GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Civil Engineering

Program: M. Tech Energy & Environmental Engineering

Scheme: 2018 – 2020

Date of BoS:

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	CENG5001	Professional and Communication Skills	0	0	4	2	**50**	**-**	**50**
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	**20**	**50**	**100**
3	MENE5001	Renewable Energy Technology	3	0	0	3	**20**	**50**	**100**
4	MENE5002	Physic-chemical, Biological Principles and Processes	4	0	0	4	**20**	**50**	**100**
5	MENE5003	Environmental Quality Monitoring	2	0	0	2	**20**	**50**	**100**
6	MENE5004	Energy Auditing, Conservation & Management	3	0	0	3	**20**	**50**	**100**
7	MENE5005	Renewable Energy Technology Lab	0	0	2	1	**50**	**-**	**50**
8	MENE5006	Environmental Quality Monitoring Lab	0	0	4	2	**50**	**-**	**50**
		Total	**15**	**1**	**10**	**20**			

Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	MENE6001	Energy, Instrumentation, Measurement & Control	3	0	0	3	20	50	100
2	MENE6002	Environmental Audit & Impact Assessment	3	0	0	3	20	50	100
3	MENE6003	Design of Water & Wastewater Treatment Systems	3	0	0	3	20	50	100
4	MENE6004	Air Pollution & Its Control	3	0	0	3	20	50	100
5	MENE6019	Elective-I (Energy Environment Climate Change)	3	0	0	3	20	50	100
6	MENE6039	Elective-II (Risk Assessment and Disaster Management)	3	0	0	3	20	50	100
7	MENE6005	Seminar	0	0	0	1	50	-	50
8	MENE6006	Energy, Instrumentation, Measurement & Control Lab	0	0	2	1	50	-	50
		Total	**18**	**0**	**2**	**20**			

Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MENE7001	Comprehensive Examination	0	0	0	2	50		50
2	MENE7002	Project (Phase I)	0	0	0	5	50		50
3	MENE6029	Energy Efficient Buildings (Elective-III)	3	0	0	3	20	50	100
4	MENE6032	Solid Waste Management (Elective-IV)	3	0	0	3	20	50	100
5	MENE6037	Remote Sensing & GIS Applications (Elective-V)	3	0	0	3	50	50	50
		Total	**9**	**0**	**0**	**16**			

Semester IV									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MENE8001	Project (Phase II	0	0	0	15	**50**	**-**	**50**
		Total	**0**	**0**	**0**	**15**			

List of Electives

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**CAT I/II**	**ETE**
1	MENE6013	Solar Energy Technology	3	0	0	3	20	50	100
2	MENE6015	Hydrogen & Fuel Cells	3	0	0	3	20	50	100
3	MENE6019	Energy Environment Climate Change	3	0	0	3	20	50	100
4	MENE6027	Bioenergy Technologies	3	0	0	3	20	50	100
5	MENE6029	Energy Efficient Building	3	0	0	3	20	50	100
6	MENE6032	Solid Waste Management	3	0	0	3	20	50	100
7	MENE6034	Design of Wastewater Treatment & Disposal System	3	0	0	3	20	50	100
8	MENE6035	Urban Environmental Quality Management	3	0	0	3	20	50	100
9	MENE6037	Remote Sensing & GIS Applications	3	0	0	3	20	50	100
10	MENE6038	Application of Bio-technology in Environmental Engineering	3	0	0	3	20	50	100
11	MENE6039	Risk Assessment and Disaster Management	3	0	0	3	20	50	100
12	MENE6040	Mathematical Modeling in Environmental Engg.	3	0	0	3	20	50	100
13	MENE6041	Clean Development Mechanism & Green Technologies	3	0	0	3	20	50	100
14	MENE6042	Environmental Ecology	3	0	0	3	20	50	100
15	MENE6046	Environmental Economics, Legislation and Management	3	0	0	3	20	50	100

Detailed Syllabus

Name of The Course	Professional and Communication Skills			
Course Code	CENG 5001			
Prerequisite				
Corequisite				
Antirequisite				
L	**T**	**P**	**C**	
0	0	4	2	

Course Objective:

1. To develop the professional and communicational skills of learners in a technical environment.
2. To enable students acquire functional and technical writing skills.
3. To enable students acquire presentation skills to technical and non-technical audience.

Course Outcomes:

CO1	Improve their reading fluency skills through extensive reading
CO2	Use and assess information from academic sources, distinguishing between main ideas and details
CO3	Compare and use a range official support through formal and informal writings
CO4	The students will be able to exhibit language proficiency in comprehending, describing, and investigating.

Text Books

1. Rajendra Pal and J.S.Korlahalli. Essentials of Business Communication. Sultan Chand & Sons. New Delhi.

Reference Books

1. Kaul. Asha. Effective Business Communication.PHI Learning Pvt. Ltd. New Delhi.2011.
2. Murphy, Essential English Grammar, CUP.
3. J S Nesfield, English Grammar: Composition and Usage
4. Muralikrishna and S. Mishra, Communication Skills for Engineers.

Course Content:

UNIT 1:
Aspects of Communication; Sounds of syllables; Past tense and plural endings; Organizational techniques in Technical Writing; Paragraph Writing, Note taking, Techniques of presentation
UNIT 2:
Tense, Voice, conditionals, Techno-words; Basic concepts of pronunciation; word stress; Business letters, email, Techniques for Power Point Presentations; Dos and don'ts of Group Discussion
UNIT 3:
An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50		**50**	**100**

Name of The Course	Advanced Numerical and Statistical Methods			
Course Code	MATH5001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objective:

With ever growing demand of computational techniques, scope of numerical methods is penetrating aggressively into major and important fields including Science, Engineering &Technology, Medical, Space Science, Economics, Business and Environment. The objective is to achieve knowledge and understanding of numerical methods and to apply appropriate methods to model and solve problems where ordinary analytical methods fail. Statistical methods are used in manufacturing, development of food product, computer software, energy sources, pharmaceuticals and many other areas. The objective of statistics and probability is to analyze data to make scientific judgments in the face of uncertainty and variation for the improvement of the desired quality.

Course Outcomes:
At the end of the course, students will be able to:

CO1	Apply various numerical methods to solve system of linear and non-linear equations.
CO2	Apply standard interpolation methods to interpolate required/ missing value.
CO3	Apply appropriate methods of numerical differentiation /integration to solve related problems.
CO4	Solve ordinary differential equations and partial differential equations using appropriate numerical methods.
CO5	Identify the type of distributions and apply a suitable test to draw the conclusion.

Text Books:

1. Numerical Methods for Scientific and Engineering Computation (6^{th} edition) by Jain, Iyengar & Jain, New Age International publishers.
2. Probability & Statistics for Engineers & Scientists (9^{th} edition) by R.E.Walpole, R,H,Myers & K.Ye.

Reference Books:

1. Numerical Methods by E Balagurusamy, Tata McGraw Hill
2. Curtis F. Gerald and Patrick O Wheatley, Applied Numerical Analysis, Pearson Education Ltd.
3. Introductory Methods of Numerical Analysis by S.S. Sastry, PHI learning Pvt Ltd.
4. Numerical methods for Engineers (6^{th} edition), Steven C. Chapra and Raymond P. Caynale.
5. Numerical Methods in Engineering & Science (9^{th} edition), by B.S.Grewal
6. Statistical Methods by S.P. Gupta, Sultan Chand and Sons
7. Probability and Statistics by Schaum's series (3^{rd} edition)

Course Content:

Unit –I

System of Linear Equations: Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss- Seidel and Jacobi method, ill conditioned matrix System of Non-linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods

Unit -II

Interpolation and Approximation: Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.

Unit -III

Numerical Integration: Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills

Unit -IV

Numerical Solution of Differential Equations: Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor-Corrector method, Solution of Laplace's and Poisson's equations by Liebman's method, Solution of one dimensional time dependent heat flow.

Unit -V

Probability and statistics: Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Renewable Energy Technology				
Course Code	MENE5001				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. Fundamental knowledge to the student about renewable and non-renewable energy.
2. Brief idea to students about types of energy and conversion technologies, processes, systems and devices.
3. Plasticize students to work with instruments
4. Encourage students to take up projects in those areas.
5. Implementation of renewable energy in project and development.

Course Outcomes

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

CO1	Explain the basic principles of various renewable energy conversion processes and devices used therein.
CO2	Understand the relationships between natural resources, consumption, population, economics of consumerism, etc in an environmental context.
CO3	Identify various parameters that influence the performance of devices/processes.
CO4	An understanding the problems of energy distribution, design, plan and execute.
CO5	To make a thought in terms of scientific and technological advancement in the spirit of a sustainable energy.

Course Content

Unit I: Introduction to energy and resources **9 Hours** Introduction to energy and resources – Renewable energy sources - Availability of solar energy – Sun-earth relationships - Estimation of solar radiation using Page-Angstrom method - Solar radiation measurement – Flat plate collectors – Solar water heating systems – Evacuated Tubular Concentrators - Solar air heating systems and applications – Concepts on solar drying, cooking, desalination, solar ponds and solar cooling - Passive heating and cooling of buildings – Basics of solar concentrators and types - Solar thermal power generation.
Unit II: Solar Cells **10 Hours** Physics of solar cells – Cell types and manufacture – PV applications - Characteristics of cells and module – Performance parameters - Estimation of module power output – PV system configurations – System components: Battery, charge controller and inverter.
Unit III: Biomass **10 Hours** Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristics and application - Biomass combustion and power generation – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.
Unit IV: Wind Power **7 Hours** Power in the wind - Types of wind mills – WEG components - Airfoils: lift and drag – Power curves and energy estimation - Micro siting – Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components.
Unit V: Renewable Energy Technologies **9 Hours** Technologies for harnessing other renewable energy sources like geothermal, wave, tidal and ocean thermal energy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Physico-chemical, Biological Principles and Processes			
Course Code	MENE5002			
Prerequisite	Basic physics, chemistry and mathematics			
Corequisite				
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives

The objective of this course is to:

1. To study about the solid- liquid- gas interactions
2. To understand about process kinetics
3. To deal with the microbial applications in environmental engineering

Course Outcomes

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

CO1	Understand the mass transfer and transport of impurities in system
CO2	Apply the concepts of oxidation- reduction equilibrium
CO3	Study and applying practically about microbial kinetics

Text Books

1. Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA
2. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003

Reference Books

1. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
2. Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers.
4. Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill,

Course Content

Unit I: Structure and Properties of Water **8 Hours**

Structure and Properties of Water- their significance in environmental engineering, Sources of Water impurities, Abiotic reactions, Biological metabolism. Solid-Liquid-Gas interactions, Mass transfer and transport of impurities in water, diffusion, dispersion. Physical and Chemical interactions due to various forces, suspensions and dispersions.

Unit II: Chemical Reactions **8 Hours**

Chemical reactions, Chemical equilibrium and thermodynamics, Acid-baseequilibria, solubility equilibria, oxidation-reduction equilibria. Process kinetics, reaction rates and catalysis, surface and colloidal chemistry, Adsorption. Settling of particles in water stabilization.

Unit III: Eco Systems **8 Hours**

Ecosystems; biotic and abiotic components, biogeochemical cycles, ecology of population; Ecological niche, Mortality and survivorship, CommModuley Interactions. typical natural and artificial ecosystems
Unit IV : Biochemistry **8 Hours** Biochemistry; Biological compounds– enzymes, coenzymes and amino acids, Microbiological concepts; Cells, classification and characteristics of living organisms, Characterization techniques, Reproduction, Metabolism, Microbial growth kinetics.
Unit V: Applications of Microbiological principles to environmental engineering **8 Hours** Applications of Microbiological principles to environmental engineering; assimilation of wastes, engineered systems, Concepts and Principles of carbon oxidation, Nitrification, Denitrification, Methanogenasis, etc., Concepts of quantization of degradable pollutants.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Environmental Quality Monitoring				
Course Code	MENE5003				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To teach students about various water quality parameters and their effect
2. Explain brief procedure for collection and preservation of samples of water and wastewater
3. Give idea to students about different standard methodologies for sampling and analysis of environment at whole and its constituents like water, wastewater, air and soil
4. To teach advance analytical methods for environmental quality monitoring
5. Conduct small projects on water quality monitoring of polluted and waste water in field condition

Course Outcomes

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

CO1	Schedule field studies and other data acquisition activities to be considered for compliance
CO2	Use a tiered monitoring approach consisting of rapid assessment or screening studies at site
CO3	Supervise monitoring techniques of various environmental parameters
CO4	Generate monitoring data relevant to decision making process
CO5	Manage and report environmental quality data in a way that is meaningful and understandable to intended audience

Text Books

1. Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN:978-00-704-9539-5.Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, 2nd Edition, 2006
2. S.K.Garg (2010), Sewage Disposal and Air Pollution Engineering, Khanna Publishers, ISBN:978-81-740-9230-4
3. MN.Rao, H.V.N.Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.
2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9
4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8

Course Content

Unit I: General Sampling and Analytical Techniques 9 Hours

General principles for collection of representative sample, frequency of sampling, validation, interpretation and analysis of data, various statistical techniques, quality control, assessment and management.

Unit II: Methods for Physicochemical Analysis of Water/ Wastewater 10 Hours

Gravimetric methods for solids analysis in water and wastewater, determination of acidity, alkalinity and turbidity, analysis of common cations and anions in water/wastewater through various chemical techniques, determination of nitrogen, phosphorus and chemical oxygen demand (COD), acid-base titrations, precipitation titrations, complexometric titrations, oxidation-reduction titrations, working principles of electrodes, different types of electrodes.

Unit III: Biological Methods and Microbiology **10 Hours**

Biochemical oxygen demand (BOD), MPN test for microbial pollution, plate counts; confirmatory tests for various microbiological agents.

Unit IV: Air Pollution Measurements **7 Hours**

Sampling techniques for air pollution measurements; analysis of particulates and common chemical air pollutants, analysis of oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon and poly aromatic hydro carbons.

Unit V: Advanced Analytical Methods **9 Hours**

Working principles of Spectrophotometric methods; Nephelometric methods; Atomic absorption spectroscopy and its various analytical versions; Ion chromatography, High performance liquid chromatography, CHNO/S Analyzer, TOC analyzer and other advanced analytical instruments.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Energy Auditing Conservation and Management				
Course Code	MENE5004				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To teach the basic concepts of energy audit and management.
2. Give brief knowdge about mathematical calculation and modelling of energy performance
3. Teach students about data collection and analysis
4. The energy auditing procedures, techniques, policy planning, implementation and energy audit instrument
5. To give a broadly knowledge about planning and management for economical growth

Course Outcomes

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

CO1	Understand the general aspect of energy auditing and management
CO2	Development of knowledge about the energy auditing procedures, techniques, policy planning and implementation.
CO3	Understand about energy audit instrument.
CO4	Mathematical approach of data collection and analysis.
CO5	Design of energy modelling and optimization

Text Books

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Efficient Use of Energy : I.G.C.Dryden (Butterworth Scientific)
4. Energy Economics -A.V.Desai (Wieley Eastern)
5. Industrial Energy Conservation : D.A. Reay (Pergammon Press)

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.
2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O’Reilly, 2005.
3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9
4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8

Course Content

Unit I: General Aspects **9 Hours**

General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Audit: Need, Types, Methodology and Approach. Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

Unit II: Procedures and Techniques **10 Hours**

Data gathering : Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation.

Unit III: Energy Policy Planning and Implementation **10 Hours**

Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating – Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.

Unit IV: Energy Balance &MIS **7 Hours**

First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification of losses, Improvements. Energy Balance sheet and Management Information System (MIS) Energy Modeling and Optimization.

Unit V: Energy Audit Instruments **9 Hours**

Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Renewable Energy Technology Lab				
Course Code	MENE5005				
Prerequisite	Renewable Energy Technology				
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives

This subject is taught

1. To impart knowledge in the area of biomass to energy
2. Working principle knowledge of instruments
3. Brief knowledge about various renewable energy parameters
4. Knowledge about handling the instruments and how to operate in filed
5. The role of instruments in different engineering applications.

Course Outcomes

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

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measuring devices
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem solving
CO5	Technical approach of the instruments in field condition

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson , Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

COURSE CONTENT

1. Determination of proximate analysis (Moisture content, ash, Volatile matter & fixed carbon) for a Given Biomass Sample.
2. Determination of Total solids, volatile Solids and calorific value for a given organic Biomass Sample.
3. Determination of elemental analysis (chemical method) for a Given Biomass Sample.
4. Determination of C/N Ratio for a given organic Biomass Sample.
5. Determination of Chemical Oxygen Demand, BOD, Total dissolved solids (TDS) and pH for a Given Slurry or Liquid Sample.
6. Determination of Dissolved Oxygen & Biochemical in a Liquid Slurry Waste Sample.
7. Determination of Calorific Value of a solid and liquid Biomass Sample using Bomb calorimeter.
8. To study the Effect of Different Loading Rates, Total Volatile Solids and Hydraulic Retention time on Generation of Biogas in Batch Type Digesters.
9. Determination of Lignin, Cellulose, Hemicelluloses in a Given Biomass Sample.
10. Determination of Potassium, Sodium and Phosphorous in a Given Waste Slurry Sample.
11. Determination of Crude Protein in a Given Biomass Sample.

12. Study of Gasifier and its performance evaluation with solid and loose biomass.
13. Characterization of liquid biomass (Viscosity, density, flash/fire point, cloud point) and its comparison with diesel

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (EA)	Total Marks
50	**50**	**100**

Name of The Course	Environmental Quality Monitoring Lab				
Course Code	MENE5006				
Prerequisite	Environmental Quality Monitoring				
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	4	2

Course Objectives

This subject is taught

1. To impart knowledge in the area of sampling and statistical analysis
2. Working principle knowledge of instruments
3. Brief knowledge about various parameters
4. Knowledge about handling the instruments and how to operate in field
5. The role of instruments in different engineering applications.

Course Outcomes

At the end of the laboratory experiments, the student will be able to

CO1	Learn various instruments process and about their features
CO2	How to handle the instruments
CO3	Supervise monitoring techniques of various environmental parameters
CO4	Generate monitoring data and their application in various treatment process
CO5	Manage and report environmental quality data in a way that is meaningful and understandable to intended project

Text Books

1. Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN: 978-00-704-9539-5.
2. S.K.Garg (2010), Sewage Disposal &Air Pollution Engineering, Khanna Publishers, ISBN: 978-81-740-9230-4
3. MN.Rao, H.V.N.Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.
2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.
3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9
4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8
C.S.Rao (2006), Environmental Pollution Control Engineering, New Age International, ISBN:978-81-224-1835-4

List of Experiments

1. Estimation of pH
2. Determination of Total, suspended, dissolved volatile & fixed residue in a waste/water sample
3. Determination of Turbidity
4. Determination of the Carbonate, Bicarbonate, and Hydroxide Alkalinity
5. Determination of the type and Extend of Acidity
6. Estimation of the Optimum Dose of Coagulants for Coagulation
7. Estimation of the Hardness of water (EDTA Method)
8. Estimation of the Chloride Concentration.

9. Determination of the Dissolved Oxygen (DO) and percentage saturation
10. Determination of Biochemical Oxygen Demand (BOD) of wastewater
11. Determination of Chemical Oxygen Demand (COD) of wastewater

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	**50**	**100**

Name of The Course	Energy, Instrumentation, Measurement & Control			
Course Code	MENE6001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

This subject is taught

1. To impart knowledge in the area of numerical integration and Calculus
2. Working principle knowledge of energy meter
3. Brief knowledge about various flow parameters
4. Knowledge about handling the instruments and how to operate in filed
5. The role of instruments in different engineering applications.

Course Outcomes

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

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measuring devices
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem solving
CO5	Technical approach of the instruments in field condition

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

Course Content

Unit I: Electrical Energy Metering **9 Hours** Electrical energy meter, One –Phase energy meters, Three Phase Energy meters, working principle, various compensation, and Automatic meter reading systems.
Unit II: Thermal Energy Metering **10 Hours** Combustion analyser, Fuel efficiency monitor , Flue gas analyzer, Thermometers, Thermocouples & RTDs, Potentiometric & Paperless Recorders, I/P Converters, Temperature Transmitters, Optical Pyrometer, Digital indicators, PID Controllers, Loop Powered Indicators & Isolators, BTU meters, Thermistors, Heat Flux sensor.
Unit III: Air Flow Metering **10 Hours** Air flow meters: vane (flap) type air flow meters and “hot wire" and "hot film" air mass meters. Anemometer,

types and its classification, working principle.

Unit IV: Gas Flow Metering **7 Hours**

Types and its basic working principle, Odometer.

Unit V: Fluid Flow Metering **9 Hours**

Classification of fluid flow meters based on the operating principle- Differential Pressure Flowmeters, Velocity Flow meters, Positive Displacement Flowmeters, Mass Flowmeters, Open Channel Flowmeters, Types:-Orifices, Venturies, Nozzles, Rotameters, Pitot Tubes, Calorimetrics, Turbine, Vortex, Electromagnetic, Doppler, Ultrasonic, Thermal, Coriolis.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Environmental Audit & Impact Assessment				
Course Code	MENE6002				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The course is intended

1. To teach the basic concepts of environmental audit impact assessment and policy.
2. To provide a critical overview of the theory and practice of EIA as operated internationally to those students who need to understand EIA
3. Field visit and EIA study of different field cases
4. How to conduct project on sustainability of environment

Course Outcomes

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

CO1	Define EIA, different types of EIAs and benefits of EIA
CO2	Describe the role of EIA in sustainable development
CO3	Skill development for project planning process
CO4	Take a decision-making process in environmental clearance and public relation
C05	Make a plan for International environmental issues and sustainable development

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

Course Content

Unit I: General Aspects **9 Hours**

Definition of Environmental Audit (EA). Types of environmental audits. Policies and legislation relating to environmental audits. Conducting an audit. Audit reports. Relationship between an environmental audit and an EIA. The benefits of EA. Guidelines for EAs (General Principles, Criteria, evidence and findings, Reporting). EA objectives, roles and responsibility. EA as environmental management tool for small scale and large scale enterprises. EA and sustainable development. Responsibilities in conducting EAs.
The benefits of database in EAs. Future Direction of EA

Unit II: Environmental Impact Assessment-1 **10 Hours**

Economic development, population growth and impact on the environment. Introduction to Environmental Impact assessment. The history of Environmental Impact assessment (EIA). Purpose and aims of EIA. EIA administration and practice Converging opportunities (i.e. development and environmental protection are complimentary), environmental management and sustainable development.

EIA in project planning and management. The costs and benefits of EIA. Introduction to the key principles and elements of EIA, core values (sustainability, integrity, utility). EIA guiding principles (e.g. participation, transparency, flexibility, etc). Introduction to the main features of the EIA system. Role of public participation stages that follow EIA Understanding of the strengths and limitations of EIA.

Unit IV: Environmental Policy-1 **7 Hours**

Overview of the legislative and institutional characteristics essential for the support of a national EIA system. Factors that help to establish an effective national EIA system. Steps involved in establishing and modifying a national EIA system.

Unit V: Environmental policy-2 **9 Hours**

The level of public involvement in EIA and the relative advantages and disadvantages they offer. Techniques for communicating with the public. Consensus building and dispute resolution mechanisms. International environmental issues and sustainable development plans. International environmental laws and policies of relevance to EIA -Treaties, conventions etc.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Design of Water and Wastewater Treatment Systems			
Course Code	MENE6003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

Brief knowledge to the student about

1. various water treatment processes and their designing criteria
2. implementation of technologies in wastewater treatment in order to make water safe to drink
3. to teach various options available in treatment of waste water for recycle and safe disposal
4. design of bioreactors for degradation of nutrients
5. application of wastewater treatment in field by research projects

Course Outcomes

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

CO1	Understand various unit operations involved in water treatment and design various water treatment units required
CO2	Planning and siting of water treatment plant
CO3	Effect of wastes disposal to water
CO4	Design of physical units for waste treatment.
C05	Design of bioreactors for biodegradation of wastewater treatment

Text Books

1. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003
2. Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA
3. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
4. Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
5. Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers.
6. Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill

Reference Books

McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto

Course Content

Unit I: Definitions and Concepts **9 Hours** Water sources, Philosophy of water treatment, Review of water quality characteristics and potable water standards, Estimation of water quantity, Theory and design of Conventional Unit Operations used in Water Treatment: Screening, Sedimentation, Floatation, coagulation, flocculation, filtration, softening and disinfection processes.
Unit II: Theory and Design of Advanced Unit Operations used in Water Treatment

10 Hours

Membrane processes, Ion Exchange, Aeration/stripping, Precipitation, Adsorption, Oxidation-reduction and advanced oxidation processes; Water Treatment Plant Design; Selection of raw water source, Planning and siting of water treatment plant, Chemical requirement and residuals management.

Unit III: Philosophy of Wastewater Treatment **10 Hours**

Philosophy of wastewater Treatment, Review of Wastewater quality parameters and discharge standards for aquatic and land disposal, Estimation of wastewater quantity; Wastewater Collection; Design of sewers and sewerage systems

Unit IV: Wastewater Disposal **7 Hours**

Disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land. Wastewater treatment; Preliminary treatment, Bar-rack, Screens, Grit chamber, Equalization tank, Primary sedimentation

Unit V: Secondary treatments **9 Hours**

Aerobic processes, Anaerobic processes. Tertiary treatment, Nutrient removal, Residual management, Design; Planning and siting of Wastewater treatment plant, Chemical requirements and material balance.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Environmental Quality Monitoring				
Course Code	MENE6004				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The course is intended to teach

1. The basics concept of air pollution
2. Instruments of monitoring of air quality
3. Technology required controlling air pollution
4. Effect of air pollution on environment
5. How to apply study for clean air development

Course Outcomes

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

CO1	Brief knowledge and experience to identify the type the source of pollutant.
CO2	Monitoring of air quality by different instruments
CO3	Control of air pollution by using different ECS.
CO4	Field project on remediation of air quality
C05	Use of different methods for air quality improvement

Text Books

1. M.N.Rao& H V N Rao (2000), Air pollution, Tata McGraw Hill Publishing Ltd

Reference Books

1. Air Pollution Control Technology Handbook, Second Edition" by Karl B Schnelle Jr and Russell F Dunn

Course Content

Unit I: Air Pollution & its Classification **9 Hours** Definition, Air Quality, Classification of Air Pollutants.
Unit II: Effects of Air pollution **10 Hours** Effects of Air pollution on human, plant and animal, Air Pollution Episodes.
Unit III: Air Pollution Monitoring **10 Hours** Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Measurement of SO_2, Nox, CO, Oxidants and Ozone.
Unit IV: Meteorology & Dispersion of pollutants **7 Hours** Wind Circulation, Lapse Rate, Stability Conditions, Maximum Mixing Depths, Plume Rise and dispersion.
Unit V: Emission Control Systems **9 Hours** Air pollution control technologies for particulates and gaseous contaminants, Gravity settlers, Electrostatic precipitators, Bag Filters, Scrubbers, Cyclone, control for moving sources.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Energy, Environment and Climate Change				
Course Code	MENE6019				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To impart the knowledge of modern energy and climate change
2. Lays the foundation for energy conservation by analyzing various schemes, which is of prime importance in the modern energy crisis
3. To conduct energy audit and hence suggest means to improve energy management
4. To understand the importance of economic dispatch and unit commitment problem
5. This subject is taught to impart knowledge in environmental degradation due to the technical advancement.

Course Outcomes

Student will get the knowledge of:

CO1	Current emerging technologies and conduct energy audit and hence suggest means to improve energy management
CO2	India's stand in terms of various technologies
CO3	Environmental impacts due to energy production
CO4	Measures taken to control the global environmental changes
C05	Understand the importance of economic dispatch and unit commitment problem

Text Books

1. Adrian Bejan, Peter Vadasz, Detlev G. Kroger (1999), Kluwer Academic Publishers.
2.A K De (2001), Environmental Concerns, New Age Publications Pvt Ltd.

Reference Books

1. O.L. Elgard (1987), Electrical Energy System Theory – An Introduction, Tata McGraw-Hill Publication.
2. Robert H.MillerandJamesH.MalinOwaki(1987), PowerSystemOperation,3rdEdition,Tata McGraw-Hill.
3.P.S.R. Murthy(1994), Power System Operation and Control, Tata McGraw-Hill Publication

COURSE CONTENT

Unit I: Energy Sources **9 Hours**

Definition, Modules, Forms of Energy, Power, Origin of Fossil fuels, World and Indian Resources of Coal, Oil, Natural gas, Nuclear, Geothermal, Renewable Energy potential : Solar Energy, Wind Energy, Bio-Energy, Hydro, Tidal, Ocean , Nuclear Energy, Nuclear Fission and Fusion , Geothermal Energy.

Unit II: Energy Scenario **10 Hours**

Global Energy Scenario: Energy consumption pattern in various sectors, Impact on economy, India`s Energy Scenario, Urban and Rural energy consumption patterns, Impact of Energy on Development, Energy Infra structure in India

Unit III: Impact of Energy Projects on Environment **10 Hours**

Overview of global environmental problems, Environmental degradation due to Energy production and use, Pollution due to thermal power stations , Environmental aspects of Wind Energy Farms ,Environmental aspects of Nuclear power generation, Nuclear waste disposal, Impact of Hydro power generation on Ecology and Environment, Guidelines for Environmental impact assessment (EIA) of Energy Projects

Unit IV: Climate Change Concerns **7 Hours** Green House Gas Emissions, Depletion of Ozone layer, Global Warming, Climate Change Concerns, Climate Change in India, Kyoto protocol, Clean Development Mechanism [CDM], Carbon Fund Concept of Carbon credit
Unit V: Climate Change Policy Issues **9 Hours** Impact of Climate Change on Glaciers, Rivers and Water Resources, Climate Change Policy Issues in Himalayas, International Status of Climate Change Policies, Indian Action Plan on Climate Change

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Risk Assessment and Disaster Management				
Course Code	MENE6039				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

1. To provide knowledge related to the broad field of environmental risk assessment
2. Steps involved in the risk assessment process, including statistical characterization of observed data
3. Knowledge about tools that can be used in defining environmental risks, particularly as related to human health.
4. To develop practical skills in disaster mitigation, planning, response and post disaster rehabilitation, particularly related to health and public health.

Course Outcomes

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

CO1	To gain knowledge related to the broad field of environmental risk assessment
CO2	Statistical characterization of field data
CO3	Use of tools for environmental risks, particularly as related to human health
CO4	To apply biotechnological concept and tools for green production technologies
CO5	Gain knowledge on eco-sustainable waste management ensuring sustainable development

Text Books

1. Rao V. Kolluru,"Environmental Strategicshand book", Mc-graw Hill Inc., New York, 1994.

Reference Books

1. BrockNeely.W&BlanG.E,"EnvironmentalExposurefromchemicals,VolumeII,ChcPressIunc., Florida,1989.
2. WoodsenW.E.,"Humanfactorsdesignhandbook– informationandguidelinesfordesigntosystems, facilities, equipment and product for human use", McGraw Hill, New York, 1981.

Course Content

Unit I: Risk Assessment **9 Hours**

Introduction- Methodologies and Guidelines: Principles, Code of practice – Appointment of personnel and their responsibilities–Emergency plans: onsite and offsite. Steps in risk assessment: Identification of risk, Extent of risk and disaster, Risk-Based Decisions for Corrective Action –Timely updation. Developing a Site Conceptual Model -Focusing on Risk-Based Decisions in Corrective Action –Risk Assessment: Dose Response and Target Level Calculations-Experiences in Environmental Risk Assessment.

Unit II: Occupational Health and Safety **10 Hours**

Occupational risk analysis survey and health evaluation, behavioral studies, occupational injury, disease reporting, investigation: monitoring and control of environmental hazards. Occupationally induced illness, non-occupational illness, and discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease. Occupational health services.

Unit III:Methodologies and Management Techniques **10 Hours**

Risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment. Operations Management(OM),Risk Assessment and Disaster Response, Quantification Techniques, NGO Management, SWOT Analysis based on Design &Formulation Strategies, Insurance & Risk Management.

Unit IV: Disaster Management7 Hours

Introduction & Dimensions of Natural & Anthropogenic Disasters, Principles/Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes/SOPs, Natural Disasters and Mitigation Efforts, Flood Control, Drought Management, Cyclones, Avalanches, Mangroves, Land Use Planning, Inter-Linking of Rivers, Role of Union/States, Role of Armed Forces/Other Agencies in Disasters, Role of Financial Institutions in Mitigation Effort, Group Dynamics, Concept of Team Building, Motivation Theories and Applications, School Awareness and Safety Programs, Psychological and Social Dimensions in Disasters, Trauma and Stress, Emotional Intelligence, Electronic Warning Systems.

Unit V: Use of Information systems, Experiences and case studies 9 Hours

Recent Trends in Disaster Information Provider, GeoInformatics in Disaster Studies, Cyber Terrorism, Remote Sensing &GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology, Quick Reconstruction Technologies, Role of Media in Disasters, Management of Epidemics, Bio-Terrorism, Forecasting / Management of Casualties. Important Statutes/ Legal Provisions, IEDs/Bomb Threat Planning, NBC Threat and Safety Measures, Forest Fires.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Seminar**				
Course Code	**MENE6005**				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	**0**	**0**	**1**	

Course Objectives

To enable a comprehensive understanding of:

1. To prepare students to compete for a successful career in Energy & Environmental Engineering profession through global education standards.
2.To enable the students to aptly apply their acquired knowledge in basic sciences and mathematics in solving Energy & Environmental Engineering problems.
3.To produce skillful graduates to analyze, design and develop a system/component/ process for the required needs under the realistic constraints.
4.To train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts
5. To create an awareness among the students about the need for lifelong learning to succeed in their professional career

Course Outcomes

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

CO1	To demonstrate the ability to identify, formulate and solve engineering problems.
CO2	To demonstrate the ability to design and conduct experiments, analyze and interpret data.
CO3	The ability to visualize and work on laboratory and multi-disciplinary tasks.
CO4	To demonstrate the skills to use modern engineering tools, software's and equipment to analyze problems.
CO5	To demonstrate the knowledge of professional, ethical responsibilities and in both verbal and written form.

COURSE CONTENT

Unit I: Student presentations **9 Hours**

- Each student will present one paper during the term

Unit II: Class evaluations **10 Hours**

- Each week each student is asked to write a short evaluation of one of the papers being presented

Unit III: Class Discussion **10 Hours**

- Discuss the papers – expose the flaws, analyse the writing, what was the impact?

Unit IV: Assessment **7 Hours**

- Short review submitted each week (you may work in pairs)
- Longer review of the paper you presented

Unit V: Key skills **9 Hours**

- Summarise
- Evaluate
- Identify the important questions
- Understand the context

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	**50**	**100**

Name of The Course	Energy, Instrumentation, measurement & Control Lab				
Course Code	MENE6006				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives

This subject is taught

1. To impart knowledge in the area of numerical integration and Calculus
2. Working principle knowledge of energy meter
3. Brief knowledge about various flow parameters
4. Knowledge about handling the instruments and how to operate in filed
5. The role of instruments in different engineering applications.

Course Outcomes

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

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measuring devices
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem solving
CO5	Technical approach of the instruments in field condition

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

COURSE CONTENT

1. Determination of electrical Energy in One –Phase & Three Phase energy meters,
2. Fuel efficiency by Flue gas analyzer,
3. Fuel efficiency Thermometers,
4. Determine the difference in potential by Potentiometric
5. Measurement of temperature and converts into current signals by Temperature Transmitters
6. Determination of intensity of light by Optical Pyrometer
7. Measurement of air flow in Air flow meters
8. Determination of speed of airflow in Anemometer
9. Measurement of volumetric flow rate of fluid by Rotameter
10. Determination fluid flow velocity by Pitot Tube
11. Measurement of mass flow rate by Mass Flowmeters
12. Determination of velocity of water by Open Channel Flowmeters

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	50	100

Name of The Course	**Project (Phase I)**				
Course Code	**MENE7002**				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	**0**	**0**	**5**	

Course Objectives

1. To provide a comprehensive understanding of the concepts and methodologies for project identification, project preparation, project evaluation and project financing
2. To make the student understand the project cycle and their wide socio-economic and environmental impacts
3. To make the student learn how to evaluate a project in view of global concern about sustainable development of energy and environment projects

Course Outcomes

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

CO1	Identify various energy and environmental features of a project
CO2	Small projects for environmental development and sustainability
CO3	Develop a project with suitable technology, and environmental impacts
CO4	Solve complex environmental problems by different tools and techniques
CO5	Carry out techno-economic evaluation of energy projects with environmental considerations

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	**50**	**100**

Name of The Course	Energy Efficient Buildings				
Course Code	MENE6029				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

1. Importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. The concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. Understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. The importance of Environmental Management as well as Environmental Impact Assessment methods in Energy efficient buildings.

Course Outcomes

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

CO1	Understand why buildings should be made energy efficient.
CO2	Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, photovoltaics.
CO3	Ground source heat pumps, and their adaption to green building concepts.
CO4	Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
CO5	Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies.

Text Books

1. William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc

Reference Books

1. Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.
2. Sim Van Der Ryn, Stuart Cowan, “Ecological Design”, Island Press (1996).
3. Dianna Lopez Barnett, William D. Browning ,”A Primer on Sustainable Building”, Rocky Mountain Green Development Services,.
4. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, John Wiley.
5. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc
6. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons
7. Ben Farmer &HentieLouw., Companion to Contemporary Architectural Thought, London & New York: Routledge
8. PeterNoever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

Course Content

Unit I: Green Buildings, Energy and Environment 9 Hours Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design.
Unit II: Renewable Energy, Site and Climate 10 Hours

Renewable Energy sources that can be used in Green Buildings – Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Climate and Energy, Macro and Microclimate. Indian Examples.

Unit III: Building Form and Fabric **10 Hours**

Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material.

Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation 7 Hours

Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modeling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, and mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water.

Unit V:Energy Awareness **9 Hours**

Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED). Ecohomes, Sustainable architecture and urban design – principles of environmental architecture. Benefits of green buildings – Energy Conservation Building code - NBC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Solid Waste Management				
Course Code	MENE6032				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

1. To gain insight into collection, transfer and transport of municipal solid waste
2. Understand the design and operation of municipal solid waste landfill
3. Understand the design and operation of resource recovery facility
4. Understand the design and operation of waste to energy facility
5. Understand the effect of waste management on environmental sustainability

Course Outcomes

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

CO1	Understand solid waste and its composition
CO2	Understand method solid waste collection and transportation
CO3	Understand various processes involved in solid waste collection, segregation and transportation.
CO4	Design solid waste disposal facility.
CO5	Understand the identification of hazardous wastes

Text Books

1. GeorgeTechobanoglous et al," Integrated SolidWaste Management ", McGraw-HillPublication, 1993

Reference Books

1. HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication
2. Bagchi, A., Design,Construction, andMonitoringofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.
3. Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.
4. GeorgeTechobanoglous et al," IntegratedSolidWasteManagement ", McGraw HillPublication, 1993.
5. CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995.

Course Content

Unit I: **9 Hours**

Legal and Organizational foundation: Definition of solid waste–waste generation–major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.

Unit II: **10 Hours**

Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit III:Process of Solid Waste and Energy recovery **10 Hours**

Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators

Unit IV: Disposal of Solid Wastes **7 Hours**

Land farming, deep well injections. Landfills**:** Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,linersandcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution,designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.

Unit V: Household Hazardous Waste Management **9 Hours**

Design practices of solid wastes. Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport. Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous waste.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Remote Sensing & GIS Applications			
Course Code	MENE6037			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

This subject explains the basic concepts of

1. Basic concept of Remote Sensing
2. Knowledge of Geographic Information Systems with its applications.
3. History of development of GIS
4. Concepts of digital image processing
5. Applications of GIS and remote sensing

Course Outcomes

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

CO1	Basic remote sensing concepts and its characteristics
CO2	GIS and its requirements
CO3	Data management with GIS
CO4	Carry out analysis and interpretation of GIS results
CO5	Modelling through GIS

Text Books

1. A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur.
2. A. Burrough(2000), Principle of Geographical Information Systems for Land Resources Assessment,ClarendonPress,Oxford.

Reference Books

1. T.M.Lilles and R.W.Kiefer (1999),Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
2. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005),Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.

Course Content

Unit I: Basic concepts of remote Sensing **9 Hours**

Basic concepts of Remote Sensing - Introduction to remote sensing – Electromagnetic radiation - Characteristic of real remote sensing systems–Plat forms–Satellite-Indian remote sensing satellite- Sensors

Unit II: Image Processing **10 Hours**

Image processing - Elements of image interpretation –Concepts of digital image processing

Unit III: Basic concepts of GIS **10 Hours**

Basic concepts of GIS – Introduction to GIS-History of development of GIS- Elements of GIS-Computer hardware and software

Unit IV: Map Overlay **7 Hours**

Map overlay-Vector and raster data model-Mapping concept-Data storage and data base management-

Development of map overlay – Overlay operation
Unit V: Applications of GIS and Remote Sensing **9 Hours** Applications of GIS and remote sensing in resource management

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Project (Phase II)**				
Course Code	**MENE8001**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**15**

Course Objectives

1. To provide a comprehensive understanding of the concepts and methodologies for project identification, project preparation, project evaluation and project financing
2. To make the student understand the project cycle and their wide socio-economic and environmental impacts
3. To make the student learn how to evaluate a project in view of global concern about sustainable development of energy and environment projects

Course Outcomes

After taking this course the student will be able to

1. Identification various energy and environmental features of a project
2. Laboratory and field based study
3. Small projects for environmental development and sustainability
4. Develop a project with suitable technology, and environmental impacts
5. Solve complex environmental problems by different tools and techniques
6. Carryout techno-economic evaluation of energy projects with environmental considerations

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	**50**	**100**

PROGRAMME ELECTIVES

Name of The Course	Solar Energy technology			
Course Code	MENE6013			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To impart the knowledge in the area of solar energy
2. Solar energy and the effective utilization to improve energy management
3. To understand the importance of economic dispatch and unit commitment problem
4. Solar energy using different technologies.
5. Design of liquid and air heaters

Course Outcomes

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

CO1	Atmospheric attenuation
CO2	Fixing of Solar energy
CO3	Application of energy into daily life activities
CO4	Find out heat removal rate
CO5	Design of active systems for liquid and air heaters

Text Books

1. DuffieJ.A and Beckman, W.A., "Solar Engineering of Thermal Processes", 2nd Edition, John Wiley& Sons Inc., Newyork, -1991
2. G.N. Tiwari. "Solar Energy: Fundamentals, Design, Modelling and Applications", Third Reprint, Narosa Publishing House, New Delhi-2006

Reference Books

1. Edward Anderson, "Fundamentals for Solar Energy Conversion", Addison Wesley pubCO.,1983.
2. FankKreith,Jan F.Kreider,:Principles of solar Engg", 1978.
3. Koushika M.D," Solar Energy Principles and Applications", IBT publications and distributors, 1988.
4. Kaushik S.C, Tiwari G.N and Nayak J.K, "Thermal control in passive solar buildings" .IBT Publishers & Distributors, 1988.

Course Content

Unit I: Solar Radiation **9 Hours**

Source of radiation – Sun earth relationship- extra-terrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes relations between horizontal radiation and inclined surfaces – relations between monthly, daily and hourly radiation and components of the radiations– solar charts – Critical radiation-Measurement of global, direct and diffuse solar radiation- pyrohelio meter, pyrano meter, pyro geo meter, net pyradiometer-sunshine recorder .

Unit II: Solar Collectors – Flat Plate Collectors **10 Hours**

Design considerations – classification- Flat plate collectors- air heating collectors liquid heating –Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors-for efficiency of flat plate collectors – selective surfaces – tubular solar energy collectors analysis of concentric tube collector – testing of flat plate collectors.

Unit III: Concentric Solar Collectors and Thermal Application 10 Hours Concentric collectors-Limits to concentration – concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats. Solar powered absorption A/C system (Ammonia/water) solar water pump, solar chimney, solar drier, solar dehumidifier, solar still, solar cooker.
Unit IV: Simulation and Energy Storage 7 Hours Simulation in Solar Process Design- TRANSYS- Design of active systems- f chart methods for liquid and air heaters- phi bar, of chart method - sensible, latent heat and thermo-chemical storage-pebble bed etc. materials for phase change- Glauber'ssaltorganic compounds -solar ponds.
Unit V: Solar PV System 9 Hours Photo- voltaic cell – characteristics-maximum power- tracking-cell arrays-power electric circuits for output of solar panels--inverters-batteries-charge regulators, Construction concepts.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Hydrogen Fuel Cells				
Course Code	MENE6015				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

1. Importance of hydrogen as a future energy carrier
2. How to storage compressed gas
3. Fuel cell classification
4. Different parameters of fuel cell
5. Design of fuel cell

Course Outcomes

Student will get the knowledge of:

CO1	Knowledge about hydrogen energy
CO2	Able to get techniques to store compressed gas
CO3	Knowledge about various types of fuel cell
CO4	Find out the energy transferred and effect of various parameters
CO5	Design of fuel cell

Text Books

1. Aldo V. da Rosa(2005),Fundamentals of Renewable Energy Processes, Elsevier Academic Press.

Reference Books

1. Wolf Vielstich, Arnold Lammand H.A. Gastieger(2003), Handbook of Fuel Cells Vol 1-4, John Wiley.
2. GregorHogenEd. (2003), Fuel Cell Technology Handbook, CRC Press.

COURSE CONTENT

Unit I: **9 Hours**

Importance of hydrogen as a future energy carrier –Thermodynamic and thermo physical properties-Chemical production of hydrogen–Steam reforming, thermal decomposition etc. - Purification - Desulfurization, removal of CO_2, CO, etc.- Electrolytic hydrogen production– Electrolyzer configurations -Thermolytic hydrogen production – Direct dissociation of water, chemical dissociation of water, photolytic hydrogen production, photobiological hydrogen production

Unit II: **10 Hours**

Compressed gas storage-Cryogenic liquid storage-Solid state storage–Adsorption and chemical compounds, Metal hydrides, hydride heat pumps and compressors

Unit III: **10 Hours**

Fuel cells classification – operating temperatures, state of electrolyte, type of fuel, chemical nature of electrolyte. water pump, solar chimney, solar drier, solar dehumidifier, solar still, solar cooker.

Unit IV: **7 Hours**

Polymer Electrolyte Membrane Fuel Cells (PEMFC) – Alkaline Fuel Cells (AFC)-Phosphoric Acid Fuel Cells (PAFC)- Direct Methanol Fuel Cells (DMFC)-Molten Carbonate Fuel Cells (MCFC)-Solid Oxide Fuel Cells

(SOFC)
Unit V: **9 Hours** Stationary systems, automotive systems, portable fuel cells, small (less than 1 kW) fuel cells

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Energy Environment and Climate Change				
Course Code	MENE6019				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

This subject is taught to impart knowledge in the area of emerging technologies in various energies and environmental degradation due to the technical advancement.

Course Outcomes

Student will get the knowledge of:

CO1	Current emerging technologies
CO2	India's stand in terms of various technologies
CO3	Environmental impacts due to energy production
CO4	Measures taken to control the global environmental changes
CO5	Able to play role in policy making process

Text Books

1. Adrian Bejan, Peter Vadasz, Detlev G. Kroger (1999), Kluwer Academic Publishers.
2. A K De (2001), Environmental Concerns, New Age Publications Pvt Ltd.

Reference Books

1. Wolf Vielstich, Arnold Lammand H.A. Gastieger(2003), Handbook of Fuel Cells Vol 1-4, John Wiley.
2. GregorHogenEd. (2003), Fuel Cell Technology Handbook, CRC Press.

COURSE CONTENT

Unit I: 9 Hours Definition, Modules, Forms of Energy, Power, Origin of Fossil fuels, World and Indian Resources of Coal, Oil, Natural gas, Nuclear, Geothermal, Renewable Energy potential : Solar Energy, Wind Energy, Bio-Energy, Hydro, Tidal, Ocean , Nuclear Energy, Nuclear Fission and Fusion , Geothermal Energy
Unit II: 10 Hours Global Energy Scenario: Energy consumption pattern in various sectors, Impact on economy, India`s Energy Scenario, Urban and Rural energy consumption patterns, Impact of Energy on Development, Energy Infra structure in India
Unit III: 10 Hours Overview of global environmental problems, Environmental degradation due to Energy production and use, Pollution due to thermal power stations , Environmental aspects of Wind Energy Farms ,Environmental aspects of Nuclear power generation, Nuclear waste disposal, Impact of Hydro power generation on Ecology and Environment, Guidelines for Environmental impact assessment (EIA) of Energy Projects
Unit IV: 7 Hours Green House Gas Emissions, Depletion of Ozone layer, Global Warming, Climate Change Concerns, Climate Change in India, Kyoto protocol, Clean Development Mechanism [CDM], Carbon Fund Concept of Carbon credit
Unit V: 9 Hours Impact of Climate Change on Glaciers, Rivers and Water Resources, Climate Change Policy Issues in Himalayas, International Status of Climate Change Policies, Indian Action Plan on Climate Change

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Bio-Energy Technologies				
Course Code	MENE6027				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

Student will learn about

1. Bio-energy and its mechanism
2. Different processes for production of bioenergy
3. To under different techniques and tools
4. Bioenergy production from different solid wastes
5. Energy Consumption and Cost - Environmental Aspects

Course Outcomes

Student will get the knowledge of:

CO1	Solid waste management by bioenergy
CO2	Different processes used for biodegradation of solid waste and production of bioenergy
CO3	The industrial applications of Bio-Energy.
CO4	Environmental aspect of Bio-Energy
CO5	Energy Consumption and Cost - Environmental Aspects

Text Books

1.R.C.Maheswari, Bio Energy for Rural Energisation , Concepts Publication, 1997

Reference Books

1.David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood, Chichester, 1984
2.Khandelwal KC, Mahdi SS, Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986
3. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, New York, 1980
4.EL - Halwagi MM, Biogas Technology : Transfer &Diffusio, Elsevier Applied SC, London 1986

COURSE CONTENT

Unit I: 9 Hours Bio Energy - Bio Conversion Mechanism - Utilization of Photosynthate
Unit II: 10 Hours Combustion, Pyrolysis, Gasification and Liguefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways
Unit III: 10 Hours Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes
Unit IV: 7 Hours Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas. Operation and Maintenance

Unit V:	**9 Hours**
Energy Effectives and Cost Effectiveness - History of Energy Consumption and Cost - Environmental Aspects of Bio-energy Conversion.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Energy Efficient Buildings				
Course Code	MENE6029				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

5. Importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
6. The concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
7. Understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
8. The importance of Environmental Management as well as Environmental Impact Assessment methods in Energy efficient buildings.

Course Outcomes

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

CO1	Understand why buildings should be made energy efficient.
CO2	Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, photovoltaics.
CO3	Ground source heat pumps, and their adaption to green building concepts.
CO4	Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
CO5	Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies.

Text Books

2. William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc

Reference Books

1. Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.
2. Sim Van Der Ryn, Stuart Cowan, “Ecological Design”, Island Press (1996).
3. Dianna Lopez Barnett, William D. Browning ,”A Primer on Sustainable Building”, Rocky Mountain Green Development Services,.
4. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, John Wiley.
5. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc
6. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons
7. Ben Farmer &HentieLouw., Companion to Contemporary Architectural Thought, London & New York: Routledge
8. PeterNoever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

Course Content

Unit I: Green Buildings, Energy and Environment 9 Hours Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design.
Unit II: Renewable Energy, Site and Climate 10 Hours Renewable Energy sources that can be used in Green Buildings – Solar energy, Passive Solar Heating, Passive

Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Climate and Energy, Macro and Microclimate. Indian Examples.

Unit III: Building Form and Fabric 10 Hours

Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material.

Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation 7 Hours

Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modeling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, and mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water.

Unit V:Energy Awareness 9 Hours

Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED). Ecohomes, Sustainable architecture and urban design – principles of environmental architecture. Benefits of green buildings – Energy Conservation Building code - NBC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Solid Waste Management				
Course Code	MENE6032				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

6. To gain insight into collection, transfer and transport of municipal solid waste
7. Understand the design and operation of municipal solid waste landfill
8. Understand the design and operation of resource recovery facility
9. Understand the design and operation of waste to energy facility
10. Understand the effect of waste management on environmental sustainability

Course Outcomes

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

CO1	Understand solid waste and its composition
CO2	Understand method solid waste collection and transportation
CO3	Understand various processes involved in solid waste collection, segregation and transportation.
CO4	Design solid waste disposal facility.
CO5	Understand the identification of hazardous wastes

Text Books

1. GeorgeTechobanoglous et al," Integrated SolidWaste Management ", McGraw-HillPublication, 1993

Reference Books

6. HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication
7. Bagchi, A., Design,Construction, andMonitoringofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.
8. Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.
9. GeorgeTechobanoglous et al," IntegratedSolidWasteManagement ", McGraw HillPublication, 1993.
10. CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995.

Course Content

Unit I: **9 Hours**

Legal and Organizational foundation: Definition of solid waste–waste generation–major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.

Unit II: **10 Hours**

Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit III:Process of Solid Waste and Energy recovery **10 Hours**

Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators

Unit IV: Disposal of Solid Wastes **7 Hours**

Land farming, deep well injections. Landfills**:** Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,linersandcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution,designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.

Unit V: Household Hazardous Waste Management **9 Hours**

Design practices of solid wastes. Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport. Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous waste.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Design of Wastewater Treatment & Disposal System			
Course Code	MENE6034			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The student will be exposed

1. Need of advanced wastewater treatment
2. Process for removal nutrients
3. Physical and chemical methods
4. Economic value of environmental resources
5. Economics of biodiversity conservation

Course Outcomes

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

CO1	Know about the conventional treatment units and processes.
CO2	Role of microorganisms in wastewater treatment.
CO3	Nutrients removal by chemical and biological process
CO4	Sludge treatment, handling and disposal.
CO5	Wastewater reuse, recycling and disposal of treated effluents

Text Books

1. R.K.Turner,D.W.PearceandI.Bateman(1994),EnvironmentalEconomics:AnElementary Introduction,HarvesterWheatsheaft,London.
2. D.W.PearceandR.K.Turner(1990),EconomicsofNaturalResourcesandtheEnvironment, HarvesterWheatsheaf, London.

Reference Books

1.D.W.Pearce,A.MarkandyaandE.B.Barbier(1989),BlueprintforaGreenEconomy,Earthscan, London.

2.MichaelS.CommonandMichaelStuart(1996),EnvironmentalandResourceEconomics:An Introduction, 2nd Edition,Harlow:Longman.

3.RogerPerman,MichaelCommon,YueMaandJamesMcGilvray(2003),NaturalResourceand Environmental Economics,3rd Edition, Pearson Education.

4.N.Hanley,J.ShogrenandB.White (2001),AnIntroductiontoEnvironmentalEconomics,Oxford University Press.

COURSE CONTENT

Unit I: Chemical Nutrient Removal **9 Hours**

Effects of chemical constituents in wastewater / Need of advanced wastewater treatment / Basis of process selection and development of treatment flow sheets. Membrane Bio-Reactor (MBR) applications / Removal of residual suspended solids by micro screening.

Unit II: Chemical Nutrient Removal **10 Hours**

Sources and forms of Nitrogen (N) and Phosphorus (P) / Processes for N and P removals. Conventional biological nitrification/ denitrification processes and its process fundamentals. Sequencing Batch Reactor (SBR) and Simultaneous Nitrification – Denitrification (SND) processes for nitrogen removal. New

processes for nitrogen removal: ANAMMOX, SHARON, CANON etc. Biological removal of Phosphorus-Process fundamentals and types of processes. Combined removal of N and P by biological methods.
Unit III: Economic Value of Environmental Resources 10 Hours Nitrogen removal by physical and chemical methods-Air stripping of ammonia/Break point Chlorination/Ion – exchange. Removal of phosphorus by chemical addition
Unit IV: Concept of Total Economic Value 7 Hours Economic value of environmental resources and environmental damage-Concept of Total Economic Value-Alternative approaches to valuation-Cost benefit analysis and discounting
Unit V: Economics of bio-diversity Conservation 9 Hours Economics of biodiversity conservation - Valuing individual environmental damage-Concept of Total Economic Value - Policy responses at national and international levels

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (EA)	Total Marks
50	50	100

Name of The Course	Urban Environmental Quality Management				
Course Code	MENE6035				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

1. Investigating the causes, consequences and degradation of environmental resources
2. Possible solutions to problems associated with degradation of environmental resources
3. Analyse the potential non-sustainability of certain types
4. Economic activities using economic analysis as a tool
5. To plan and to execute monitoring programmes

Course Outcomes

Student will get the knowledge of:

CO1	Have knowledge of the nature and effects of environmental pollutants and energies
CO2	Have a detailed knowledge of the techniques involved in the efficient management of the environment
CO3	Be able to measure and assess the effects of noise, air, water, terrestrial pollution and noise pollution on human activity and health
CO4	Have an awareness of the need for integrated pollution control
CO5	Have the skills to plan and to execute monitoring programmes for the detection and control of environmental pollutants, including water, air and noise terrestrial pollution

Text Books

1. Varshney, C.K. "Water Pollution andManagement",Wiley Eastern Ltd., New Delhi, 1998

Reference Books

1. Plowden,S., "TheCostofNoise",London, Metra, 1996.
2.Fallion, A.B. &E. Simon,"TheUrbanPattern", Van Nistrand, New York.
3. M.J. Suess&S.R. Craxford, "Manualon Urban AirQuality",WHO, Copenhagen.

COURSE CONTENT

Unit I: Urbanization & Pollution **9 Hours**

Consequences of urbanization, demand of resources by the public - Sources of Pollution to the urban environment: Status of pollution levels in major cities- Slum formation: Impact of slum on general quality of life on Urban elite – status of slum settlements in major cities

Unit II: Air & Noise Pollution in Urban Environment **10 Hours**

Air Pollution Sources: Nature of air pollution in theUrban environment due to human activities ofindustrialization,effectofairpollutiononUrbanEnvironment. AirpollutionIndicesforAssessment of status of Urbanairquality.-SourcesofnoisepollutioninUrbanareas, effectofnoisepollutiononUrban environment, status ofnoise pollution in major cities.

Unit III:Water and Land pollution in Urban Environment **10 Hours**

Water Demands and Pollution in Urban areas: Nature of water pollutants and as similative capacity of natural

Urban aquatic systems. Urban water quality indices-Sources of land pollution in urban areas: Impact of urban soil pollution on quality of living system– prediction of soil pollution indices.

Unit IV: Management of Urban Environment Quality **7 Hours**

Land use planning–traffic management. Safe municipal water supply and planning of safe municipal water supply and drainage system–solid waste management including disposal–abatement of noise pollution – Provision of zones – regulation

Unit V: Conservation and Disaster Management **9 Hours**

Natural Conservation: Planning of urbanization on ecological basis, preservation and development of green recovery areas.- Urban Disaster Management: Management of Industrial explosions, landslides, earthquakes, Floods and Management of epidemics.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Remote Sensing & GIS Applications			
Course Code	MENE6037			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

This subject explains the basic concepts of

1. Basic concept of Remote Sensing
2. Knowledge of Geographic Information Systems with its applications.
3. History of development of GIS
4. Concepts of digital image processing
5. Applications of GIS and remote sensing

Course Outcomes

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

CO1	Basic remote sensing concepts and its characteristics
CO2	GIS and its requirements
CO3	Data management with GIS
CO4	Carry out analysis and interpretation of GIS results
CO5	Modelling through GIS

Text Books

1. A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur.
2. A. Burrough(2000), Principle of Geographical Information Systems for Land Resources Assessment,ClarendonPress,Oxford.

Reference Books

1. T.M.Lilles and R.W.Kiefer (1999),Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
2. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005),Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.

Course Content

Unit I: Basic concepts of remote Sensing **9 Hours**

Basic concepts of Remote Sensing - Introduction to remote sensing – Electromagnetic radiation - Characteristic of real remote sensing systems–Plat forms–Satellite-Indian remote sensing satellite- Sensors

Unit II: Image Processing **10 Hours**

Image processing - Elements of image interpretation –Concepts of digital image processing

Unit III: Basic concepts of GIS **10 Hours**

Basic concepts of GIS – Introduction to GIS-History of development of GIS- Elements of GIS-Computer hardware and software

Unit IV: Map Overlay **7 Hours**

Map overlay-Vector and raster data model-Mapping concept-Data storage and data base management-Development of map overlay – Overlay operation
Unit V: Applications of GIS and Remote Sensing **9 Hours** Applications of GIS and remote sensing in resource management

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Application of Bio-Technology in Environmental Engineering			
Course Code	MENE6038			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

This subject explains the basic concepts of

1. To introduce microbial and biotechnological concepts and theories.
2. To understand the biotechnological tools and their applications for environmental management.
3. To become familiar with the effective use of biotechnology in eco-sustainable waste management.

Course Outcomes

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

Apply biotechnological concept and tools for green production technologies and eco-sustainable waste management ensuring sustainable development.

Text Books

1. Pelczar, M. Microbiology, 5thEdn,Tata McGraw Hill, ISBN 0074623206
2. Wainwright,M. An Introductionto Environmental Biotechnology,Kluwer AcademicPublisher,ISBN 0792385691

Reference Books

1. Alexander, M.Biodegradationand Bioremediation.2ndEd.,AcademicPress, California,USA.ISBN 012049860X
2. Sayler, Gray S.,RobertFox, JamesW.Blackburn,Environmental Biotechnology forWasteTreatment, PlenumPress, New York. ISBN 0306439433
3. BruceE. Rittmann, Eric Seagren,Brian A.Wrenn,Albert J.Valocchi, ChittaranjanRay, LutgardeRaskin, In-SituBioremediation, 2ndEd., Noyes Publications,U.S.A. ISBN0815513488.

Course Content

Unit I: 9 Hours Principlesof biology-Cell,structure,types, functionsandcommunicationduringdevelopments; Genes and development-geneexpressionandtheir regulation,regulation ofcellandanimalbodydevelopment; EnvironmentandEcosystemanditscomponents;Energy andbiogeochemicalcycles;Microorganismsand Environment- microbes as functionary part of ecosystem, terrestrial and non-terrestrial environments, marineandfreshwaterenvironments; Ecological Niche;
Unit II: 10 Hours HistoricalOverview of Development andPollution,EnvironmentalSustainabilityandBiodiversity; Biotechnology,Humanandenvironment-conceptsofbiotechnology,itsusefulnesstohumankindand global environment,theoriesand philosophy; Contradiction betweeneconomicandenvironment; Environmental Management Strategies for Sustainable Development;
Unit III: 10 Hours Microbial cell and enzyme technology-adaptedmicroorganisms,bioremovalofnutrients,micro-algal biotechnology; Interactionofmixedmicrobial population andits applications in bioprocessing of wastes, role of extracellular polymers, bioremediation of environmental problems; Concept of DNA technology, plasmid,mutation,geneticallyengineeredmicrobial strainsandapplicationsofgeneticengineeringin environmental management;
Unit IV: 8 Hours

Problemsoftoxicchemicals-sourcesandcategories, halogenated and non-halogenated, petroleum hydrocarbons, metals,humanhealtheffectscausedbytoxicchemicalpollutions; Biodegradationoftoxic pollutants,mechanisms of detoxification- oxidationreactions, dehalogenation, biotransformation of metals; XenobioticCompounds- types, sources and its hazards;Recalcitranceof xenobioticcompoundsand leading factors; Biodegradation of xenobiotic compounds

Unit V: **9 Hours**

Biotechnological remedies forenvironmental damages- decontamination of ground water systems, subsurfaceenvironment,reclamationconcepts-bioremediation;Productionofproteins,Biotransformation of waste into biofertilizers, biogasandelectricalenergy, affectingphysical,chemicalandmicrobiological factors, health risk, odor management, technological advances; Environmental effects and ethics of microbial technology; Biosafety; Clean Technology- concepts and applications inindustrial process,clean synthesis; Farmingasanengineeringprocess.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Risk Assessment and Disaster Management				
Course Code	MENE6039				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

5. To provide knowledge related to the broad field of environmental risk assessment
6. Steps involved in the risk assessment process, including statistical characterization of observed data
7. Knowledge about tools that can be used in defining environmental risks, particularly as related to human health.
8. To develop practical skills in disaster mitigation, planning, response and post disaster rehabilitation, particularly related to health and public health.

Course Outcomes

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

CO1	To gain knowledge related to the broad field of environmental risk assessment
CO2	Statistical characterization of field data
CO3	Use of tools for environmental risks, particularly as related to human health
CO4	To apply biotechnological concept and tools for green production technologies
CO5	Gain knowledge on eco-sustainable waste management ensuring sustainable development

Text Books

2. Rao V. Kolluru,"Environmental Strategicshand book", Mc-graw Hill Inc., New York, 1994.

Reference Books

3. BrockNeely.W&BlanG.E,"EnvironmentalExposurefromchemicals,VolumeII,ChcPressIunc., Florida,1989.
4. WoodsenW.E.,"Humanfactorsdesignhandbook– informationandguidelinesfordesigntosystems, facilities, equipment and product for human use", McGraw Hill, New York, 1981.

Course Content

Unit I: Risk Assessment **9 Hours**

Introduction- Methodologies and Guidelines: Principles, Code of practice – Appointment of personnel and their responsibilities–Emergency plans: onsite and offsite. Steps in risk assessment: Identification of risk, Extent of risk and disaster, Risk-Based Decisions for Corrective Action –Timely updation. Developing a Site Conceptual Model -Focusing on Risk-Based Decisions in Corrective Action –Risk Assessment: Dose Response and Target Level Calculations-Experiences in Environmental Risk Assessment.

Unit II: Occupational Health and Safety **10 Hours**

Occupational risk analysis survey and health evaluation, behavioral studies, occupational injury, disease reporting, investigation: monitoring and control of environmental hazards. Occupationally induced illness, non-occupational illness, and discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease. Occupational health services.

Unit III:Methodologies and Management Techniques **10 Hours**

Risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment. Operations Management(OM),Risk Assessment and Disaster Response, Quantification Techniques, NGO Management, SWOT Analysis based on Design &Formulation Strategies, Insurance & Risk Management.

Unit IV: Disaster Management7 Hours

Introduction & Dimensions of Natural & Anthropogenic Disasters, Principles/Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes/SOPs, Natural Disasters and Mitigation Efforts, Flood Control, Drought Management, Cyclones, Avalanches, Mangroves, Land Use Planning, Inter-Linking of Rivers, Role of Union/States, Role of Armed Forces/Other Agencies in Disasters, Role of Financial Institutions in Mitigation Effort, Group Dynamics, Concept of Team Building, Motivation Theories and Applications, School Awareness and Safety Programs, Psychological and Social Dimensions in Disasters, Trauma and Stress, Emotional Intelligence, Electronic Warning Systems.

Unit V: Use of Information systems, Experiences and case studies 9 Hours

Recent Trends in Disaster Information Provider, GeoInformatics in Disaster Studies, Cyber Terrorism, Remote Sensing &GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology, Quick Reconstruction Technologies, Role of Media in Disasters, Management of Epidemics, Bio-Terrorism, Forecasting / Management of Casualties. Important Statutes/ Legal Provisions, IEDs/Bomb Threat Planning, NBC Threat and Safety Measures, Forest Fires.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Mathematical Modelling in Environmental Engg.			
Course Code	MENE6040			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

1. The scope and extent of mathematical modelling
2. The basic tenets of mathematical modelling and its application to environmental Processes
3. Mathematical modelling techniques
4. Plume Rise estimation Emissions inventories
5. Mathematical modelling methods applied to Global Environmental Problems

Course Outcomes

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

CO1	Basic understanding of how mathematical models can be used to solve environmental problems
CO2	Set up material balance models for conservative and non-conservative systems
CO3	Formulate and solve Boundary value problems.
CO4	Plume Rise estimation Emissions inventories
CO5	Formulate, Set-up, and solve complex environmental Problems.

Text Books

1.Gilbert M., Master,'Introductionto Environmental Engineering and Science' Prentice-Hall ofIndia,NewDelhi,1998

Reference Books

1. Howard S.Peavy, Donald R. Rowe, and George Tchobanoglous.'Environmental Engineering'. McGraw-Hill BookCompany, New York.1985
2. Roland b. Stull : Introduction to Boundary Layer Meteorology. John Wiley 1988.
3. Plus, Journal Articles from J.Geophys. Res.,Geophysical Research Letters, Quarterly Journal of the Royal Meteorological Society.

Course Content

Unit I: 9 Hours

The origins: Formation of the Physical Environment. The evolution of the Earth's atmosphere. Quantification of the Lapse Rate. The states of stability of the atmosphere Quantification of Wind circulation : Geo-strophic winds. Necessity of mathematical models. Concentration calculationsand conversions in liquids and gases. Converting ppm into micro grammes/m3 and vice-versa. Material Balance–Steady-stateconservativesystems-non-conservativepollutants.Mass-nergyflowsandbalances–specific examples in real-life environmental problems: Thermal pollution of a River

Unit II: 10 Hours

The importance of Air Pollution modelling. Modelling the Atmospheric Boundary Layer–mixing length, and eddy diffusion. The formulation and solution of the Gaussian Plume Model. Gaussian Dispersion Coefficients. Plume Rise estimation Emissions inventories. Point, Line and Area Sources. Simple noise quality models : Models for Road way Noise

Unit III: 10 Hours

Modelling the mass transport of Sulphur Dioxide into falling raindrops. Reaction Pathways. Mass and Charge

Balance.Theconvective diffusion equation. Normalisation of the CDE with reaction kinetics. Modelling the Homogeneous and Heterogeneous Pathways for Ozone depletion.

Unit IV: **7 Hours**

Solar and Terrestrial Radiation. Quantifying the Green House Effect. A model for estimating the Equilibrium temperature of the Earth. Aerosol and cloud processes. The Basic tenets of Global Circulation Models for Weather Forecasting

Unit V: **9 Hours**

The unusual qualities of water. Modelling Biochemical Oxygen demand (BOD). Estimating the BOD Reaction Rate Constant. The effect of Oxygen-demanding wastes on rivers. A model for De-oxygenation. The Oxygen- sag curve. Solid waste modelling: Waste to Energy. Modelling the methane potential of discards.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Clean Development Mechanism & Green Technologies			
Course Code	MENE6041			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

1. The course is intended to teach the basics of CDM.
2. To become familiar with CDM processes.

Course Outcomes

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

CO1	Well aware of developments in Clean Development Mechanism.
CO2	Understanding of Global Warming and Climatic changes.
CO3	Develop ecologically sustainable production and industry through developing the potential of all fibres.
CO4	Develop environmentally and socially friendly alternatives
CO5	Many of the deleterious practices, processes and products currently in use

Text Books

1. Introductionto Environmental Engineeringand Science. Gilbert M.Masters.Prentice-Hall of India. 2005.

Reference Books

1.White. I.D., Mottershead. D.N., Harrison .S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998.
2.Colinvaux.P.,"Introduction toEcology", JohnWiley& sons,Newyork,1973.

Course Content

Unit I: Principle of Clean Development Mechanism **9 Hours**

Introduction to Climate Change and Global Warming, International Response to Climate Change & Global Warming

Unit II: Kyoto Protocol **10 Hours**

Kyoto Protocol and its mechanism, objectives of Kyoto protocol and details of the agreement, Amendments of Kyoto Protocol.

Unit III: Clean Development Mechanism Process **10 Hours**

Overview of Clean Development Mechanism, Administration and Participation, CDM, Project Cycle and Financing, Post Kyoto Negotiations and India.

Unit IV: Sustainable Development in CDM **7 Hours**

CDM, Sustainable Development and its Assessment, The CDM Market, Types of Major CDM Projects, Small Sectors and CDM, preparing CDM project design document (PDD) Course Project

Unit V: Case Studies of CDM Projects **9 Hours**

Types of Major CDM Projects, Small Sectors and CDM, Detailed studies of CDM approved projects.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Environmental Ecology				
Course Code	MENE6042				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

1. To establish Ecology's credibility in high environmental, ethical and quality standards of goods and services.
2. Access the market opportunity presented by the 'greenmarket'.
3. Raise consumer awareness and concern for environmental issues, and encourage their support for ecological values in consumer practices.
4. To develop affair and equitable means to link economic and environmental values
5. The development of mutually beneficial relationships with all segments of the community.

Course Outcomes

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

CO1	Develop legal and economic structures
CO2	Able to provide reasonable return on investment, financial or personal effort, dividends, wages and so forth.
CO3	Develop ecologically sustainable production and industry through developing the potential of all fibres.
CO4	Develop environmentally and socially friendly alternatives
CO5	Many of the deleterious practices, processes and products currently in use

Text Books

Odum. E. P, "Fundamentals of ecology",W.B. Sanders, Philadelphia, 2002

Reference Books

1.White. I.D., Mottershead. D.N., Harrison .S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998.
2.Colinvaux.P.,"Introduction toEcology", JohnWiley& sons,Newyork,1973.

Course Content

Unit I: Concepts of Ecology **9 Hours**

Fundamentals of ecology, Natural ecosystems and their food chains, food webs, bioenergetics, biochemical cycles and ecological succession**,** deoxygeneation nutrient enrichment

Unit II: Bio Diversity **10 Hours**

Biological diversity and its importance, reduction in biological diversity by human activities, classes and general effects of physical and Biological interaction with pollutants, lethal and sub-lethal effects.

Unit III: Ecosystem Ecology **10 Hours**

Ecosystems responses to deoxygeneation nutrient enrichment, pesticides, hydrocarbons, metal and salts, thermal pollution, suspended solids and silt.

Unit IV: CommunityEcology **7 Hours**

Principles of population and community ecology–concepts of systems and models–building and analysis

Of models–environmental systems, structures and interaction between coastalaeolian, glacial, fluvial, weathering, soil and detrital systems.
Unit V:Integration Ecological Principles **9 Hours** Integration of classical, agro and restoration ecological principle sand methods, Biomonitoring and its role in the evaluation of aquatic ecosystem, rehabilitation of ecosystem through ecological engineering principles.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Environmental Economics, Legislation and Management				
Course Code	MENE6046				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The student will be exposed

1. To make the student investigating the causes, consequences
2. possible solutions to problems associated with degradation of environmental resources
3. Analyse the potential non-sustainability of certain types of economic activities using economic analysis as a tool.
4. The economic implications of alternative to pollution
5. Alternative methods for valuing environmental resources and environmental damage

Course Outcomes

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

CO1	The economic significance and the economic causes of environmental degradation, including loss of diversity
CO2	The extent to which market based mechanisms might provide a solution to the environmental degradation problem in the absence of overt intervention
CO3	The economic implications of alternative 'intervention' approaches to pollution management, including the use of charges, subsidies and market permits.
CO4	Alternative methods for valuing environmental resources and environmental damage
CO5	The economic consequences of policy instrument for biodiversity conservation

Text Books

1. R.K.Turner, D.W.Pearce and I.Bateman (1994), Environmental Economics:AnElementaryIntroduction, Harvester Wheatsheaft, London.

2. D.W. Pearce and R.K. Turner (1990), Economics of Natural Resources and the Environment, Harvester Wheatsheaf, London.

Reference Books

1. D.W.Pearce, A.Markand ya and E.B.Barbier(1989),Blue print for a Green Economy, Earthscan, London.

2. Michael S.Common and Michael Stuart(1996),Environmental and Resource Economics: An Introduction, 2nd Edition, Harlow: Longman.

3. RogerPerman, Michael Common,YueMaand James Mc Gilvray(2003),Natural Resource and Environmental Economics,3rd Edition, Pearson Education.

4. N.Hanley,J. Shogren and B.White (2001), An Introduction to Environmental Economics, Oxford University Press..

Course Content

Unit I: Introduction to Sustainable Development 9 Hours Introduction to sustainable development -Economy-Environment inter-linkages -Meaning of sustainable development- Limits to growth and the environmental Kuznets curve –The sustainability debate- Issues of energy and the economics of energy – Non-renewable energy, scarcity, optimal resources, back stop technology, property research, externalities, and the conversion of uncertainty
Unit II: Economic Significance 10 Hours Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation - Equi-marginal principle.
Unit III: Economics of Pollution 10 Hours Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions - Managing pollution through market intervention: Taxes, subsidies and permits.
Unit IV: Economic Value of Environmental Resources 7 Hours Economic value of environmental resources and environmental damage-Concept of Total Economic Value-Alternative approaches to valuation-Cost benefit analysis and discounting
Unit V: Economics of bio-diversity Conservation 9 Hours Economics of biodiversity conservation - Valuing individual species and diversity of species - Policy responses at national and international levels

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100