

## **MEEM 301 (1): Water and Waste Water Treatment -**

**Waste Water: Primary Treatment;** Equalization Basin, Screening, Comminuting, Grit Removal, Grease Removal & Skimming, Flow Measurement, Primary Sedimentation.

**Secondary Treatment;** Waste Water Microbiology: Growth & Food Utilization Activated Sludge Process, Extended Aeration, Trickling Filter, Ponds & Lagoons, Secondary Clarification.

**Sludge Treatment & Disposal;** Sludge Characteristics, Sludge Thickening, Sludge Digestion, Sludge Disposal: Sludge Incineration, Air Drying, Composting, ASTE Water Reuse & Application.

**Advanced & Tertiary Treatment,** Nutrient Removal, pH Control System, Neutralization Agents & Processes.

### **References:**

1. Waste Water Treatment by Hammer & Hammer
2. Design of Water Treatment Plants by Dr. A.g. Bhole- IWWA Nagpur centre
3. Hand book of Environmental Engineering Vol2, Lawrence K. Wang and Worman C. Pereira, The Human Press, Clifton, New Jersey (1980)
4. Handbook of Environment Engg, Vol. I Liptak
5. Environmental Engineering by Peavy , Rowe, Tchobanogolous
6. Waste Water Treatment by Steel & Meghee
7. Waste water Treatment , Disposal & Reuse , Metcalf & Eddy
8. Manual on Water Supply & Treatment, CPHEEO, Ministry of Urban development, New Delhi, GOI.
9. Environmental Pollution Control Engineering, By C.S. rao
10. Theory & Practice of Industrial Waste Treatment, Addison Wesley Publishing Co. NY
11. Water & Waste Water Technology, Marle J. Hammer & Hammer
12. Waste Water Treatment by Liu, Liptak , Lewis

## **MEEM 301(2): Instrumentation and Control in Energy System -**

Basic measurement concepts, measurement errors. Transducer classification , Static and dynamic Characteristics of transducers, Instruments for measuring temperature, pressure, velocity and flow, heat flux, liquid level and concentration in energy systems, characterization of combustors, flue gas analysers, Exhaust gas analysers.

Solar energy measurement requirements, Solar radiation measuring instruments, Meteorological data measurements, Energy auditing instruments,  
Probe measurements in plasmas, general plasma spectroscopy, Laser interferometry developments, Plasma density and temperature measurement, Mass spectroscopy for plasma species.

Characterisation of electrical power systems, Instruments for monitoring electrical parameters, analysis of power system measurements.

Analog signal conditioning, A/D and D/A converters, Digital data processing and display, Computer data processing and control. Feed back control system Stability and transient analysis of control systems, Application of PID controllers, General purpose control devices and controller design.

Air pollution sampling and measurements of particulates, SO<sub>x</sub>, NO<sub>x</sub>, CO, O<sub>3</sub>, hydrocarbons, Waste water sampling, determination of organic and in-organic and in-organic substance, Physical Characteristic and bacteriological measurements, Solid waste measurements and disposal.

### **References:**

1. Electrical Measurements & Measuring instruments by F W Golding
2. Principles of Measurements of Instrumentation by A S Morris
3. Instrumentation Measurement & Feedback by E Barry jones
4. Instrumentation Measurement & Analysis by B C Nakra

## **MEEM 301 (3): Economics & Planning of Energy System**

Energy theory of value: Principles and systems of energy flows, Methods of energy analysis; Energy intensity method, process analysis input –output method based energy accounting. Energy cost of goods and services energy to produce fuels; coal, oil, natural Gas, Energy cost of various modes of passenger & freight transportation.

Industrial energy analysis; Aluminum, Steel, Cement, Fertilizers. Energetic of materials recycling, Energetic of Renewable Energy Utilization.

Energy and Exergy analysis of Thermal & Chemical Plants.

### **References:**

1. Electrical Energy Systems: Theory & Introduction by L Olle Elgerd
2. Industrial Organization & Engineering Economics by T R Banga
3. Engineering Economics by R Pannersewan
4. Managerial Economics by Joel Deal

## **MEEM 301 (4): Industrial & Commercial Applications of Renewable Energy Sources -**

Renewable energy sources for Power Generation potential and application with regard to Indian power scenario.

Commercial & industrial energy demand; qualitative & quantitative features and characteristics. Renewable & electricity for growing economy.

Water heating, process heating and drying applications; solar biomass and geothermal energy based systems, combined space and building service hot water systems.

Electricity generation from renewable to meet commercial & industrial power requirement. Stand alone & grid connected systems.

Ethanol & methanol from cellulosic biomass, Use of renewable in commercial & industrial building for load leveling, lighting and space heating and cooling.

Economics of renewable energy based commercial and industrial installations, case studies.

### **References:**

1. Renewable Energy Technology and the Environment by Jayogh
2. Renewable Energy: Power for sustainable Future by Boyle
3. Renewable Energy sources by W John Twidell
4. Renewable Energy Technology – Ed. Pachauri, TERI
5. Renewable Energy Sources & their Environment Impact by S A Abbassi

## MEEM 301 (5): SOLID WASTE MANAGEMENT

**Integrated Solid waste Management;** Management option for solid Waste, Generation Rate Variation, Waste Reduction at the sources Collection Techniques Materials and resources Recovery/Recycling.

**Municipal Solid waste:** Characteristics (Physical, Biological and chemical) ; Transport of Municipal Solid Waste, Routing and Scheduling ,Treatment Transformations and disposal Techniques (Composting, Vermi Composting , Incineration, Refuse Derived fuels)

**Ultimate Disposal:** Sanitary Landfills. Norms, Rules and Regulations, Land Fill method of solid waste disposal;, Layout & preliminary design of landfills;, Movement and control of landfill leachate & gases.

**Waste to energy options:** combustion (unprocessed and processed fuel), gasification, anaerobic digestion, pyrolysis.

**Hazardous Waste:** Sources, Generation and classification. Transportation, Treatment,& disposal methods.

Hazardous Waste Minimization Reuse& Recycling. Cleanup of Contaminated Waste Sites, Remediation of Hazardous waste contaminated soils, Engineering issues in waste remediation case studies.

### References:

- 1) Solid Waste Management Collection :A.D. Bhide and B.B. Sudershan
- 2) Solid Waste Engineering Principles, Tecobanoglous G.
- 3) Handbook of Solid Management, Frank Kreith, Mcgraw Hill,Inc USA
- 4) Solid waste Management- A practical approach by Manoj Datta
- 5) Energy form solid waste by Jackson
- 6) Refuse recycling and recovery by John R. Holmes
- 7) Handbook of Solid Waste Management Frank Kreith, Mcgraw Hill, Inc USA
- 8) Hand Book Environmental Engineering Vo12, Lawrence K.Wang and Worman C. Pereira,The Human Press Clifton, New Jersey (1980)
- 9) Hand Book Environmental Engineering Vo1, I Liptak
- 10) Environmental Engineering by Peavy, Rowe Tchobanogolous
- 11) Manual on Solid Waste Management CPHEEO,GOI
- 12) Waste Management and Resource Recovery by Rhyner, Schwartz & Kohrell
- 13) Hazardous Air Pollutant Handbook Spicer Garden Holdren Kally Mukund
- 14) Basic Hazardous Waste Management by CRC Lews
- 15) An Introduction to Management & Regulation of Hazardous Waste by Moore
- 16) Basic Hazardous Waste Management by Willian C.Balckman ,Jr,Lewis (CRC)
- 17) Ramachandra T.V , 2006. Management of Municipal Solid Waste , Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore.

## **MEEM 302(1): Energy Efficiency in Electrical Utilities -**

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Energy audit in Electrical Systems

Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities

HVAC and Refrigeration System: Vapor compression refrigeration cycle, refrigerants, coefficient of performance, capacity, factors affecting Refrigeration and Air conditioning system performance and savings opportunities.

Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potential.

Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues.

Diesel Generating system: Factors affecting selection, energy performance assessment of diesel conservation avenues. Energy audit in Mechanical Systems – Fans, Blowers, Compressors & Pumps.

### **References:**

1. Energy Auditing Made Simple by P Balsubramaniam
2. Power Plant Performance by A B Gill
3. An Introduction to Thermodynamics by Y V C Rao
4. Energy Management by W K Murphy & G McKay
5. Energy Reduction through improved Maintenance Practices by Bannister
6. Energy Efficiency in Electrical Utilities by BEE

## **MEEM 302 (2): Environmental Audit & Impact Assessment -**

Introduction: Origin and Development of Environmental Impact Assessment. (EIA), Current Status of EIA.

Essential Components of EIA: Concepts, EIS, Disaster Management Plan Baseline Study, Impact Prediction, Mitigation & Enhancement, Monitoring, and Conclusion.

National environmental policy, Methodology of environmental impact studies, Methods of impact identification, Environmental setting, Production and assessment of impacts on the air environment, Prediction and assessment of impacts on surface water, soil and ground water environment, Socioeconomic environment, Evaluation alternatives, Public participation in environmental decision making. EIA Legislation.

Environment Impact Statement & Environmental Management Plan for Selected Industries-Case Studies on power plants, Cement industry, Iron & Steel, Chemical & Refinery.

Guidelines for Environmental Audit :Concepts and definitions of Environmental Audit, Audit objectives , Scope, Types of Audit, Need for Environmental Audit , Application.

Key steps to Environmental Audit: Pre , Onsite & Post Environment audit activities. Audit Procedure, Format of Environmental Audit.

### **References:**

- 1 Environmental Impact Assessment- Larry W. Canter, University of Oklahoma- McGraw Hill Company
2. Environment Impact Assessment, Clark D. Brain, Biesel Donald
- 3 EIA for Developing Countries, Biswas Asit K.
- 4 Environment Impact Assessment, W. Canter (II Edition)
- 5 EIA Guidelines 1994, Notification of Govt. of India Impact Assessment Methodologies Publications Ltd. (1995)
6. Guidelines for environmental audit. By Central Pollution Control Board. DELHI, Place and Publisher: Delhi : CPCB
7. Environmental audit and business strategy: Total quality approach by G. Ledgerwood, TERI
8. A-Z organization of environmental audit by A. Mehrotra, mpIIFM
9. Environmental audit (an overview), , Ashok Keshav Mhaskar, CSE
10. An outline of environmental audit by K. V. Bengeri, CSE
11. Environmental audit (an overview) by A. K. Mhaskar, CSE
12. Clarck KC Parks, B O, Crane ,MP “Geographic Information Systems and environmental Modeling” Prentice Hall of India Pvt Ltd.2002.
13. Reddy, MA “Text book of remote sensing & GIS”, BS publications 2001.

## **MEEM 302 (3): Project Evaluation & Management**

Project Management: Definition and scope of project, technical design, financing, contracting, implementation and performance monitoring.

Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification

Life cycle approach and analysis, conception, definition, planning, feasibility and analysis environmental impact analysis, project planning matrix, aim oriented project planning.

Network analysis for project management- PERT, CPM and CERT. Fuzzy logic analysis, stochastic based formulations.

Project evaluation techniques, funds planning, project material management, evaluation & analysis, Implementation & monitoring, Performance indices, case studies.

### **References:**

1. Projects Planning Analysis, Financy by Prassanna Chandra
2. Pert/CPM and Project Management by S K Bhattacharjee



## **MEEM 302 (4): Environmental Modeling & Simulation**

Modeling- Classification of Models; Model Based on Transport Phenomena-Principal & Applications; Population Balance Models & Application; Empirical Models- Form of Empirical Model, Model Parameters Estimation.

Simulation- General Techniques of Simulation, Monte Carlo Methods Comparison of Simulation and Analytical Methods, Numerical Computational Techniques for Continuous and Discrete Models, Distributed by Models, Cobweb Models, Simulation Study.

Environmental Modeling-I- Development of Environmental Model, Characteristics of Aquatic Ecosystem, Overview of Groundwater Models and Model of Waste Water Treatment Plants. Introduction, Characteristics Features and Classification of Eco-Toxicological Models.

Environmental Modeling-II- Models of Atmospheric Pollution, general consideration on Modeling Air Pollution & Climate Change, Modeling Population Dynamics.

### **References:**

1. Process Modeling, simulation & Control for Chemical Engineers by W.L. Lyben – McGraw Hill
2. Introduction to Simulation by T.A. Payer
3. System simulation by G. Gordan- PHI
4. Fundamentals of Ecological Modelling by S.E. Jorgesen-Elsevier publication.
5. An Introduction to Mathematical Ecology by Pielou E.C.- Wiley inter science Publication
6. Energy Models beyond 2000 by Jyoti Parikh, Mumbai.
7. Operational research by Aspani, Seisani,
8. Energy Models by A.K.Desai
9. Operational Research by Bafaa.
10. Mathematical Modeling by J.N. Kapoor.

## **MEEM 302 (5): SOLAR THERMAL TECHNOLOGIES**

### **Solar Thermal Systems**

Solar still, Solar cooker, Solar pond, Greenhouse technology: Fundamentals, design, modelling and applications. Solar Thermal Power Systems ; Flat Plate Collector, Hot Air Collector, Evacuated Tube Collector, Parabolic , Compound Parabolic and Fresnel Solar Concentrators, Central Receiver System, Thermal Analysis of Collectors Performance of Solar Collectors.

### **Properties and Characteristics of Materials**

Reflection from ideal specular, ideal diffuse and real surfaces; Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization.

### **Design & modelling of solar energy systems**

Performances of solar collectors, F Chart method,  $\phi$ - F Chart method; Utilizability modelling & simulation of Solar Energy Systems.

### **Thermal applications of solar energy:**

Solar Water Heating Systems (Active & Passive), Solar Space Heating & Cooling Systems, Solar Industrial Process Heating Systems, Solar Dryers & distillation Systems, Methods of modelling and design of Solar heating system, Cooling requirements of buildings, Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; Solar desiccant cooling; thermal power generation.

### **Storage and Economic analysis**

Solar Thermal Energy Types: Sensible storage; Latent heat storage; Thermo-chemical storage; Design of thermal storage system; Transport of energy.

Life cycle analysis of Solar Energy Systems; Time Value of Money; Evaluation of Carbon Credit of Solar Energy Systems. Case studies of solar thermal plants.

### **Reference Books:**

1. J.A.Duffie & W.A. Beckman: Solar Engineering of Thermal Process
2. S.A.Kalogirou: Solar Energy Engineering
3. Principles of Solar Engineering – F. Kreith and J.F. Kreider, (McGraw Hill Pub.)
4. Solar Energy Handbook – Kreider and Kreith ( McGraw Hill Book Company)
5. Solar Distillation : Malik, tiwari etc. ( Pergamon Press1982)
6. Solar Energy Engineering – A.A.M. Sayigh