INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**WASTE TO ENERGY**					
Course Code	BCSB30					
Programme	M.Tech					
Semester	III	ECE				
Course Type	Elective					
Regulation	IARE - R18					
Course Structure	**Theory**			**Practical**		
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**	
	3	-	3	-	-	
Chief Coordinator	Ms. CH.SRIVIDYA, Assistant Professor, CSE					
Course Faculty	Ms. CH.SRIVIDYA, Assistant Professor, CSE					

I. COURSE OVERVIEW:

The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course description is: to understand what municipal solid waste, composition is its characteristics and to improve the methods to minimize municipal solid waste. To understand the methods of disposal of solid waste by thermal biochemical and land filling methods and to know the environmental impacts of all types of municipal waste .To get a good knowledge of environmental in context of global trade.

II. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Waste to Energy	70 Marks	30 Marks	100

III. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

IV. EVALUATION METHODOLOGY:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIE during the semester, marks are awarded by taking average of two sessional examinations.

Semester End Examination (SEE):

The SEE shall be conducted for 70 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern shall be as defined below.Two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Technical seminar/Term paper.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Technical seminar/Term paper	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar

PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment and Seminar
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Assignment
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Seminar

3 = High; 2 = Medium; 1 = Low

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	-	-
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	2	Seminar
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES :

The course should enable the students to:

I	Understand the principles associated with effective energy management and to apply these principles in the day to day life
II	Develop insight into the collection, transfer and transport of municipal solid waste
III	Explain the design and operation of a municipal solid wasteland fill.
IV	Device key processes involved in recovering energy from wastes, systematically evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe basic concepts of waste to energy resources and their conversion devices.	CLO 1	Explain about different types of waste to energy resources.
		CLO 2	Understand basic concept of energy conversion and explore different types of conversion devices.
CO 2	Understand the concept of pyrolysis and the production of different products by using pyrolysis.	CLO 3	Understand basic concept of pyrolosis and their types.
		CLO 4	Describe the concept of Manufacture of charcoal, and their Methods.
		CLO 5	Describe the concept of Manufacture of pyrolytic oils and gases and their applications.

CO 3	Explore different types of biomass gasification techniques and understand Biochemical conversion of biomass for energy application.	CLO 6	Describe the concept of biomass gasification technique and their gasification types and techniques.
		CLO 7	Explain about the Gasifier engine arrangement for the production of electrical power and their considerations.
CO 4	Explore different types of biomass combustion techniques and their working operations.	CLO 8	Understand about the concept of biomass combustion through some exotic designs .
		CLO 9	Explore on various combustion techniques and their operations.
CO 5	Describe the basic concepts of biogas and explore Biogas plant technology and their applications.	CLO 10	Understand about the basic concepts of biogas.
		CLO 11	Demonstrate about Biogas plant technology and Bio energy system.
		CLO 12	Explain about the concept of Alcohol production from biomass and Bio diesel production.
		CLO 13	Discuss about the Biomass energy program in India.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCSB30.01	CLO 1	Explain about different types of waste to energy resources.	PO2	2
BCSB30.02	CLO 2	Understand basic concept of energy conversion and explore different types of conversion devices.	PO1	3
BCSB30.03	CLO 3	Understand basic concept of pyrolosis and their types.	PO1, PO2	2
BCSB30.04	CLO 4	Describe the concept of manufacture of charcoal, and their Methods.	PO3, PO5	2
BCSB30.05	CLO 5	Describe the concept of manufacture of pyrolytic oils and gases and their applications.	PO3, PO5	2
BCSB30.06	CLO 6	Describe the concept of biomass gasification technique and their gasification types and techniques.	PO1, PO5	2
BCSB30.07	CLO 7	Explain about the Gasifier engine arrangement for the production of electrical power and their considerations.	PO3, PO5	2
BCSB30.08	CLO 8	Understand about the concept of biomass combustion through some exotic designs .	PO1	2
BCSB30.09	CLO 9	Explore on various combustion techniques and their operations.	PO2	2
BCSB30.10	CLO 10	Understand about the basic concepts of biogas.	PO7	2
BCSB30.11	CLO 11	Demonstrate about Biogas plant technology and Bio energy system.	PO3, PO5	2
BCSB30.12	CLO 12	Explain about the concept of Alcohol production from biomass and Bio diesel production.	PO1	2
BCSB30.13	CLO 13	Discuss about the Biomass energy program in India.	PO7	3

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X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				
	PO1	PO2	PO3	PO5	PO7
CO 1	2	2		1	
CO 2	2		2		2
CO 3		3		2	1
CO 4	1		2	2	
CO 5		2		2	2

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

CLOs	Program Outcomes (POs)				
	PO1	PO2	PO3	PO5	PO7
CLO 1		2			
CLO 2	3				
CLO 3	2	2			
CLO 4			2	2	
CLO 5			2	2	
CLO 6	2			2	
CLO 7			2	2	
CLO 8	2				
CLO 9		2			
CLO 10					2
CLO 11			2	2	
CLO 12	2				
CLO 13					3

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XII.ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2, PO3,PO5.PO7	SEE Exams	PO1,PO2, PO3,PO5.PO7	Term paper	PO3,PO5	Seminars	PO2,PO7
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-

XIII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT I	**INTRODUCTION TO ENERGY FROM WASTE**	**Classes: 09**
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**	**Classes: 09**
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**	**Classes: 09**
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**	**Classes: 09**
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**	**Classes: 09**
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.		
Text Books:		
1. Desai, Ashok V, "Non Conventional Energy", Wiley Eastern Ltd., 1990.		
Reference Books:		
1. Khandelwal, K. C. and Mahdi, S. S, "Biogas Technology - A Practical Hand Book", Vol. I & II Tata McGraw Hill Publishing Co. Ltd., 1983. 2. Challal, D. S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.KL Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.		
Web References:		
1. http://nptel.ac.in/courses/103107125/		
E-Text Books:		
1. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.		

XV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	CLOs	Reference
1	Summarize about waste to energy sources and its importance.	CLO 1	T1:3.3 T2: 1.2
2	Discuss solid waste properties and its composition.	CLO 1	T1: 3.4 T2: 1.4
3	Provides the information regarding collection and transfer of solid waste.	CLO 2	T1: 3.5 T2: 1.5
4	Discuss the need of waste minimization and recycling.	CLO 2	T1: 3.7 T2: 1.8
5	Discuss the need MSW in waste conversion.	CLO 2	T1: 3.9 T2: 1.10
6	Acquire the knowledge about the technologies for generation of energy from waste resources.	CLO 2	T1: 5.5 T2: 6.2
7	Acquire the knowledge about the Biomass pyrolysis and their types.	CLO 3	T1: 5.6 T2: 6.3
8	Discuss the Manufacture of charcoal.	CLO 3	T1: 4.3 T2: 5.2
9	Discuss the different techniques to produce charcoal.	CLO 4	T1: 4.4 T2: 5.3
10	Discuss the Manufacture of pyrolytic oils and gases.	CLO 4	T1: 4.5 T2:5.4
11	Analyze different types of yields and their applications..	CLO 4	T1: 4.6 T2: 5.5
12	Summarize the properties and characteristics of gasifiers.	CLO 5	T1: 4.5.2 T2: 5.6
13	Aquire the knowledge of generating energy from gasifiers and their types..	CLO 5	T1: 4.6 T2: 5.5
14	Discuss the emission of gasses by different techniques.	CLO 5	T1: 4.6.2 T2: 5.5.2
15	Discuss the environmental monitoring system for land fill gases	CLO 6	T1: 4.7 T2: 5.6
16	Discuss about biochemical conversion.	CLO 6	T1: 4.7 T2: 5.8
17	Illustrate the sources of biochemical conversion.	CLO 6	T1: 4.7.2 T2: 5.8.2
18	Discuss about Gasifier burner arrangement for thermal heating.	CLO 7	T1: 4.8 T2: 5.9
19	Analyze power generation from gasifiers.	CLO 7	T1: 4.9 T2: 5.7
20	Discuss about the different considerations in producton of power.	CLO 7	T1: 6.2 T2: 5.6
21	Discuss about biomass stoves..	CLO 8	T1: 6.3 T2: 5.7
22	Understand the concept of Thermo-chemical Conversion by combustion.	CLO 8	T1: 6.4 T2: 5.8
23	Discuss about Biogas production.	CLO 8	T1: 6.5 T2: 5.3
25	Illustrate sources of thermo chemical energy generation.	CLO 9	T1: 6.7 T2: 5.3
26	Explain gasification of waste using gasifies briquetting.	CLO 9	T1: 6.5 T2: 7.5
30	Explain combustion of waste using different types of combustors.	CLO 9	T1: 6.3 T2: 7.3
31	Outline of E-waste in India	CLO 10	T1:6.4 T2:7.5
32	Summarize E-waste in the global context	CLO 10	T1: 6.2 T2: 5.6

33	Understand the Growth of electrical and electronics industry in India	CLO 10	T1: 6.3 T2:5.7
34	Identify environmental concerns and health hazards.	CLO 11	T1: 6.4 T2:5.8
35	Discuss about Biogas plant technology.	CLO 11	T1: 2.1 T2: 9.1
36	Explain bio energy system and their features.	CLO 11	T1: 2.2 T2:9.2
37	Discuss about Biomass resources and their classification.	CLO 11	T1: 2.1 T2: 9.1, 9.2
38	Explain about Biomass conversion processes.	CLO 12	T1: 2.6 R1: 5.1
39	Discuss about Types of biogas Plants, Applications.	CLO 12	T1: 2.7 R1: 5.2
40	Explain about Alcohol production from biomass.	CLO 13	T1:2.8 R1:5.5
41	Summarize government regulations on e-waste management	CLO 13	T1: 2.1 R1: 5.6
42	Outline international waste management	CLO 13	T1: 2.2 R1:5.4
43	Explain need for stringent health safeguards	CLO 13	T1:2.4 R1:5.5
44	Discuss need for environmental protection laws	CLO 13	T1: 2.2, 2.3 R1:5.2
45	Outline environmental protection laws of India.	CLO 13	T1: 2.5 R1:5.2.2

XVI. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No.	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Case studies on conversion of municipal solid and waste to energy conversion technologies.	Seminars/ NPTEL/ Guest lectures	PO 1	PSO 2

Prepared by:
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HOD, ECE