Semester- II

New & Renewable Energy, Sources And Technologies			
Course Code	MESE201	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

1. To introduce concepts of solar energy conversion and the various ways of storing the solar energy
2. To understand the principles of wind energy conversion devices, types of wind turbines and Generators.
3. To study about Geothermal energy, ocean energy, wave energy, tidal energy, fuel cell, hydrogen energy, biomass and its conversion technologies.

Module-1

Energy Scenario World Energy Scenario Use and their availability and overall energy demand. Energy Consumption in various sectors and its changing pattern, exponential increase in energy consumption and projected future demands. Sustainable Development, Role of Renewable Energy sources in Sustainable development, Energy Consumption and its impact on environmental climatic change. Indian Energy Scenario: Commercial and non-commercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption.

Module-2

Wind potential in India and world, basic principle of wind energy Conservation characteristics of wind power, Extractable wind power, Site selection, wind data analysis and predictions, Use of statistical tools, Different types of Wind Machines Electricity generating standalone systems & grid connected systems, Performance Estimation of Wind turbines, Aerodynamic construction of rotor blades, Wind Farms, wind mills & their applications.

Module-3

Small Scale Hydroelectric (Mini & Micro Hydel): Classification of Small Hydro Power Stations, Components of a Hydroelectric Scheme, Civil Works Design Considerations for Mini and Micro Hydel Projects, Turbines and Generators for Small Scale Hydro Electric, Protection, Control and Management of Equipment, Advantages and Limitations of Small Scale Hydro-Electric, Hybrid Systems, Hydrolic Ram and its Applications.

Module-4

Geothermal Energy Potential Sites, Estimations of Geothermal Power, Nature of Geothermal Sites, Hot-Dry Rocks Resources, Magma Resources, Systems for Energy Generation, Applications of Geothermal Energy, Environmental Issues. Ocean Energy: Basic Theory of OTEC, Potential and application of Technologies, Basic Theory of Wave Energy, Potential and Technologies, Basic Theory of Tidal Energy, Potential and Technologies.

Module-5

Direct Energy Conversion FUEL CELLS: Basic Principle of working, potential, classification of Fuel Cells, Types of Fuels cells, Advantages & Disadvantages, Conversion efficiency of fuel cells, Types of Electrodes, Applications, Thermo – Electric Generators and Refrigeration. HYDROGEN ENERGY Production, Electrolysis, Thermo-chemical methods, Fossil fuel methods, Solar Energy Methods, Storage, Transportation, Applications.

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Sl. No.	Experiments
1	Solar PV systems
2	Performance analysis of standalone PV systems Analysis of effect of dust and temperature on Solar PV Module
3	Effect of shading on solar panels
4	Performance testing of PV system with tracking
5	Effect of tilt angle on solar PV system
6	Effect of bypass diode and blocking diode for a solar PV panel
7	Solar thermal systems: Testing of solar flat plate collectors thermo syphonic flow and forced flow
8	Performance testing of solar thermal concentrators
9	Performance testing of solar thermal concentrators with oil for heat transfer
10	Performance testing of solar cooker
11	Can be Demo experiments for CIE.: Analysis of grid synchronized solar PV system
12	Can be Demo experiments for CIE. : Solar simulator experiment

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of IPCC

1. Two Tests each of 20 Marks
2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Twidell & AW. Wier, Renewable energy resources, English Language book, Society I E & FN Spon (1986).
2. Grey & O.K. Ganhus, Tidal power, Plenum Press, New York (1972).
3. Goswami. Alternative energy in agriculture, Vol. II CRC Press Inc. Florida, 1986.
4. E.R. Berman, Geothermal Energy; 'Noyes DATA Corporation, New Jersey, 1975.
5. D.A Stafford. & D.L. Hawkee & R Horton, CRC Press Inc., Florida.
6. N.K. Bansal., M. Kleeman & M. Mielee, Renewable conversion technology, Tata McGrawHill, New Delhi.
7. S.S.L. Chang, energy Conversion, Prentice Hall Inc., 1963
8. V.D., Hunt, Wind power: A handbook on Wind energy Conversion systems. Van Nostrand Reinhold Company, 1981.
9. D.A. Stafford, D.A, Hawkees, D.L. & R. Hoston, Methane production from waste organic matter, CRC Press, Boca Raton, 1980

Web links and Video Lectures (e-Resources):

1. TERI Energy Data Year Books.
2. Planning commission statistics
3. www.bp.com/centres/energy
4. www.eia.doe.gov
5. www.epa.org
6. Bureau of Energy Efficiency- Volume 1

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

Water and Waste Water: Pollution and Control Technologies			
Course Code	MESE212	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Systems designed to remove waterborne wastes from communities, industries, and so on while protecting the health of people and the environment.

(1)To collect wastewater from residences, industries, institutions, and so on,

(2) To find a place to discharge the wastewater (usually the nearest water course is chosen, but wastewater could also be used for groundwater recharge or even recycled to water supply),

(3) To remove water pollutants that would produce adverse impacts to the receiving water or adversely affect the health of people subsequently using the water and

(4) To do all the above in a cost - effective manner.

Module-1

Fundamentals: Definition, Classification, Sources Water quality Standards. Water Chemistry: Theory of Acid Base Equilibrium, Water Pollution And Control: Indicators, Hardness & Determination of DO BOD, COD of Water, and Water Pollution due to heavy metals and Organic Pollutants. Surface Water Treatment: Water Purification, Processes in Natural Systems (Physical, Chemical, Bio-Chemical Processes) and Its Application, Response of Stream to Bio-Degradable Organic Wastes

Module-2

Water Treatment Methods: Principles and Design, Aeration Systems, types of settling and settling equations, design criteria and design of settling tanks. Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, optimum dose of coagulant, jar test method, design criteria and numerical examples.

Module-3

Unit processes, Water Softening- Principles and design- Ions causing hardness, various methods. Waste Water Treatment: Principles and Design, Objectives of wastewater treatment, characteristics, flow variations, types of reactors and reactors analysis. Mass Loading Factors, Impacts, Estimation and Their Unit Loading**.**

Module-4

Principle of Biological Treatment; Microbial Growth Rates, Treatment Kinetics, Food/Micro Organism Ratio, Substrate Removal Efficiency. Theoretical principles and design : Aerobic Suspended Growth Systems, Activated Sludge, Aerated Lagoon, Principles and design of stabilization ponds, Aerobic Attached Growth, Trickling Filters.

Module-5

Anaerobic - UASBS, Sludge Digesters, Anaerobic Ponds. Different Types of Industrial Effluent Treatment Plants. Sludge Processing: separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Numerical problems and Case Studies**.**

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Environmental Pollution and Its Control Jeffrey J. and P.A. Vesilind.
2. Chemistry for Environmental Engineering Clair N. Sawyer & McCarty, TATA McGrawHill International Publication IIIrd Edition.1986
3. Environmental Engineering - Howard S. Peavy et.al, TATA McGraw Hill International Publication 1st Edition. 1986 4. Environmental Engineering – Ruth F. Weiner and Robin Matthews fourth edition.
4. Water & Waste Water Technology - Marle J. Hammer, Prentice Hall of India Ltd. NewDelhi 2nd
5. Waste Water Treatment, Disposal & Reuse - Metcalf & Eddy, TATA McGraw HillPublication New Delhi 3rd Edition.
6. Waste Water Treatment for Pollution Control – Soli J. Arceivala, TATA McGraw Hill Publication New Delhi 2nd Edition.
7. Energy Conservation in water and wastewater facilities.Water Treatment Handbook, Vol. 1& 2
8. Manual on water supply and Treatment ", CPHEEO, Ministry of Urban Development,GOI, New Delhi, 1999

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/105107207
https://nptel.ac.in/courses/105106119
https://onlinecourses.nptel.ac.in/noc21_ce25/preview
https://onlinecourses.nptel.ac.in/noc19_ce32/preview
https://nptel.ac.in/courses/105104102
https://nptel.ac.in/courses/103107084

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

Energy Policies For Sustainable Development			
Course Code	MESE203	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Frame issues from a public policy energy and sustainability perspective
2. Create a matrix of crosssectoral issues and linkages
3. Assessment of unintended outcomes and risks
4. Assessment of Policy implementation challenges
5. Have an understanding of path dependencies

Module-1

Energy policies of India - Supply focus approach and its limitations - Energy paradigms - DEFENDUS approach - End use orientation - Energy policies and development.

Module-2

Case studies on the effect of Central and State policies on the consumption and wastage of energy - Critical analysis - Need for renewable energy policies in India. Energy and environment – Green-house effect - Global warming - Global scenario - Indian environmental degradation.

Module-3

Environmental laws - Water (prevention & control of pollution) act 1974 - The environmental protection act 1986 - Effluent standards and ambient air quality standards - Latest development in climate change policies & CDM

Module-4

Energy conservation schemes - Statutory requirements of energy audit - Economic aspects of energy audit - Capital investments in energy saving equipment - Tax rebates - Advantages of 100% depreciation – India's plan for a domestic energy cap & trade scheme.

Module-5

Social cost benefit analysis - Computation of IRR and ERR - Advance models in energy planning - Dynamic programming models in integrated energy planning - Energy planning case studies - Development of energy management systems - Decision support systems for energy planning and energy policy simulation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. J. Goldemberg, T.B. Johansson, A.K.N. Reddy and R.H. Williams: Energy for a Sustainable World, Wiley Eastern, 1990

2. IEEE Bronze Book: Energy Auditing, IEEE Publications, 1996

3. P. Chandra: Financial Management Theory and Practice, Tata McGraw Hill, 1992
4. Annual Energy Planning Reports of CMIE, Govt. of India
5. A.K.N. Reddy and A.S. Bhalla: The Technological Transformation of Rural Inda, UN Publications, 1997
6. A.K.N. Reddy, R.H. Williams and J.B. Johanson: Energy After Rio-Prospects and Challenges, UN Publications, 1997
7. P. Meier and M. Munasinghe: Energy Policy Analysis & Modeling, Cambridge University Press, 1993
8. R.S. Pindyck and D.L. Rubinfeld: Economic Models and Energy Forecasts, 4e, McGraw Hill, 1998

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_hs68/preview
https://onlinecourses.nptel.ac.in/noc21_mg94/preview
https://onlinecourses.nptel.ac.in/noc21_de07/preview
https://nptel.ac.in/courses/124106157
https://onlinecourses.nptel.ac.in/noc22_hs126/preview

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

Alternative Fuels For Transportation			
Course Code	MESE204	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

This course helps satisfy the following objectives:

1. Develop professional fundamentals
2. Understand energy infrastructure
3. Comprehend traditional, alternative, and sustainable energy production technologies. Work with alternative fuels.
4. Prepare for an alternative fuelled economy.
5. Assess societal, economic, environmental, ethical, and legal impacts of alternative fuel systems.

Module-1

An introduction to hydrocarbon fuels - their availability and effect on Environment. Gasoline and Diesel self ignition characteristics of the fuel, octane number, cetane number.

Module-2

Alternative fuels - Liquid and Gaseous Fuels. Physico-chemical characteristics. Alternative Liquid Fuels. Alcohol fuels - Ethanol & Methanol. Fuel composition, Fuel Induction techniques, fumigation, emission of oxygenates, applications to engines and automotive conversions.

Module-3

Biodiesel formulation techniques, trans esterification, application in diesel engines. CME (Dimethyl ether), properties Fuel injection consideration

Module-4

General introduction to LPG and LNG. Compressed Natural Gas components, mixtures and kits, fuel supply system and emission studies and control. Hydrogen combustion characteristics, flashback control techniques, safety aspects and system development, NOx emission control.

Module-5

Biogas, Producer gas and their characteristics, System development for engine application.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Alternative Fuels for Transportation (Mechanical and Aerospace Engineering Series) Hardcover – 13 October 2010 by Arumugam S. Ramadhas CRC Press; 1st edition (13 October 2010)
2. Alternative Fuels for Transportation Edited By A S Ramadhas, ISBN 9781439819579, Published November 16, 2010 by CRC Press, 463 Pages 187 B/W Illustrations

3. Alternative Fuels for Transportation, https://library.oapen.org/handle/20.500.12657/41650, Publisher Taylor & Francis Publisher website, https://taylorandfrancis.com/, Publication date and place 2011,Imprint,CRC Press
4. Alternative Transportation Fuels A.S. Ramadhas, CRC Press; April 2016, ISBN: 9781439819586, Edition: 1, CRC Press

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108105058
https://library.oapen.org/bitstream/20.500.12657/41650/1/9781439819586.pdf
https://nptel.ac.in/courses/103102022

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II----Professional Electives-1

ENERGY CONSERVATION BY WASTE HEAT RECOVERY			
Course Code	MESE215A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Waste heat recovery is so important because by reducing the amount of fuel used to produce heat in a boiler installation, heating efficiency increases, resulting in lower fuel use. This serves both the requirement to increase efficiency and reduce carbon emissions.

Module-1

Introduction: heat losses, its quality and quantity, potential for energy conservation. Waste heat sources: steam, compressed air, refrigeration, flue gases, furnace/air stream exhaust, high grade heat, low grade heat.

Module-2

Optimal utilization of fossil fuels, Total energy approach; Coupled cycles and combined plants; Cogeneration systems. Exergy analysis; Utilization of industrial waste heat; Properties of exhaust gas; Gas-to- gas, gas-to-liquid heat recovery systems;

Module-3

Recuperators and regenerators; Shell and tube heat exchangers; Spiral tube and plate heat exchangers Waste heat boilers: various types and design aspects. Heat pipes: theory and applications in waste heat recovery.

Module-4

Prime movers: sources and uses of waste heat; Fluidized bed heat recovery systems; Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems; Thermoelectric system to recover waste heat; Heat pump for energy recovery; Heat recovery from incineration plants .

Module-5

Waste Heat Recovery calculations: Quantifying available heat (kWh), Pinch analysis, typical energy costs/construction costs, pay back analysis, Thermo- economic viability.

Need for energy storage: Thermal, electrical, magnetic and chemical storage systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. Hewitt, G. F., Shires, G. L., and Bott, T. R. (1993); Process Heat Transfer, CRC Press, Florida.
2. Li K. W. and Priddy A. P. (1985); Power Plant System Design, John Wiley
3. Goswami, D. Y., and Kreith, F. (2007); Energy Conversion, CRC Press.
4. Harlock J. H. (1987); Combined Heat and Power, Pergaman Press
5. Kreith F. and West R. E. (1999); Handbook of Energy Efficiency, CRC Press
6. Kays W. M. and London A. L. (1984); Compact Heat Exchangers, Third Edition, McGraw-Hill
7. Jensen J. (1980); Energy Storage, Newnes - Butterworths.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_mm20/preview
https://nptel.ac.in/courses/112105221
https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-mm23/

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

COGENERATION AND ENERGY EFFICIENCY			
Course Code	MESE215B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Course Learning objectives: Primary objective of the course is to introduce students the basis of the Energy 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/ M.Tech students in thermal engineering and energy studies. The students need to have basic background of thermal science and thermodynamics. Students other than thermal science background should consult the instructors before registering this course.

Module-1

Introduction The concept of cogeneration, main design parameters for cogeneration, cogeneration Alternatives, bottoming and topping cycles, Cogeneration potentials.

Module-2

Steam turbine plants, Gas turbine plant, Diesel and gas engine plants, Thermodynamic evaluation, combined cycle applications, Sterling engine.

Module-3

Industrial Cogeneration Industry / utility cogeneration, Tri generation, Techno economic and Environ-mental aspects.

Module-4

Economic & Environmental Aspects Environmental evaluation, cost allocation methods.

Module-5

Sizing & operating cogeneration systems, Case Studies Cogeneration in sugar, textile, paper and steel industry.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course**.**

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions)
4. from each module.
5. Each full question will have a sub-question covering all the topics under a module.
6. The students will have to answer five full questions, selecting one full question from each moduleunder a module.

Suggested Learning Resources:

Energy Cogeneration Hand Book for Central Plant Design by George Polimeros.

1. Power Plant Technology by M.M.EI- Wakil

Web links and Video Lectures (e-Resources):

http://knowledgeplatform.in/wp-content/uploads/2017/03/2.7-Cogeneration-.pdf.
https://freevideolectures.com/course/4166/nptel-steam-power-engineering/11
https://alison.com/course/sustainable-architecture-energy-efficiency-andquality?utm_source=google&utm_medium=cpc&utm_campaign.

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

Semester- II

AIR AND NOISE POLLUTION: EFFECTS AND CONTROL TECHNOLOGIES			
Course Code	MESE215C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Course Learning objectives: Demonstrate the concept of participates, air pollutants, natural and artificial methods of ventilation; the concept of noise pollution ELO3 CLO2 Calculate the units for participates and air pollution treatment G2 CLO3 Analyse the effect of air pollution, noise pollution

Module-1

Noise Pollution and Control

The Decibel Scale, Sound Intensity Level. Classification of Noise, Noise Standards. Effects of Noise, Noise Control Methods, Acoustical Materials, Acoustical Enclosures, Silencers and Muffle Reverberation Control, Personal Hearing Protection Devices, Role of Vegetation in Noise Control.

Module-2

Air Pollution & Control: Definition, Air Quality, Classification of Air Pollutants, Air Pollution Episodes.

Module-3

Air Pollution Monitoring

Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Measurement of SOx, NOx, CO, Oxidants and Ozone.

Module-4

Meteorology & Dispersion of pollutants:

Wind Circulation, Lapse Rate, Stability Conditions, Maximum Mixing Depths. Air pollution control technologies for particulates and gaseous contaminants. Gravity settlers, Electrostatic precipitators, bag Filters Scrubbers Cyclone, control for moving sources.

Module-5

Global Concerns, Light Pollution and Thermal Pollution.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. Understanding Environmental Pollution Marquita K.
2. Environmental Pollution And Its Control, COGENT International, 1st edition 1998 S.A.Abbasi
3. Environmental Noise Pollution And Its Control, Anmol Publication 1st edition 1992 Chhatwal G.R.et al
4. Environmental Pollution And Its Control Jeffrey J. and P.A. Vesilind
5. Air Pollution: M. N. Rao & HVN Rao, TATA McGraw Hill Publication, New Delhi, 12th edition, 1998
6. Chemistry for Environmental Engineering Clair N. Sawyer & McCarty, TATA McGraw Hill International Publication IIIrd Edition.1986
7. Environmental Engineering - Howard S.Peavy et.al, TATA McGraw Hill International Publication 1st Edition. 1986.
8. T K Ray, Air Pollution Control in Industries , Vol-1,2
9. J.N.B, Air Pollution and Plant Life.
10. Robert Jennings Heinson, Air Pollution.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc22_ce22/preview
https://nptel.ac.in/courses/105102089
https://nptel.ac.in/courses/103107084
https://nptel.ac.in/courses/105107213

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

Semester- II

ENGINEERING THERMODYNAMICS, HEAT TRANSFER AND PROCESS INTEGRATION			
Course Code	MESE215D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

To improve the efficiency of a process for the transformation between energy and work. To study energy conversion in different forms. To study the entropy of a system.

Estate definition of system, surrounding, closed and open system, extensive and intensive properties.

Calculate absolute and gage pressure, and absolute temperature. calculate changes in kinetic, potential, enthalpy and internal energy.

Module-1

Basic Heat Transfer Concept and Terminology:

Basic Concepts Terminology, Heat Transfer Coefficients, Thermal Resistance, Overall Heat Transfer Coefficient. Conduction: Conduction Equation, Steady State Conduction in simple geometries, Thermal; Contact Resistance Critical Thickness of Insulation, Multidimensional Steady State Heat Conduction (Shaper Factor), Types of Fins, Effectiveness and Efficiencies of Fins Area Weighted Fine Efficiency, Transient Heat Conduction ,Lumped Heat Capacity Analysis, Heiler's Charts for Semi-Infinite Medium, Slab Cylinder and Sphere, Periodic Heat Conductions.

Module-2

Convection: Similarity Principle, Mass moments and Energy Balance equations, Evaluation of Dimensionless Parameters, Forced Flow Convection (Laminar, Turbulent &Mixed) Thermal and Velocity Boundary Layer Thickness Convective Heat Transfer Coefficient ,Drag Coefficient for Flat Plate, Inside tube , Cylinder, Sphere and banks of tubes, Free convection (Laminar, Turbulent &Mixed) on horizontal Verticals and Inclined Plates, Inclined Parallel Plates, Horizontal, Verticals, Cylinder and

Module-3

Radiation: Blackbody Radiation, View Factor Algebra, Enclosures with Black Surfaces and Grey Surfaces, Radiosity, Heat Exchangers and its Types, Effectiveness, LMTD and NTU Methods.

Module-4

Pinch Technology and Process Integration

Principle of pinch Technology , Stream Network, Design of Energy Recovery System, Selection of Pinch Temperature Difference: Graphical and Tabular Methods, Stream Splitting, Process Retrofit Application, Installation of heat pump and engines, Grand Composite Curves.

Module-5

Engineering Thermodynamics: Quantity and Quality Aspects, Properties of Pure Substances: Ideal gas, Equation of State and corresponding state correlations for PVT Systems, Fundamental Concepts and basic Principles. **The First Law of Thermodynamics:** Fundamentals, Closed Systems, first Low Analysis of Control Volumes, Steady Flow Process, Steady Flow Engineering Devices, Reversible Work, Irreversibility energy, Exergy

Second Law Efficiency of Thermodynamics: Fundamentals, Carnot Cycle, Availability Analysis of Closed Systems, Analysis of Steady Flow Systems, and Analysis of unsteady Flow Systems. Sterling Engine: Principle, working and efficiency.

Thermodynamics of Flow Process: Nozzle, Throttling of Gases and Vapours, Mixing of gases, Compressors.

Chemical Thermodynamics: Chemical Reactions, Chemical and Phase Equilibrium, Thermodynamics Analysis of Process

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. M.N. Oziesik, Heat Transfer - A Basic Approach, McGrew Hill Book Co., New Delhi.
2. M. Becter, Heat Transfer: A Modem Approach
3. S.P. Shukatme, Heat Transfer, Orient Longman, New Delhi.
4. W.H. Giedt, Principles of Engineering Heat Transfer, D.Van Norstand Company Inc.(1961)
5. F. Kireth, Radiation Heat Transfer, International Text book Co., Semton, USA (1962).

- Process Integration, Chapter of Energy Efficiency, By Eastop. Bejan Adrian – Heat Transfer
- Y. Bayazitoglu – Element of Heat Transfer Karlekar – Heat Transfer J.P. Holman – Heat Transfer
- Robin Smith -- Chemical Process (Design and Integration)

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/103107094
https://archive.nptel.ac.in/content/syllabus_pdf/103107094.pdf
https://www.digimat.in/nptel/courses/video/103101137/L42.html
https://www.digimat.in/nptel/courses/video/103103144/L12.html
https://www.digimat.in/nptel/courses/video/103107093/L01.html

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II----Professional Electives-2

INSTRUMENTATION AND CONTROL IN ENERGY SYSTEMS			
Course Code	MESE216A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

The basic objective of Instrumentation and control is to operate the thermal power station efficiently. Economically, safely, reliably, continuously, and qualitatively. The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices, that are in use to measure the important physical variables of various mechatronic systems.

Module-1

Overview of Instruments and Measurement Systems Principles of measurements and Measurement errors, Classification of instruments, static and dynamic characteristics, Input Output configurations of measurement system.

Module-2

Types, characteristics and applications of Mechanical transducers, Types, characteristics and applications of electrical transducers, Principles of Modern sensors and typical applications. instruments for measuring temperature, pressure, velocity and flow, heat flux, liquid level and concentration in energy systems, characterization of combustors, flue gas analyzer, exhaust gas.

Module-3

Solar energy measurement requirements and instruments, meteorological data measurements, energy auditing instruments, energy audit kit, humidity measurements, Introduction to Control Systems: Overview of control systems, types and components, Feedback and non-feedback systems and their applications.

Module-4

Transfer function, block diagram, Representation and reduction techniques, Signal conditioning: Operational amplifier types and characteristics, Application circuits- inverter, adder, subs tractor, multiplier and divider, Analog /digital/analog conversion techniques.

Module-5

Microcontrollers and compilers: Overview of microprocessor and microcontroller, Microcontroller Types and architecture, Use of compilers for data acquisition, processing and display, typical microcontroller Applications for monitoring and control of electrical and non–electrical parameters/processes.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub questions) from each module.

Suggested Learning Resources: Books

1. Morris A. S. (1998); Principles of Measurements and Instrumentation, Prentice Hall of India
2. Sawhney A. K. (2011); A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai
3. Bentley J. P. (2005); PrinciplesofMeasurement Systems, Fourth Edition, Pearson Prentice Hall
4. Jain R. P. (1998); Modern Digital Electronics, McGraw Hill.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108105064
https://nptel.ac.in/courses/108105063
https://nptel.ac.in/courses/108105088
https://onlinecourses.nptel.ac.in/noc22_me59/preview
https://onlinecourses.nptel.ac.in/noc22_de09/preview

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

SOLAR REFRIGERATION AND AIR CONDITIONING			
Course Code	MESE216B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Course Learning objectives: To understand the concept of refrigeration
To acquire knowledge of methods of refrigeration
To acquire knowledge of Air refrigeration system
To acquire knowledge of vapour compression and vapour absorption refrigeration system.
To acquire knowledge of refrigerants

Module-1

Introduction Basics of refrigeration and air conditioning, comfort zones, potential and scope of solar cooling and heating, fundamentals of conventional vapor compression system and vapour absorption system. Solar cooling technology: solar electrical cooling, solar thermal cooling:- open cycles (liquid and solid desiccant system), closed cycle (absorption cycle, adsorption cycle, solar radiation cooling), thermo mechanical systems, steam ejector cycle, solar combined power/cooling.

Module-2

Desiccant Air Conditioning Desiccant materials, classification of desiccant material, fundamentals of desiccant material: adsorption process, regeneration process, adsorption rate, regeneration rate, factor affecting adsorption and regeneration of desiccant material, heating/humidification, cooling/dehumidification, and desiccant dehumidifiers: desiccant bed, desiccant wheel, desiccant coated heat exchanger, solar powered desiccant air conditioning system.

Module-3

Adsorption Refrigeration System Introduction, principle of adsorption, thermodynamics of adsorption cycles: - basic adsorption cycle, heat recovery adsorption refrigeration cycle, mass recovery adsorption refrigeration cycle, thermal wave cycle, convective thermal wave cycle, intermittent adsorption systems: silica-gel/water and silica-gel methanol systems, zeolite–water systems, activated carbon– methanol systems, activated carbon–ammonia systems.

Module-4

Absorption Refrigeration System Absorption cycle of operation, maximum, COP, properties of solution, aqua-ammonia solution, simple absorption system, h-x diagram, ammonia enrichment process and water -lithium bromide refrigeration system, single-effect solar absorption cycle, half-effect solar absorption cooling system, double-effect solar-assisted absorption cooling systems, diffusion absorption solar cooling system, hybrid solar absorption cooling systems.

Module-5

Solar Air-conditioning and Economics Refrigerant storage for solar absorption cooling systems. Solar thermoelectric refrigeration and air conditioning. Economics of solar cooling.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. Morris A. S. (1998); Principles of Measurements and Instrumentation, Prentice Hall of India
2. Sawhney A. K. (2011); A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai
3. Bentley J. P. (2005); Principles of Measurement Systems, Fourth Edition, Pearson Prentice Hall
4. Jain R. P. (1998); Modern Digital Electronics, McGraw Hill.

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https://nptel.ac.in/courses/108105063
https://nptel.ac.in/courses/108105088
https://onlinecourses.nptel.ac.in/noc22_me59/preview
https://onlinecourses.nptel.ac.in/noc22_de09/preview

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

ENERGY MODELING & PROJECT MANAGEMENT			
Course Code	MESE216C	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Course Learning objectives: Students will understand: The different types of energy models and their applications; How energy modeling can help optimize facilities and enhance the performance of facilities; The advantages and disadvantages for some of the popular energy modeling tools in use today; and How energy models have been used to optimize facility performance. Assumes responsibility as a professional practitioner of project management, applying PM principles and practices while maintaining high standards of practice, making ethical judgments and decisions in a respectful, and sustaining professional standing through a commitment to life-long learning

Module-1

Introduction:

Role of modeling and project management in energy project

Module-2

Energy Markets: Monopoly, oligopoly and competitive markets, behavior of markets with price change of energy, balance payment problems.

Basic Pricing: Basic Pricing Principles, Growing Demands and Dynamic effects, Short Run versus Long Run Marginal Cost Pricing, Peak load and seasonal pricing, Pricing of Non-renewable energy resources. Subsidized Prices and life line rates.

Module-3

Energy Planning: Planning and Role of Demand Management, Integrated National Energy Plan, Supply and Demand analysis, Energy action planning, Energy Balance, Perfect competitive economy, economic second best considerations, life line rates for poor consumers, Decentralized Energy Planning, Energy Modeling, Date Analysis & Demand management, LP models, Case studies, Force Field Analysis, Energy Policy Purpose, Perspective, Contents, Formulations and Ratification.

Module-4

General Management: Organizing, Location of Energy Management, Top Management Support, Managerial Functions, Roles and Responsibilities of Energy Manager, Accountability, Motivating – Motivation of Employees.

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs, and Case Studies. Concept and purpose of projects management, functions of project manager, project feasibility analysis, project appraisal criteria, monitoring and control of a project,

Module-5

Project Management: Definition and scope of project, Technical Design, Financing, Contracting, Implementation and Performance Monitoring, Implementation Plan for top management, Planning Budget, Procurement procedures, Construction, Measurement and Verification. Investment needs Appraisal and Criteria, Financial Methods of Projects evaluations, Case Studies. Network Analysis: PERT and CPM network

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

   to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. D. Deo, S. Modak and P. R. Shukla, Decentralized Energy Planning Oxford and IBH Publishing Co. Pvt.Ltd.,
2. B. Bukhootaeo et al. Energy, Planning and Policy

3. J.K. Parikh,Modeling Approach to long term de and Energy Implications.
4. Markdias, Forecasting Methodologies.
5. Koontz,O.Donnel and We@ich,Managewnt Kogakuj3ha.Tokyo.
6. R.D. Agrawal, Organization and Management, Tata McGrew Hill, New Delhi.
7. Newman and Warren, The Process of Management, Concepts, Behavior and Practice, Prentice Hall of India, Mm Delhi.

Web links and Video Lectures (e-Resources):

TERI Energy Data Year Books.
Manual on Industrial Energy Audit, Energy Management Centre
https://onlinecourses.nptel.ac.in/noc19_mg30/preview
https://nptel.ac.in/courses
https://onlinecourses.nptel.ac.in/noc22_mg71/preview
https://www.classcentral.com/institution/nptel

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

BIO AND SOLID WASTE MANAGEMENT			
Course Code	MESE216D	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

Upon successful completion of this course, students will be able to: Learn basic concepts of solid waste management, beginning from source generation to waste disposal in a system of municipality organizational structure.

Develop understanding on various technological applications for processing of waste and their disposals in various ways. Acquire knowledge on waste to energy productions in the perspectives of sustainable development.

Apply basic concepts in hazardous waste management and integrated waste management for urban areas.

To acquire a fair amount of knowledge on waste characterization and its management practiced in various cities of India.

To achieve this objective, students will be taught different case studies reported by previous researchers and technical bodies.

To protect the risk of spreading diseases.

To protect the health and well-being of health care workers and the community.

To protect against injury and potentially fatal infection.

To provide environment-friendly waste management solutions.

To promote the quality and sustainability of the environment.

Module-1

Biomass & Biomass management

Biomass availability, Characteristics of biomass or organic wastes, Energy Plantation, Waste Biomass/Organic utilization Technology options, Potential, Process and technologies, characteristics of Briquettes and their use.

Module-2

Biochemical Process

Aerobic and Anaerobic Bioconversion process, Biogas production process, Effect of feed and Operational parameters, Types of digesters and their suitability, Applications. Design criterion of some Bio-methanation Plants, optimum sizing of landfill digesters & gas storage systems.

Module-3

Thermo chemical Process

Biomass Gasification Process, Types of Gasifiers and their working, Feed and operational parameters on output gas production, properties of output gases (mainly producer gas), Design of a Gasifier.

Biomass Pyrolysis: Process of slow and fast Pyrolysis for solid and liquid fuel Production, Technologies, Applications.

Module-4

Bio-oils and Composting

Characteristics of Bio-diesel, Materials and Methods, and its applications, Alcoholic Fermentation Process, Technologies and its applications. Composting: Process Material and operational, Parameters, characteristics of manure, applications. Vermi-composting: Process, Types of Species, Materials and Methods, Characteristics of Manure, Applications.

Module-5

Characterization of Different Types of Solid Waste, Municipal Solid Waste, Agro Waste, Others.

Hazardous Waste: Characterization, Collection, Transportation, Treatment, Storage and Disposal.

Waste Management: Different Option, Integrated Waste Management Strategies, Collection, Transportation and Environmental Impact.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four subquestions)

from each module.
4. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources: Books

1. Biomass – Thermo-chemical Characteristics Edited by PVR Iyer; T R Rao; P D Grover and N P Singh, Published by Biomass gasifier Action Research Centre, Dept of Chemical Engineering , IIT Delhi
2. Kaup and Goss (1984) "Small Scale Gas Producer Engine System" Published by Friedr, Vieweg & Sohn Braunschweig/ Wiesbaden.
3. ABETS, IISc, Bangalore (2003) "Biomass to Energy – The science and technology of the IISc Bioenergy systems" Published by Science & Technology of the Indian Institute of Science, Bangalore
4. Reed, T. B. and Das, A. (1988) "Hand book of biomass down draft gasifier engine systems". Published by Solar Energy Research Institute, U.S. Dept. of Energy K M Mital ,Biogas System - Principles & Applications Published by new Age international (p) Ltd, New delhi
5. Klaus von Mitzlaff, "Engines for biogas- theory, modification & economic operation" Published by friedr. Vieweg & Sohn Braunschweig/ Wiesbaden
6. Orion Polinsky "A Bio-fuels Handbook" Published by Oasis Publishing 2002.

Web links and Video Lectures (e-Resources):

https://swayam.gov.in/courses
https://nptel.ac.in/courses/105103205
https://onlinecourses.nptel.ac.in/noc22_ce82/preview
https://archive.nptel.ac.in/courses/105/103/105103205/
https://www.digimat.in/nptel/courses/video/105103205/L01.html

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Semester- II

Renewable Energy Laboratory			
Course Code	MESEL207	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	1:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	2	Exam Hours	03

Course Learning objectives:

The aim of Renewable Energy Laboratory is to ground the analytical subject material in a practical problem, meaning that the skills and knowledge students learn throughout the programme will be applied in real energy engineering work.

SL No	Experiments
1	Solar Radiation Data Monitoring and Analysis: Sunshine hour duration, Direct Solar Radiation, Global Solar Radiation, Diffuse Solar Radiation
2	Solar Photovoltaic: Current-voltage characteristics of Solar Cell, Efficiency Variation of solar cell, Performance variation of solar photo cell at different light intensities.
3	Determination of power produced by a solar photo voltaic system, Performance Evaluation of a Solar Photo voltaic lighting system and its components: inverter, charge controller and battery, Performance evaluation of a solar photovoltaic water pump.
4	Fuel Properties and analysis: Proximate and ultimate analysis, Calorific value of solid fuels, Density, Viscosity, Flash-point, Fire-point Pour-point, Distillation of liquid fuels.
5	Fuel properties determination: Cloud and pour (melt) point, Viscosity, Calorific value, Sulfur percentage, Flash point, relative density of fuel, Iodine value of bio-fuel, Ash percentage of fuel.
6	Solar thermal measurements and analysis: Experimental study of thermal performance of Solar water heater, Evacuated tube solar collector, Solar still.
7	Thermal performance of solar drying system, Thermal testing of a box type Solar Cooker, Concentrator type and community solar cookers, Designing and testing of Innovative solar thermal systems.
8	Introduction to Engineering Equation Solver software.
	Demonstration Experiments (For CIE) Study Experiments on Energy Systems from the Following List:
9	Heat Exchanger , Refrigeration Systems and heat pumps
10	Air-conditioning Coils , Heat pipes
11	Wind Energy System
12	Fluidized Bed System , Waste Heat Recovery Systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for theevaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will beevaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of thesemester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carrya weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks. SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University. All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

Suggested Learning Resources:

Books

1. Twidell & AW. Wier, Renewable energy resources, English Language book, Society I E & FN Spon (1986).
2. Grey & O.K. Ganhus, Tidal power, Plenum Press, New York (1972).
3. Goswami. Alternative energy in agriculture, Vol. II CRC Press Inc. Florida, 1986.
4. E.R. Berman, Geothermal Energy; 'Noyes DATA Corporation, New Jersey, 1975.
5. D.A Stafford. & D.L. Hawkee & R Horton, CRC Press Inc., Florida.
6. N.K. Bansal., M. Kleeman & M. Mielee, Renewable conversion technology, Tata McGrawHill, New Delhi.
7. S.S.L. Chang, energy Conversion, Prentice Hall Inc., 1963
8. V.D., Hunt, Wind power: A handbook on Wind energy Conversion systems. Van Nostrand Reinhold Company, 1981.
9. D.A. Stafford, D.A, Hawkees, D.L. & R. Hoston, Methane production from waste organic matter, CRC Press, Boca Raton, 1980

Web links and Video Lectures (e-Resources):

1. TERI Energy Data Year Books.
2. Planning commission statistics
3. www.bp.com/centres/energy
4. www.eia.doe.gov
5. www.epa.org
6. Bureau of Energy Efficiency- Volume 1

Skill Development Activities Suggested

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Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		