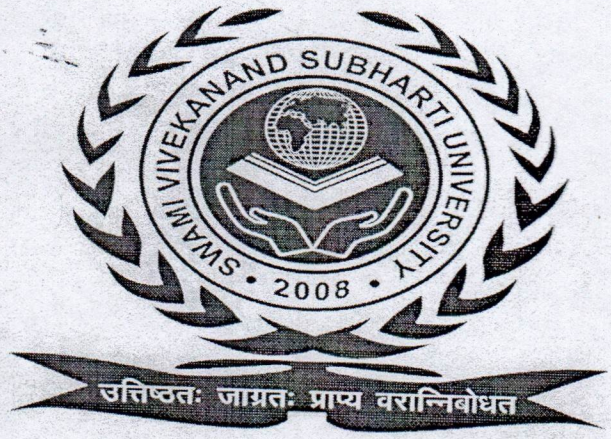
# ORDINANCE No. V (42A) (B9)

# Master of Technology (M.Tech)

# Environmental Engineering & Management

## (Syllabus Effective From 2023-24)




SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING

DEPARTMENT OF ENVIRONMENTAL ENGINEERING

(FACULTY OF ENGINEERING AND TECHNOLOGY)

Swami Vivekanand Subharti University Meerut, Uttar Pradesh

(Established under the UP Act No. 29 of 2008 & approved under Section 2 (f) of UGC Act, 1956)

Manoj Kapil

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

UGC Approved Meerut

*Where Education is a Passion ...*

ACCREDITED WITH GRADE A NAAC

# Syllabus of M.Tech Environmental Engineering and Management (EEM)



**Department of Environmental Engineenring**

**Subharti Institutre of Technology and Engineering (SITE)**

**Swami Vivekanand Subharti University, Meerut-250005**

**M.TECH (Environmental Engineering and Management)**

**W.E.F ACADEMIC SESSION 2018-19**

**LIST OF ELECTIVE, OPEN ELECTIVE AND AUDIT COURSES**

**PROGRAM CORE COURSE (PCC)**

1. ENERGY & ENVIRONMENT (MEEM–101)
2. WATER SUPPLY SYSTEMS (MEEM-102)
3. ENVIRONMENTAL POLICY & IMPACT ASSESSMENT (MEEM-103)
4. AIR SAMPLING & TESTING LAB (MEEM-151)
5. UNIT OPERATIONS & PROCESSES (MEEM-201)
6. WATER & WASTE WATER TREATMENT (MEEM -202)
7. SOLID & HAZARDOUS WASTE MANAGEMENT (MEEM-203)
8. WATER SAMPLING & TESTING LAB (MEEM-251)
9. WATER & SEWAGE TREATMENT (MEEM-301)
10. AIR POLLUTION CONTROL (MEEM-302)
11. MINOR PROJECT (MEEM-353)
12. PHASE-II DISSERTATION (MEEM-451)

**List of Electives:**

**PROGRAM ELECTIVE-1 (PE-1)**

1. ENVIRONMENT SANITATION HEALTH & HYGIENE (MEEM-111)
2. BIOMEDICAL ENGINEERING (MEEM-112)
3. WATER RESOURCES MANAGEMENT (MEEM-113)
4. INDUSTRIAL EMISSION CONTROL SYSTEMT (MEEM-114)
5. NATURAL RESOURCES AND BIODIVERSITY (MEEM-115)
6. ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY(MEEM-116)
7. WASTE TREATMENT SYSTEMS (MEEM-117)
8. ENVIRONMENTAL POLICY (MEEM-118)
9. INDUSTRIAL WASTE MANAGEMENT (MEEM-119)

**PROGRAM ELECTIVE-1 (PE-2)**

1. ENVIRONMENTAL BIOTECHNOLOGY (MEEM-211)
2. ENERGY AND CLIMATE CHANGE (MEEM-212)
3. ENVIRONMENTAL REMOTE SENSING AND GIS (MEEM-213)
4. ENVIRONMENTAL BIOREMEDIATION TECHNOLOGY (MEEM-214)
5. ENVIRONMENTAL MICROBIOLOGY (MEEM-215)
6. ADVANCED WATER AND WASTEWATER TREATMENT TECHNIQUES (MEEM-216)
7. ENVIRONMENTAL MANAGEMEN (MEEM-217)
8. INSTRUMENTATION (Spectrometry & Chromatography) (MEEM-218)

**OPEN ELECTIVE COURSES (OPC)**

1. QUALITY SYSTEM MANAGEMENT (MEEM-001)
2. ENERGY AND GREEN TECHNOLOGIES (MEEM-002)
3. INDUSTRIAL SAFETY (MEEM-003)
4. CLIMATE CHANGE AND CURRENT ISSUES (MEEM-004)
5. ENVIRONMENTAL AUDITING (MEEM-005)

## Audit course I & II

METC-111/ METC-211: English for Research Paper Writing

METC-112/ METC-212: Disaster Management

METC-113/ METC-213: Sanskrit for Technical Knowledge

METC-114/ METC-214: Value Education

METC-115/ METC-215: Constitution of India

METC-116/ METC-216: Pedagogy Studies

METC-117/ METC-217: Stress Management by Yoga

METC-118/ METC-218: Personality Development through Life Enlightenment Skill

# EVALUATION SCHEME

## FIRST SEMESTER

| SEMESTER I | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN | Course Code | Course Title | Course Type | Periods | | | CCA | | | | ESE | | Total | Credit |
| | | | | L | T | P | CT | AT | Total | PS | TE | PE | | |
| 1 | MEEM - 101 | Energy & Environment | PCC-1 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 2 | MEEM - 102 | Water Supply Systems | PCC-2 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 3 | MEEM - 103 | Environmental Policy & Impact Assessment | PCC-3 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 4 | MEEM – (111-119) | Elective-I | PE- 1 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 5 | MEEM - 151 | Air Sampling & Testing Lab | PCC-4 | 0 | 0 | 8 | - | - | - | 30 | - | 70 | 100 | 4 |
| 7 | METC-101 | Research Methodology and IPR | MC-1 | 2 | 0 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 2 |
| 8 | METC-111-METC-118 | Audit-I | MC-2 | 2 | 0 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 0 |
| TOTAL | | | | | | | | | | | | | 700 | 18 |

## SECOND SEMESTER

| SEMESTER II | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN | Course Code | Course Title | Course Type | Periods | | | CCA | | | | ESE | | Total | Credit |
| | | | | L | T | P | CT | AT | Total | PS | TE | PE | | |
| 1 | MEEM - 201 | Unit Operations & Processes | PCC-5 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 2 | MEEM - 202 | Water & Waste water Treatment | PCC-6 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 3 | MEEM - 203 | Solid & Hazardous Waste Management | PCC-7 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 4 | MEEM –(211-218) | Elective-II | PE- 2 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 5 | MEEM - 251 | Water Sampling & Testing Lab | PCC-8 | 0 | 0 | 8 | - | - | | 40 | - | 60 | 100 | 4 |
| 8 | METC-211-METC-218 | Audit- II | MC-3 | 2 | 0 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 0 |
| TOTAL | | | | | | | | | | | | | 600 | 16 |

# THIRD SEMESTER

| SEMESTER III | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN | Course Code | Course Title | Course Type | Periods | | | CCA | | | | ESE | | Total | Credit |
| | | | | L | T | P | CT | AT | Total | PS | TE | PE | | |
| 1 | MEEM - 301 | Water & Sewage Treatment | PCC-9 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 2 | MEEM - 302 | Air Pollution Control | PCC-10 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| 3 | MEEM - 353 | Minor Project | PROJ | 0 | 0 | 16 | - | - | - | 30 | - | 70 | 100 | 8 |
| 4 | MEEM – (001-005) | Open elective | OEC-1 | 3 | 1 | 0 | 20 | 10 | 30 | - | 70 | - | 100 | 3 |
| TOTAL | | | | | | | | | | | | | 400 | 17 |

# FOURTH SEMESTER

| SEMESTER IV | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN | Course Code | Course Title | | Periods | | | CCA | | | | ESE | | Total | Credit |
| | | | | L | T | P | CT | AT | Total | PS | TE | PE | | |
| 1 | MEEM-451 | Phase-II Dissertation | PROJ | 0 | 0 | 32 | - | - | - | 100 | - | 300 | 400 | 16 |
| TOTAL | | | | | | | | | | | | | 400 | 16 |

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## FIRST SEMESTER

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: ENERGY AND ENVIRONMENT** **Code: MEEM-101**

***Objective:*** *To cover the technological and scientific aspects of energy and environment questions including energy conservation, Papers covering energy related aspects of wider environmental questions are included.*

**Unit 1:** Environment and its component, biosphere 2, Energy sources and their impact on environment, Laws of energy, Future energy option and challenges.

**Unit 2:** **Wind Energy:** Origin of wind, quantification of wind energy in India, wind energy conversion systems, introduction to wind mill and wind electric generators.
**Hydro-Power:** Introduction, hydro-power generation, hydro-power potential in India, Micro, Mini & Mega-power projects potential & prospects.
**Geothermal Energy:** Introduction and nature of geothermal fields, geothermal energy, Physics of geothermal resources, Technology for exploiting geothermal resources, Potential and prospects in India.

**Unit 3:** Characteristics of solar radiation, solar radiation measurement, solar energy conservation techniques: Solar collectors Photo-Voltaics: Principle of solar cell, Physics of semiconductor junction, Hierarchy of PV system, development of amorphous silicon solar cells technology, application of solar photovoltaic for lighting and water pumping

**Unit 4:** **Bio-Energy:** Biomass potential and production in India, biomass conversion processes. Introduction of biogas plant, biomass gasifies and smokeless chullah Energy from fossil fuels: Sources, properties, production & processing.
Tidal Energy: Introduction and principle of tidal power generation, potential and prospects of tidal energy in India.

**Unit 5:** **Major alternative fuels:** Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), Methanol, Ethanol and Hydrogen as a fuel, Biofulels .Energy Conservation & Economics: Principles of energy conservation and its impact on environment, energy conservation approaches/techniques, energy auditing and economic assessment.

***Outcomes:***
*Developments of knowledge in the specific field of practice*
*Working effectively and confidence improvement*
*Use the proper decision tools to critically, analytically, and creatively solve problems and drive results*

**Reference Books:**


1. Renewable energy by Godfrey Boyle
2. Renewable energy by N.K. Bansal
3. Non-Conventional energy system by K.M. Mittal
4. Renewable energy Sources and their environmental impact by S.A. Abbasi & Nassema Abbasi
5. Non-Conventional energy by Ashok K Desai
6. Energy by Hinrices R.A. & Kleinbach, M
7. Energy by Jeffrey Gordon
8. Green Energy by Ajit Verma & Basant Behera

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: WATER SUPPLY SYSTEMS** **MEEM-102**

***Objective:*** *Identify The Sources And Quantity Of Surface And Ground Water Bodies And Their Demand For The Public And Also To Study The Quality Of Water And Their Treatment Techniques.*

**Unit 1:** Necessity and Objectives of Public Water Supply Schemes, Planning and Financing, Water Requirements, Continuous and Intermittent Supply, Water Demand, Variations in Rate of Demand, Its Effect on water table, Estimating the Quantity of Water Required.

**Unit 2:** **Hydrological Concepts and Sources of Water:** Hydrological Concepts, Hydrological Cycle, Sources of Water intakes, Types of intakes, Infiltration Galleries, Infiltration Well, Types of Wells, Sanitary Protection of Wells.

**Unit 3:** **Quality of Water and Transportation of Water:** Quality of Water, Portable Water and Mineral Water, Contamination of Water, Sampling Techniques, Physicochemical and Bacteriological analysis of Water, Water Borne Diseases, quality standards for drinking and wastewater, Transportation of Water.

**Unit 4:** **Purification of Water:** Working Principles of all the Unit Process of Water Treatment, Settling Operation, Softening, Filtration, Disinfection, Desalination, Dissolved Solids Removal, Adsorption and Ion Exchange, Electrolysis, Osmosis. Groundwater Remediation, Sorption and other chemical reactions, Flow and transport in the Unsaturated Zone.

Water Harvesting: Types of storage structures, water yield from catchments, runoff diversion, pond and reservoirs, earth embankments.

**Unit 5:** **Other Treatments and Distribution of Water:** Removal of Iron and Manganese, Fluoridation and defluoridation, Distribution of Water :Planning, Methods of Distribution, Service Reservoirs, Requirements of Good Distribution System, Layout of Distribution System, Net Work Analysis, Preventive Methods To Reduce Wastage of Water,

***Outcomes:*** *The Students Completing the Course Will Have*
*An Insight into The Structure Of Drinking Water Supply Systems, Including Water Transport, Treatment And Distribution*
*An Understanding of Water Quality Criteria And Standards, And Their Relation To Public Health,*
*The Ability to Design And Evaluate Water Supply Project Alternatives On Basis of Chosen Selection Criteria*

**Reference Books:**


1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2001
2. Punmia B.C, Arun K. Jain, Ashok K. Jain, "Water Supply Engineering" Lakshmi Publication Private Limited, New Delhi, 1998.
3. Birdie G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai And Sons, 1991.
4. Fair. G.M., Geyer. J.C., "Water Supply And Wastewater Disposal", John Wiley And Sons, 1954.
5. Babbit. H.E, and Donald. J.J, "Water Supply Engineering", McGraw Hill Book Co, 1984.
6. Steel. E.W. et al., "Water Supply Engineering", Mc Graw Hill International Book Co, 1984.
7. Duggal. K.N., "Elememts of Public Health Engineering", S. Chand and Company Ltd, New Delhi, 1998.
8. Mark J. Hammer & Mark J. Hammer Jr., "Water and Waste Water Technology", Prentice Hall Of India Pvt. Ltd., New Delhi, 2008.
9. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill., 1984
10. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: ENVIRONMENTAL POLICY AND IMPACT ASSESSMENT** **Code: MEEM-103**

***Objective:*** *The Environmental Impact Assessment EIA is very important for preventing environmental degradation and promoting a sustainable society. Its objective of course is to consider environmental protection properly by understanding a procedure for the EIA of a projects and the assessment results in the decision-making.*

**Unit 1:** Introduction to EIA: Definition and objectives of EIA, purpose of EIA, terminology, hierarchy in EIA, basic data collection for EIA Legislation and framework: EIA legislative requirements and administrative procedures in India/Indian States, EIA notification of MOEF, 2006 National Environmental Policy Act and implementation

**Unit 2:** Public participation in environmental decision making: Regulatory requirements, techniques, advantages and disadvantages of public participation, managing a public hearing Impact assessment techniques and methodology: Description of the environmental setting, methods of impact analysis, environmental risk assessment, baseline data collection Prediction and assessment of impacts: Air, Gaussian plume model for air pollution assessment, water, noise, biological, cultural and socio-economic damage. Case studies of EIA for Industries: Oil, petrochemical, fertilizer, sugar and distilleries, mining industries (iron and steel, cement industry) Case studies of development: Roads, dams and housing, denial cases for development projects based on EIA clearance.

**Unit 3:** Environment Management Plan: Planning, selection of appropriate procedures, introduction to budget, minimizing environmental impacts The Environmental Audit: Environmental auditing and its importance, types of audits, general audit methodology and basic auditing structure, 1SO14000 requirements of Rule 14 for Environmental Audit under Environmental Protection Act of 1986, definitions of. Consumption audits, pollution audits, hazardous issues audits, voluntary audits.
Case studies: Thermal power plant, refineries and water reservoir.

**Unit 4:** Environmental Policy and Laws: Common environmental laws, their historical perspective & constitutional provision for environmental protection. Some laws for environmental protection e.g. Water (Prevention and Control of Pollution) Act 1974; Air (Prevention and Control of Pollution) Act, 1981, Environmental (Protection ) Act, 1972, Forest Conservation Act, 1980; National Forest Policy Act 1988; Wild Life (Protection) Act, 1972, Public Insurance & Liabilities Act, 1991.

**Unit 5:** Environmental Convections and Treaties: Stockhome Conference, The Rio Earth Summit, 1992; Convection on climate change; Agenda-21; Montreal Protocol, Kyoto Summit, 1997; World on sustainable development, 2002; Movements (Chipko, Apiko and Khejarli Ka Khadana).

ISO 14000: Environmental Management Plan: The evolution of Environmental Management Standards, ISO 14000 implementation, preparation of documentation, internal auditing compliance, Eco-labeling communication to the public.

***Outcomes***

*Developments of knowledge in the specific field of practice*
*To understand Environmental laws, different regulations policies and/or Executive orders related to Physical, Chemical, and Biological, Cultural.*
*To understand the interpretation of existing environmental conditions It provides a basis for interpreting the anticipated impact of the Project.*

**Reference Books:**


1. Larry W. Canter: Environmental Impact Assessment
2. Glasson T: Environmental Impact Assessment
3. Petter Morris: Environmental Impact Assessment
4. Eceleston, C.H.: Environmental Impact Assessment
5. Paras Dewan: Environmental Administration Law & Judicial Attitude
6. K.c.Aggarwal: Environmental Law
7. Revesy . R., Sands, P & Stewarts, B: Environmental Law and sustainable Development
8. Khanna, P.: Primer on Environmental Management

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: Air Sampling & Testing Lab** **Code: MEEM- 151**

***Objective:*** *laboratory is to determine the quality of air characteristics .The laboratory course will help the students to understand the concepts learned in the course.*

1. Estimation of SPM (Suspended Particulate Matter)
2. Estimation of Sulphur dioxide
3. Estimation of oxides of nitrogen
4. Respirable particulate matters ($PM_{10}$ and $PM_{2.5}$)
5. Estimation of Ozone
6. Estimation of Carbon mono-oxide
7. Estimation of hydrocarbons

***Outcomes:***

*Students have been taught the lab experiments as per syllabus.*
*Practical Knowledge of field*

**Reference books:**


1. Air Pollution Control by Johnson
2. Dynamics of Environmental Bio-processes by J.B. Snape and I. J. Dunn

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## OTHER ELECTIVE PAPER OF

## FIRTST SEMESTER

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: ENVIRONMENT SANITATION HEALTH & HYGIENE** **Code: MEEM-111**

***Objective:*** *The aim is to improve quality of life of by making them aware of their hygiene situation also give the knowledge about toxicology and occupational diseases and occupational health problems. .*

**Unit 1:** Introduction: Linking Environment and Health , indicator of health, global Health Pattern, Health Programme in India, physiological responses of man to different environmental stresses.

**Unit 2:** Occupational Health: Occupation environment and its relation to health; offensive industries; occupational health hazards associated with some important industries; hazards associated with radiological environment; health safety measures in industries.

**Unit 3:** Sanitation: Water quality parameters, criteria and standards of safe drinking water, pollution water bodies due to domestic and agricultural wastes, water borne diseases; water disinfection techniques; purification of water.

**Unit 4:** Environmental Toxicology and Diseases: Environmental mutagenesis, carcinogenesis, some important diseases viz malaria, schistosomiasis and trypanosomiasis- their epidemiology and control, general methods of vectors of diseases i.e insects and rodents.

**Unit 5:** Health Planning and Management: Objectives and goals, planning cycle management methods and techniques, Health Planning in India, role of International bodies in Health Planning and Management i.e WHO, UNICEF, UNDP, FAO, FAO, ILO, World Bank, and Red Cross, etc. Civil Panning for Health: Construction of hygienic housing, lighting systems, artificial cooling and heating systems, other sanitary provisions such as internal plumbing and sanitation of buildings, efficiency of ventil;ation and lighting of room; problem of indoor pollution.

***Outcomes:*** *Developments of knowledge in the specific field of practice.*
*Working effectively and confidence improvement*
*Use the proper decision tools to critically, analytically, and creatively solve problems and drive results*



**Reference Books:**

1. Nutrition for Health and health care by Whitney and Cataldo
2. Environmental Health by M.T Morgan
3. Textbook of Preventive and social Medicine by J.E Park and K. Park

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*M.Tech (Environmental Engineering & Management)*

**Subject: BIOMEDICAL ENGINEERING** **Code: MEEM-112**

***Objectives:*** *To learn about Specifications of bio-medical instrumentation system To learn about Cardiovascular Measurements To learn about Respiratory system Measurements*

**Unit-1** Introduction: Specifications of bio-medical instrumentation system, Man-Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body. Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses Electrodes and Transducers: Electrode theory, Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes. Biomedical Transducer

**Unit-2** Cardiovascular Measurements: Electrocardiography –ECG amplifiers, Electrodes and Leads, ECG recorders –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators. Patient Care & Monitoring: Elements of intensive care monitoring, displays, diognosis, Calibration & Reparability of patient monitoring equipment.

**Unit-3** Respiratory system Measurements: Physiology of Respiratory system ,Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments: Inhalators, Ventilators &Respirators, Humidifiers, and Nebulizers & Aspirators. Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.

**Unit-4** Ophthalmology Instruments: Electroretinogram, Electrooculogram, Ophthalmoscope, Tonometer for eye pressure measurement.Diagnostic techniques: Ultrasonic diagnosis, Ecocardiography, Eco-encephalography, Ophthalmic scans, X-ray &Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI.

**Unit-5** Bio-telemetry: The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring.Prosthetic Devices and Therapies: Hearing Aides, Myoelectric Arm, Dia-thermy, Laser applications in medicine.

***Outcomes:***

*To understand Specifications of bio-medical instrumentation system – ECG, EEG, EMG, ERG, EOG etc*
*To understand about Cardiovascular Measurements*
*To understand about Respiratory system Measurements*
*To understand about Ophthalmology Instruments*
*To understand about Bio-telemetry*

**REFERENCE BOOKS:**

1. Cromwell- Biomedical Instrumentation and Measurements- PHI

2. Webster,j.g. –Bio- Instrumentation ,Wiley (2004)

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*Course: M.Tech (Environmental Engineering & Management)*

**Subject: WATER RESOURCES MANAGEMENT** **Code: MEEM-113**

***Objectives:*** *understand the basics of water resources planning and management,*

**Unit 1:** Introduction: Water Resources planning, multi-objective planning role in national development, basic concepts of hydrology and hydrogeology. River monitoring, gauging silting, silt load etc.

**Unit 2:** Ground water pollution. National water policy. Water Resources planning and processes: Management of water bodies.

**Unit 3:** Application of Remote-sensing Techniques. Integrated approach – carrying capacity based planning. Water resources conservation: quantity aspects, surface and ground water development,

**Unit 4:** Rainwater harvesting, Ground water Recharge, conjuctive use of ground and surface water Water resources development in coastal areas. Basic concepts of economics, welfare economics.

**Unit 5:** Inter basin transfer of water. EIA of water Resource development projects.

**Outcomes:**

Knowledge of field water resource and management
Knowledge of Remote-sensing Techniques

**Reference Book**

1. Linsley R.K. & Franzini, J.B.; Water resources Engineering. McGraw Hill 1979.

2. Grigg N.S. Water Resources planning McGraw Hill Book company.

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*Course: M.Tech (Environmental Engineering & Management)*

**Subject: INDUSTRIAL EMISSION & CONTROL SYSTEM** **Code: MEEM-114**

***Objective:*** *To develop a basic knowledge about the concept of industrial wastewater management and apply the same in the field application*

**Unit-1:** Industries & Environment: Industrial scenario in India - Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests.

**Unit-2:** Industrial Pollution Prevention: Prevention V/S Control of Industrial Pollution - Benefits and Barriers - Source reduction techniques - Waste Audit - Evaluation of Pollution prevention options - Environmental statement as a tool for pollution prevention - Waste minimization Circles.

**Unit-3:** Treatment Of Industrial Waste Water: Equalisation - Neutralisation - Oil separation - Flotation - Precipitation - Heavy metal Removal - Refractory organics separation by adsorption - Aerobic and anaerobic biological treatment - Sequencing batch reactors - High Rate reactors - Chemical oxidation - Ozonation - Photocatalysis - Wet Air Oxidation - Evaporation - Ion Exchange - Membrane Technologies - Nutrient removal.

**Unit-4:** Management Of Treatment Plants: Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse - Industrial reuse - Disposal on water and land - Residuals of industrial wastewater treatment - Quantification and characteristics of Sludge - Thickening, 17 SRM-M.Tech.-Env. Engg.- 2015-16 digestion, conditioning, dewatering and disposal of sludge - Management of RO rejects.

**Unit-5:** Practical Application In Industries: Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper - Petroleum Refining - Pharmaceuticals - Sugar and Distilleries - Food Processing - fertilizers - Thermal Power Plants and Industrial Estates.

***Outcomes:***

*Develop educate the students on complete management principles related to individual wastewater - starting from wastewater source identification up to reuse concepts.*

**Reference Book**


1. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill, 2001.
2. Arceivala, S.J., "Wastewater Treatment for Pollution Control", Tata McGrawHill, 2008.
3. Frank Woodard,"Industrial waste treatment Handbook", Butterworth Heinemann, New Delhi, 2001.

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**NATURAL RESOURCES AND BIODIVERSITY** **Code: MEEM-115**

***Objectives:*** *To multidisciplinary knowledge about natural resources management related to the research within the specialization*
*To knowledge in a specific area based upon research experience from a masters project to knowledge about various methodological and analytic approaches that are used within the specialization*

**Unit 1:** **Introduction to Natural Resource Bases:** Concept of resource, classification of natural resources, Factors influencing resource availability, distribution and uses, Interrelationships among different types of natural resources. Concern on Productivity issues, Ecological, social and economic dimension of resource management.

**Unit 2:** **Energy resources:** Renewable & non-renewable resources, Fossil fuels, nuclear energy, solar energy, wind energy, tidal energy, geothermal energy, hydropower. Hydrogen as a source of energy, energy from biomass, bioconversion technology, energy plantations and petro-crops, Environmental impacts of various forms of energy use.

**Unit 3:** **Biological resources:** forests, their importance, types, primary and secondary products - value & uses, forest resources of India, Wild-life of India, and convention on biodiversity (CBD).
**Soil resources:** soil type, soil profile and soil erosion. Water resources: Surface water, ground water, hydrological cycle. Mineral resources: Types, their characteristics & uses, minerals from the sea.
**Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources
**Poverty and implications in Resource Management in developing countries:** Poverty in developing countries causes and link with resources scarcity and poverty.

**Unit 4:** **Biodiversity:** Definition, Types of diversity; threats to biodiversity and species extinction, threatened and endangered species, hot spots of biodiversity, Calculation of alpha, beta and Gamma biodiversity
**Biodiversity conservation strategies:** National parks, wild life sanctuaries, biosphere reserves, gene banks, germ plasma Banks, Zoo.

**Unit 5:** **Biodiversity Conservation:** in situ and ex situ conservation, Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends, Mega diversity zones and hot spots, Biodiversity valuation, goods and services provided by biodiversity, Threats to biodiversity, major causes, extinctions, vulnerability of species to extinction, IUCN threat categories, Red data book, Principles and strategies of biodiversity conservation

***Outcomes:***

*Describe ecological processes, including human impacts that influence ecosystems change, natural succession and the future sustainability of natural resources.*

*Characterize natural resources and be able to quantify at least one of these resources.*

*Envision desired future conditions in an area to achieve a set of natural resource-related objectives, prescribe management actions needed to achieve those objectives, and evaluate success of these actions.*

*Describe how the use, management and allocation of natural resources are affected by: laws, policies, economic factors (both market and non-market), and characteristics (including demographic, cultural, ethnic, and "values" differences) of private and public resource owners and users.*

**Reference Books:**


1. Natural Resources conservation-Oliver S Owen & Chiras
2. Living in the Environment –T.J.Miller
3. Environmental Science- Cunningham Saigo
4. Ecology of Natural Resources-Ramade
5. Global Biodiversity-W.R.L. IUCN
6. Soils-Miller, W & R.L. Donhau

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY** **Code: MEEM-116**

***Objective:*** *To impart knowledge on the relevance and applications of environmental chemistry and microbiology in managing environmental problems*

**Unit-1:** **General Chemistry:** Basic principles, chemical equations, types of chemical reactions, calculations from chemical equations; gas laws; Equilibrium and Le Chatelier's Principle, factors affecting chemical equilibrium, activity and activity coefficient, ionic strength.

**Unit-2:** **Physical Chemistry:** Thermodynamics, heat and work, enthalpy, entropy, free energy, temperature dependence of equilibrium constant; membrane processes; principles of solvent extraction; ; electrochemistry; chemical kinetics; adsorption.

**Unit-3:** **Organic Chemistry And Biochemistry:** Organic compounds of interest to environmental engineers, general properties of the functional groups of organic compounds; Enzymes, classification enzymes catalyzed reaction, energy considerations coupling of reaction; Breakdown and synthesis of carbohydrates, fats, proteins under aerobic and anaerobic reactions; CNP cycles under aerobic and anaerobic reactions, Concepts of BOD, COD, TOC.

**Unit-4:** **Environmental Chemistry:** Fundamentals of surface and colloidal chemistry; chemistry involved in water treatment procedure like coagulations, softening, fluoridation, defluoridation, iron and manganese removal, demineralization, analysis of pesticide and heavy metals; Atmospheric chemistry; soil chemistry

**Unit-5:** **Environmental Microbiology:** Introduction of microbiology, classification and characterization of microorganisms, viruses; Morphology and structure of bacteria, nutrient requirement, growth of bacteria; Basic microbiology of water and sewage; Basic principals involved in the analysis of fecal indicator bacteria – coli forms and streptococci, plankton analysis, analysis of pseudomonas & streptococci; Pathways of aerobic and anaerobic metabolism, Energy transfer in metabolism; Kinetics of microbial growth.

***Outcomes:***

*Understand the fundamentals principles of environmental chemistry.*
*Understand water chemistry required in the treatment processes of water and wastewater*
*Analyze the growth kinetics of microorganisms.*
*Understand the processes in biological treatment systems.*

**Reference Books:**


1. Benefield D. L., Judkins F. J., Weand L. B., Process Chemistry for Water and Wastewater Treatment, 1st Edition, Prentice Hall, 1982
2. Bitton, G., Wastewater Microbiology, 3rd Ed., Wiley, 2005
3. Mitchell, R., and Gu, J.D., Environmental Microbiology, 2nd Ed., Wiley-Blackwell, 2010
4. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**WASTE TREATMENT SYSTEMS** **Code: MEEM-117**

***Objective**: To impart knowledge on the relevance and applications of waste water system and related problems.*

**Unit-1:** **Introduction:** Wastewater Characteristics, Standards of Disposal, Treatment Objective and, Strategies, Layouts of Primary, Secondary and Advanced Treatment Units.

**Unit-2:** **Design of Preliminary and Primary Treatment Operations:** Screens, Grit Chambers, Skimming Tank, Primary and Secondary Sedimentation Tanks.

**Unit-3:** **Biological Treatment Processes:** Types, Kinetics of Plug Flow and Completely Mixed Systems.

**Unit-4:** **Attached Growth Processes:** Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors.

**Unit-5:** **Suspended Growth Processes**: Activated Sludge Process, Modifications and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements - Classification and Design of Oxidation Ponds, Lagoons.
Sludge Treatment And Disposal: Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment.

**Outcomes:**

- Identify and assess the characteristics of wastewater and their impacts
- Plan and design the components of wastewater treatment systems
- Understand underlying principles of processes involved in secondary wastewater treatment systems
- Design sludge treatment and disposal methods.

**Reference Books:**


1. Benefield L.D. and Randall C.D., *Biological Process Designs for Wastewater Treatment*, Prentice Hall Pub. Co., 1980
2. Metcalf and Eddy, *Wastewater Engineering – Collection, Treatment, Disposal and Reuse*, 4th Ed., McGraw Hill Pub. Co., 2003
3. Udo Wiesmann, In Su Choi and Eva-Maria Dombrowski, *Fundamentals of Biological Wastewater Treatment*, 1st Ed., Wiley, 2007

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**ENVIRONMENTAL POLICY** **Code: MEEM-118**

***Objective:*** *To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.*

**Unit-1:** **Introduction:** Economics and Environmental Policy Theory of externalities: Relevance. Externalities: definitions, significant types, and optimal pricing conditions, formal analysis

**Unit-2:** **Uncertainty and choice of policy instruments:** price or quantity controls, Market imperfections and the number of participants.

**Unit-3:** Detrimental externalities and non-convexities in the production set, optimal pricing of exhaustible resources ntroduction to design of Environmental policy. Efficiency without optimality: the charges and standard approaches.

**Unit-4:** Marketable emission permits for the protection of the environment. Stochastic influences, direct controls, and taxes, Taxes vs subsidies: a partial analysis, Environment protection and the distribution of income.

**Unit-5:** International environmental issues, National and local standards for environmental quality

***Outcomes:***

*Describe national and international policy issues related to environmental media.*
*Understand existing environmental laws and regulation.*
*Assess influence of policy decisions on the environment.*
*Apply knowledge of environmental analysis in planning and policy making.*

**Readings:**


1. Baumol, W. J. and Oates, W. E. "The theory of environmental policy", Cambridge: Cambridge University Press, 1988
2. Dixon, J. Economic Analysis of Environmental Impacts. London: Earthscan Publications, 1994
3. Mehta, S.; Mundle, S. and Sankar, U. Incentives and regulation for pollution control. Sage Publishers, 1997
4. Bohm, P. and Russell, C. "Comparative analysis of alternative policy instruments", in Allen Kneese, V. and Sweeney, J.L. (eds.) Handbook of natural resource and energy economics. North Holland, 1985

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**INDUSTRIAL WASTE MANAGEMENT** **Code: MEEM-119**

***Objective:*** *To impart knowledge on the concept and application of Industrial pollution prevention, technologies, industrial wastewater treatment and residue management. • Understand principles of various processes applicable to industrial wastewater treatment • Identify the best applicable technologies for wastewater treatment from the perspective of yield production.*

**Unit-1:** **Introduction:** General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and onto land for irrigation - Toxic chemicals from industry.

**Unit-2:** **Pretreatment Of Industrial Wastewater:** Necessity of pretreatment - Equalization - Segregation - Process Changes - Salvaging - By product Recovery. Removal by Reverse Osmosis, Ion Exchange, Electrodialysis, Solvent Extraction, Floatation, Removal of Refractory Organics - Removal of Nitrogen and Phosphorus.

**Unit-3:** **Major Industrial Effluents:** Sources, Characteristics and Treatment. Food Industries: Sugar, Dairy, Distilleries

**Unit-4:** **Chemical Industries:** Paper and Pulp, Tanneries, Textiles, Fertilizers, Pharmaceuticals, Cement and Steel.

***Outcomes:***

*Sample and analyze the characteristics of industrial wastewaters.*
*Analyze the effects of disposal of industrial wastes*
*Identify and design treatment options for handling industrial wastewater.*
*Identify and design treatment options for handling industrial wastewater.*

**Reference Books:**


1. Industrial Wastewater Management, Treatment and Disposal, WEF Manual of practice No. FD-3, 3rd Ed., WEF Press and McGrawHill, 2008
2. Numersorn, N.L., Liquid Waste from Industry – Theories, Practice and Treatment, Addison-Wesley, 1971
3. Patwardhan, A.D., Industrial Waste Water Treatment, PHI Learning, 2009 Rao, M.N., and Dutta, A.K., Wastewater Treatment, IBH Publ., 1995

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*M.Tech (Environmental Engineering & Management)*

**Paper Na : Research methodology and IPR (RM)** **Paper code: METC-101**

**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 problems, Approaches of investigation of solutions for research problems, Data collection, Analysis, interpretation, and Necessary instrumentation.

**Unit II:** Effective literature studies approaches, Analysis plagiarism, and Research ethics

**Unit III:** Effective technical writing, Report and paper writing, developing a research proposal, Format of research proposal, Presentation and assessment by review committee.

**Unit IV:** Nature of Intellectual Property Right (IPR): Patents, Designs, Trade and Copyright, Process of patenting and development, technological research, innovations, patenting, International Scenario, international Cooperation's on Intellectual Property Rights, Procedure for grants of patents, Patenting under PCT.

**Unit V:** Patents rights, Scope of patents rights, Licensing and transfer of technology, Patent information and database, geographical indications.

**Unit VI:** New development in IPR: Administration of patent system, IPR of biological system, Computer software etc. traditional Knowledge, case studies, IPR and IIT's.

***Outcomes:***

*To understanding the process of patenting*
*To expose the students on various aspects of report writing*
*To motivate the students for research*

**Reference Book:**


1. Kumar, R. (2011). Research Methodolgy. SAGE Publications Asia-Pacific Pte Ltd. ISBN 978-1-84920-300-5
2. ISBN 978-1-84920-301-2 (pbk).
3. Mishra, S. B. and Alok, S.(2011) Handbook of Research Methodology: A Compendium for Scholars & Researchers. Educreation Publishing, New Delhi

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

**AUDIT-I PAPER OF**

**FIRST SEMESTER**

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*Course: M.Tech (Environmental Engineering & Management)*

**Subject: DISASTER MANAGEMENT** **Code: METC-112**

**Course Objectives: -**Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

**Unit I: Introduction:** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**Unit II: Repercussions of Disasters and Hazards**: Economic Damage, Loss Of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**Unit III: Disaster Prone Areas in India:** Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

**Unit IV: Disaster Preparedness and Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

**Unit V: Risk Assessment:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment.Strategies for Survival.

**Unit V: Disaster Mitigation:** Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

**Refrences:**


1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New
2. Royal book Company.
3. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of
4. India, New Delhi.
5. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep &Deep
6. Publication Pvt. Ltd., New Delhi.

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## SECOND SEMESTER

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: UNIT OPERATION & PROCESSES** **Code: MEEM-201**

***Objective:*** *To provide the knowledge about various unit operations and processes used in wastewater treatment techniques.*

**Unit 1:** **Introduction:** Concept of unit operations, Standard & requirements, water treatment process & system, waste water treatment process & treatment REACTORS: A simplistic view of reactors. Homogeneous reactions, Non homogenous reactions Effectiveness factor models. Continuous homogeneous reactors, conversion, Non homogeneous reactors, Problems

**Unit 2:** **Chemical & Biological Unit Processes:** Chemical precipitation – phosphate removal – Adsorption – Activated carbon – Isotherms – Disinfection – principles – types of chlorination – De-chlorination. Principles of Biological growth – Suspended and attached growth processes.

**Unit 3:** **Physicochemical Removal of Dissolved Materials:** Adsorption, Ion exchange Membrane processes, chemical oxidation, precipitation, problems Gas Transfer: Mass-Transfer models, Bubble aeration, temperature effects.

**Unit 4:** **Disinfection:** Objectives, Different Types, Chlorinator (Advantages & Disadvantages), Bleaching Powder, Ozone Treatment, UV Irradiation, Types of Chlorination, Breakpoint chlorination, de-chlorination.

**Unit 5:** **Aerobic and Anaerobic:** Activated sludge, process parameter, mass transfer limitations on removal rate , cell yield , process operation performance and control, extended aeration process, step aeration, high rate activated sludge , bio sorption on contact stabilization, pure-oxygen-activated sludge –aerated lagoons, aerobic digestion , centrifugal screen, nitrification, anaerobic bacterial denitrification, oxidation lagoons , problems, Biological Film Flow Process: Trickling filter, development of a design equation maximum influent concentrations, airflow rate , physical factor in trickling filter design, rotating biological contractor, references.

***Outcomes:***

*Developments of knowledge in the specific field of practice*
*To design water and wastewater treatment facilities*
*To understand and analyze the urban hydrological cycle and its components*
*To acquire knowledge regarding wastewater reuse and its challenges*

**Reference Books:**


1. Waste Water Treatment by Edward
2. Unit Operation in Environmental Engg by R. Elangovan
3. Design of anaerobic processes for the treatment of industrial and municipal wastes by joseph F. Malina
4. Waste water Engg by Metcalf and Eddy
5. Elements of Chemical Reaction Engg by H. Scott. Fogler
6. Dynamics of Environmental Bio-processes by J.B. Snape and IJ Dunn

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: WATER AND WASTE WATER TREATMENT** **Code: MEEM-202**

***Objective:*** *To provide the knowledge about various steps (Primary, Secondary and Tertiary treatment) which are used in wastewater treatment process.*

**Unit 1:** Water Treatment: Treatment: Introduction: Quality standard of domestic and industrial water, source classification of water pollutants, Sedimentation: Principle of sedimentation, Design of sedimentation tank, Design example of sedimentation tank. Coagulation: Coagulation process, the constituents of coagulation-sedimentation plant, Flocculation process, methods of determining optimum coagulation dose.

**Unit 2:** **Wastewater Treatment:** Design of wastewater treatment plant units – screen chamber, Grit chamber with proportional flow weir, sedimentation tank, Trickling filters (standard rate, high rate), Rotating Biological contactor, activated sludge process, oxidation ditches, aerated lagoons, waste stabilization ponds – hydraulic profile and layout of primary and secondary nits – Anaerobic treatment systems, septic tank and disposal system, Sludge management, Sludge thickening, sludge digestion, sludge dewatering (mechanical and gravity) Sludge drying; Composting.

**Unit 3:** **Design 0f Biological Units:** Attached and suspended growth, Design of units - UASB, up flow filters, Fluidised beds - septic tank and disposal - Layout and Hydraulic profile - Recent advances.

**Unit 4:** **Design of Sludge Units:** Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical and gravity) - upgrading existing plants - ultimate residue disposal - Recent Advances.

**Unit 5:** **Filtration:** Headloss through filters, Type of filters, Slow sand filter, Rapid sand filter, Pressure filter, filter media, components, Filter operation, cleaning and backwashing process the under drain system and filter control, Design examples

***Outcomes:***

*Developments of knowledge in the specific field of practice.*
*Ability to understand the sources and characteristics, Effects of Discharges of Industrial Waste on receiving bodies of water*
*Ability to understand the Specific Industrial treatment Processes*
*Ability to understand the methods of treatment of Industrial Wastewater*
*Ability to understand the methods Potentials for Wastewater recycle and reuse in industries.*



**Reference Books:**


1. Waste water engineering: Treatment, Disposal and reuse by Metcalf and Eddy
2. Water supply and sewage by Terence J. Mc.Ghee
3. Industrial water pollution control by W. Wesley and Eckenfelder, jr.
4. Water works Engg. by Qasim, S.R., Motley and E.M. Zhu. G.
5. Water supply and sanitary Engg by G.S. Birde and J.S. Birde
6. Water supply, Waste disposal and Environmental Engg by A.K. Chatterjee
7. Basic Environmental Technology by Jerry. A. Nathanon

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*Course: M.Tech (Environmental Engineering & Management)*

**Subject: SOLID AND HAZARDOUS WASTE MANAGEMENT** **Code: MEEM-203**

***Objective:*** *To identify and classify solid and hazardous wastes, explain the techniques of solid and hazardous waste management, treatment, minimization and recovery.*

**Unit 1: Introduction:** Types, source and characteristics of solid wastes. Solid waste generation, handling and storage, Collection of solid waste, collection services, types of collection system and their analysis, transfer and transport, Solid waste management, reduction, reuse, and recovery.

**Unit 2: Transfer, Transport and Processing Techniques:** Need for transfer operation, transport means and methods, transfer station types and design requirements. Landfills: Site selection, design and operation, drainage and leachate collection systems – requirements and technical solution, designated waste landfill remediation Integrated waste management facilities, Shredding, pulverizing, baling, component separation, incineration, gasification, and pyrolysis.

**Unit 3: Disposal:** Dumping, land filling- site selection, Leachate contamination, land filling methods, design and operation of landfills occurrence and movement of gases and leachate in landfills, treatments of leachates, land farming and deep well injection.

**Unit 4: Materials Recovery System:** Processing of recyclable materials (case study of Somerset country materials recycling facility), metal recover from solid wastes Recovery from biological conversion products: Aerobic and anaerobic conversion. Recovery of thermal conversion products: Energy recovery system, energy from food waste, animal waste potential. Biogas plant, Utilization of fly ash, Economics of waste disposal

**Unit 5: Hazardous Waste Management:** Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites, Techniques.

***Outcomes:***

*Developments of knowledge in the specific field of practice*
*Knowledge about characteristics of solid waste and problems associated with solid waste disposal.*
*Knowledge about various methods of solid waste treatment*

**Reference Books:**


1. Environmental Hazards- Smith, Keith
2. Environmental Hazards-Iqbal, M, Srivastava, A.S. and Siddiqu, T.Q.
3. Basic Environmental Technology-Nathanson, J.A.

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*M.Tech (Environmental Engineering & Management)*

**Subject: WATER SAMPLING AND TESTING** **Code: MEEM –251**

***Objective:*** *The laboratory is to determine the qualities of water and waste water characteristics for the measurement of waste water and pollution level.. This laboratory course will help the students to understand the concepts learned in the course of water & wastewater engineering.*

Experiment No.1: Estimation of Solids, Acidity, Alkalinity, Hardness, Chlorides and Fluorides

Experiment No.2: Determination of pH and Conductivity

Experiment No.3: Estimation of Dissolved Oxygen

Experiment No.4: Total Hardness and Carbonate Hardness in water sample.

Experiment No.5: Estimation of Nitrogen (Different Forms like Nitrite, Nitrate)

Experiment No.6: Estimation of Phosphates and Sulphates

Experiment No.7: Estimation of Residual Chlorine

Experiment No.8: Determination of Available Chlorine in bleaching powder

Experiment No.9: Determination of Total Solids, Suspended & Dissolved Solids in a given sample of sewage

Experiment No.10: Determination of Residual Chlorine

Experiment No.11 Determination of Chemical Oxygen Demand of a given sample of sewage.

Experiment No.12 Determination of Bio-Chemical Oxygen demand of a given sample of sewage.

Experiment No.13: Determination of Heavy Metals

***Outcomes:***

*Students have been taught the lab experiments as per syllabus.*
*Practical Knowledge of field*

**Reference books:**


1. Manual on water and waste water analysis by NEERI
2. Manual on water and waste water analysis by APHA
3. Wastewater Engineering Treatment and Reuse – Metcalf and Eddy
4. Theory and Practice of Water and Wastewater Treatment – Ronald Droste

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## OTHER ELECTIVE PAPER OF

## SECOND SEMESTER

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: ENVIRONMENTAL BIOTECHNOLOGY** **Code: MEEM-211**

***Objective :****To understand the design concepts and operations of aerobic and anaerobic bioprocesses and proper selection of bioreactors for remediation and pollution control also address the important topics with respect to modern trends in biotechnology, such as treatment and disposal of biosolids, biotreatment of sludge and reuse, Industrial Wastewater treatment, and bioenergy production*

**Unit1**: Environment & Biotechnology; Issue and Scope of Environmental Biotechnology; Role of Biotechnology in Environmental Protection; De-nitrification; Degradation of hazardous chemicals.

**Unit 2:** Biotechnological methods of pollution detection; Bio-degradation and Bio-remediation of organic pollutants; Bio-degradation of pesticides; Bio-venting; Bio-fuels; Bio-scrubber; Bio-fuels; Bio-sensor; Bio-film; Energy from waste

**Unit 3**: Genetic concepts in Environmental Protection; DNA structure; DNA Replication; DNA Hybridization; Polymeric Chain Reaction (PCR); Transcription and Translation; Ribosome's (Structure and function); Gene mutation; DNA-Gene Probe; Gene – Environment interaction

**Unit 4:** Concept of Bio-monitoring and Biodegradation of solid wastes:, Types of Biological Markers, Applications of bio-monitoring in occupational and environmental health risk assessment. physical, chemical and microbiological factors of composting – health risk – pathogens – odour management – technologies of commercial importance advances in biogas technology

**Unit 5:** Regulatory and Ethical issues: Environmental effects and ethics of microbial technology – safety of genetically engineered organisms.

**Outcomes:**

Developments of knowledge in the specific field of practice
Working effectively and confidence improvement
Use the proper decision tools to critically, analytically, and creatively solve problems and drive results

**Reference books:**


1. Pradipta Kumar Mohpatra; Text Book of Environmental Biotechnology; Publ: IK International, New Delhi, 2006
2. Indu Shekhar Thakur; Environmental Biotechnology: Basic Concept and Applications; Publ: IK International, New Delhi, 2006
3. SK Agarwal; Advanced Environmental Biotechnology; SB Nangia APH Publishing Corporation, New Delhi; 2005
4. Hans-Joachim Jordening and Josef Winter; Environmental Biotechnology: Concepts and Applications; Publ Wiley-VCH Verlag, GmBH & Co. KGaA

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

## ENERGY AND CLIMATE CHANGE Code: MEEM-212

***Objectives:*** *To Explain Earth's natural greenhouse effect. To Identify natural and human created sources of greenhouse gases. To Understand that the Earth's systems keep its temperature balanced as long as those systems are also balanced.*

**Unit-I:** Energy and carbon emissions, World energy use and current energy scenario, Trends in energy use of oil, coal and gas, Energy use and air quality, Nuclear energy and environment, Energy production, Fission and fusion, Geoengineering

**Unit-II:** $CO_2$ challenge, Energy efficiency, Fossil fuels and $CO_2$ emission reduction, Global warming as an energy problem Impact of climate change on energy demand, Sensitivity of energy demand to temperature changes, Climate protection and energy changes.

**Unit–III:** Global climate change: Greenhouse effect, greenhouse gases: sources, trends, radiative forcing, warming potential of gases. Photosynthetic mechanism and global climate change, Impacts of global warming: Polar ice caps and melting of glaciers, sea level increase, weather extreme.

**UNIT IV:** Tools to study climate change: Mitigation strategies for global warming; biological carbon sequestration, carbon sequestration in geological formations, role of forests and drylands in carbon sequestration, carbon capture and storage technologies, Kyoto protocol, CDM and carbon trading.

**UNIT V:** Ecosystems, human health, coral leaf bleaching, surface ocean chemistry, biogenic calcification in oceans, Climate change modeling and general circulation models.

***Outcomes:***

*To understand the physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing*

*To know something of the way various human activities are increasing emmissions of the natural greenhouse gases, and are also contributing to sulphate aerosols in the troposphere*

*To demonstrate an awareness of the difficulties involved in the detection of any unusual global warming 'signal' above the background noise' of natural variability in the Eath's climate and of attributing (in whole or in part) any such signal to human activity*

**Reference Books:**


1. Aguado, E. and James, E.B. 2001. *Understanding weather and climate,* Prentice Hall, New Delhi.
2. Armstrong, F. and Blundell, B., K. 2003. *Energy.....beyond oil*, Oxford, New York.
3. Burroughs, W.J. 1999. *The climate revealed,* Cambridge University Press.
4. Cleveland, C. J. 2008. *Encyclopedia of Energy*, Elsevier, New Delhi.
5. Cleveland, C.J. and Morris, C. 2006. *Dictionary of energy*. Elsevier, Oxford.
6. Goudie, A. S. and Cuff, D. J. 2002. *Encyclopedia of global change,* Oxford, New York.
7. Gupta, K.R. 2005. *Encyclopedia of environment Global warming: problems and policies*, Atlantic Publication, New Delhi.
8. IPCC (Intergovernmental Panel on Climate Change) 1990. *Climate Change: The IPCC Assessment.* Cambridge University Press, Cambridge.
9. James C., Werksman H. and Roderick P. 2006. *Improving compliance with International Environmental Law,* Earthscan, London.
10. Newton, P. C.D., Carran R.A., Edwards, G.R., Pascal A. and Niklaus. 2007. *Agroecosystems in a Changing Climate.* Advances in Agroecology, CRC/Taylor & Francis.
11. Sorokhtin, O.G.,Chilingar, G.V. and Khilyuk, L.F. 2007. *Global warming and global cooling: Evolution of climate and earth,* Elsevier, Netherland.
12. Steffen, W., Sanderson A., Tyson P. D., Jager J., Matson P. M., Moore B., Oldfield F., Richardson K. , Schnellnhuber H. J., Turner B. L. and Wasson R. J. 2004. *Global change and the Earth system: a Planet under Pressure*, Springer-Verlag, New York, USA.

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

### ENVIRONMENTAL REMOTE SENSING AND GIS — Code: MEEM-213

***Objectives:*** *To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing To acquire skills in storing, managing digital data for planning and development.To acquire skills in advance techniques such as hyper spectral, thermal and LiDAR scanning for mapping, modeling and monitoring.*

**Unit-I:** Physical basis of Remote Sensing, Electromagnetic spectrum, Atmospheric windows, Rayleigh scattering, Spectral reflectance, Energy-matter interaction, Basic principles of global positioning system, GIS- basic concept

**Unit-II:** Remote Sensing process, Platforms and sensors used in Remote Sensing; Systems for data collection-Passive Remote Sensing and Active Remote Sensing; Microwave Remote Sensing, Multispectral Remote Sensing.

**Unit-III:** Visual image processing, Classifications, Procedures and Map accuracy, Elements of visual image interpretation, Ground truthing, Digital image processing, Photogrammetry: Basic concepts, Types of aerial photographs, Application of Remote Sensing in Energy resource management.

**Unit-IV:** Data structure: Raster and Grid data, Analytical modeling in GIS- A general account. GIS project design and management, problem identification, implementation evaluation

**Unit-V:** GIS application in natural resource management, biodiversity and gap analysis, Environmental impact assessment, solid waste management and disaster management.

***Outcomes:***

*Understand main concepts that define Geographic Information Systems.*
*Describe the geographic space with concepts and terms commonly used to build operating models in GIS. Use diverse techniques and instruments adequately to measure, locate and find bearingson a map and in a field.*
*Photo-interpret basic environmental and socioeconomic variables using photographs taken in Spain. Know and use GIS and its geo-processes and functions.*

**Reference**


1. Bettinger, P. and Wing, M.G.2004. *Geographic Information Systems: Applications in Forestry and Natural Resources Management*, McGraw Hill, London.
2. Burrough, P. A. and McDonnell, R. A. 2007. *Principles of Geographical Information Systems*, Oxford University Press, New York.
3. Campbell, J. B. 2003. *Introduction to Remote Sensing*, Taylor & Francis, London and New York.
4. Gupta, R. P. 2005. *Remote Sensing Geology*, Springer, New Delhi.
5. Jensen, J. R. 2006. *Remote Sensing of the Environment: An Earth Resource Perspective,* Dorling Kindesle (Pearson Education) South Asia.
6. Lo, C.P. and Yeung, A. K.W. 2006. *Concepts and Techniques of Geographic Information Systems,* Prentice Hall, New Delhi.
7. Longley, P. A., Goodchild, M.F., Maguine, D. J. and Rhind, D. W. 2003. *Geographic Information Systems and Science,* John Wiley and Sons Ltd., New York.
8. Quattrachi, D.A. and Goodchild M.F. 1977. *Scale in remote sensing and GIS*, Lewis Publishers, New York.
9. Sahu, K. C. 2008. *Textbook of Remote Sensing and Geographical Information Systems*, Atlantic Publication, New Delhi.
10. Schowengerdt, R.A. 2007. *Remote Sensing: Models and Methods for Image Processing,* Academic Press, Elsevier, New York.
11. Wilson, J. P. and Fotheringham, A. S. 2008. *The Handbook of Geographic Information and Science CABI*, UK Blackwell, USA.
12. Lillesand, T.M. and Kiefer, R.W. *Principles of Image Interpretation.*

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

## ENVIRONMENTAL BIOREMEDIATION TECHNOLOGY Code: MEEM-214

***Objectives:***

*To introduce the underlying biogeochemical concepts pertinent to remediation of soil and groundwater, and describe how systems can be successfully engineered to support/promote remediation with an emphasis on bioremediation. Bioremediation is an increasingly utilized remediation technology that employs biological agents (microorganisms and plants) to treat hazardous contaminants in soil, and water; can lead to the permanent removal of contaminants from the environment; and may be inexpensive when compared to conventional techniques.*

**Unit-I:** Introduction to bioremediation, Historical development of environmental bioremediation, Requirements for bioremediation, Constraints and priorities of bioremediation, Applications of bioremediation technologies. Xenobiotic compounds, their structure and persistance in environment, Oil spills, Oil products in environment. Biodegradation- principles and mircobiology; Microconversions of xenobiotics

**Unit-II:** Biotransformation of pesticides and hydrocarbons, Biodegradation kinetics, Bioavailability, Biomineralization, Testing for biodegradability, Numerical modelling of biodegradation. environment.

**Unit-III:** Biological processing of waste water, Bioreactors – designs used for treatement of sludge and removal of metals from waste water. Biodegradable plastic, Biodegradation of PAH in

**Unit-IV:** Bioremediation strategies – biostimulation and bioaugmentation, Bioremediation techniques *in-situ* and *ex-situ*. Bioremediation of organic and metal contaminated environments. Metal toxicity and bioavailability. Biosorption and precipitation. Bioremediation technologies for heavy metal and radionuclides removal. Phytoremediation and its processes, role of phytochelatins. Applications of genetic engineering in phytoremediation. Algal and fungal based bioremediation.

**Unit-V:** Gaseous bioremediation, biofilms, bioscrubbers, bioventing, Soil Vapour Extraction (SVE), Water recirculation systems, Air sparging, Biobarriers, Composting, Phytoremediation for air pollutants. Political and scientific challenges for broader implementation of bioremediation technologies. Role of biosensors in bioremediation technologies, Biofilms and their applications.

***Outcomes:***

*Pollutants are of greatest concern, describe the principles of various physical and chemical remediation technologies and relate selection of these technologies to the properties of contaminants.*
*It is needed for site characterization, explain the relevance to selection of appropriate remediation strategies, determine when bioremediation is an appropriate technology and its advantages and limitations.*
*Interactions between contaminants, soil, presence of a NAPL phase, water and microorganisms and explain how these impact the fate of the contaminant and its bioavailability for biodegradation.*

**Reference Books:**


1. Scragg A., 2008. *Environmental Biotechnology*, Oxford Univesity Press. New York
2. Singh S.N., Tripathi R.D., 2007. *Environmental Bioremediation Technologies*, Springer, New York.
3. Das H.K. 2007. *Textbook of Biotechnology*, Kanak Enterprises Ltd. Gaziabad.
4. Mohapatra P.K. 2007. *Textbook of Environmental Biotechnology*, I.K. Publishing House, New Delhi.
5. Olguin E.J., Sanchez G., Hernandez E. 2005. Environmental Biotechnology and Cleaner Processes, Replika Press, Kundli.
6. Trivedi P.C. 2008. Pollution and Bioremediation, Sheetal Printer, Jaipur, India.

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**ENVIRONMENTAL MICROBIOLOGY** **Code: MEEM-215**

***Objectives:***

*To understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.*

*To understand the structural similarities and differences among various physiological groups of bacteria/archaea .*

*To know various Culture media and their applications and also understand various physical and chemical means of sterilization.*

*To know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae*

**Unit-I:** Aquatic Microbiology: Microbes in aquatic systems, Measuring activity of microbes in water, Pathogens in water, Water health standards, bio-films.

**Unit-II:** Soil microbiology: Microbes in soils and their role, microbial interactions, mineralization and immobilization of nutrients in soil, Microbial degradation of cellulose, lignin Microbe mediated C, N and S transformations mycorrhiza and their environmental significance.

**Unit-III:** Biodegradation microbiology: Interaction of biological, chemical and environmental factors in Biodegradation processes. Bioremediation processes; Definition and classification including *in situ and ex situ* types.

**Unit-IV:** Applied Environmental Microbiology: Biodegradation of pesticides and hydrocarbons, Sewage sludge treatment using microbes, microbial fermentations, biohydrometallurgy and microbial recovery of oil.

***Outcomes:***

*To learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries*

*Identify ways to control microorganisms in foods and thus know the principles involving various methods of food Reservation*

*Understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food*

*Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.*

**Reference Books:**


1. Microbiology- J.G. Black
2. Microbial Biotechnology-A.N. Glazer
3. Microbial Ecology- R.M.Atlas & Bartha
4. Microbiology- Pelczar
5. Introduction to Environmental Microbiology - Barbara Kołwzan, Waldemar Adamiak, Kazimierz Grabas and Adam Pawełczyk

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***M.Tech (Environmental Engineering & Management)***

**Subject: ADVANCED WATER AND WASTEWATER TREATMENT TECHNIQUES**

**Code: MEEM – 216**

***Objective:*** *To provide the detailed knowledge about various steps(Primary, Secondary and Tertiary treatment) include in wastewater treatment also different processes for sludge treatment*

**Unit 1:** Gas transfer, Aeration system, Energy requirement, Design of aeration systems, Membrane filtration: Terminology, Process classification, membrane configurations, membrane operations for micro filtration, Ultra filtration and reverse osmosis, Area requirement, membrane fouling and its control, Application of membranes, Electro-dialysis: Theory, area and power requirement, Disposal of concentrate waste streams.

**Unit 2:** Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Floatation: Objective, Types of floatation systems, Design considerations, Chemical precipitation for removal of phosphorus, heavy metals and dissolved inorganic substances.

**Unit 3:** Microbial growth kinetics, Modeling suspended and attached growth treatment processes, Suspended growth processes for biological nitrification and de-nitrification, Biological nitrogen and phosphorus removal.

**Unit 4:** Anaerobic sludge blanket processes: Design considerations for Up Flow Anaerobic Sludge Blanket process; Theory and design of sludge treatment, Sludge thickening, Sludge drying, Incineration, Aerobic and Anaerobic digestion of sludge.

**Unit 5:** wet-ands and aquatic treatment systems; Types and applications, Treatment kinetics and effluent variability in constructed wet-ands and aquatic systems, Free water surface and subsurface constructed wMETL-ands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wMETL-ands, Management of constructed wet-ands and aquatic systems.

***Outcomes:***

*Developments of knowledge in the specific field of practice*
*Working effectively and confidence improvement*
*Use the proper decision tools to critically, analytically, and creatively solve problems and drive results*



**Reference Books:**

1. Wastewater Engineering Treatment and Reuse – Metcalf and Eddy
2. Theory and Practice of Water and Wastewater Treatment – Ronald Droste
3. Physio-Chemical Processes and Water Purification – Weber
4. Wastewater Treatment for Pollution Control – Soli Arceivala

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: ENVIRONMENTAL MANAGEMENT** **Code: MEEM-217**

***Objectives**: To provide knowledge in scenario National environmental policy Environmental organizations also about risk assessment methodologies*

**Unit 1:** General Global and India scenario National environmental policy Environmental organizations for planning and implementation sustainable development and reactive strategies for environmental pollution control.

**Unit 2:** Environmental impact and risk assessment. Methodologies: Adhoc, checklist, network, matrix etc.

**Unit 3:** Environmental Management Plan, Typical case studies of environmental impact assessment. Environmental impact statements

**Unit 4:** Environmental Audit

**Unit 5:** Environmental Legislation Air, Water and environmental acts.

***Outcomes:***

*Provide definitions of environment, management, systems and organizations in relation to environmental management*

*Describe organizations as systems and their role in environmental management*

*Understand the usefulness of systems thinking in relation to environmental management in organizations*

*Explain how environmental management can be used as environmental protection and how organizations can define and manage risk.*

**Reference Books:-**

1. Rosencranz, S. Divan, M.L. Noble, Environmental law and policy in India, cases, materials and statutes, Tripathi pvt. Ltd. Bombay.
2. S. Musharaf, legal aspects of Environmental pollution and its management, C.B.S publishers, Delhi 19932.
3. R.K. Jain L.V. Urban, G.S. Stacey H. E. Balbach, Environmental Assessment McGraw-Hill, Inc. N.Y. Rao, J. G. and Wooten, Environmental Impact Analysis, Handbook, 1980.
4. Canter L.W., Environmental Impact Assessment, - N.Y. McGraw-hill Book Co., 1977

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: INSTRUMENTATION (Spectrometry & Chromatography)** **Code: MEEM – 218**

***Objectives**: To provide knowledge in various instrumentation techniques used in analysis of water and air pollutants.*

**Unit 1:** Principle of Spectrometry, Beer Lambert Law, Scope of Spectrometry, UV Spectrometry, IR Spectrometry.

**Unit 2:** Chromatography: Basic Principle and construction –Different types of columns – Detectors – Recorders and associated equipment. Industrial and laboratory applications of gas Chromatography, Principle of Chromatography, Types of Chromatography, Adsorption Chromatography; Paper Chromatography, Thin Layer Chromatography (TLC), Gas Liquid Chromatography (GLC), High Performance Liquid Chromatography (HPLC); High Performance Thin Layer Chromatography (HPTLC); Electrophoresis

**Unit 3:** Mass Detectors (MSD), Electron Capture Detector (ECD), Fame Ionization Detector (FID), Nitrogen Phosphorus Detector (NPD), Photo Diode Array Detector; Fluorescence detector; Photo-ionization detector Electrical Conductivity Detector; Electro Chemical Detector

**Unit 4:** Electrophoresis – Principle and applications; Techniques of Electrophoresis; Gel Electrophoresis; Poly Acrylamide Gel Electrophoresis (PAGE); Capillary Electrophoresis; Agrose Gel Electrophoresis

**Unit 5:** Flame Photometry, Atomic Absorption Spectrometry (AAS), Microwave Spectroscopy, Differential Thermal Analysis, Nuclear Magnetic Resonance (NMR); Fourier Transform infrared spectroscopy (FTIR); Raman Spectroscopy

***Outcomes:***

*Students have been taught the lectures and tutorials as per syllabus.*
*Knowledge of field instrumentations*
*Application of control systems in processes*

**Reference Books:**


1. Oliver Thomas and Christopher Burgess; UV-Visible Spectrometry of Water and Wastewater : A Practical Approach; Elsevier Science and Technology, 2007
2. Dimiter L Tsalev; Atomic Absorption Spectrometry in Occupational and Environmental Health Practice, Publ: CRC Press, Vol III, 1995
3. BK Sharma; Chromatography; Publ: Goel Publishing House, Meerut, 2007
4. Dunkan J Shaw; Electrophoresis; Academic Press, 1969
5. Roger S Macomber; A Complete Introduction to Modern NMR Spectroscopy; John Wiley & Sons, Inc, New York; 1998

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## AUDIT-II PAPER OF

## SECOND SEMESTER

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: VALUE EDUCATION** **Code: METC-214**

***Objectives:*** *Understand value of education and self- development Imbibe good values in students Let the should know about the importance of character*

**Unit-I:** Values and self-development, Social values and individual attitudes, Work ethics, Indian vision of humanism. Moral and non- moral valuation, Standards and principles, Value judgments,

**Unit-II:** Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity. Patriotism, Love for nature , Discipline

**Unit-III:** Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature

**Unit-IV:** Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control. Honesty, studying effectively

**Outcomes:** Knowledge of self-development
Learn the importance of Human values
Developing the overall personality

***Reference Books:***

Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## THIRD SEMESTER

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: WATER AND SEWAGE TREATMENT** **Code: MEEM-301**

***Objective:*** *To provide the knowledge about various steps (Primary, Secondary and Tertiary treatment) which are used in wastewater treatment process?*

**Unit 1: Introduction:** objective of wastewater treatment, Need for Urban Drainage System, Planning Objectives, Interaction of Urban and Surrounding Areas, Approaches to Urban Drainage Types of sewerage system: Combined system, Separate System, Partially separate system, Patterns of Collection System, Components of sewerage system, design and planning of sewerage systems.

**Unit 2: Quantity estimation of Sewage:** Sources of Sanitary Sewage, Dry Weather Flow, Evaluation of Sewage Discharge, Design Period, Design Discharge, Population forecasting Quantity Estimation of Storm Water: Factors Affecting the Quantity of Storm water, Storm hyetographs – Rainfall excess calculations, time of concentration, Methods for Estimation of Quantity of Storm Water

**Unit 3: Hydraulic Design of Sewers and Storm Water Drains:** Difference Between Water Supply Pipes and Sewer Pipes, Requirements of Design and Planning of Sewerage System, Hydraulic Formulae for Determining Flow Velocities, Minimum and maximum Velocity, Hydraulic characteristics of circular sewer running full or partially full Design of Storm Water Drains for Separate System: Important points for design Sewer materials, Laying of Sewer Pipes, Hydraulic Testing of Sewers

**Unit 4: Sewer Appurtenances:** Manholes, Drop manholes, Lamp holes, Clean-outs, Street inlets, Catch basins, Flushing Tanks, Grease & Oil traps, Inverted Siphons, and Storm Regulators Maintenance, cleaning and ventilation of Sewers Sewage and Storm water Pumping Stations: Types of Pumps, Pumping System Design, Types of Pumping Stations.

**Unit 5: Sewage Treatment:** Design of sewage treatment plant, Primary treatment: screening, sedimentation, Secondary Treatment (Aerobic & Anaerobic processes), anaerobic treatment systems, septic tank and disposal system.
Sludge management, Sludge thickening, sludge digestion, sludge dewatering (mechanical and gravity)
Source and classification of water pollutants, Quality standard of domestic and industrial water.

***Outcomes:***

a. *Developments of knowledge in the specific field of practice.*
b. *Ability to understand the sources and characteristics, Effects of Discharges of Industrial Waste on receiving bodies of water*
c. *Ability to understand the Specific Industrial treatment Processes.*
d. *Ability to understand the methods of treatment of Industrial Wastewater*
e. *Ability to understand the methods Potentials for Wastewater recycle and reuse in industries.*

**Reference Books:**


1. Waste water engineering: Treatment, Disposal and reuse by Metcalf and Eddy
2. Water supply and sewage by Terence J. Mc.Ghee
3. Industrial water pollution control by W.Wesley and Eckenfelder, jr.
4. Water works Engg. by Qasim, S.R., Motley and E.M. Zhu.G.
5. Water supply and sanitary Engg by G.S. Birde and J.S. Birde
6. Water supply, Waste disposal and Environmental Engg. by A.K. Chatterjee
7. Basic Environmental Technology by Jerry. A. Nathanon

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**Subject: AIR POLLUTION CONTROL** **MEEM-302**

***Objective:*** *The basic principles followed for eliminating negative impacts on the quality of air .The course emphasis on control and prevention of air pollution by providing knowledge about Meteorology and methods of controlling of air pollution*

**Unit 1:** Introduction: Definition, Sources and classification of Air Pollutants: Natural contaminants-aerosol – gases and vapour. Air quality standards, air quality, classification of air pollutants, air pollution episodes. Air pollution Sources and their Inventory: Particulate matter, carbon dioxide, carbon monoxide, oxides of sulphur, oxides of nitrogen, hydrocarbons, photochemical oxidants, asbestos and metals.

**Unit 2:** Meteorology and Dispersion of Pollutants: Winds, wind rose, maximum mixing depth, lapse rate, stability conciliations, plume behavior, calculation of effective stack height, The Gaussian dispersion model, heat island effect.

**Unit 3:** Air Pollution Monitoring: Sampling of gaseous and particulate air pollutants, Measurement of $SO_2$, Nitrogen oxides, Carbon monoxide, Oxidants and Ozone, Hydrocarbons and particulate matter $PM_{10}$ & $PM_{2.5}$. Effect of Air Pollution: Effect of air pollution on humans, animals, vegetation and materials.

**Unit 4:** Control of Air Pollution: General methods of control of Gaseous pollutants- scrubbers, condensers, control equipment's for particulate matter, gravity settling chambers, cyclone, fabric filters, electrostatic precipitators, scrubbers, Incinerator and catalytic converters (their design, operation and application).

**Unit 5:** Green belt development, Strategy for effective control of air pollution in India.

***Outcomes:***

*Ability to understand the various sources of air pollution and their classification*
*Knowledge about Emission inventories & Emission factor*
*Ability to understand about Economic Effects of air pollution*

**Reference Books:**


1. Air Pollution and Control by K.V.S.A. Murali Krishna
2. Environmental Air Pollution and control by G,R. Chhatwal, T .Katyal and Mohan Katyal
3. Environmental Chemistry by Mammahan
4. Introduction to Environmental Engineering and Science by Gilbert M. Masters
5. Air Pollution & Control by C.S.Rao
6. Air Pollution by Boubel Fox, Turner & Stern.

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## OTHER ELECTIVE PAPER OF

## THIRD SEMESTER

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**QUALITY SYSTEM MANAGEMENT** **Code: MEEM-001**

**Objectives:** The basic skills for interpreting the requirements of the ISO 9000 quality management system standards and their application, taking into account customer satisfaction and stakeholders' interest in a company for the purpose of continual improvement;Skills in the auditing of firm quality management systems, nonconformity identification, and corrective action planning to rectify those nonconformities;Working knowledge of how to help companies to gain and maintain third party ISO 9001 certification.

**Unit-1:** Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

**Unit-2:** Quality Management Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

**Unit-3:** Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

**Unit-4:** Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

**Unit-5:** ISO-9000 and its concept of Quality Management ISO 9000 series, Taguchi method, JIT in some details.

***Outcomes:***

*Examine an existing work situation in quality management with reference to ISO 9000 standards and to formulate a quality management system in a company to enhance customer satisfaction;*

*Identify and apply appropriate quality management system practices to improve existing or design new work methods and procedures;*

*Apply quality audit techniques to identify quality management system nonconformities and apply problem-solving* techniques for corrective action;

**Reference Books:**


1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***M.Tech (Environmental Engineering & Management)***

**Subject: ENERGY AND GREEN TECHNOLOGY** **Code: MEEM –002**

***Objectives:*** To bring in the importance and the underlying principles of green and sustainable technology

**Unit-1:** The twelve Principles of Green Chemistry and green engineering with examples

**Unit-2:** Green chemistry metrics- atom economy, E factor, reaction mass efficiency and other green chemistry metrics, application of green metrics analysis to synthetic plans

**Unit-3:** Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling

**Unit-4:** Pollution – types, causes, effects and abatement

**Unit-5:** Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy efficient design of processes- photo, electro and sono chmemical methods, microwave assisted reactions

***Outcomes:***

*To understand the principles of green chemistry and engineering*
*To design processes that are benign and environmentally viable*
*To design processes and products that are safe and hazard free*
*To learn to modify processes and products to make them green safe and economically acceptable.*

**References:**


1. Green Chemistry – An introductory text - M. Lancaster, RSC
2. Green chemistry metrics- Alexi Lapkin and david constable(Eds)
3. Environmental chemistry- Stanley E Manahan,Lewis publishers.

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***M.Tech (Environmental Engineering & Management)***

**Subject: INDUSTRIAL SAFETY** **Code: MEEM – 003**

***Objective:*** *To educate about the health hazards and the safety measures to be followed in the industrial environment. Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings Describe methods of prevention and control of Occupational Health diseases, accidents/emergencies and other hazards*

**Unit-1: Introduction:** Occupational environment and its relation to health, physiological response of man to different environmental stresses.

**Unit-2: Occupation Health:** Types of interaction of man in occupation environment, Types of hazards associated with occupation environment, Occupational diseases with stress on antidotes, Ergonomics.

**Unit-3: Hazardous chemicals:** Classification of hazardous chemicals, transportation of hazardous chemicals, hazchem code, Storage and handling of hazardous substances, Major accidents involving hazardous substances, Emergency preparedness (on site & offsite), and Safety audit.

**Unit-4: Health and Safety Measures:** Medical and engineering measures, Stress at work and its management, Personal protection equipment, Risk Management.

**Unit-5: Legislation Measures:** Occupational Health and Safety Standards, The workmen's Compensation Act , 1923 , The factory Act,1948, The Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.

***Outcomes:***

*Describe, with example, the common work-related diseases and accidents in occupational setting*
*Name essential members of the Occupational Health team*
*What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee*

**Reference Book:**


1. Environmental Health by M.T.Morgan
2. Textbook of Preventive and Social medicine by J.E.Park and K.Park
3. Industrial safety and Environment by A. Prashar and P. Bansal
4. Industrial Hygiene and Chemical Safety by M.H. Fulekar
5. Aspects of Labour Welfare and Social Security by A. M. Sharma
6. Safety at work by John Ridley and John Channing.
7. Hazardous Chemicals Handbook by Phillip Carson and Clive Mumford.

# Swami Vivekanand Subharti University, Meerut

# Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***Course: M.Tech (Environmental Engineering & Management)***

**CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT** **Code: MEEM-004**

***Objective:*** *To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.*

**Unit-1:** Earth's Climate System: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

**Unit-2:** Observed Changes And Its Causes: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

**Unit-3:** Impacts Of Climate Change: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

**Unit-4:** Climate Change Adaptation And Mitigation Measures: Adaptation Strategy/Options in various sectors – Water – Agriculture — Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)-Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

**Unit-5:** Clean Technology And Energy: Clean Development Mechanism –Carbon Trading-examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

***Outcomes:***

*Identify factors influencing the global climate systems*

*Assess impacts of climate change on global, regional and local scales*

*Develop strategies for adaptation and mitigation measures*

*Identify clean technologies for sustainable development*

**Reference Book:**


1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998
4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996
5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*M.Tech (Environmental Engineering & Management)*

**Subject: ENVIRONMENTAL AUDITING** **Code: MEEM – 005**

**Objectives:**

To understand the energy management, conservation processes, principles of energy auditing, energy flow diagra m, economics of energy conservation opportunities.

To understand the energy management information systems, various key features of Energy Conservation Act and ECBC.

To understand the scope for energy conservation in electrical and thermal energy utilities.

**Unit 1:** Concept of energy management programme, basic components of an energy audit, types of energy audit, energy audit flow chart; Understanding energy use patterns and costs, Fuel and energy substitution; concepts of energy conservation and energy efficiency Energy audit tools; financial analysis techniques and options, Energy service companies, Project planning techniques; case studies; Energy conservation.

**Unit 2:** Energy and heat balances, Methods for preparing process flow chart, Procedure to carry out the material and energy balance in different processes Energy management systems, energy conservation policy and performance assessment, baseline and benchmarking, Action planning, monitoring and targeting, Energy management information systems Electricity tariff analysis, load management and maximum demand management, Reactive power management, Power factor and its improvement, Electric Power systems analysis

**Unit 3:** Performance assessment and energy conservation opportunities in compressed air systems, Refrigeration plants, Fans and blowers, Pumping systems and cooling towers; Performance assessment of DG Systems, Case studies Lighting systems: Lamp and Luminaries types, recommended illumination level; Methodology of lighting systems energy efficiency study, Energy conservation opportunities; Case studies.

**Unit 4:** Energy conservation in buildings, Building heating and cooling load management, Buildings code, solar passive and green building concepts Energy conservation in boilers, Performances evaluation, Energy conservation opportunities in steam systems, Performance assessments; Performance analysis of furnaces, Analysis of losses and energy conservation opportunities .

**Unit 5:** Heat exchanger networking, concept of pinch; Waste heat recovery systems, Insulations and Refractory: Types and applications; insulation thickness; Economic thickness of insulations; Types and properties of refractory; Industrial use of refractory; Heat losses from furnace.

***Outcomes:***

*To understanding on energy management, and conservation and energy auditing.*
*To expose the students on various aspects of energy auditing and conservation techniques.*

**Reference Book:**


1. Doty S. and Turner W. C. (2012); Energy Management Handbook, Eighth Edition, Fairmont Press
2. Kreith F. and West R. E. (1996); Handbook of Energy Efficiency, First Edition, CRC Press Reference Books Thumann A. and Mehta D. P. (2008); Handbook of Energy Engineering, Sixth Edition, Fairmont Press Capehart B. L. Turner W. C. and Kennedy W. J. (2011); Guide to Energy Management, Seventh Edition. Fairmont Press
3. Kao C. (1999); Energy Management in Illumination System, First Edition, CRC Press
4. Bureau of Energy Efficiency (BEE) (2012); Study material for Energy Managers and Auditors Examination: Paper I to IV
5. Thumann A. Niehus T. and Younger W. J. (2012); Handbook of Energy Audits, Ninth Edition, CRC Press

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

*M.Tech (Environmental Engineering & Management)*

**Subject: PHASE-I DISSERTATION (Minor project)** **Code: MEEM – 353**

***Objective:***

*Environmental Engineering Dissertations: (Core Course) Research Project and Dissertation specifically designed to give the student practical experience in technologies and principles appropriate to developing a Environmental technologies. Students under the supervision of Faculty Advisor, and with the due permission from the Chairperson / Coordinator will undertake a research based project for a duration of one full semester (four months) at Subharti University/ associated academic institution/ industrial partner/ any other industry /research organization outside Subharti University practicing Environmental technologies. A thesis written for this project will be evaluated by an expert followed by viva-voce.*

1. The outline of the report should be as per the following-
   a. Introduction
   b. Review of Literature
   c. Materials and Methods
   d. Results and Discussion
   e. Conclusion and Summary
   f. References

**Department of Environmental Engineenring**

# Syllabus of M.Tech Environmental Engineering and Management (EEM)

## FOURTH SEMESTER

# Swami Vivekanand Subharti University, Meerut

## Subharti Institutre of Technology and Engineering (SITE)

## Department of Environmental Engineenring

***M.Tech (Environmental Engineering & Management)***

**Subject: PHASE-II DISSERTATION (Major project)** **Code: MEEM – 451**

***Objective:***

*Environmental Engineering Dissertations: (Core Course) Research Project and Dissertation specifically designed to give the student practical experience in technologies and principles appropriate to developing a Environmental technologies. Students under the supervision of Faculty Advisor, and with the due permission from the Chairperson / Coordinator will undertake a research based project for a duration of one full semester (four months) at Subharti University/ associated academic institution/ industrial partner/ any other industry /research organization outside Subharti University practicing Environmental technologies. A thesis written for this project will be evaluated by an expert followed by viva-voce.*

2. The outline of the report should be as per the following-
   g. Introduction
   h. Review of Literature
   i. Materials and Methods
   j. Results and Discussion
   k. Conclusion and Summary
   l. References



Manoj Kapil