be two class test (CT) I &II each 15 marks, 05 marks for assignment, surprise test, quiz etc. and 05 marks attendance
CH-Chemical Engineering, CE-Civil Engineering, ME-Mechanical Engineering, IT-Information Technology
IP-Industrial and Mechanical Engineering, CSE-Computer Science & engineering,
EC-Electronics and Communication Engineering

BoS Held on 06-10-2023

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
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SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FOURTH YEAR, SEVENTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH407TPC14	Process Equipment Design-II	3	0	0	30	70	100	3
02.	CH407TPC15	Transport Phenomena	3	0	0	30	70	100	3
03.	CH407TPE4X	Professional Elective-IV	3	0	0	30	70	100	3
04.	CH407TPE5X	Professional Elective-V	3	0	0	30	70	100	3
05.	XX207TOEXX	Open Elective-II	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH407PPC09	Vocational Training Viva cum Seminar	0	0	4	30	20	50	2
02.	CH407PPC10	Minor Project	0	0	6	30	20	50	3
		Total	15		10	210	390	600	20

IA – Internal Assessment
ESE - End Semester Examination
Total Credits – 20
Total Marks – 600
Total Periods / Week – 25

28/06/2023

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
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SCHEME FOR EXAMINATION (Effective from Session 2023-24)

B.TECH. (FOUR YEAR) DEGREE COURSE, CHEMICAL ENGINEERING

FOURTH YEAR, EIGHTH SEMESTER (AICTE-NEW)

S. No.	Subject Code	Subject Name	Periods			Evaluation Scheme			Credits
						Sessional			
	THEORY		L	T	P	IA	ESE	TOTAL	
01.	CH408TPC16	Process Equipment Design-III	3	1	0	30	70	100	4
02.	CH408TPE6X	Professional Elective-VI	3	0	0	30	70	100	3
03.	XX208TOEXX	Open Elective-III	3	0	0	30	70	100	3
	PRACTICAL								
01.	CH408PPC11	Major Project	0	0	12	120	80	200	6
		Total	9	1	12	210	290	500	16

IA – Internal Assessment
ESE - End Semester Examination
Total Credits – 16
Total Marks – 500
Total Periods / Week - 22

28/06/2023

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DEPARTMENT OF CHEMICAL ENGINEERING

List of Professional Elective Courses (Seventh and Eighth Semester)

S.No.	Semester	Course No.	Subjects
01.	VII	CH407TPE41	New Separation Processes
02.		CH407TPE42	Water Conservation and Management
03.		CH407TPE43	Process Modeling and Simulation
01.	VII	CH407TPE51	Petroleum Refinery Engineering
02.		CH407TPE52	Process Utilities and Safety
03.		CH407TPE53	Design and Development of Catalyst
01.	VIII	CH408TPE61	Environmental Engineering
02.		CH408TPE62	Optimization Techniques
03.		CH408TPE63	Petrochemical Technology

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List of Open Elective Courses (Seventh and Eighth semester)

S.NO.	SEMESTER	COURSE NO.	SUBJECTS	DEPARTMENT CODE
01.	VII	CH207TOE02	WASTE TO ENERGY	CH
02.		ME207TOE02	PRINCIPLES OF MANAGEMENT	ME
03.		EC207TOE02	CMOS DIGITAL VLSI DESIGN	EC
04.		CE207TOE02	GREEN BUILDING AND SUSTAINABLE MATERIALS	CE
05.	IT207TOE01	~~IT207TOE02~~	MACHINE LEARNING	IT
06.	CS207TOE01	~~CS207TOE02~~	GIS & REMOTE SENSING	CS
07.	IP207TOE02	~~IP207TOE21~~	MANUFACTURING PROCESSES-I	IP
01.	VIII	CH208TOE03	PROJECT ENGINEERING ECONOMICS AND MANAGEMENT	CH
02.		ME208TOE03	SUPPLY CHAIN MANAGEMENT	ME
03.		EC208TOE03	INTRODUCTION TO IOT	EC
04.		CE208TOE03	INFRASTRUCTURE PLANNING AND MANAGEMENT	CE
05.	IT208TOE01	~~IT208TOE03~~	SOFT COMPUTING	IT
06.	CS208TOE01	~~CS208TOE03~~	ARTIFICIAL INTELLIGENCE	CS
07.	IP208TOE03	~~IP208TOE41~~	ADVANCED MANUFACTURING PROCESSES	IP

4

BUDTOI **Energy and Environment** **[L:3, T:0, P:0]**

Objectives

The objectives of this course are to introduce the basics of environment & ecosystem, different sources of pollution, its control measures and various energy resources. The course gives awareness about global environmental issues.

Contents:

Unit-I

Introduction to Energy, Sources of Energy, Scenario of Energy, Conservation of Energy, Energy audit, Possibilities for energy storage or regeneration

Unit-II: Conventional and non-conventional energy sources and their uses. Fossil fuels - past, present & future, Remedies & alternatives for fossil fuels - Solar, Wind, Biomass, Hydrogen, Geothermal, Ocean and Hydro energy.

Unit-III : Components of environment and their relationship, impact of technology on environment, environmental degradation.
Global Environmental Issues: climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust; Social Issues and the Environment.

Unit-IV : Overview of Environmental Pollution: Sources, effects, and control measures.

Unit-V: Environmental Legislation: Environmental protection laws in India; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Issues involved in enforcement of environmental legislation; Public awareness; Case studies.

Suggested Text Books :

1. Textbook of Environmental Studies for Undergraduate Courses by ErachBharucha Second edition,2013 Publisher: Universities Press (India) Private Ltd, Hyderabad.
2. Dr. Suresh K Damecha, Environemental Studies, S K Kataria & Sons, New Delhi.
3. R. Rajagopalan, Environemental Studies, Oxford University Press.
4. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey Brack, Energy and the Environment, wiley Publication

Reference Book:

1. Wright Richard and Nebal Bernard, Environmental studies, Prentice Hall, New Jersey.
2. U K Khare, Basics of Environmental Studies, Tata McGrawHill
3. Daniel B Botkin& Edward Akeller, Environmental Sciences, John Wiley & Sons

Course Outcome:

Students would be able

1. To comprehend components of environment and ecosystem and to get aware about environmental degradation.
2. To identify different types of pollutions and control measures.
3. To create awareness about global environmental issues.

CHUCTK2 Water Treatment and Management [L:3, T:0, P:0]

Objectives

- To introduce the water management principles related to process plants.
- To focus on the wastewater transport system and the theory for the wastewater treatment process.
- To analyze water quality parameters and their impact on human and environmental health.

Contents:

Unit I: Introduction to Water Treatment and Management, Importance of water treatment and management, Water cycle and its relevance to water management.

Unit II: Water Quality Assessment, Water quality parameters (physical, chemical, biological), Sampling techniques, water borne diseases and analysis methods.

Unit III: Drinking Water Standards and Regulations, water act, National and international drinking water standards, Regulatory frameworks and compliance,.

Unit IV: Water Treatment Processes, Screening and pre-treatment b. Coagulation, flocculation, and sedimentation, Filtration (slow sand, rapid sand, membrane), Disinfection (chlorination, UV, ozone), Desalination and water softening.

Unit V: Sustainable Water Management, Water conservation and efficiency, Integrated water resource management, Rainwater harvesting and storm water management

Suggested Text Books :

1. Water Conservation, Management and Analysis by V. Madireddi and Subba Rao, Read worthy Publications (Pvt) Ltd
2. Protection and Conservation of, Water Resources by Hadrian F. Cook, John Wiley & SonsInc.
3. Water Resources, Conservation and Management by S.N. Chatterjee, Atlantic Publishers &Dist.
4. P.C.Bansil "Water Management in India", Concept Publishing company, New Delhi, First Edition, 2004.
5. G.S.Bridie and J.S.Bridie "Water Supply and Sanitary Engineering", Dhanpat Raj Publishing company (P) Ltd., New Delhi, 7th Edition, 2003.

Course Outcome:

Students would be able to

1. Evaluate the performance of industrial boilers.
2. Choose methods for waste minimization and water conservation.

CO-PO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2	2						1		
CO2						2	2						1		

Weightage : 1-Slightly; 2-Moderate; 3-Strongly

BoS Held on 06-10-2023

CH408TPE61 **Environmental Engineering** [L:3, T:0, P:0]

Objectives

To understand the significant issues of environmental pollution and their control principals.

Contents

Unit I: Environmental Pollution and Its Effect: Environment and its components, Sources and type of pollutants, General effects on man, animal, vegetation and property.

Unit II: Air Pollution: Air quality criteria and standards, Ambient air sampling and analysis, Stack emission standards, Stack sampling and analysis, Meteorology and dispersion of air pollutants, Atmospheric lapse rate and stability, Plume behavior, Control of gaseous and particulate pollutants from mobile and stationery sources, air pollution acts.

Unit III: Water Pollution: Water quality criteria and effluent discharge standards, Domestic and industrial sources of waste water, Waste water sampling and analysis methods as per BIS specifications, Physico-chemical and biological methods of waste water treatment, Recovery of material from process effluents, water pollution acts.

Unit IV: **Pollution Due to Hazardous Industrial Waste**: Nature of hazardous waste materials from various chemical and allied Industries, Methods of disposal, destruction and reuse, nuclear wastes and their management. Solid waste from commercial, domestic and industrial sectors-composition and characterization, recycle, resource recovery and disposal.

Unit V: **Environmental Pollution Management**: Case studies of air and water pollution control in chemical industries.

Suggested Text Books:

1. Environmental Pollution Control Engineering by C. S. Rao, New Age International Ltd.
2. Environmental Engineering by N. N. Basak, Tata McGraw-Hill Pub. Co. Ltd.
3. Essentials of Environmental Studies by K. Joseph and R. Nagendran, Pearson Education (Singapore) Pvt. Ltd.

Course Outcome:

The students will be able

1. To explain environmental pollution and its effect.
2. To develop the understanding of air pollution and to describe methods of controlling of air pollution.
3. To analyze water quality, evaluate water pollution, and describe the control methods.
4. To analyze the characteristics of hazardous industrial waste and understand its handling and management.
5. To understand the application part through case studies.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1										3		
CO2	3	2	1	2		2							3		
CO3	3	2	1	2		2							3		
CO4	3	2	1	2		2							3		
CO5	3	2	2	1		2							3		

28/07/23

B.Tech. VIII Semester

CH207TOE02 **Waste to Energy** [L:3, T:0, P:0]

Contents

Unit I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit II: Biomass Pyrolysis: Pyrolysis – Types, slow, fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes:

At the end of the course, students will be able to

1. Classify the waste for fuel and identify the devices for conversion of waste to energy.
2. Implement the Biomass Pyrolysis
3. Evaluate the methods of Biomass Gasification and implement their applications.
4. To design, construct and operation the Biomass Combustion devices.
5. Classify biomass, apply the bio energy systems design and construction.

CO-PO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	0	-	1	1	-	-	-	-	-	1	-	-
CO2	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO3	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO4	3	2	2	1	-	1	1	-		-	-	-	3	-	-

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