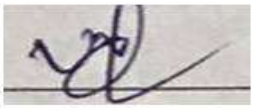
ACADEMIC YEAR 2019-2020 & 2020-2021

CENTRE FOR ENVIRONMENT
INSTITUTE OF SCIENCE & TECHNOLOGY (Autonomous)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

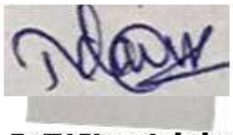
COURSE STRUCTURE AND SYLLABUS

M.Tech (ENVIRONMENTAL MANAGEMENT)
(Full Time PG Program)



Dr.V.Hima Bindu

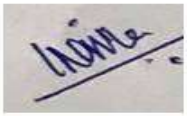
Dr.M.Anji Reddy



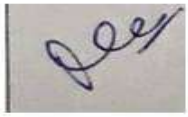
Dr.T.Vijaya Lakshmi

Dr.Debraj Bhattacharya

Mr.Sunil Kulakarni



Dr.K.Kiran



Mr.ASRKV. Murali Mohan

Mr.Ramesh

CENTRE FOR ENVIRONMENT
INSTITUTE OF SCIENCE & TECHNOLOGY
JAWAHARLALA NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY: HYDERABAD – 500 085.

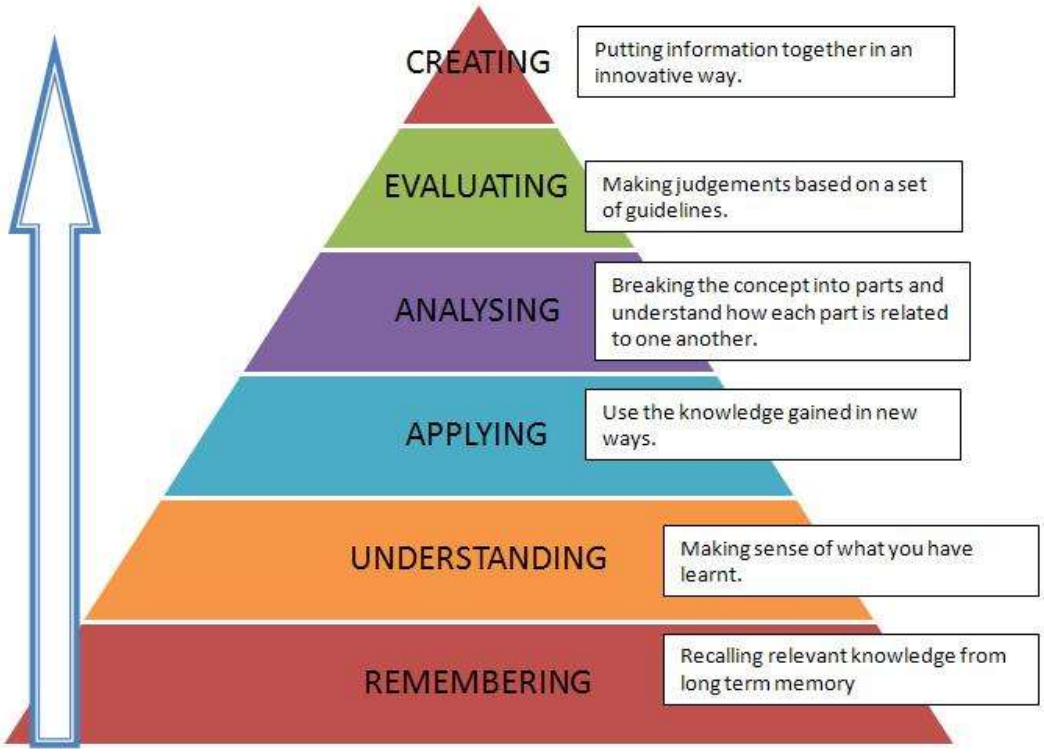
Vision:

- To disseminate advance knowledge by providing effective instruction and innovative research in environmental science and technology by promoting inter-disciplinary studies and research.
- To respond and to find technological solutions for pollution monitoring, abatement and control through innovation in environmental chemistry, environmental biotechnology and Environmental Geomatics.
- To maintain and develop liaison/collaboration with reputed universities, R&D organizations, industries and consultancy firms in India and abroad.

Mission:

- Producing highly motivated, technically competent, morally strong graduates with deep roots in our culture and with ability to respond to global challenges, thereby delighting all stakeholders namely parents, employers and humanity at large.
- To excel as a centre of Higher Education and Research in the field of Environmental Science & Technology.

Blooms Taxonomy:



ACADEMIC YEAR 2019-2020 & 2020-2021
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
CENTRE FOR ENVIRONMENT
INSTITUTE OF SCIENCE & TECHNOLOGY (Autonomous)

COURSE STRUCTURE AND SYLLABUS
M.Tech (ENVIRONMENTAL MANAGEMENT)

OBJECTIVES OF PROGRAMME

To provide the engineering graduates and science post graduates with technical expertise in Environmental Management which will enable them to have a career and professional accomplishment by allowing them to work in multidisciplinary/interdisciplinary areas in the public or private sector.
The program educational objectives of the **M. Tech (Environmental Management)** are:To:

1. Give in depth knowledge of interdisciplinary areas including wider and global perspective, with an ability to discriminate, quantify, evaluate, analyze and synthesize existing and new knowledge.
2. Impart interdisciplinary knowledge to develop innovative entrepreneurial and ethical future professionals for globally competitive environment.
3. Develop a problem solving capability by evaluating a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, societal, economical and environmental factors.
4. Apply usage of modern tools, techniques, and resources, including prediction and modeling have to solve complex activities.
5. Provide knowledge on the scope, steps involved and various methods related to assessment of environmental impacts in different fields.
6. Oversee the environmental performance including compliance with environmental legislation across the organization, and coordinating all aspects of pollution control, waste management, environmental health and conservation.
7. Provide practical exposure so that they become aware of the practical applications of the theoretical concepts.
8. Lead the implementation of environmental policies and practices and raise awareness, at all levels of an organization, about the emerging environmental issues

PROGRAM OUTCOMES:

PO1: Ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: To Train and make the student ready with appropriate skills

OUTCOME

By the time of their graduation, the students are expected to be able to:

1. An ability to independently carry out research/investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4. Understand the environmental, social and economic framework in which environmental management decisions are made understand the life cycle perspective, systems approach and environmental technologies for converting process, products and service related industrial environmental problems into opportunities to improve performance
5. Anticipate, recognize, evaluate, and control environmental issues in a variety of sectors and industries and liaison with federal, state, and local agencies and officials on issues pertaining to environmental protection
6. Recognize, evaluate, and control factors in the workplace and the environment that cause health and environmental hazards and utilize quantitative knowledge and skills and modern tools and technologies to asses, analyze, plan, and implement environmental management systems
7. Engage in critical thinking and contribute to research in solving contemporary environmental problems with professional and ethical responsibility.
8. Pursue lifelong learning as a means of enhancing the knowledge and skills in environmental modeling.
9. Identify, formulate, analyze, and develop management systems and formulate solutions that are technically sound, economically feasible, and socially acceptable.
10. Communicate proficiently in writing and speaking for promoting and coordinating public consultations on environmental matters and for negotiate
11. Collaborate with environmental engineers, planners, technicians, and other specialists, and experts in to address environmental problems.
12. Find professional level employment, pursue higher studies and pursue research and become an entrepreneur for contributing to the betterment of humanity and in shaping a sustainable society.

ACADEMIC YEAR 2019-2020 & 2020-2021

CENTRE FOR ENVIRONMENT
INSTITUTE OF SCIENCE & TECHNOLOGY(AUTONOMOUS)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH-ENVIRONMENTAL MANAGEMENT
COURSE STRUCTURE

M.Tech I year I Semester

Course Number	Subject	Scheme of Studies Per Week			Credits	Int Marks	Ext Marks
		L	T	P			
1EMT01	**Program Core I** Environmental Chemistry	3	0	0	3	30	70
1EMT02	**Program Core II** Environmental Microbiology	3	0	0	3	30	70
1EMTPE01	**Program Elective I** 1.Solid and Hazardous Waste Management 2.Instrumental Methods of Analysis 3.Ecology and natural resources	3	0	0	3	30	70
1EMTPE02	**Program Elective II** 1.Environmental Geomatics 2.Geomatics for Disaster Risk Reduction & Management 3. Geomatics for Climate Change and Sustainable Development	3	0	0	3	30	70
1A01	Research Methodology & Intellectual Property Rights	2	0	0	2	30	70
1A02	**Audit Course I** 1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4.Value Education 5.Constitution of India 6. Pedagogy Studies 7. Stress Management by Yoga 8. Personality Development through Life Enlightenment Skills.	2	0	0	0	0	0
1EMT03	Environmental Pollution Monitoring Lab	0	0	4	2	30	70
1EMT04	Environmental Microbiology Lab	0	0	4	2	30	70
Total Credits		**16**	**0**	**08**	**18**	**210**	**490**

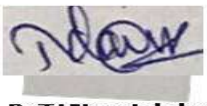
M.Tech I year II Semester

Course Number	Subject	Scheme of Studies Per Week			Credits	Int Marks	Ext Marks
		L	T	P			
2EMT05	**Program Core III** Air Pollution & Control Technologies	3	0	0	3	30	70
2EMT06	**Program Core IV** Water and Wastewater Engineering	3	0	0	3	30	70
2EMTPE03	**Program Elective III** 1.Bioremediation Technologies 2.Contaminant Transport in Environmental Systems 3. Higher numerical analysis	3	0	0	3	30	70
2EMTPE04	**Program Elective IV** 1.Environmental Impact Assessment 2. Environmental Geo Statistics 3. Prokaryotic Diversity and Bio-Prospecting(Tiny Earth course of USA)	3	0	0	3	30	70
2A03	**Audit Course II** 1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4. Value Education 5. Constitution of India 6. Pedagogy Studies 7. Stress Management by Yoga **8.** Personality Development through Life Enlightenment Skills.	2	0	0	0	0	0
2EMT07	Environmental Geomatics Lab	0	0	4	2	30	70
2EMT08	Water and waste water Treatment Lab	0	0	4	2	30	70
2A04	Mini Project with Seminar	2	0	0	2	30	70
Total Credits		**16**	**0**	**08**	**18**	**210**	**490**

*Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break


Dr.V.Hima Bindu


Dr.M.Anji Reddy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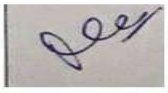

Mr.ASRKV. Murali Mohan


Mr.Ramesh

M.Tech II year III Semester

Course No.	Subject	Scheme of Studies Periods Per Week			Credits	Int Marks	Ext Marks
		L	T	P			
3EMTPE05	**Program Elective- V** 1.Water Supply Engineering and Hydrology 2. Microbial Diversity for Environmental Management 3.Energy and Environment	3	0	0	03	30	70
3EMTOE	**Open Elective- I** 1.Environment Health and Safety 2. Waste to Energy 3. Energy Audit	3	0	0	03	30	70
	Dissertation - I						
	a) Project review-I				0	0	0
3A05	b) Project review-II	0	0	20	10	100	0
Total Credits		**06**	**0**	**20**	**16**	**160**	**140**

M.Tech II year IV Semester

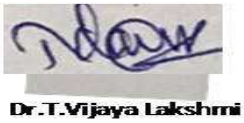
	Subject	Scheme of Studies Per Week			Credits	Int Marks	Ext Marks
		L	T	P			
	Dissertation Phase –II (Project Review-III 30 Marks + Project Evaluation 70 Marks = 100 Marks						
4A06	a. Project review-III	0	0	32	16	30	0
4A07	b. Project Evaluation (Viva-Voce)				0	0	70
Total Credits		**0**	**0**	**32**	**16**	**30**	**70**

Total Credits – 68

(**L**: Lecture periods, **T**: Tutorial periods, **P:** Practical periods)


Dr.V.Hima Bindu


Dr.M.Anji Reddy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Dr.Debraj Bhattacharya


Mr.Sunil Kulakarni


Dr.K.Kiran


Mr.ASRKV. Murali Mohan


Mr.Ramesh

M.Tech – EMT
I Year I Semester

Course Title	**ENVIRONMENTAL CHEMISTRY**		
Course code	**1EMT01**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Core -I**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:** understand the essential theoretical background of the principles of chemistry applied to the solutions of environmental problems **CO2:**describe the reactions that occurs in polluted and non-polluted atmosphere **CO3:** explain the significance of water, water quality, redox reaction that occurs in water and effects of water pollutants. **CO4**: describe the difference between polluted soil and non-polluted soils, causes for soil deterioration and chemical reaction that occur in soil **CO5:**explain the principle, parts and operation of the instruments used for analyzing the pollution parameters in environmental samples		

UNIT I: FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY

Stoichiometry, chemical equilibria and kinetics, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclidesgreen chemistry.

UNIT II: ATMOSPHERIC CHEMISTRY

Structure and composition of atmosphere - Chemical reactions in the atmosphere: Ozone chemistry- CFC's – Acid Rain – Photochemical smog - Aerosols types- production and distribution- Aerosols and Radiation–- Green House gases

UNIT III: WATER CHEMISTRY

physical and chemical properties of water, complexation in natural and waste water - Water pollutants- Types – Sources- Heavy metals – Metalloids – Organic – Inorganic – Biological and Radioactive – redox reactions in various water bodies including marine environment– Groundwater – Potable water -Aquatic Stratification and chemical species distribution

UNIT IV: SOIL CHEMISTRY

Physical and Chemical Properties – Cation exchange capacity – soil pH –Leaching and erosion - reactions with acids and bases – Geochemical reactions that neutralize acidity – Biological Proces that neutralize acidity – salt affected soils – Trace metals in soils.

UNIT V: ENVIRONMENTAL ANALYTICAL CHEMISTRY

Chemical methods of analysis gravimetry, titrimetric,Instrumental methods and analysis: Spectroscopy (UV-Visible,AAS,Flame photometer) Chromotography: (GC, GC-MS, HPLC& LCMS), TOC analyser, TN analyser, Radioactive: Gama spectrometer, alpha, beta Counters.

Books Recommended

1. Environmental Chemistry, aglobal perspective by Gary W. Vanloon& Stephen J. Duffy - Oxford University press.

2. Chemistry for environmental Engineering and science fifth edition by clair N. Sawyer, Perry L Mecarty, Gene F. Parkin, Tata megrahil edition.
3.Environmental Chemistry by A.K. de, 4th edition New Age International (p) Ltd. Nee Delhi, India, 2000.
4. Fundamentals of Environmental chemistry, 2nd ed. CRC press, Inc., USA, 2001.
5. Water chemistry - Vernon L. Snoeyink, David Jenkins

Course Title	**ENVIRONMENTAL MICROBIOLOGY**		
Course code	**1EMT02**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Core -II**		
Course outcomes (POs)	**At the end of the course, the student will be able to** **CO1:** The students will be able to draw the structures of typical prokaryotic and eukaryotic cell structures and label. They would be able to find out the similarities and differences between the two cell types. They would be able to explain the general characters and their beneficial and harmful effects **CO2:** The students will be able to list various nutritional requirements of microorganisms and classify the nutrients. They will be able to categorize different nutritional types based on different criteria and classify microorganisms into different nutritional types. From media composition students will be able to predict nutritional types of organisms. **CO3:** The students will be able to list, describe, differentiate and suggest suitable methods of isolation, preservation of microorganisms. Students will be able to explain different methods for determining growth and differentiate and analyze relative advantages and disadvantages. Students will be able to draw bacterial growth curve and label them. They will be able to explain the changes that take place during various stages. **CO4:** Students will be able to categorize microorganisms based on the range of environmental parameters in which they grow. Students will be able to explain different effects of extremes of environment and microbial adaptations to grow under extremes. Students will be able to list out, define and explain different types of microbial control. They will also be able to list various physical and chemical control agents, their mode of action applications, advantages and limitations. They will be able to compare and contrast between different processes and agents of microbial control. Students will be able to suggest a suitable antimicrobial agent for a particular situation and substantiate. **CO5:** They will be able to draw a flow chart explaining the principle and different components of biosensor. They would classify biosensors based on different criteria. They will explain, differentiate and indicate applicability of different transducing principles for biosensors. They will explain the working of different specific biosensors for glucose, ammonia, BOD, methane and mutagen. They would able to suggest appropriate biochemical recognition element and transducer to be used for biosensors of any analyze of interest.		
UNIT I: DIVERSITY OF MICROORGANISMS			
Eukaryotic and prokaryotic cell structure. Prokaryotes and eukaryotes. General characters,			

beneficial and harmful effects of major groups of microorganisms, protozoa, algae, fungi, bacteria and viruses.

UNIT II: MICROBIAL NUTRITION

Microbial nutrition, Nutritional requirements, major elements, minor elements trace metals and growth factors, Nutrient media (selective, differential, enriched, enrichment and special purpose media) and growth conditions. Nutritional types based on energy source, principal carbon source, electron donor. Proto and auxotrophs, copio and oligotrophs, phago and osmotrophs.

UNIT III: MICROBIAL GROWTH

Isolation, cultivation (aerobic & anaerobic) and preservation of microorganisms, methods for determining growth (bacterial numbers, mass and cell constituents). Physiology of growth, bacterial growth curve, Exponential growth and generation time. Bacterial growth in batch and continuous culture (chemostat and turbidostat), synchronous growth.

UNIT IV: EFFECT OF ENVIRONMENT & CONTROL MICROORGANISMS

Effect of temperature, pH, O_2, radiant energy, osmotic pressure and dessication on microorganisms and microbial adaptations. Control of microorganisms by physical and chemical agents, sterilization disinfection, sanitization and antisepsis. Physical agents – temperature, filtration, and radiation. Classes of disinfectants – phenol and phenolics – alcohol, halogens, surfactants, and heavy metals. Desirable characteristics of an antimicrobial agent; mode of action of antimicrobial agent. Evaluation of antimicrobial agents.

UNIT V: BIO-INDICATORS AND BIOSENSORS

Plankton and hydrophyte community as indicators of water pollution. Diversity index in evaluation of water quality; species richness & species evenness. Determination of microbiological quality of potable and recreational waters. Indicators of air pollution. Microbial biosensors – definition, advantages and limitations, different components of biosensor, various transducer principles. (conductometric, potentiometric, amperometric, optical,). Specific biosensors-glucose, ammonia gas, BOD, methane and mutagen sensor.

Books Recommended

1. Environmental Microbiology – Maier, R.M; Pepper, L; Gerba, C.P.-2009-2nd edition Academic Press.
2. Microbiology – Pelczar, K.J; Chan, E.C.S; Kreig, N.R.-2008-5th edition – Tata McGraw-Hill Publishing Biotechnology: the science & the business-Moses, V; Springham, D.G; cape, R.E-1999-2nd edition
3. Microbial Biotechnology – Glazer, A.N; Nikaido, H-2007-2nd edition.
4. Microbiology Prescott, L., JoahnneM.Willey, Linda M. Sherwood, Christopher J. Woolverton-2010, 8th Edition, McGraw-Hill publishing company.

ReferencesText Books:

5. Review articles in Advances in Applied Microbiology, critical reviews in microbiology, Annual review of Microbiology, Bacteriology etc.

Course Title	**SOLID & HAZARDOUS WASTE MANAGEMENT**		
Course code	**1EMTPE01**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective – I**		
Course outcomes (COs)	**At the end of course, the student will able to** **CO1:** explain about different solid wastes sources, characteristicsandtheir effects on environment. **CO2:** Explain about the MSW management practices and the required level of treatment based on regulatory aspects. **CO3:** Define the hazardous waste and explain the characteristics, treatment and disposal methods according to regulatory aspects. **CO4:** give introduction to the radioactive waste management and can describe the biomedical waste segregation, treatment and disposal according to BMW rules. **CO5:** Define E-waste, explain the characteristics and sources, illustrate the treatment and recovery processes of E-waste.		

UNIT I: SOLID WASTE
Definition of solid wastes – types of solid wastes – Sources - Industrial, mining, agricultural, municipal solid waste, Construction demolition waste, E-waste and Biomedical waste. Solid waste Problems - impact on environmental health
UNIT II: FUNCTIONAL ELEMENTS OF SOLID WASTE MANAGEMENT
Handling and segregation of wastes at source. Collection and storage of municipal solid wastes; analysis of Collection systems. Transfer stations. Solid waste processing technologies: Mechanical and thermal volume reduction, Biological and chemical techniques for energy and other resource recovery, composting, vermicomposting, fermentational. Incineration of solid wastes. Disposal in landfills: site selection, design, and operation of sanitary landfills; Leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Regulatory aspects of municipal solid waste management, Plastic waste management.
UNIT III: HAZARDOUS WASTE AND MANAGEMENT
Hazardous waste definition. Physical and biological routes of transport of hazardous substances – sources and characterization. Sampling and analysis of hazardous wastes –proximate analysis – survey analysis – directed analysis - handling, collection, storage and transport. Hazardous waste treatment technologies: TSDF concept - Physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation, encapsulation, pyrolysis and incineration. Hazardous waste land fills - Site selections, design and operation. HW reduction, recycling and reuse fly ash bricks, Regulatory aspects of HWM/HWM rules.
UNIT IV: BIOMEDICAL AND RADIOACTIVE WASTE MANAGEMENT
Classification, collection, segregation Treatment and disposal. Radioactive waste: Definition, Low level and high level radioactive wastes and their management, Radiation standard by ICRP and AERB
UNIT V: E-WASTE MANAGEMENT

Waste characteristics, generation, collection, transport and disposal, regulatory aspects of e waste, Global strategy, recycling.
Books Recommended 1. Hazardous waste management Charles A. Wentz. Second edition 1995. McGraw Hill International. 2. Integrated solid waste management George Tchobanoglous, Hilary Theisen&Sammuel A. Vigil. 3. Criteria for hazardous waste landfills – CPCB guidelines 2000. 4. Hazardous waste management by Prof. Anjaneyulu. 5. Environmental Sciences by Daniel B. Botkin and Edward A. Keller, Wiley student, 6th edition- 2009. 6. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997. 7. Management of Solid waste in developing countries by FrankFlintoff , WHO regional publications 1976

Course Title	**INSTRUMENTAL METHODS OF ANALYSIS**		
Course code	**1EMTPE01**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective – I**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**To develop a basic knowledge about the analytical errors and uncertainties and basic principle, operation and applications of pH meter, Conductivity meter and ion selective electrodes **CO2:** understand the principles, operation and applications of UV-VIS and Infra red spectrophotometer **CO3:** understand the principles, operation and applications of AAS and atomic emission spectrophotometer **CO4:** understand the principles, operation and applications of chromatographic techniques(GC,HPLC, GCMS,LCMS) **CO5:** understand the principles, operation and applications of U.V flourimetry, laser fulorimetry, scintillation counters, α, β counters, gamma spectrometry.		

UNIT I INTRODUCTION:

Type of Instrumental methods of Analysis – accuracy, precision, types of errors Uncertainties in Instrumental measurements – Sensitivity and detection limit for instruments. Measurement of pH and Conductivity, Ion selective electrodes

UNIT II UV- VISIBLE SPECTROSCOPY INFRARED SPECTROSCOPY:

Electromagnetic spectrum- frequency - wave number– Absorptivity – deviations from Beer's law – single & double beam spectrophotometer - Instrumentation –Photometric accuracy – Qualitative and quantitative analysis.

Infrared spectroscopy – Theory, Instrumentation & applications.

UNIT III ATOMIC ABSORPTION AND EMISSION SPECTROSCOPY:

AAS- Principle – Instrumentation – Interference – applications;

ICP-Theory, Instrumentation & applications; Flame photometer-Principle Instrumentation and applications.

UNIT IV CHROMATOGRAPHY:

Column, ion exchange, TLC, GLC, HPLC, GCMS, LCMS: Principles and applications, Instrumentation: detectors, columns, injectors - temperature programming- isocratic and gradient programming - qualitative and quantitative analysis

UNIT V RADIOACTIVE TECHNIQUES:

Radio activity- Half life decay, U.V flourimetry, laser fulorimetry, scintillation counters, α, β counters, gamma spectrometry.

Books Recommended

1. **R.A. Day** 7 A.L. Underwood, Quantitative analysis, Prentice-Hall of India Pvt. Ltd., 1985.
2. Skoog & West, Fundamentals of Analytical Chemistry, 1982.
3. Hobert H. Willard, D.L. Merrit& J.R.J.A. Dean, Instrumental methods of analysis, C.B.S Publishers and Distributors, 1992.
4. Vogel, Textbook of quantitative inorganic analysis, 1990.
5. Ewing, Instrumental Methods of Chemical Analysis, 1992, Mc Graw Hill
6. Instrumental Methodology of Analysis by Chatwal Anand, Himalaya Publishing House.
7. Separation chemistry (2006), R.P Budhiya, PP424. New age international (p) Ltd.

Course Title	**ECOLOGY AND NATURAL RESOURCES**		
Course code	**1EMTPE01**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective – I**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Describe fundamental processes that shape ecosystem structure and function in forests, range lands and aquatic systems **CO2:** Analyze and anticipate ecosystem response to disturbance and management activities **CO3:**Identify science-based management practices to address common ecological challenges **CO4:**Manipulate and interpret ecological data from natural resource systems.		

UNIT I CONCEPT OF ECOSYSTEM:

Definition, Concept of a system; Biotic, abiotic and ecological systems. structure, functions and classification of ecosystems. Ecological pyramids.

Ecological energetic: Flow of energy through food chains and food webs; Laws of thermodynamics; entropy, Law of tedith; ecological efficiency; food chain concentration. Biogeochemical cycles or Nutrient Cycles: General considerations of recycling; Gaseous and sedimentary cycles; rates of turnover and turnover time. Causes and consequences of disruption of nutrient cycles with reference to Greenhouse gases and SO_x. Hydrological cycle.

UNIT II POPULATION ECOLOGY:

Concept of a species and definition of a population. Biological and group attributes of populations. Density, natality, mortality, migrations and growth of populations. Natural regulation of populations. Human population explosion and its consequences.

UNIT III NATURAL RESOURCES:

Classification of natural resources, biotic resources; Renewable and non-renewable resources: mutable and immutable resources; Different types of resources and their natural sources. Demographic quotient; rate of consumption and depletion. Value system, equitable resource use.Soil formation and soil erosion; Changes in land use and land cover pattern; conservation of soil and nutrients.Water resources: Distribution, exploitation, depletion of water resources; conservation of water; water use efficiency; water poverty index.

UNIT IV MINERAL AND LAND RESOURCES:

Distribution and exploitation; environmental implications of mining; strategies for conservation of mineral resources, land evaluation and suitability, land use/land cover mapping, LU/LC for Environmental Planning.

UNIT V ENERGY RESOURCES:

Renewable and non-renewable resources energy; Alternate and additional sources of energy; depletion of energy resources; Conservation of energy resource; Energy use efficiency. Solar radiation and its technological ways of harvesting; Solar collectors, photovoltaic, solar ponds; Hydroelectric power, Tidal, Ocean Thermal Energy Conversion, Wind, Geothermal Energy, Nuclear energy-fission and fusion, Hydrogen & Fuel cells.

Books Recommended

Fundamentals of Ecology by EP odum, WB Saurders& Co.
Environment and Natural Resources conservation by Trivedi R.K.
Remote sensing in Geology to Seigal, John wiely 1999

Course Title	**1ENVIRONMENTAL GEOMATICS**		
Course code	**1EMTPE02**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Geomatics		
Course type	**Program Elective – II**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:** Validate Air and space borne sensors with respect to spectral and radiometric resolutions. Appraise satellite navigation systems, outer space explorations, chadrayan and Mangalyan. **CO2:**Formulate spectral information in estimation of vegetative indexes, precision agriculture, and crop and forest management. **O3:**Illustrate role of remote sensing and GIS in Geological mapping, and identification of spectral signature on mining. **CO4:**Assess crop type classification and estimates, watershed impact on soil erosion and water quality modeling. **CO5:**Analyze spectral response on upland and wetland vegetation ecosystem, urban and municipal solid waste studies.		

NIT I: SENSORS AND SATELLITES

SENSORS AND PLATFORMS

i. Introduction, satellite system parameters- instrumental and Viewing, Sensors- Active and passive, classification, sensor parameters- spatial, spectral and radiometric resolutions
ii. Platforms- Airborne and Space borne, constraints of satellite geometry, effects of the local environment, common orbits and details of elevation angle and ground area, types of Scanners

TELLITE PROGRAMS

i. INSAT series, IRS series, RADAR imaging satellites, other satellites, GAGAN & IRNSS satellite navigation system
ii. Extra terrestrial exploration- chandrayaan-1 and 2 &Mangalayaan, International cooperation of ISRO, future projects of ISRO

UNIT II: SPECTRAL INFORMATION FOR SENSING VEGETATION & APPLICATIONS

ECTRAL INFORMATION FOR SENSING VEGETATION

i. Estimation of Vegetation Cove: Spectral Indices -Vegetation indices and vegetation descriptors.
ii. Microwave vegetation indices- estimation of vegetation using Lidar.

INTEGRATED APPLICATIONS

i. Detection and diagnosis of plant stress.
ii. Precision agriculture and crop management
iii. Ecosystems and Forestry Management.

UNIT III: SOIL SCIENCES

i. Role of Remote sensing and GIS in geological studies and case studies. Evaluation of Geological Mapping
ii. Introduction to Prospection Techniques, History of Remote Sensing in Geological

	Exploration. Image Lineaments and structural origin, Prospecting, Applications of thermal and Radar remote sensing in structural geology.
iii.	Spectral response of Minerals, Rocks, Alterites, case studies
UNIT IV: WATER RESOURCES, AGRICULTURE AND FORESTRY	
i.	The hydrological cycle, Hillslope hydrology, the drainage basin, Channel networks, Automatic derivation of catchment characteristics, the global cycle.Ground water exploration and targeting Introduction, Characteristics, Watershed and people, Watershed characteristics, watershed management and Integrated approach for sustainable planning. Water quality modeling. Watershed Management in India, Case studies.
ii.	Soil and altitude, Soil and aspect, Soil and slopes, Soil landscapes, Soil erosion modeling.
iii.	Crop type classification, area estimates, and spectral response of different crops. Crop diseases and Assessment, Crop and Water management and monitoring. Advances in Crop monitoring.
UNIT V: RESPONSE OF ECOLOGICAL FACTORS AND IMPACT STUDIES, MODELLING	
i.	Spectral response of vegetation and mapping, Ecosystem Analysis, Environmental impact analysis and monitoring, Ecosystem modeling,
ii.	Wetland mapping.
iii.	Urban growth studies
iv.	Municipal solid waste studies
v.	Land use land cover change detection studies
vi.	Spatial Models of Ecological Systems and Process

Books Recommended

1). M.Anji Reddy, Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.

2). Principles of Remote sensing, An introductory Text book by the international institute for Geo Information sciences and Earth Observation (ITC).

3). Satellite Technology: Principles and Applications, 2nd Edition, Anil K. Maini, Varsha Agrawal ISBN: 978-1-119-95727-0694 pages, June 2011.

course Title	**GEOMATICS FOR DISASTER RISK REDUCTION & MANAGEMENT**		
Course code	**1EMTPE02**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective – II**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:**Relate definitions, levels of disaster risks and phenomena. **CO2:**List Disaster trends at Global and regional levels, differentiate natural and manmade disasters. **CO3:** Compare disaster risk vulnerabilities, hazard mapping prevention and mitigation of disasters. **CO4:** Assess impact of climate change, Biodiversity loss on desertification and disasters. **CO5:** Evaluate Disaster Management Policy, organizational frame work in preparation of disaster management plans.		

UNIT I: UNDERSTANDING ECOSYSTEM AND DISASTER PHENOMENA
Concept and definitions and functions of different terms of disaster and Ecosystem, Approaches to understand disaster phenomena (natural science, applied science, progressive and holistic approaches), Parameters of Disaster Risk, Levels of disaster as per national guideline.
UNIT II: OVERVIEW, CLASSIFICATION, CHARACTERISTICS, PROBLEM AREAS OF DISASTERS
Disaster trends (Global, national and regional),Selected models for understanding the causes of disaster and disaster risk mitigation, Classification of hazards (natural and manmade),Response time, frequency, forewarning, exposure time of different hazards, General characteristics and problem areas of different natural and man-made hazards (e.g. flood, erosion, earthquake, landslide, lightning, tropical cyclone, drought, civil unrest etc.),Common approaches to study natural and manmade hazards; vulnerability and disasters.
UNIT III: DISASTER RISK MITIGATION
Disaster risk assessment (Hazard-Vulnerability-Capacity analysis), Hazard mapping and forecasting; Principles and aspects of Disaster prevention, Disaster mitigation, Preparedness for damage mitigation and coping with disasters; Capacity building for disaster/damage mitigation (structural and non-structural measures); Contingency planning for damage mitigation of different hazards; Relevance of indigenous knowledge, appropriate technology and local resources in disaster risk mitigation; Community based disaster risk reduction mechanism; Counter disaster resources and their roles.
UNIT IV: ENVIRONMENT AND DISASTERS
Environment, ecosystem and disasters. Climate change – issues and concerns. Biodiversity loss and DRR; Global water crisis and DRR; Desertification, soil erosion and DRR; ecosystems for urban risk reduction; Industrial hazards and safety measures; Post disaster impact on environment; Impact of developmental projects on disaster risk; Aspects of environmental management for disaster risk reduction; Environmental Impact Assessment (EIA).
UNIT V: PLANNING FOR DISASTER MANAGEMENT
Concept of spatial planning for DRR; Community-hazard profile in India; Different phases of Disaster Management (DM cycle; Relief mechanism (needs assessment, relief administration and

distribution, management of relief centres, external support etc.);Disaster Management Act (2005); Disaster Management Policy (2009); organizational framework for disaster management in India.

Case studies: Hazard mapping of vulnerable areas, Vulnerability assessment (physical, social, organizational, economical, technological), Risk mitigation planning for vulnerable areas.

Books Recommended

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
4. National Policy on Disaster Management, NDMA, New Delhi, 2009.
5. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.
6. Parasuraman, S &Unnikrishnan, P. V. (ed.), India Disasters Repot Towards a policy initiative. Oxford, 2000.

Course Title	**GEOMATICS FORCLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT**		
Course code	**1EMTPE02**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective – II**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:** Categorise the role of aerosols and radioactive effects of aerosols on global climate change. **CO2:** Elaborate changes in global climate and evaluate climate change policies **CO3:** Debate the impact of ecosystem, water resources developmental planning and their adaption on climate change. **CO4:** Infer GHG management, inorganic carbon sequestration on mitigation of climate change. **CO5:** Recommend climate modelling and early warning systems using GST towards Sustainable development in view of SDG's		

UNIT I: INTRODUCTION TO CLIMATE CHANGE

i. Introduction to atmospheres: vertical structure and residence time.
ii. overview of aerosols, radioactive effects of aerosols: direct and indirect; scattering and absorbing behaviour of aerosols
iii. Energy budget - and greenhouse effect

Global climate change- Evidences and Observations of climate change; Ice and climate change; Isotope evidence

UNIT II: CLIMATE CHANGE GOVERNANCE , INTERNATIONAL POLICY AND LEGAL FRAMEWORK

i. Global Climate Change Governance
ii. Climate change finance sources : Challenges and opportunities to accessing and managing climate finance
iii. Evaluate climate change policies :
   - UNFCCC and other entities
   - Kyoto protocol
   - Climate negotiations
iv. National scenario: NAPCC, India's commitments (INDCs) and National Communication (NATCOM) initiative

Policies and regulation : Important agencies and organizations

UNIT III: CLIMATE CHANGE IMPACTS AND ADAPTATION

i. Climate Change Adaptation: Importance of adaptation- Adaptation options .
ii. Linkages between climate change adaptation and development planning
iii. approaches to climate change impacts and adaptation practices for :
   - ecosystems,
   - land use,
   - water resources and
   - human health

Green Engineering

UNIT IV: CLIMATE CHANGE MITIGATION

i. Mitigation options :
   - technological and economic mitigation strategies:

ii. Biological and Inorganic Carbon Sequestration

iii. GHG Management

iv. energy system transformation and renewable energy technologies

v. Carbon trading and carbon offsetting. Key sectors for low carbon development

vi. The basic concepts of life cycle assessment (LCA) and Life cycle cost assessment(LCCA), common tools for performing LCA and LCCA

UNIT V: CLIMATE CHANGE EARLY WARNING SYSTEM & SUSTAINABLE DEVELOPMENT

i. Climate modelling global and regional climate models, its applications and importance. Climate change projections.

ii. Climate Prediction and Early Warning System: Tools and Technologies

iii. Preparedness to Climate Change: Geospatial Approach

iv. Human Behaviour and Climate Change, Overview on SDG 2030:

v. Sustainability- need and concept, understanding sustainability and threats,Different types of tools for assessing sustainability in engineering,

References • Business and Climate – UNFCCC • GHG protocol – A Corporate Accounting and Reporting Standard • Kyoto Protocol – UNFCCC • Low carbon inclusive growth – GoI • Making Paris Work (Accepted Manuscript) • Fundamentals of Climate change • IPCC – Climate change Action, Trends and Implications for Business • India-Biennial report to UNFCC – 2015 • Global Warming – Six Indians • IPCC technical guidelines for assessing Climate change impacts and adaptation

TED talks • Can clouds buy us more time to solve climate change https://www.ted.com/talks/kate_marvel_can_clouds_buy_us_more_time_to_solve_climate_change• A critical look at Geoengineering against climate change - https://www.ted.com/talks/david_keith_s_surprising_ideas_on_climate_change • Let's prepare for our new climate(Adaptation) - https://www.ted.com/playlists/78/climate_change_oh_it_s_real

Documentaries • Before the flood (2016) • An inconvenient truth (2006) • National Geographic: Six Degrees Could Change the World (2007) • An Inconvenient Sequel: Truth to Power (2017)

Course Title	**ENVIRONMENTAL POLLUTION MONITORING LAB**		
Course code	**1 EMT03**	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Laboratory - I**		
Course outcomes (COs)	**At the end of course, the student will able to** **CO1:** Analyze and assess the soil quality **CO2:**Collect water samples analyze water and assess the quality of water. **CO3:**Assess the wastewater characteristics and suggest suitable treatment techniques. **CO4:** Collect the ambient air samples and analyze the air samples.		

ANALYSIS OF PHYSICAL AND CHEMICAL PARAMETERS

Physical parameters of soil:

1. Moisture content
2. Bulk density
3. Specific gravity
4. Water holding capacity

Chemical parameters:

1. pH
2. Electrical conductivity
3. Turbidity
4. Hardness – Calcium, Magnesium and total hardness
5. Alkalinity
6. Nitrates, Nitrites and Ammonical nitrogen
7. Phosphates
8. Sulfates by Spectrophotometric Method
9. Residual Chlorine
10. Dissolved Oxygen
11. Fluorides
12. Sodium
13. Potassium
14. Biological oxygen demand / organic matter
15. Chemical oxygen demand
16. Instrumentation analysis-HPLC,GC,AAS

Air Pollution Monitoring:

1. NO_x
2. SO_x
3. Particulate matter

Course Title	ENVIRONMENTAL MICROBIOLOGY LAB		
Course code	1 EMT04	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	Laboratory – II		
Course outcomes (COs)	**After completion of course the students will be able to** **CO1:**understand and perform the different techniques of isolation, identification, cultivation ad enumeration of microorganisms. **CO3:**assess microbiological quality of potable water after performing a suitable experiment potable water, **CO3:** exploit the microorganisms for various sustainable technologies CO4: design and execute and write a report about microbilogical quality or exploitation of microbes for environmental pollution mitigation after literature survey.		

General techniques of Microbiology

1) General techniques of Microbiology
   Media preparation
   Sterilization
   Inoculation
   Cultivation of microorganisms
   Isolation of microorganisms
   Preservation of microorganisms
2) Ubiquitous nature of microorganisms.
3) Isolation and enumeration of air-borne bacteria.
4) Effect of $P^H$and temperature on microbial growth
5) Kirby-Bauer test.
6) Crowded plate technique for isolation of antibiotic producing microorganisms
7) Microbial fuel cells for bioelectricity generation.
8) crystal forming bacteria for nutrient recovery from industrial effluents
9) bioaugmentation for composting
10) Microbial concrete
11) Constructed wetlands for waste water treatment
12) Standard plate count.
13) Standard coliform test.
14) Presence absence test.
15) Fecal coliform test.
16) 7hr FC test.
17) Membrane filtration test.
18) Enumeration of coliform bacteria by MPN method.
19) H_2S strip test.

Course Title	**RESEARCH METHODOLOGY & IPR**		
Course code	1A01	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**RM & IPR**		
Course outcomes (COs)	**At the end of the course, the student will be able to** **CO1:**Understand research problemformulation. **CO2:** Analyze research relatedinformation, Follow researchethics **CO3:**Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, andcreativity. **CO4**: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering inparticular. **CO5:**Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and socialbenefits.		

UNIT I :

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

NIT II :

fective literature studies approach, analysis Plagiarism, Research ethics,

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT III:

ture of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV:

tent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V:

w Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Books Recommended

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineeringstudents'"

2. Wayne Goddard and Stuart Melville, “Research Methodology: AnIntroduction”
3. Ranjit Kumar, 2 nd Edition, “Research Methodology: A Step by Step Guide forbeginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd,2007.
5. Mayall , “Industrial Design”, McGraw Hill,1992.
6. Niebel , “Product Design”, McGraw Hill,1974.
7. Asimov, “Introduction to Design”, Prentice Hall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”,2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand,2008

Course Title	**ENGLISH FOR RESEARCH PAPER WRITING**		
Course code		No. of credits	00
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Audit Course I**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:**Understand that how to improve writing skills and level of readability **CO2:**Learn about what to write in each section, **CO3:**Understand the skills needed when writing a Title Ensure the good quality of paper at very first-timesubmission **CO4**: establishing the skills needed for the result/ report framing. **CO5:**Visualize the research article quality.		
UNIT I :			
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness			
NIT II :			
Clarifying Who DidWhat, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.			
UNIT III:			
key skills are needed when writing a Title, key skills are needed when iting an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,			
UNIT IV:			
lls are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions			
UNIT V:			
eful phrases, how to ensure paper is as good as it could possibly be the first- timesubmission			
Books Recommended 1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. 1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011			

M. TECH. -ENVIRONMENTAL MANAGEMENT
COURSE STRUCTRURE
I YEAR

II SEMESTER

Course Title	**AIR POLLUTION & CONTROL TECHNOLOGIES**		
Course code	**2 EMT 05**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Core**		
Course Outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**List the air pollutants, their resources, effects and can explain about the turbulence and reasons for Indoor air pollution **CO2:**Explain atmospheric dispersion equation and calculate the ground concentration of the pollutants due to stack emissions. Student will be able to explain the ambient air sampling and stack sampling techniques **CO3:**List and describe and explain the design criteria for different air pollution control techniques **CO4:**Explain the pollution emissions from two stroke and four stroke engines and the type of fuel and air pollution, existing vehicular pollution control technologies and need for improvement **CO5:**Explain about sources of noise pollution, impact of meteorological aspects on noise preparation and the noise measurement and control techniques		

UNIT I: CLASSIFICATION AND PROPERTIES OF AIR POLLUTANTS
Emission sources -major emissions from Global sources -importance of anthropogenic sources-behaviour and fate of air pollutants- photochemical smog effects of air pollution health, vegetation and materials damage in India air pollution standards -different types of terrain – effects of terrain features on atmosphere – mechanical and thermal turbulence- Indoor air pollution.
UNIT II: METEOROLOGICAL ASPECTS OF AIR POLLUTION DISPERSIONS
Temperature lapse Rates and Stability, wind velocity and turbulence, Plume behaviour dispersion of air pollutants- solutions to the atmospheric dispersion equation - the Gaussian Plume Model. Air pollution sampling and measurement- types of pollutant sampling and measurement- Ambient air sampling- collection of gaseous air pollutants- collection of particulate pollutants- stock sampling, analysis of air pollutants-sulphur dioxide- nitrogen dioxide, carbon monoxide, oxidants and ozone-hydrocarbons and particulate matter (Suspended particulate matter(SPM), $PM_{10,}$ $PM_{2.5,}$ PM_{1}), Air pollution modelling.
UNIT III: CONTROL METHODS
Sources- correction methods-particulate emission control- gravitational settling chambers- cyclone separators- fabric filters- electrostatic precipitators- wet scrubbers-control of gaseous emissions-adsorption by solids- absorption by liquids- combustion, condensation – control of SO_2 emission –

desulphurization of flue gases – dry methods – wet scrubbing methods. Control of sulphur dioxide emission- desulphurization of flue gases- dry methods- wet scrubbing methods- control of nitrogen oxides- modification of operating conditions- modification of design conditions- effluent gas treatment methods- carbon monoxide control- control of hydrocarbons.

UNIT IV: VEHICULAR AIR POLLUTION

Genesis of Vehicular emissions- Natural Pollution- Gasification of Vehicles- Point sources of Air Pollution from automobiles- Fuel tank, carburettor, crank case- Exhaust emissions- Mechanism of Origin of air pollution from automobiles. Automobile air pollution – Indian Scenario- Population and pollution loads of vehicles- Automobile Pollution Control- Control at sources- Exhaust gas treatment devices- Alternate fuels comparison- Thermal Reactor- Catalytic Converter- Automobile Emission Control- Legal measures.

UNIT V: NOISE POLLUTION

Sources of noise pollution – measurement of noise and indices – effect of meteorological parameters on noise propagation- noise exposure levels and standards – noise control and abatement measures – impact of noise on human health.

Books Recommended

1. Air Pollution, H.C.V.Rao, 1990, McGraw Hill Co.
2. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
3. Air Pollution, M.N.Rao McGraw Hill 1993.

Reference Text Books:

4. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing Co.
5. Air Pollution, Kudesia, V.P. International Student Edition McGram-Hill-KosakushaLtd.,Tokyo.
6. Fundamentals of Environmental Pollution, Krishnan KhannanS.Chand& Company Ltd.,1994
7. Environmental Air Analysis, Trivedi&Kudesia, Akashdeep Pub.1992
8. Air Pollution Control and Engineering, De Nevers, McGraw- Hills, 1993
9. Energy Technology and the Environment AtilioBisio, Sharan Boots, Wiley Encyclopaedia Series in Environmental Science
10. Noise Pollution -VandanaPandey, Meerut Publishers,1995

Course Title	**WATER AND WASTE WATER ENGINEERING**		
Course code	**2 EMT 06**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Core**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Describe the different unit operations that are used in water treatment based on the water sources **CO2:**Access the quality of effluent and design the biological treatment system **CO3:**Describe the tertiary treatment techniques and decide which treatment technique is feasible based on the quality of effluent **CO4:**Differentiate between water and sewage treatment unit operations along with the characteristics **CO5:**Illustrate the different industrial processes, its effluent characteristics and appropriate treatment scheme		

UNIT I: WATER POLLUTANTS AND TREATMENT

Types and Sources, quality of water (water, sewage and industrial wastewater), various stages of water treatment flocculation and coagulation, Sedimentation, Filtration: slow and rapid sand filters, disinfection.

UNIT II: WASTEWATER TREATMENT

Characterization and degree of treatment-Self purification in a stream, characteristics of waste water and treatment plant effluents, Dissolved oxygen, Esturine pollution **Primary treatment**: Screening, Grit removal, Neutralization, Equalization, Coagulation, Flocculation, Sedimentation, Flotation (oil & grease removal), Air stripping**Secondary treatment**- principles of waste treatment, basic kinetic equations, continuous flow treatment models, oxygen requirement in aerobic process, production of sludge. Conventional biological process: Activated Sludge Process (ASP), UASB, Trickling Filters and RBC, ***Nitrogen removal***: Nitrification and denitrification process, phosphorous removal. Low cost wastewater treatment: Aerated lagoons, stabilization ponds, oxidation ditches.

UNIT III: TERTIARY TREATMENT OF WASTEWATER

Tertiary treatment-ion exchange, ***Membrane separation Techniques***: Brief description of MF, UF, NF membranes. Reverse osmosis principle, Membrane materials, Types of membranes – Plate & frame, tubular, hollow fibre, spiral wound membranes, application of membranes in various industrial applications., ***electro chemical techniques***: electro dialysis, electro coagulation,***Evaporators***: forced evaporation, Multiple effect evaporators – falling film, raising film, forced circulation, agitated thin film driers. Advanced oxidation process, photo catalysis, Ozonation, Fenton process, Hydrodynamic cavitation.

UNIT IV: SEWAGE TREATMENT AND DISPOSAL

Introduction, importance of sewage, Characteristics of sewage, Sewage treatment and disposal: Grit chamber, Sedimentation tanks, Secondary treatment: Activated sludge process, sludge digestion. Sludge disposal. Septic tank.

UNIT V: INDUSTRIAL WASTEWATER TREATMENT

Sources, Characteristics, methodology and process for the treatment of industrial wastes of sugar industry- beverage industry- tannery industry- textile mill waste industry- fertilizer plant- steel plant- oil refinery-paper and pulp mill. Legislation, Cleaner technologies: Water conservation, By-product recovery, Zero liquid discharge (ZLD).

Books Recommended

1. Water Supply and Sanitary Engineering G.S.Bridie&J.S.Brides, Dhanpat Rai & Sons 1993.
2. A treatise on Rural, Municipal, and industrial water management KVSG Murali Krishna
3. Environmental sanitation (Social and Preventive medicine) Dr.P.V. Rama Raju& KVSG Murali Krishna.
4. Waste water engineering, treatment and reuse by Metcalf and eddy, fifth edition, Tata McGraw Hill.

Reference Text Books:

1. Municipaland Rural Sanitation-Ehlers,V.M. &Steel,E.W.McGRAW-HILLBookCompany,IncV.edition. 1987.
2. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
3. Environmental pollution and Toxicology, MeeraAsthana and Asthana D.K, Alka Printers (1994).

Course Title	BIO REMEDIATION TECHNOLOGIES		
Course code	2EMTPE03	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	Program Elective		
Courseoutcomes (COs)	**On successful completion of the course student will be able to:** **CO1:** define and explain what, when, where, why and how of bioremediation. List out advantages and its application. They will be able to explain the phenomena of biodegradation, acclimation, detoxification, activation, co-metabolism and biotransformation and recalcitrance and their significance in bioremediation. They would be able to explain the concept of bio-availability, the effect of chemical structure on biodegradation and predict biodegradability and the products of biodegradation of any given compound. **CO2:**classify bioremediation into different types, based on different criteria. They will also be able to list and explain different factors which aid or are detrimental to bioremediation and thus identify criteria to be met for bioremediation. They will be able to list explain different methods available for assessing biotreatability and also analyze, differentiate and explain relative advantages, disadvantages and application. **CO3:** list and describe different bioremediation technologies, bringing about the differences between them and practical application. They will be able to suggest suitable bioremediation technologies for specific pollutants/environments. **CO4:** define phytoremediation and explain physical, chemical and biological mechanism of phytoremediation the students will be able to suggest the type of plants/mechanism to be applied for different pollutants/environments. **CO5:** explain how oil pollution can be bioremediated. The students will be able to explain the mechanism of metal bioremediation. The students will be able to outline bioremediation technologies for various inorganic pollutants like arsenic, chromium, selenium, uranium, nitrate, cyanide and mercury.		

UNIT I: INTRODUCTION TO BIOREMEDIATION
What is Bioremediation, Constraints, advantages and applications. Biodegradation, Acclimation, detoxification, activation, cometabolism and biotransformation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation.
UNIT II: TYPES OF BIOREMEDIATION AND FACTORS AFFECTING
Types of bioremediation (definition) - Natural (attenuation) and engineered, ex-situ and in-situ, Bioaugmentation and biostimulation, solid phase and slurry phase bioremediation. Criteria to be met for considering bioremediation- factors affecting bioremediation, treatability studies for bioremediation.
UNIT III: SPECIFIC BIOREMEDIATION TECNOLOGIES

Application, Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, biofilters, biotricking filters, bioscrubbrers, bioreactors for bioremediation.

UNIT IV: PHYTOREMEDIATION

What is phytoremediation? Basic physiological processes involved, Mechanism of Phytoremediation, Phytosequestration, Phytovolatilisation (evapotranspiration): Phytodegradation: Rhizofiltration: Phytoextraction, PhytostabilizationPhytotransformation, Phytomining. Maintenance of hydraulic control using deep rooted tree systems. Constructed wetlands.

UNIT V: BIOREMEDIATION OF OIL SPILLS AND METALS

Bioremediation of oil pollution, advantages and limitations. Biostimulation, Bioaugmentation. Microbial inoculants. Bioremediation of metals and other inorganic pollutants: Biosorption and bioaccumulation, Reduction, Solubilization/Oxidation, Precipitation, Methylation, Individual pollutants (arsenic, chromium, selenium, uranium, nitrate, cyanide, and mercury)

Books Recommended

Reference Text books:

1. Bioremediation 1994. Baker, K.H and Herson, D.S.McGraw Hill, Inc. New York
2. Biotreatment of Industrial & Hazardous Waste 1993, M.V.Levin&Gealt, M.A McGraw Hill. Inc.
3. Biodegradation and Bioremediation 1999 (2nd editon). Martin Alexander, Elsevier Science & Technology.
4. Environmental Microbiology 2001. Raina M. Maier, Ian L. Pepper, Academic Press.

Bioremediation engineering.. J.T.Cookson, Mc.Grwhill Inc.

Course Title	**CONTAMINANT TRANSPORT IN ENVIRONMENTAL SYSTEMS**		
Course code	**2EMTPE03**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Explain the role of modeling in environmental sciences and management, it's advantages and limitations; **CO2:**be familiar with main principles and approaches to modeling surface and ground water modeling and software **CO3:**explain the salt water intrusion **CO4:**be familiar with main principles and approaches to air pollution modeling **CO5:**be familiar with air pollution modeling softwares		

UNIT – I: WATER QUALITY AND MODELLING

Groundwater Occurrence: Groundwater hydrologic cycle, origin of groundwater, rock properties effecting groundwater, vertical distribution of groundwater, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention. Groundwater Movement: Permeability, Darcy's law, storage coefficient. Transmissivity, differential equation governing groundwater flow in three dimensions, groundwater flow equation in polar coordinate system. Groundwater flow contours their applications.

UNIT – II: WATER QUALITY AND MODELLING

Groundwater Quality. Groundwater Modelling: Groundwater Flow, Transport and transformation of contaminants in groundwater: processes, formulation of the governing equations and initial and boundary conditions, solutions for simple cases. Groundwater Basin Management: Concepts of conjunctive use, Case studies.

UNIT – III: SALT WATER INTRUSION

Saline Water Intrusion in Coastal aquifer: Occurrence of saline water intrusions, Ghyben-Herzberg relation, Shape of interface, control of seawater intrusion.

UNIT–IV: INTRODUCTION TO AIR QUALITY MODELING

Necessity, application and limitation of air quality modelling. Introduction to Dispersion Modeling, Photochemical Modeling and Receptor Modeling. Different air quality Dispersion models and their limitations.

UNIT –V: AIR QUALITY MODELS

Gaussian convection-diffusion model for point, line and areal sources. Introduction to commonly used Air quality models such as AERMOD, CALPUFF, CALINE4, ISCST3 models and CMAQ (CMAQ: The Community Multiscale Air Quality Modeling System). The Weather Research and Forecasting (WRF) Model.

Books Recommended

1. Air Quality Modeling: Theories, Methodologies, Computational Techniques, and Available Databases and Software, Anfossi
2. Planning and managing regional air quality (Modeling and measurement studies)**Author** Solomon, P.A.Publisher : Lewis Publishers
3. An Introduction to Water Quality Modelling by James , 2nd Edition, published by Wiley.
4. Water Quality Modeling: Rivers, Streams, and Estuaries

By R. Manivanan, New India pyblishing.

Course Title	**HIGHER NUMERICAL ANALYSIS**		
Course code	**2EMTPE03**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	Upon successful completion of this course, it is expected that students will be able to: **CO1:** Be aware of the mathematical background for the different numerical methods introduced in the course. **CO2:** Understand the different numerical methods to solve for the roots of the algebraic equations and to solve system of linear and non-linear equations. **CO3:** Understand the different numerical methods for interpolation, differentiation, integration and solving set of ordinary and partial differential equations. Use the built in functions in MATLAB and EXCEL.		

UNIT I:
Errors in numerical calculations - Accuracy of approximate calculations. Solution of Algebraic Equations equations – Bisection method, method of false position, Iteration method, Newton Raphson method. Solution to system of Nonlinear equations – method of iteration, Newton-Raphson method.
UNIT II:
Interpolation – Errors in polynomial interpolation, Finite differences – forward differences, Backward differences, central differences. Least squares Curve fitting procedures – fitting a straight line, multiple linear least squares, curve fitting by polynomials.
UNIT III:
Numerical Differentiation – Errors, Cubic splines method, Differentiation formulae with Function values.Numerical integration – trapezoidal rule, Simpsons 1/3 rule, Simpsons 3/8 rule. Numerical integration with different step sizes.
UNIT IV:
Numerical solution of ordinary differential equation – Taylor's series Picard's method, Euler's method, Runge-Kutta method. Finite difference methods, Predictor corrector methods, Cubic spline method, Boundary value problems
UNIT V:
Finite Element method – Introduction, Methods of approximations, Application, Finite element method. Examples in MATLAB.
Books Recommended 1. Introductory Methods of Numerical Analysis Paperback – 2012 Sastry S.S

Course Title	**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**		
Course code	**2EMTPE04**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:** Direct, Indirect, cumulative and induced environmental impacts at Regional, sectoral and project level. **CO2:** Data products, thematic maps, collateral data in planning and management of baseline data acquisition. **CO3:**Screening of environmental clearance, for category B&B2 industries and feasibility studies. **CO4:** Predicting impact of Air, Water, Noise, Socio economic status on environment. **CO5:** Environmental management plans on emission controls and green belt development and hazardous wastes.		

UNIT I: CONCEPTUAL FACTS OF EIA

Introduction, Definition and Scope of EIA, Objectives in EIA, Basic EIA Principles, Classification of EIA: Strategic EIA (SEIA),
Regional EIA, Sectoral EIA, Project Level EIA and Life Cycle Assessment, Project Cycle, Grouping of Environmental Impacts: Direct Impacts, Indirect Impacts, Cumulative Impacts and Induced Impacts. Significance of Impacts: Criteria/Methodology to Determine the Significance of the Identified Impacts

UNIT II: BASELINE DATA ACQUISITION, PLANNING AND MANAGEMENT OF IMPACT STUDIES

Environmental Inventory, Data Products and Sources: thematic data, topographical data, collateral data and field data. Environmental Baseline Monitoring (EBM), Preliminary Study to determine impact significance, Environmental Monitoring network Design, Monitoring Stations, Air quality data acquisition, Water Quality data acquisition, soil data, socioeconomic data and biological data acquisition. Impact on Environmental Components: Significance of Impacts, Criteria to determine the significance of the identified Impacts.
Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Study Management, Fiscal Control

UNIT III: OPERATIONAL ASPECTS OF EIA AND METHODS FOR IMPACT IDENTIFICATION

Screening: Application for Prior Screening for Environmental Clearance, Screening Criteria; Category A Projects, Category B Projects, Criteria for Classification of Category B1 and B2 Projects, Consistency with other Requirements and Siting Guidelines. Scoping: Identification of Appropriate Valued Environmental Components (VEC), Identification of Impacts, Information in Form 1, Structure of a Pre-feasibility Report. Public consultation: Appraisal, Decision Making, Post-clearance Monitoring Protocol.
Background Information, Interaction-Matrix Methodologies: simple matrices, stepped matrices, development of a simple matrix, other types of matrices, summary observations on matrices, Network Methodologies: Checklist methodologies, simple checklists, descriptive Checklists, summary observations on simple and descriptive Checklists.

UNIT IV: PREDICTION OF IMPACTS (AIR-WATER- NOISE- BIOLOGICAL AND SOCIO-ECONOMIC)

a) Air Environment: Basic information on air quality, Sources of Pollutants, effects of pollutions, Conceptual approach for addressing air environment impacts, Air quality standards, Impact Prediction, Impact significance.

b) Water Environment: Basic Information on surface-Water Quantity and Quality, Conceptual Approach for Addressing Surface-Water-Environment Impacts, Identification of Surface-Water Quantity or Quality Impacts, Procurement of Relevant Surface-Water Quantity-Quality Standards, Impact Predictions, Assessment of Impact Significance.

c) Noise Environment: Basic Information on Noise Key Federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts, Identification of Noise Impacts, Procurement of Relevant Noise Standards and/or Guidelines, Impact Prediction, Assessment of Impact Significance.

d) Biological Environment: Basic Information on Biological Systems, Conceptual Approach for Addressing Biological Impacts, Identification of Biological Impacts, Description of Existing Biological Environment Conditions.

e) Socio-Economic Environment: Procurement of Relevant Legislation and Regulations, Impact Prediction, Assessment of Impact Significance.

UNIT V: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Case Study, identification of Impacts, EMP for Air Environment: Dust Control Plan, Procedural Changes, Diesel Generator Set Emission Control Measures, Vehicle Emission Controls and Alternatives, Greenbelt Development. EMP for Noise Environment, EMP for Water Environment: Water Source Development, Minimizing Water Consumption, Domestic and Commercial Usage, Horticulture, Storm Water Management. EMP for land Environment: Construction Debris, hazardous Waste, Waste from temporary Labour settlements.

Books Recommended

1. Textbook of Environmental Science & Technology by M.Anji Reddy, BS Publications, 2010
2. Technological guidance manuals of EIA. MoEF.
3. Environmental Impact Assessment by Harry W. Canter, McGraw Hill, 1996, 2nd edition.
4. Man and Environment D.H.Carson 1976 Interactions Part I and III.
5. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications
6. Erickson, P.A.1979 Environmental Impact Assessment Principles and applications
7. Basic Concepts in Remote Sensing & Arial Photogrammetry Lillesand&KeiferPrintice Hall Intl., 1994.
8. Renewable Energy: environment and development, MaheswarDayal, Konark Publishers, 1989..

Course Title	**ENVIRONMENTALGEO STATISTICS**		
Course code	**2EMTPE04**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Describe how basic statistical methods can be used to describe and analyse environmental data **CO2:**calculate position and deviation measurements **CO3:**analyze correlation between variables **CO4:**analyze differences in frequencies **CO5:**.analyze differences in mean values **CO6:** estimate the basis for statistical tests and when necessary perform transformations of data.		

UNIT I: INTRODUCTION AND FREQUENCY DISTRIBUTION:

Types of proof, Generality of Applications of statistics, Examples of statistical problems
Raw data, Arrays, Frequency Distributions, Class interval and Class limits ,Class boundaries, Size ,width of a class interval ,class mark, general rules for forming frequency distributions,
Histograms and frequency polygons, relative frequency distributions, cumulative frequency distributions and 0gives, Relative cumulative-frequency distribution and percentage 0gives, frequency curves and smoothed 0gives,types of frequency curves

UNIT II: MEASUREMENTS AND THEIR ANALYSIS:

Introduction, Sample Versus Population, Range and Median, Graphical Representation of Data, Numerical Methods of Describing Data, Measures of Central Tendency, Standard deviation and other measures of Dispersion.

UNIT III: RANDOM ERROR THEORY AND CONFIDENCE INTERVAL:

Introduction, Theory of Probability, Properties of the Normal Distribution Function, Probability of the Standard Error, Uses of Percent Errors, Moments, Skewness and Kurtosis
Introduction, Distributions used in Sampling Theory, Confidence Interval for the Mean, Sampling, its uses, some sampling distributions, Analysis of Variance.

UNIT IV: CORRELATION AND REGRESSION:

Curve fitting and the method of Least squares, Correlation theory, Multiple and partial correlations, Linear regression, Multiple regression, R^2, regression modeling.

UNIT V: STATISTICAL TESTING AND STATISTICAL ANALYSIS :

Tests of significance, Chi-square and F-test, Non parametric tests, t-tests.
Analysis of Time series, Statistical Process control and Process capability

Books Recommended

1) Theory and Problems of STATISTICS by Murray R. Spiegel and Larry J. Stephens, 7th edition, Mc. Graw Hill, 2007.
2). Basics Statistics by B.L.Agarwal, 4 th edition, New age International Publications, 2006.
3). Introduction to statistical Analysis by Wilfred J. Dixon and Frank J. Massey JR, 2nd edition, Mc.GrawHill, 1957.

Course Title	**PROKARYOTIC DIVERSITY AND BIO-PROSPECTING**		
Course code	**2EMTPE04**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Program Educational Objectives(PEOs)	Students will be exposed to the basic and applied science of microorganisms in their environment. Students will develop an understanding of: • To make students learn about prokaryotic diversity and discovery of novel antimicrobial compounds from them through hands on experience involving research. • To provide knowledge and training in diverse isolation techniques for prokaryotes including the new approaches. Provide knowledge and hands on experience on screening techniques for the production of antimicrobial compounds.		
Program outcomes (POs)	Up on completion of course the student will be able toCarryout guided research involving isolation, purification, identification of prokaryotes and screening them for antimicrobial activity against pathogen surrogates will develop interest in science and scientific research.		

UNIT I: Isolation and purification of microorganisms: Conventional methods.
Media preparation and various types of media, Sterilization, Inoculation- different inoculation devices, Incubation, Isolation and purification using Streak plate, Spread Plate and Pour plate, Cultivation of microorganisms –Plate cultures, Stroke cultures, stab culturesroll tube culture, Shake culture etc , use of diverse media and culture conditions, Preservation of microorganisms
UNIT II: Isolation and purification of microorganisms: New Approaches.
Great plate count anamoly& enrichment bias. Specific methods devised for isolating"uncultured microorganisms in pure culture, community culture and coculture, high through put methods eg. diffusion chambers, I chip, microbial trap, micropipette holder plate, use of optical tweezers, high throughput microbioreactor single cell isolation, use of genomic information and preparation of smart media etc. .
UNIT III: CHARACTERIZATION, IDENTIFICATION AND DESCRIPTION OF NEW TAXA OF PROKARYOTES
Polyphasic characterization: Ecological,cultural, morphological, physiological, biochemical and genetic characterization.Taxogenomics, Diagnostic features.Bacterial nomenclature, etimology in nomenclature of prokaryotes. Bacteriological code, valid and effective publication of description of newtaxa
UNIT IV: Screening for antimicrobial activity
Sample collection, Dilution plating of soil sample, Solid versus liquid culture, Picking and Patching Colonies, Choosing ESKAPE Pathogens, Screening for isolate with antibiotics production- Patch/Patch, Spread/Patch, Top Agar, Identification and characterization of antibiotic producing isolates
UNIT V: Separation, isolation and identification of antimicrobial compounds.
Organic molecules, secondary metabolites, Extraction of secondary metabolites, extraction using organic solvents, chromatographic methods, Assessing the antibiotic resistance of isolates, Biochemical characterization of organic molecules

Books Recommended

1. Bergey's manual of systematic bacteriology.
2. Review articles. From:
   a) Annual Review of microbiology
   b) Adv. Microbial physiol.
   c) FEMS microbial reviews.
   d) Bacterial reviews.
   e) Int. J. Systematic and Evolutionary microbiology.
3. The Prokaryotes. 7 volumesSpringer's, New York.
4. The prokaryotes. An evolving electronic resource for the Microbiological community. – Springer – verlag, New York.
5. The latest edition of *Tiny Earth: A Research Guide to Student sourcing Antibiotic Discovery* and *Tiny Earth: Instructor Guide*

Course Title	**ENVIRONMENTAL GEOMATICS LAB**		
Course code	**2EMT07**	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Laboratory**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Master and apply methods of interpreting and analyzing remote sensing data. **CO2:**Use GIS to identify, explore, understand, and solve spatial problems Demonstrate GIS modeling skills. **CO3:**Demonstrate critical thinking skills in solving geospatial problems. Design and implement a GIS project. **CO4:** Use queries in GIS Analysis Formulate applications of GIS technology.		

1. Study of toposheet and base map preparation;
2. Description of satellite and sensor details of the imagery used for thematic mapping;
3. Land use / land cover map preparation;
4. Field visits for finalization of land use / land cover map and soil map;
5. Scanning / digitization of maps;
6. Digital image display; image enhancement;
7. Image registration
    a. Ground Control points from toposheets (GCP)
    b. Geo referencing
8. Image classifications for land use / land cover using ERDAS, PCI Geomatica and ENVI.

Digital Mapping: GIS Software, ARC GIS and Geo-Server.

Course Title	**WATER & WASTE WATER TREATMENT LAB**		
Course code	**2EMT08**	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Laboratory**		
Courseoutcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Demonstrate different physico, chemical and biological treatment techniques **CO2:**Choose appropriate tailor mode treatment techniques for different effluent streams **CO3:**Experiment to find suitable low cost treatment scheme **CO4:**Think on cost economics for wastewater treatment. **CO5:**Choose the treatment method for ZLD system and also for recovery of materials		

Water and waste water treatment methods

1. Coagulation
2. Softening
3. Mixing and Flocculation
4. Chlorinating and Disinfection
5. Defluoridation
6. Hardness removal by lime soda process
7. Reverse Osmosis

Unit operations for wastewater treatment

1. Trickling filter
2. Activated Sludge
3. Rotating biological contractor
4. Anaerobic digester
5. UASB
6. Adsorption
7. Ion exchange

Course Title	**MINI PROJECT WITH SEMINAR**		
Course code	**2A04**	No. of credits	02
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Mini Project with Seminar**		
Course outcomes (COs)	**the end of the course, the student will be able to** **CO1**: Students will get an opportunity to work in actual industrial environment if they opt for internship. **CO2:** In case of mini project, they will solve a live problem using software/analytical/computational tools. **CO3:** Study different techniques used to analyze complex systems **CO4:** Students will learn to write technical reports. **CO5:** Students will develop skills to present and defend their work in front of technically qualified audience.		

The mini project will be based on the work done during the industrial training/internshipof two months provided during semester break.

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done

1. Along with the report on identification of topic for the workand
2. The methodology adopted involving scientific research, collection and analysis ofdata,
3. Determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

Course Title	**ENGLISH FOR RESEARCH PAPER WRITING**		
Course code		No. of credits	00
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Audit Course II**		
Course outcomes (COs)	**At the end of the course, The student will be able to** **CO1:**Understand that how to improve writing skills and level of readability **CO2:**Learn about what to write in each section, **CO3:**Understand the skills needed when writing a Title Ensure the good quality of paper at very first-timesubmission **CO4**: establishing the skills needed for the result/ report framing. **CO5:**Visualize the research article quality.		
UNIT I :			
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness			
NIT II :			
Clarifying Who DidWhat, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.			
UNIT III:			
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,			
UNIT IV:			
lls are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions			
UNIT V:			
eful phrases, how to ensure paper is as good as it could possibly be the first- timesubmission			
Books Recommended 4. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks) 5. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress 6. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. 2. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011			

M. TECH. -ENVIRONMENTAL MANAGEMENT
COURSE STRUCTRURE
II YEAR /

III SEMESTER

Course Title	**WATER SUPPLY ENGINEERING AND HYDROLOGY**		
Course code	**3EMTPE05**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Program Educational Objectives(PEOs)	To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain and computer application on design.		
Program outcomes (POs)	**CO1:**On Completion of the Course the student will Be able to select various pipe materials for water supply main, distribution network and sewer **CO2 :**Be able to design water supply main, distribution network and sewer for various field conditions **CO3:**Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network.		

UNIT I: GENERAL HYDRAULICS AND FLOW MEASUREMENT
Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.
UNIT II: WATER TRANSMISSION AND DISTRIBUTION
Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps-characteristics- economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.
UNIT III: WASTEWATER COLLECTION AND CONVEYANCE
Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.
UNIT IV: STORM WATER DRAINAGE
Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods
UNIT V: CASE STUDIES AND SOFTWARE APPLICATIONS
Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

Books Recommended

1. Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003
2. “Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. “Manual on Sewerage and Sewage Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

Course Title	**MICROBIAL DIVERSITY FOR ENVIRONMENTAL MANAGEMENT**		
Course code	**3EMTPE05**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Explain the necessity for renewable sources of energy need for energy production from waste and non-conventional fuels like methane (biogas) hydrogen and ethanol **CO2:**Explain various mechanisms of microbial augmentation of oil recovery, overcoming problems in secondary oil recovery. Students will be able to explain the role of microorganisms can play in biodiesel production and also in transesterification of vegetable oils. Students will be able to explain the mechanism, limitations and application of bioelectricity generation through microbial fuel cells. **CO3:**Explain the role of microorganisms and mechanism of transformation accumulation concentration and leaching of metals. Specific application of microbes in copper and uranium extraction will be explained Exploitation of microbes as single cell protein will be explained. They will be able to analyze relative advantages and limitations of different groups of microorganisms for use as SCP. **CO4:**Explain various mechanisms in which microorganisms help plants by providing nutrients like Nitrogen, Phosphorous and also by helping in their uptake. They will be able to list out microbes which can be applied as biofertilizers and biopesticides. They will be able to explain the mechanism of biological control. They will be able to suggest appropriate biofertilizers and biocontrol agents for different crops/soils. **CO5:**Explain the importance of 1PR in encouraging innovation and disclosure in biotechnology. They will be able to list out different types of 1PR, explain their significance and applicability of growth cure. They will be able to calculate doubling time and growth rate. They will predict conditions for varying lag period-both nutritional and environmental. They will be able to explain compare and differentiate between batch and continuous culture. Students will be able to predict how to achieve synchronous culture and explain their application in microbiological studies.		

UNIT I: DIVERSITY OF MICROORGANISMS

Eukaryotic and prokaryotic cell structure. Prokaryotes and eukaryotes. General characters, beneficial and harmful effects of major groups of microorganisms, protozoa, algae, fungi, bacteria and viruses.

UNITII: MICROBIAL BIOFUELS-1
Scope and importance Renewable sources, energy from waste materials, production of non-conventional fuels – methane (biogas), hydrogen and ethanol.
UNIT III: BIO FUELS 2
Use of microorganisms in petroleum augmentation and recovery; Bio-diesel from microbial sources. Microbial fuel cells.
UNIT IV: METAL BIOTECHNOLOGY
Microbial transformation, accumulation and concentration of metals, metal leaching, extraction; Exploitation of microbes in copper and uranium extraction.
UNIT V: BIO FERTILIZERS AND BIOLOGICAL CONTROL
PGPR bacteria, general mode of action of plant growth promoting microorganisms, Biofertilizers - Biological nitrogen fixation, phosphate solubilization,VAM fungi and crop productivity, Biological control-Microbial insecticides, (Microorganisms like *Bacillus* species, viral insecticides, certain fungi like *Metarhiziumanisopliae*). Biocontrol of plant pathogens. Microorganisms and mechanisms involved-amensalism, competition, predation and parasitism, antibiosis, siderophore production; Integrated Pest Management.
Books Recommended Elements of biotechnology 2001. P.K.Gupta, Rastogi. Rastogi publication. 2. Industrial microbiology- L. E. Cassida, Wiley Eastern publishers. 3. Industrial Microbiology-Prescott and Dunn. 4. Microbial Biotechnology 2007 (2^{nd} Ed)-Glazer, A.N. and Nikaido; Freeman and company. **Reference Books:** 5. Biotechnology – A new industrial revolution PrentisS.Orbis Publishing Ltd., London. 6. Review articles published in annual reviews, current opinion in microbiology etc. R.C. critical reviews in microbial. 7. Review articles in Adv. Microbial physiol; Adv. Appl microbial; Bacteriol reviews, microbial reviews etc.

Course Title	**ENERGY AND ENVIRONMENT**		
Course code	**3EMTPE05**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Program Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Give the information on energy demand and the contribution by each energy source worldwide. Can also explain about the different energy generation processes. **CO2:**Describe the present status of bio-fuels and also how to produce various bio-fuels like bio ethanol, bio-hydrogen, biogas and biodiesel etc **CO3:**Correlate the role of energy in economic development and also can explain about major treaties and energy polices worldwide. **CO4:**Give the data on Indian energy scenario and major acts related to energy conservation Act, electricity Act, Central and state electricity regulatory commission, National solar mission. **CO5:**Explain the environmental problems associated with different forms of energy production.		

UNIT I: ENERGY RESOURCES

Coal, Oil, Natural Gas, Nuclear Power and Hydroelectricity, Solar, geothermal, tidal and wave energy. Depletion of energy sources and impact, exponential rise in energy consumption on economies of countries and on international relations. Need for use of new and renewable energy sources. Status of Nuclear and Renewable Energy: Present Status and future promise, Hydrogen and fuel cell, Waste as a source of energy: Industrial, domestic and solid waste as a source of energy.

UNIT II: BIO FUELS

What are biofuels? Need, Advantages and limitations of biofuels. Debates regarding the production and use of biofuels. first, second, third and fourth generation biofuels. Production and impacts of bioethanol, biohydrogen, biogas, bioelectricity and biodiesel.

UNIT III: GLOBAL ENERGY SCENARIO

Role of energy in economic development and social transformation: Energy & GDP, GNP and its dynamics. Exponential increase in energy consumption and Projected future demands - International Energy Policies of G-8 Countries, G-20 Countries, OPEC Countries, EUCountries. International Energy Treaties (Rio, Montreal, Kyoto), INDO-US Nuclear Deal. Future Energy Options: Sustainable Development, Energy Crisis: Transition from carbon rich and nuclear to carbon free technologies.

UNIT IV: INDIAN ENERGY SCENARIO

Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption, Impact of Energy on Economy, Development and Environment, Need for use of new and renewable energy sources. Status of Nuclear Energy. Energy, Energy Conservation Act-2001 & its features, Electricity Act-2003 & its features. Framework of Central Electricity Authority (CEA), Central & States Electricity Regulatory Commissions (CERC & ERCs) , Jawaharlal Nehru National Solar Mission.

UNIT V: IMPACT OF ENERGY SYSTEMS ON ENVIRONMENT

Environmental degradation due to energy production and utilization, Primary and Secondary pollution such as SOx, NOx, SPM in air, thermal and water pollution, depletion of ozone layer, global warming, Green House Gases Emission, biological damage due to environmental degradation. Sociological and Economical problems due to Thermal and other energy projects. Physiological, ecological and environmental and health problems due to energy plants. Effect of Hydro electric power stations on ecology and environment. Environmental pollution limits guidelines for thermal power plant- Various pollution control equipments, Limitations and advantages of pollution control systems. Nuclear power plants and environmental pollution, pollution control measures. Pollution due to vehicles and Control emission from Vehicles

Books Recommended

1. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A.K.N.Reddy, Robert Williams (Wiley Eastern).
2. Energy policy for: B.V.Desai (Weiley Eastern).
3. TEDDY Year Book Published by Tata Energy Research Institute (TERI).
4. World Energy Resources: Charles E. Brown, Springer2002.
5. Environmental Impact Analysis Handbook -J.G.Rau, D.C.Wood (McGraw Hill).
6. Energy & Environment – J.M. Fowler, (McGrawHill)
7. Web site of Ministry of New and renewable energy.

Course Title	**ENVIRONMENT HEALTH & SAFETY**		
Course code	**3EMTOE**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Open Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:G**ive reasons for accident occurrence, how to investigate and report the accident and explain the responsibilities of safety officer. **CO2:**Explain about the industrial best work practices regarding machine guarding, occupational health, material handling and hazards storage practices etc. **CO3:**Give the causes for fire, describing the emergency preparedness and explain about prevention techniques of fire. **CO4:**Analyze the environmental stress in industries **CO5:**Explain the salient features of occupational safety management standards and Acts.		

UNIT I: INTRODUCTION TO SAFETY & HEALTH MANAGEMENT

Sequence of Accident Occurrence, Occupational Injuries-Effects of Industrial Accidents, Analysis of Accidents, Injury Data, Accident Investigations & Reporting, Accident Costing, Employer & Employee Responsibilities, Record-keeping & Reporting Requirements, Safety Organization, Responsibilities of Safety Officer, Supervisors, Safety committees.

UNIT II: WORK PRACTICES & BEST PRACTICES IN INDUSTRIES

Hazards in Chemical Operations, Material Handling Hazards, Lifting Machinery & Pressure Vessels, Material Safety Data Sheets, Classification of Chemicals, Hazardous Chemicals, Storage Practices, Radiation Safety, Petroleum Storage Requirements, Pesticide Safety, In Electrical, Mechanical, Fire, Machine Guarding, Personal Protective Equipment, Occupational Health, Ergonomics Ambulance, Noise Abatement Methods, Management Of Contractors.

UNIT III: FIRE SAFETY

Basic Elements, Causes, Industrial Fires, Explosions, Effect On Environment, Property & Human Loss, Prevention Techniques, Building Design, Fire Protection Systems, Contingency Plan, Emergency Preparedness, Evacuation.

UNIT IV: RISK MANAGEMENT&INDUSTRIAL HYGINE

Definitions of Hazards, Risks, Evolution of Methodical Analysis, System safety Analysis techniques, Performance measurement, Operational Reviews - Internal & External. **Environmental stresses**: physical, chemical, biological and ergonomic stresses, Principles of industrial hygiene, Overview of control measures. Permissible limits. Stress, Exposures to heat, Heat balance, Effects of heat stress, WBGT index measurement, Control Measures. Chemical agents, IS/UN classification, Flammables, Explosives, Water sensitive chemicals, Oxidants, Gases under pressure, Chemicals causing health hazards: irritants, asphyxiates, anaesthetics, systemic poisons and carcinogens, Chronic and acute exposure, Routes of entry, Types of airborne contaminants, Introduction to air sampling and evaluation methods, Occupational exposure limits, Engineering control measures, Principles of ventilation.

UNIT V: OCCUPATIONAL SAFETY MANAGEMENT STANDARDS & ACTS
Central Acts, Factory's Act, AP Factory Rules, Construction Safety Regulations, Petroleum Rule 2002, Electrical Act & Rules, Indian Standards, OHSAS 18001 Standard and its Elements, CE Certificate, Social Accountability Standards, System Implementation, Benefits.
Books Recommended 1. Industrial safety and health, David L. Goetsch, Macmillan Publishing Company, 1993. 2. Handbook of environmental health and safety, Vol I & II, Herman Kooren, MichaelBisesi, Jaico Publishing House, 1999.

Course Title	**WASTE TO ENERGY**		
Course code	**3EMTOE**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Open Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Students should able to classify the wastes as a fuel **CO2:**Students should able to understand types of pyrolysis **CO3:**Students should able to know the different types of Biomass Gasification **CO4:**Student should able to understand the Biomass Combustion **CO5:** Student should able to analyze the biogas plant design and types of biogas plant		

UNIT I: INTRODUCTION TO ENERGY FROM WASTE:

Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digesters.

UNITII: BIOMASSPYROLYSIS:

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields andapplication – Manufacture of pyrolytic oils and gases, yields and applications.

UNITIII: BIOMASSGASIFICATION:

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bedgasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifierengine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNITIV: BIOMASSCOMBUSTION:

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

UNITV: BIOGAS: PROPERTIESOFBIOGAS(CALORIFICVALUEANDCOMPOSITION)

Biogas plant technology and status - Bioenergy system - Design and constructional features - Biomass resources and their classification – Biomassconversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis andliquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications – Alcoholproduction from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energyprogramme in India.

Books Recommended

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata
3. McGraw Hill Publishing Co. Ltd., 1983.

Reference Text Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Title	**3. ENERGY AUDIT**		
Course code	**3EMTOE**	No. of credits	03
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Open Elective**		
Course outcomes (COs)	**At the end of the course, the Student will be able to** **CO1:**Demonstrate the types of energy and their production, consumption and Future strategies of energy role in climate change. **CO2:**Examine the Basics of electricity and its demand along with thermal energy production and effects. **CO3:**Estimate the energy audit practices along with Energy consumption reducing appliances and their efficiency like CFL & LED **CO4:**Assess the energy systems and process flow. Explain the energy monitoring and targeting. **CO5:** Evaluate the energy management systems, designing, marketing strategies.		

UNIT I: ENERGY SCENARIO

Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment: Air Pollution, Climate Change, Energy Security, Energy Conservationand its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.

UNIT II: BASICS OF ENERGY AND ITS VARIOUS FORMS

i. Global Climate Change Governance

Electricity basics - DC & AC currents, Electricity tariff, Load management and Maximum demand control, Power factor.Thermal basics -Fuels, Thermal energy contents of fuel, Temperature & Pressure, Heatcapacity, Sensible and Latent heat, Evaporation, Condensation, Steam, Moist air and Humidity & Heat transfer, Units and conversion

UNIT III: ENERGY MANAGEMENT & AUDIT

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Light Emitting Diode (LED) and Compact Fluorescent Lights (CFL), Fuel and energy substitution, Energy audit instruments

UNIT IV: MATERIAL AND ENERGY BALANCE

Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams
Energy Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM)

UNIT V: ENERGY ACTION PLANNING

key elements, force field analysis, energy policy purpose, perspective,contents, formulation, ratification, organizing- location of energy management, top management support, managerial functions, roles and responsibilities of energy manager, accountability, motivating-motivation of employees, information systems- designing barriers, strategies, marketing and communicating-training, and planning - Financial Management

M. TECH. -ENVIRONMENTAL MANAGEMENT
COURSE STRUCTRURE
II YEAR

III &IV SEMESTER

Course Title	**DISSERTATION - I & II**		
Course code		No. of credits	16
Centre/ Department	Centre for Environment , IST, JNTUH		
Program	M. Tech : Environmental Management		
Course type	**Dissertation Phase I & II**		

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

1. Ability to synthesize knowledge and skills previously gained and applied to an indepth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
2. Relevance to value addition to existing facilities in the institute
3. Relevance to industry need
4. Problems of national importance
5. Research and development in various domain

The student should complete the following:

1. Literature survey Problem Definition
2. Motivation for study and Objectives
3. Preliminary design / feasibility / modular approaches
4. Implementation and Verification
5. Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them.

It may be based on:

1. Experimental verification / Proof of concept.
2. Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work

Guidelines for Dissertation Phase – I and II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P co-coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include Springer/Science Direct. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – Ievaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be Published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – IIdeliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

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