Savitribai Phule Pune University
ME Environmental Engineering
(Chemical Engineering)
(w.e.f. June 2017)

COURSE STRUCTURE FOR M.E. Environmental Engineering-Chemical

SEMISTER I

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lect./Pr	Paper		TW	Oral/ Presentations	Total	
			In Semester Assessment	End Semester Assessment				
509131	Applied Statistics for Environmental Engineers	4	50	50	-	-	100	4
509132	Environmental Management	4	50	50	-	-	100	4
509133	Environmental Chemistry	4	50	50	-	-	100	4
509134	Research Methodology	4	50	50				4
509135	Elective I	5	50	50	-	-	100	5
509136	Lab Practice I	4	--	--	50	50	100	4
Total of First Term		25	250	250	250	50	600	25

SEMISTER II

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lect./Pr	Paper		TW	Oral/ Presentations	Total	
			In Semester Assessment	End Semester Assessment				
509137	Wastewater Treatment & Design	4	50	50	-		100	4
509138	Solid Waste Management	4	50	50	-	-	100	4
509139	Industrial Waste Treatment	4	50	50	-	-	100	4
509140	Elective II	5	50	50	-	-	100	5
509141	Lab Practice II	4	-	--	50	50	100	4
509142	Seminar I	4			50	50	100	4
Total of Second Term		25	200	200	100	100	600	25

SEMISTER III

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lect./Pr	Paper		TW	Oral/ Presentations	Total	
			In Semester Assessment	End Semester Assessment				
509143	Remote Sensing and GIS applications in Environmental Engineering	4	50	50	-		100	4
509144	Industrial Pollution Prevention & Cleaner Production	4	50	50	-	-	100	4
509145	Elective III	5	50	50	-	-	100	5
509146	Seminar II	4	--	--	50	50	100	4
509147	Project Stage I	8	-	--	50	50	100	8
Total of First Term		25	150	150	100	100	500	25

SEMISTER IV

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lect./Pr	Paper		TW	Oral/ Presentations	Total	
			In Semester Assessment	End Semester Assessment				
509148	Seminar II	5	--	--	50	50	100	5
509149	Project Work Stage II	20	-	--	150	50	200	20
Total of Second Term		25	--	--	200	100	300	25

LIST OF ELECTIVES

Elective I	Elective II	Elective III
1.Modeling of Environmental systems	1. Membrane Technology in Environmental Engineering	1. Ecology and Risk Assessment
2. Environmental Auditing	2 Unit Operations in Environmental Engineering	2. Water Quality Modeling
3. Environmental Policies and Legislations	3.Agricultural Pollution and Control	3. Modern Trends in Environmental Engineering
4.Air & Noise Pollution Control	4.Environmental Impact Assessment & Economics	4. Environmental Biotechnology

Semester I
509131: Applied Statistics for Environmental Engineers

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

EMPIRICAL STATISTICS:
Measures of Central tendency, dispersion, skewness and kurtosis. Principle of least squares - Correlation and regression - rank correlation.

SAMPLING DISTRIBUTIONS AND ESTIMATION:
Sampling distributions - Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method - Method of moments.

TESTING OF HYPOTHESIS:
Sampling distributions - Tests based on Normal, t, Chi-square and F distributions - Analysis of variance – one-way and two-way classifications.

DESIGN OF EXPERIMENTS:
Completely randomized design - Randomized block design – Latin square design - 2 power 2 factorial design.

LINEAR PROGRAMMING:
Basic concepts - Graphical and Simplex methods – Transportation problem - Assignment Problem.

Reference:
1. Berthouex, P.U., " Statistics for Environmental Engineers ", Lewis Publ., 1994.
2. Freund, J.E. and Miller, I.R., " Probability and Statistics for Engineers ", Prentice – Hall of India, 5th Edition, New Delhi, 1994.
3. Gupta, S.C. and Kapur, V.K., “Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.
4. Ang, A.H.S. and Tang W.H., “Probability concepts in Engineering Planning and Design – Basic Principles Vol.1 ", John Wiley and Sons, Inc. New Delhi, 1975.
5. Taha, H.A., " Operations Research: An Introduction ", Prentice - Hall of India, 6th Edition, New Delhi, 1997.
6, Wayne, R. Ott Environmental Statistics and Data Analysis, CRC Press. (1995).

509132: Environmental Management

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

Environmental Management:
Concept and scope, Systems and approaches, Standards -international and national; Ecomark; Environmental accounts and auditing, Green funding and taxes, Trade and environmental management.

Environment Impact on Business: Social, Economic, Political, Cultural, Legal and constitutional sub-systems of environment and their impact on Business. Constitution of India: Fundamental rights and duties, Directive Principles of State Policy, 74th Amendment of the Constitution pertaining to local Governments.

Introduction to Environmental Legislation: How the Parliament functions- Bill to Act to Rules. How a Bill is issued in parliament and how it becomes an Act, How a rule is notified/Gazetted. Difference between Regulation, Law and Notification Bills. Introduction to Environmental Acts, Factory Act, Safety Related rules. Environmental Policy of the Government of India for Industrial Location with respect to Ecology. The Command & Control Regime and The Economics Instruments Regime.

Public Policy for Industry and Business: Environmental Policy of the Government of India and the working of the Ministry of Environment and Forests, Central Pollution Control Board, State Pollution Control Boards. Annual Report of the Ministry of Environment and Forests(current year)

Reference:
1. Government & Business – by Amarchand, Tata McGraw Hill.
2. Government & Business Management – by Kumar & Ghosh
3. Business Law – Bulechandani. K. R.
4. Mercantile Law – Barra and Kelra.
5. The Economics of Development and Planning – by M. L. Jhingan.
6. Microeconomic Theory & Welfare Economics – by P. N. Chopra
7. Economic Development – Problems, Principles & Ploicies – by Benjamin Higgins.
8. Economic Development – Past & Present – by Gill
9. Economic Development of Business – by Dr. M. Adhikari

509133: Environmental Chemistry

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

INTRODUCTION.
Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order, Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation

AQUATIC CHEMISTRY
Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation– Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction, Eh – pH diagrams, redox zones, Fe – sorption- Chemical speciation

ATMOSPHERIC CHEMISTRY 1
Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion, greenhouse gases and global warming, CO2 capture – Acid rain - origin and composition of particulates. Air quality parameters-effects and determination

SOIL CHEMISTRY
Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil. Reclamation of contaminated land.

EMERGING AREAS
Principles of green chemistry, Atom economy, mass index - Nano materials, CNT, titania, composites, environmental applications.

REFERENCE:
1. Sawyer, C. N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
2. Colin Baird ‘Environmental Chemistry’, Freeman and company, New York, 1997.
3. Manahan, S.E., Environmental Chemistry, Eighth Edition, CRC press, 2005.
4. Ronbald A. Hites ,Elements of Environmental Chemistry, Wiley, 2007.

509134: Research Methodology

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

Introduction

Research methodology: Definition of scientific and technical research, Objectives of research Types of research, Various steps in research process, Problem formulation, Literature search and information management, Research plan, Mathematical tools for analysis, Developing a research question-choice of a problem, Literature review: surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research purposes, Ethics in research – APA Ethics code.

Quantitative methods for problem solving

Statistical modeling and analysis, Time series analysis probability distributions, Fundamentals of statistical analysis and inference, Multivariate methods, Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis, Error analysis, Applications of spectral analysis, Evaluation of results.

Design of Experiments:

a) Objectives, strategies, Factorial experimental design, Designing engineering experiments,basic principles ‐ replication, randomization, blocking, Guidelines for design of experiments.b) Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA)for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.

c) Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two ‐ factor factorial design; Models ‐ Effects, means and regression, Hypothesis testing.

Tabular and graphical description of data

Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, Preparing data for analysis.

Soft Computing

Computer and its role in research, Use of statistical soft ware SPSS, GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Structure and Components of Research Report and Presentation

Types of report, Layout of research report, Mechanism of writing a research report, Referencing in academic writing, Research report preparation: abstract, description of instruments and materials, experimental procedures, description of results, discussion of results, conclusions. Citation methods: Foot Note, Text Note, End Note and Bibliography. Writing a blogSpot, Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review. Presentation: Scientific and technical presentations, Planning the presentation (formulation of objectives, analysis of audience), Preparing the presentation, Presentation delivery techniques, Organizing the presentation forum.

Introduction to Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation

on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Recent Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Softwares etc. Traditional knowledge Case Studies, IPR and IITs.

Exercise: *One dummy Minor Research Proposal preparation in a proper format following above guidelines should be made compulsory to every student as a compulsory Assignment.*

Text Books

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H. McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0,2006

Reference Books

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engg Applications, Timothy J. Ross, Wiley Publications, 2nd Ed[d]
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven & E.H. Aarts[e]
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg.
5. Beach, D. P. and T.K.E. Alvager, 1992, Handbook for Scientific and Technical Research, Prentice-Hall, Englewood Cliffs, N.J.
6. Day, R. A., 1988, How to Write and Published Scientific Paper, Oryx Press, Phoenix, AZ, 1988
7. Hautala, P.C., 1989, Technical and Managerial Communication, Univ. of Idaho Press, Moscow, ID
8. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New”

509135 [Elective I](1) : Modeling of Environmental systems

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Definition, Classification, Examples and Models of Environmental Systems. modeling objectives and choices, sensitivity analysis and sources of error, introduction to numerical methods, reaction type and orders of reactions conservation of mass, energy and momentum, river/stream quality Introduction to air quality models; Air pollution meteorology; Atmospheric turbulence; Gaussian Plume model and Modifications; Simulations of special meteorological and topographic conditions; urban diffusion models, Model Calibration. Sensitivity Analysis, Applications, Climate change and the Models for Climatic change Introduction to river, estuarine and lake hydrodynamics, Dissolved Oxygen Models; Temperature Models, prediction of fate of organism and toxic substances. Models for management applications.

Reference:

1. R.V. Thompson and J.A. Muller Principles of Surface water Quality Modeling and Control Harper International Edition, N.D. 1987.
2. Richard W. Boubel, Donald L. Fox, D. Bruce Turner and Arthur C. Stera: Fundamentals of Air Pollution, Academic Press, 1994.
3. J.H. Seinfeld: Air Pollution, Physical and Chemical fundamentals, McGraw Hill 1990.
4. G. M. Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.
6. Process Dynamics in Environmental System by W.J. Weber and F. Digiamo 1995 Wiley Intisene

509135 [Elective I](2) : Environmental Auditing

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Concepts of Environmental Audit, Objectives of audit. Types of audits, Features of effective auditing, Programme Planning, Organization of auditing programme, Pre-visit data collection, Audit protocol, Onsite audit, Data Sampling: Inspections, Evaluation and presentation, Exit interview. Audit Report – Action Plan – Management of audits. Waste management contractor audits, Life cycle approach.

Introduction, Principles and Elements of Successful environmental management. ISO Principles, EMS, Creating an environmental management system in line with ISO 14000. Benefits of an environmental management system.

Principles and elements of successful environmental management: Leadership, Environmental management planning, Implementing an environmental management system, Measurement and evaluations required for an environmental management system, Environmental management reviews and improvements.

Legal and regulatory concerns. Integrating ISO 9000 and ISO 14000.

Reference:

1. Maheswar Dayal, “Renewable Energy Environment & Development”, Konark Pub. Pvt. Ltd., 1998.
2. Girdhar Gyani and Amit Lunia, “Planning & Implementation of ISO 14001, Environmental Management System”, Raj Publishing House, Jaipur, 2000
3. Joseph Caseion (Ed.) “The ISO 14000 Handbook”, CEMM Information Services.
4 Don Sayre, “INSIDE ISO 14000 – The Competitive Advantage of Environmental Management”, Vinity Books International, New Delhi, 2001
5. Ritchie, I & Hays, W., “A Guide to Implementation of the ISO 14000 Series on Environmental Management”, Prentice Hall, New Jersy, 1998.

509135 [Elective I](3) : Environmental Policies and Legislations

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Introduction:
Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria.

Historical aspects:
Major legislations: USEPA 1969 to Clean Water and Air Act.Significant legislations in developing and developed countries.

Legislations in Indian context:
Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution.

Norms & Standards:
OHSHAS 18001 and its significance. ISO 14000 and its significance, other acts in ESE and case studies. Feasibility Studies and Management issues.

Related Issues:
Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy.

Reference:
1. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998.
2. Handbook of Accident prevention, ILO Publication, 1998.
3. Encyclopaedia of Industrial Safety and Health, 1999.
4. G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.

509135 [Elective I](4) : Air & Noise Pollution Control

Teaching Scheme **Examination Scheme**
Lectures: 5 Hrs/Week **In Semester Assessment: 50 Marks**
End Semester Assessment: 50 Marks
Credits: 5

INTRODUCTION
Sources and classification of Air Pollutants: Natural contaminants - aerosol -gases and vapour. Air quality standards - Meteorology and Air pollution: Atmospheric stability and inversions-mixing height-plume behaviour - plume rise estimation - effluent dispersion theories-Isokinetic sampling- Modeling.

CONTROL OF PARTICULATES
Objectives - Filters, gravitational, centrifugal-multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection-ESP design procedure.

GASEOUS POLLUTANT CONTROL
Absorption: principles, description of equipment-packed and plate columns, design and performance equations. Adsorption: principal adsorbents, equipment descriptions-PSA-adsorption cycle-solvent recovery system continuous rotary bed-fluidized bed, Design and performance equations. Condensation: contact condensers-shell and tube condensers, design and performance equation. Incineration : hydrocarbon incineration kinetics, equipment description, design and performance equations.

CONTROL MEASURES FOR INDUSTRIAL APPLICATIONS
Control methods - Processes based control mechanisms - mineral products -asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field Study.
Noise Pollution, Characteristics. Sources, their Effects and Control Measures.

Reference:
1. Air Pollution Control Engineering by N.D. Nevers (1995) MC Graw Hill
2. Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
3. Noise Pollution by Tripathy, Debipras (latest edition)

509136: Laboratory Practice – I

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/Week	**Term Work: 50 Marks**
	Oral/Presentation: 50 Marks
	Credits: 4

Each student should '**perform'** at least **08** experiments from the list given below and submit the journal which will form the term-work for the subject.

Important: The students are required to preserve the samples, compounded materials, test specimens, tested specimens, 'original' result papers such as charts, graphs, data sheets soft copies of modeling and analysis etc. and should be submitted alongwith the journal for evaluation, failing which the TW will not be granted.

Lab Practice I :
The laboratory work will be based on completion of assignments confined to the courses of that semester.
The assessment will be done jointly by the pair of internal and external examiners along with the oral examination of the same.

Experiments:
1. Use of water test kits for the determination of various water pollution parameters
2. To measure common parameters using other conventional methods
3. Analysis of water samples for metals using AA Spectrometer
4. Analysis of Phosphate by using ascorbic acid method
5. Use of Ultra Filtration Technique.
6. Analysis of soil for NPK, Na, Ca.
7. Analysis of soil types
8. Analysis of soil for moisture,
9. Analysis of soil for EC, conductivity
10. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
11. Usage of conceptual, mathematical and computational models.
12. Graphical representation of environmental data and to draw inferences from them.
13. To study the differences between analytical and numerical solutions to environmental models.
14. Use of iteration technique in environmental modeling
15. To study the comparison between discrete and continuous models.
16. To validate a model and sensitivity analysis.
17. To understand the concept of spatial dependence and its modeling.
18. To analyze the automobile/diesel engine exhaust

Semester II

509137: Wastewater Treatment & Design

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/Week	**In Semester Assessment: 50 Marks** **End Semester Assessment: 50 Marks** **Credits: 4**

Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.

Coagulation processes, stability of colloids and destabilization, coagulants Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers. Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.

Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors.

Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener,

Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose.

Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.

Reference:

1. METCALF & EDDY, INC. " Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition, Tata McGraw-Hill Publishing CompanyLimited, New Delhi 1995.
2. CASEY. T.J. " Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England 1993.

509138: Solid Waste Management

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

Solid waste management:
Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.

Solid waste generation rate:
Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.

Sorting and material recovery:
Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste.

Composting of solid waste:
Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.

Landfills:
Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.

Indian scenario:
Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.

Reference:
1) Manual on municipal solid waste management – Government of India publication.
2) Integrated solid waste management – George Tchobanoglous. McGraw Hill
3) Solid waste management handbook– Pavoni.

509139: Industrial Waste Treatment

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.

Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts.

Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Treatability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and Effluent standards.

Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.

Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

Reference:

1) Theories and Practices of Industrial waste treatment- Nelson Nemerow.
2) Waste water treatment: M. N. Rao & Datta.
3) IS Standard guide for treatment and disposal of various industries.

509140 [Elective II] (1): Membrane Technology in Environmental Engineering

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Introduction to Membrane Processes, Membranes and Modules:
Principles of Membrane processes; Types and uses of membranes; Recent development in membranes; Types and uses of modules; Washing procedures.

Applications of Membrane Processes in Environmental Engineering:
Membrane bioreactors; Pervaporation and its applications; Reverse Osmosis, Ultrafiltration and Microfiltration and their applications; Dialysis and Electrodialysis and their applications; Others.

Preparation of Synthetic Membranes:
Introduction, preparation of synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes.

Characterization of Membranes:
Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes.

Module and process design:
Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations.

Case studies of Selected Environmental Processes with Membrane Technology

Reference:
1. M.H.V. Mulder, Membrane Separations. Kluwer Publications
2. S.P. Nunes, and K.V. Peinemann, membrane Technology in the chemical industry, Wiley-VCH.
3. R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons.
4. R.Y.M. Huang, Pervaporation Membrane Separation Processes, Elsevier.
5. J.G. Crespo, K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications.
6. Larry Ricci and the staff of chemical engineering separation techniques, Mc Graw Hill publications.

509140 [Elective II] (2): Unit Operations in Environmental Engineering

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

PRELIMINARY PHYSICAL UNIT OPERATIONS
Factors in selection of unit operations and processes - Principal type of Reactors – Flow measurement – Screening - Flow Equalization - Mixing - Static and Mechanical mixers - Coagulation and Flocculation - Perikinetic and Orthokinetic flocculation.

SEDIMENTATION AND FLOATATION
Sedimentation - Type of settling - Removal ratio - Tray and Titled plate settlers - Flotation - Dissolved air flotation.

FILTRATION AND GAS TRANSFER
Filtration - Type of filters - Headloss through filters - Carmen-Kozeny equation - Gas Transfer -Two film Theory - Mass transfer coefficient - Oxygenation capacity.

CHEMICAL UNIT PROCESS
Chemical precipitation - phosphate removal - Adsorption – Manufacturing of Activated carbon - ADSORPTION kinetics , Isotherms - Disinfection – Factors Influencing – Breakpoint chlorination, Leaching, Leaching calculations, Ion Exchange.

BIOLOGICAL UNIT PROCESSES
Kinetic of Biological growth - Suspended and attached growth processes - Aerobic and Anaerobic - Determination of kinetic coefficients.

Reference:
1. METCALF & EDDY, INC. "Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 1995.
2. CASEY. T.J. “Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England, 1993.

509140 [Elective II] (3): Agricultural Pollution and Control

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Environmental issues in agriculture, types of farming systems, agro meteorology, water and nutrients requirement, types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices, water logging and salinity; causes and effects. Waste water reuse in agriculture, management and control of agricultural waste; recycling and reuse.

Reference Books:

1. Bucharest, Code of Good Agricultural Practices for Farmers' Use Vol. I - Water Protection against Pollution With Fertilizers From Agriculture And Prevention Of Soil Degradation Phenomena Caused By Agricultural Practices, 2002
2. C. D. Sawyan, Chemistry of Environmental Engineers. Mc Graw Hill Publ.
3. J.W. Moore and E.A. Moore, Environmental Chemistry
4. T.V.Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI

509140 [Elective II] (4): Environmental Impact Assessment & Economics

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Environmental impact assessment: Introduction, Concepts and aims, Impact statement,Methods and Processes, Mitigation processes. Prediction and assessment of impact on air, water and noise.

Public participation in environment decision making: Environment education and awareness, Environmental economics, Economics of Pollution control, Cost benefit analysis.

Prediction and assessment of impacts on the biological, cultural and socio-economic environment, Introduction and basic concepts. Environmental impact assessment of major development projects, industries, mining, thermal power plants, atomic power stations, transport (rail, road, highway), tourism (Hotels, beaches and resorts , EIA of different xenobiotics (chemicals, fertilizers, heavy metals).

Economy and Environment, Economic operation and environmental issues, adversities on the economy. Markets and Environmental Assets Incomplete markets, externalities, non-exclusion, non-rivalry and public good, non-convexities, asymmetric information.

Economic Incentive and Environmental Protection: (i) Price rationing: Charges and subsidies, (ii) Liability rules: Non-compliance fees, bonds and deposit refunds.(iii) Quantity rationing: Marketable permits.(iv) Evaluation criteria(v) Practical Conditions for use of economic incentives. **Pollution Taxes,** Efficiency properties of a tax on emissions, problems with pollution taxes.

Tradable Pollution Permits, Basic theory of tradable pollution permits, issues in tradable permits. Transboundary pollution problem, international organizations for environmental protection. WTO agreements on environment. Agrochemical pollution and measures undertaken: national and international scenario, bio-diversity and economy.

Reference:

1. W. Canter " Environmental Impact Assessment" Mc Graw Hill (1996).
2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988)
3. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980).
4. Levy, Leboyer, C. Psychology and Environment (1982). London : Sage.
5. Cone, J.D. and Hayes, S.C. Environmental Problems / Behavioural Solutions (1980) California : Brooks Kole.
6. Altman, I. And Stokols, D. (Eds.) Handbook of Environmental Psychology (1987). New York : Wiley.

509141: Laboratory Practice – II

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Term Work: 50 Marks
Oral/Presentation: 50 Marks
Credits: 4

Each student should '**perform'** at least **08** experiments from the list given below and submit the journal which will form the term-work for the subject.

Important: The students are required to preserve the samples, compounded materials, test specimens, tested specimens, 'original' result papers such as charts, graphs, data sheets soft copies of modeling and analysis etc. and should be submitted along with the journal for evaluation, failing which the TW will not be granted.

Lab Practice II:
The laboratory work will be based on completion of assignments confined to the courses of that Semester.
The assessment will be done jointly by the pair of internal and external examiners along with the oral examination of the same.

Experiments:
1. Analysis of soils for pH,
2. Determination of phenol.
3. To study the adsorption Characteristics of the given cation exchange resins.,
4. Determination of heavy metals.
5. To study the performance Ion Exchange Column
6. Development of flow sheet of effluent treatment plant.
7. Determination of Dissolved Oxygen (DO) in Water
8. Determination of Biochemical Oxygen Demand (BOD) of Waste water
9 Determination of Chemical Oxygen Demand (COD) of Waste water
10. Designing of plant using software such as EnviroPro / SuperPro
11. Field visit to a water treatment plant and preparation of visit report.
12. Field visit to a wastewater treatment plant and preparation of visit report.
13. Analysis of water quality

509142: Seminar I

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Term Work: 50 Marks
Oral/Presentation: 50 Marks
Credits: 4

SEMINAR:
The student shall deliver the seminar on a topic approved by authorities.
Seminar I : Shall be on state of the art topic of student's own choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

Important instructions:
1. Seminar is to be presented using power point presentation.
2. Seminar report is to be submitted in soft and hard copy to the department.
3. The attendance record (signatures) of the audience must be attached and maintained with the report, clearly mentioning "Attendance Record for the ME Seminar Presentation" with Date and Topic of presentation.

Semester III

509143:Remote Sensing and GIS applications in Environmental Engineering

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

FUNDAMENTALS OF REMOTE SENSING
Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth materials and vegetation

PLATFORMS AND SENSORS
Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors

DATA PROCESSING
Data analysis - Visual Interpretation and Digital Image Processing – classification

GIS
Introduction to GIS, concepts and Data base structure, various GIS softwares.

REMOTE SENSING AND GIS APPLICATIONS
Management and monitoring of land, air, water and pollution studies, conservation of resources, coastal zone management - Limitations.

LABORATORY PRACTICES
Reflectance measurement, Visual Interpretation, Digital Image Processing, data analysis in ARC/INFO.

References:
1. Lillies and T.M. and Kiefer, R.W., " Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994.
2. Burrough, P.A. and McDonnell, R.A., " Principles of Geographical Information Systems", Oxford University Press, 1998.
3. Lintz, J. and Simonet, " Remote Sensing of Environment ", Addison Wesley Publishing Company, 1994.

509144: Industrial Pollution Prevention & Cleaner Production

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 4

Industrial Activity and Environment –
Industrialization and Sustainable Development – Indicators of Sustainability-Sustainability Strategies – Barriers to Sustainability – Industrial Ecology – Pollution Prevention (PP) and Cleaner Production (CP) in achieving Sustainability- Prevention versus Control of Industrial Pollution - Environmental Policies and Regulations to encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-based approaches

Concept of Pollution Prevention and Cleaner Production –
Definition – Importance - Historical Evolution – Benefits - Promotion - barriers – Role of Industry, Government and Institutions - Environmental Management Hierarchy – Source Reduction techniques – Process and Equipment Optimization, Reuse, Recover, Recycle, Raw material substitution - Internet information and Other PP and CP Resources

Pollution Prevention and Cleaner Production Project development and implementation –
Overview of CP Assessment steps and skills, Preparing the site, Information gathering, and Flow diagram, Material balance, PP and CP Option generation, Technical and Environmental Feasibility analysis, Total Cost analysis - PP and CP Financing, Establishing a Program - Organizing a Program- Preparing a program plan - Measuring progress – Pollution Prevention and Cleaner Production Awareness Plan - Waste Audit- Environmental Statement

Life Cycle Assessment and Environmental Management Systems:
Elements of LCA - Life Cycle Costing – Eco labeling – Designs for the Environment - International Environmental Standards- ISO 14001 - Environmental Audit..

Case Studies:
Industrial Applications of PP and CP, LCA, EMS and Environmental Audits.

REFERENCE BOOKS:
1. Paul L. Bishop, “Pollution Prevention: Fundamentals and Practice”, McGraw-Hill International, 2000.
2. World Bank Group, “Pollution Prevention and Abatement Handbook-Towards Cleaner Production”, World Bank and UNE, Washington D.C., 1998.
3. Freeman, H.M, Industrial Pollution Prevention Handbook”, McGraw Hill”, 1995.
4. James G. Mann and V.A. Liu, “Industrial Water Reuse and Wastewater Minimization”, McGraw Hill, 1999.
5. Prasad Modak, C. Visvanathan and Mandar Parasnis, “Cleaner Production Audit Environmental System Reviews”, No. 38, Asian Institute of Technology; Bangkok, 1995

509145 [Elective III] (1): Ecology and Risk Assessment

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Introduction; Principles and Concepts of Eco-system, Energy in Eco-system, Biogeochemical Cycles; Principles Pertaining to Limiting Factors; Principles and Concepts at the Community and Population Levels; Species in Eco-system; Devolution and Evolution of Eco system; Models in Ecology; Fresh Water Ecology; Marine Ecology; Estuarine Ecology; Terrestrial Ecology; Concepts and Principles in Sustainable Development and Biodiversity; Habitat, Damage Assessment; End Point Definition; Quantification of Uncertainty; Predictive Risk Assessment; Exposure, Organism-level Effects; Case Studies.

Reference Books:

1. Fundamentals of Ecology by Odhum (latest edition)
2. Ecological Engineering by Mitch / Iorgemaker (latest edition)

509145 [Elective III] (2): Water Quality Modeling

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Basic Concept of Modeling. Hydrological Considerations in Water Quality Modeling. Low Flow Frequency Analysis. Sources of Pollution and Types of Wastes; Point and Non-point Sources. General Mathematical Formulation of Water Quality Models for Streams and Rivers; Bod, Do, Bacterial Decay, and Nitrification.
Stream Surveys for Model Calibration and Verification; Application of river models for water quality management. Development of estuarine water quality models. Steady state lake models. Ocean outfalls and mathematical models of wastewater dispersion in oceans.

Reference:
1. Principles of Surface Water Quality Modeling and Control by E.V. Thomson (1987) Happer and Row Publishers New York.
2. Water Quality Modeling by M.D. Palmer the World Bank Washington DC. (latest edition)

509145 [Elective III] (3): Modern Trends in Environmental Engineering

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Emerging fields in ESE: Cleaner Production Technologies, Environmental Bio-Technology, Bioremidiation, Risk Analysis, Software and Information Systems, Global Issues.

Environmental pollution monitoring sensors. Basic understanding of the interaction of electromagnetic radiation, sound, laser etc. with matter. Familiarization with a variety of sensors and platforms

Anthropogenic Endocrine Disruption. The Scientific Basis of the Endocrine Hypothesis. Scientific Uncertainty, Risk Analysis and Policy Response Unit – IV Land pollution- Definition and scope, necessity and importance, Treatment methods: Various methods of refuse processing, fertilizer, fuel and food values. Sanitary land filling - definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.

Composting – Aerobic and anaerobic composting, Factors affecting composting Indore and Bangalore processes of composting. Incineration - Processes 3Ts to control high temperature incinerators, design approach prevention of air pollution.

Reference:

1. Special issue and reviews articles on the relevant topics in Science, Scientific American, Nature, Current Science and Environmental Science and Engineering.
2. C.S. Foster and D.A. Johnwase, Environmental Biotechnology, (Ellis Harwood) (1987).
3. B. Vallely, ‘1001Ways to Save the Planet’, (Ivy Books) New York (1990)
4. Solid Waste Management , Van Nostrand Reinhold Co. 1975.
5. C.L. ell, Solid Waste Management, John Wiley, 1975.
6. P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.

509145 [Elective III] (4): Environmental Biotechnology

Teaching Scheme
Lectures: 5 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
End Semester Assessment: 50 Marks
Credits: 5

Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.

Introduction to Genetic Engineering and Recombinant DNA Technology (RDT), Restriction endonucleases, Steps in gene cloning, cDNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.

Microbiology of waste water treatment. a) Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.

Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills.

Novel methods of pollution control – Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.

Reference:

1. Microbial Biotechnology : A. N. Glazer and H. Nikaids .
2. Molecular Biotechnology : Gleek and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Presscott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.

509146: Seminar – II

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Term Work: 50 Marks
Oral/Presentation: 50 Marks
Credits: 4

Seminar II : Shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Important instructions:
1. Seminar is to be presented using power point presentation.
2. Seminar report is to be submitted in soft and hard copy to the department.
3. The attendance record (signatures) of the audience must be attached and maintained with the report, clearly mentioning "Attendance Record for the ME Seminar Presentation" with Date and Topic of presentation.

509147: Project Work Stage I

Teaching Scheme
Lectures: 8 Hrs/Week

Examination Scheme
Term Work: 50 Marks
Oral/Presentation: 50 Marks
Credits: 8

Objective:
1. The student should be able to choose and evaluate the problem based on current interest of research at national and international level.
2. To train the student to acquire the technical data.
3. To develop analyzing ability amongst the students.
4. To train the students to make use of available resources and to procure the resources to carry out his/her project work.
5. To initiate and orient the students with R & D skills.
6. To give the students the exposure of recent advances at national and international level.

PROJECT WORK:
The project work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project Work Stage – I
Project work Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The assessment will be done jointly by the pair of internal and external examiners along with the oral/presentation examination of the same.

Important instructions:
1. The ME candidate is required to work on Original Topic.
2. It should not be the repetition earlier reported work.
3. The student is required to carry out broad literature survey in the area of work.
4. The justification for selection of project topic and originality of the topic is to be mentioned in the Project Report.
5. The student will make presentation of his project work for assessment purpose.
6. All supporting documents, samples, products, soft copies to be preserved and presented at the time of examination.

Semester IV

509148: Seminar – III

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Term Work: 50 Marks
Oral/Presentation: 50 Marks
Credits: 4

Seminar III: Shall preferably an extension of **seminar II.** The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Important instructions:
1. Seminar is to be presented using power point presentation.
2. Seminar report is to be submitted in soft and hard copy to the department.
3. The attendance record (signatures) of the audience must be attached and maintained with the report, clearly mentioning "Attendance Record for the ME Seminar Presentation" with Date and Topic of presentation.

509149: Project Work Stage II

Teaching Scheme
Lectures: 20 Hrs/Week

Examination Scheme
Term Work: 150 Marks
Oral/Presentation: 50 Marks
Credits: 20

Objective:
1. The student should be able to choose and evaluate the problem based on current interest of research at national and international level.
2. To train the student to acquire the technical data.
3. To develop analyzing ability amongst the students.
4. To train the students to make use of available resources and to procure the resources to carry out his/her project work.
5. To initiate and orient the students with R & D skills.
6. To give the students the exposure of recent advances at national and international level.

Project Work Stage - II
In Project Work Stage – II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis & **validation of results and conclusions**. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

It is mandatory for every student that his Project Outcomes (results and conclusion) are validated' in the form of minimum one Publication (published or accepted) in a refereed and peer reviewed journal of international repute till the date he/she appears for the Project Work Stage II examination. (Communicated papers will not be considered as publication)

The assessment will be done jointly by the pair of internal and external examiners along with the oral examination of the same.

Important instructions:
1. The ME candidate is required to work on Original Topic.
2. It should not be the repetition earlier reported work.
3. The student is required to carry out broad literature survey in the area of work.
4. The justification for selection of project topic and originality of the topic is to be mentioned in the Project Report.
5. The student will make presentation of his project work for assessment purpose.
6. The project report is to be submitted in Standard Hard Bound format.
7. It is mandatory for the candidate to participate and present his work at any (national/international) conference/seminar or publish his/her work in any (national/international) journal during the tenure till oral exam is conducted. (In some cases paper accepted (before the date of oral examination) for presentation or publication in conference or journal will be considered.
8. **All supporting documents to be maintained**

Non Credit Course (mandatory)

Note: Refer R-2.7 for Examination Rules of "Rules and Regulations for M.E. Programs under faculty of Engineering effective from June 2013". Non-credit courses are mandatory for the grant of the term and shall be completed by the students as a self study under the guidance of PG teacher either by referring to the Hand books, Journal/Conference papers (at least 25 in number), open source software, tools and in addition may be by organizing educational visits to the technological/professional centers in the subject, if any. Each student is required to produce in own words, one 10 pages innovative, technical paper to be submitted as a part of the semester course work of non-credit courses.

Term I, Sem I: Yoga and Meditation

Teaching Scheme
Lectures: 2 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
Credits: 2

Yoga: Sukshma (subtle) yoga techniques, Difference between physical exercises and yogasans, Impact of yogasans on human body, benefits of yogasans, Patanjali yoga sutras, technique of different yogasans like, Trikonasan, Ardhachandrasan, Padmasan, Akarnadhanurasan, Ardhamatsendrasan, Vajrasan, Pachhimottasan, Bhujangasan, Shalbhasan, Dhanurasan, Naukasan, Makrasan, Pawanmuktasan, Halasan, Sarvangasan, Shavasan, Suryanamaskar(Sun Salutation), Yoga and Food.

Meditation: Breathing technique, Pranayama, Benefits of pranayama, Prcautions for pranayama,Kumbhak, Bandh(Locks), Chakras, Mudra, Technique of pranayama,Anulom-VilomPranayam,
UjjayiPranayam, BhramariPranayam, BhastrikaPranayam, AgnisarPranayam,
KapalbhatiPranayam, Meditation(Dhyan).

References Books:

1. Light on Yoga: by B.K.S. Iyengar, Harper Collins Publishers India
2. Light on Pranayama: by B.K.S. Iyengar, Harper Collins Publishers India
3. Yoga for Dummies by Georg Feuerstein and larry Payne, Wiley India publishing
4. Yoga, Pilates, Meditation & Stress Relief By Parragon Books Ltd
5. The Yoga Sutrasby Patanjali, Swami Satchidananda, Integral Yoga Publications
6. Meditation - Science and Practice by N. C. Panda, Publisher: D. K. Printworld

Other Source:

7. http://www.artofliving.org/in-en/yoga
8. http://www.artofliving.org/in-en/yoga/sri-sri-yoga/sukshma-yoga-relaxation
9. http://www.yogsansthan.org/
10. http://www.yogapoint.com/
11. http://www.divyayoga.com/
12. http://www.yogaville.org/about-us/swami-satchidananda/
13. www.yogaVision.net
14. http://www.swamij.com/

Term I , Sem II: Human Rights and World Peace

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Semester Assessment: 50 Marks
Credits: 3

Human Rights – Concept, Development, Evolution
- Philosophical, Sociological and Political debates, Benchmarks of Human Rights Movement.

Human Rights and the Indian Constitution
- Constitutional framework, - Fundamental Rights & Duties, - Directive Principles of State Policy, - Welfare State & Welfare Schemes

Human Rights & State Mechanisms
- Police & Human Rights, - Judiciary & Human Rights, - Prisons & Human Rights, - National and State Human Rights Commissions

Human Rights of the Different Sections and contemporary issues - Unorganized Sector, Right to Environment, particularly Industrial sectors of Civil Engineering and Mechanical Engineering, Globalization and Human Rights, - Right to Development,

Citizens' Role and Civil Society
- Social Movements and Non-Governmental Organizations, Public Interest Litigation, Role of Non Government organizations in implementation of Human rights, Right to Information.

Human Rights and the international scene –Primary Information with reference to Engineering Industry, UN Documents, International Mechanisms (UN & Regional), International Criminal Court,

World Peace:
Peace; Meaning, Nature , philosophy of peace, Theories of Peace: Democratic peace theory, Active Peace theory, Game Theory, Religious Beliefs and Peace theories: Buddhism, Islam, Christianity, Hinduism, Economic equality, Social Justice, and Social Values.
Durable Peace: Challenges and Methods, Methods for Conflict Resolutions, Global Conflict and Peace Initiatives, Religious Philosophy and Conflict Resolution, Globalization and Growing Conflict, Globalization, Civil Society and World Peace, Gandhian Understanding of Peace.

References:
1. Study material on UNESCO,UNICEF web site
2. HUMAN RIGHTS IN INDIA A MAPPING, Usha Ramanathan: free download from http://www.ielrc.org/content/w0103.pdf
3. Introduction to International Humanitarian Law **by** Curtis F. J. Doebbler - CD Publishing**,** 2005.
4. Freedom of Information**,**by Toby Mendel - UNESCO **,** 2008

Term II, Sem I: Cyber Security/Information security

Teaching Scheme **Examination Scheme**
Lectures: 3 Hrs/Week **In Semester Assessment: 50 Marks**
Credits: 3

Security principles, threats and attack techniques
• Introduction to security • Information security • Security triad: Confidential, Integrity, Availability • Focus of control • Security threats and attacks • Security management
Authentication and access control
• Identification • Authentication • Authentication by passwords • Protecting passwords • Access control structures • Types of access control
Lattice and reference monitors
• Security levels and categories • Lattice diagram • Reference monitors • Security kernel • Hardware security features • Protecting memory
Security models
• Bell-LaPadula • Biba • Non-deducibility • Non-interference • Other models
Cryptography
• Cryptographic mechanisms • Digital signatures • Encryption • Certificates
Authentication in distributed systems
• Key establishments and authentication • Kerberos • Public key infrastructures • Single sign-on
Network security
• Protocol design principles • ISO architecture • IP security • SSL/TLS • Firewalls • Intrusion detection
Unix security and Windows security
• Subjects, objects and access control • General security principles • Access components • Access decisions • Administration and management issues
Software security and database security
• Memory management • Data and code • Relational databases • Access control in databases • Statistical database security
Java Security, Mobile Security
• GSM security • Wireless LAN security
Protection measures
• Business risk analysis • Prevention, detection and response • Information classifications • Security evaluation
Reference Books:
1) Bakshi P M and Sri R K, Cyber and E-commerce Laws, Bharat Publishing House, 1st Edn,2002
2) Syed shakil Ahmed, Rajiv Raheja, A handbook on Information technology: Cyber law and ECommerce, Capital Law House, 2004
3) Rodney D Ryder, Business Process Outsourcing, Date Protection and Information Security, Wadhwa & Co., 1st Edn, 2001
4) Vakul Sharma, Information Technology Law and Practice, Delhi Law House, 3rd Edn, 2011
5) Lipton, K., Cyberspace Law Cases and Materials, 2nd edition. Aspen Publishers. NY: New York, 2006
6) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003
7) Micki Krause, Harold F. Tipton, Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.
8) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003

Term II, Sem II: Industrial Safety and Equipment Maintenance
(Skill Development)

Teaching Scheme **Examination Scheme**
Lectures: 2 Hrs/Week **In Semester Assessment: 50 Marks**
Credits: 2

Machine Operation and Guarding :
Principles in machine guarding. Ergonomics of machine guarding. Type of guards, their design and selection. Guarding of different types of machinery including special, paper, rubber and printing machinery, machine, tools etc. Built-in-safety devices, maintenance and repairs of guards, incidental safety devices and tools. Safety in the use of Machines : Safety in the use of 1) power presses (all types), 2) shearing, 3) bending, 4) rolling, 5) drawing, 6) turning, 7) boring, 8) milling, shaping, 9) planning broaching, planting, 10) grinding, 11) CNCS. Need for selection and care of cutting tools. Preventive maintenance, periodic checks for safe operation. Associated hazards and their prevention
Material Handling and Storage of Materials :
Kinetics of manual handling. Maximum loads that could be carried. Lifting and carrying of objects of different shapes, size and weight. Safe use of accessories for manual handling Storage of materials. Safety in stacking and unstacking, floor loading conditions. Layout condition for safety in storage, ergonomics of manual handling and storage. Lifting machinery, lifts and hoists; safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance. Safety in design and construction, operation, inspection and maintenance of industrial trucks, lifting tackles and loose gears, conveyors. Safety features, safe locations, testing, inspection and maintenance of lifting tackles,safe working load for all mechanical material handling equipment. The competent persons in relation to safety legislation – duties and responsibilities.
Hand Tools and Power Tools : Main causes of accidents, prevention and control of accidents. Centralised and personal tool issues System. Purchase, storage and supply of tools. Inspection, maintenance and repair of tools. Detectable causes of tool failures. Tempering, safe end in and dressing of certain tool**.** Safe use of various types of hand tools used for metal cutting,
Electrical Hazards
Hazards of electrical energy. Safe limits of amperages, voltages. Safe distance from lines.Capacity and protection of conductor. Joints and connections. Means of cutting off power. Overload and short circuit protection. No load protection. Earth fault protection. Earth insulation and continuity tests. Earthing Standards. Protection against sure and voltage fluctuation. Hazards arising out of 'borrowed' neutrals. Others precautions. Types of protection for electrical equipment in hazardous atmosphere. Electrical area classification. Criteria in their selection, installation, maintains and use. Safety Check list for buying new machinery for the Plant Classification of Hazardous materials. Safety in chemical industry, Criteria for sitting and layout of Chemical and Petrochemical Plants Plant Area classification. Instrumentation for safe plant operations. Hazard in Unit Processes and Unit Operations, Control, precautions and prevention, specific safety measures for certain chemical industry like fertiliser, insecticide, pesticidescholer- alkali, explosives, polymer plants. Sampling technique for toxic and flammables, pharmaceuticals, petro-chemical etc. Precautions in the process and operations involving explosives, flammables, toxic substances, dusts, gases, vapour cloud formations and combating. Transportation of Hazardous material .Safety Precautions for transporting hazardous / toxic / flammable /explosive/ radioactive substances by all modes. Colour coding identification of contents. Safety Precautions for working on pipelines, safe entry procedures to confined spaces including reaction vessels. Safe procedure of start up and shut down procedures. Safety in preventive and emergency maintenance operations.
Fire & Explosion :

Chemistry of fire, Factors contributing towards fire, Classification of fires. Common causes of ndustrial fires. Determination of fire load.. Design of building plant, exists, etc. for fire safety and Fire resistance of building materials. Prevention of fire. Portable extinguishers. Hydrant system, sprinkler system, introduction to. Carbon-di-oxide systems. Foam extinguisher system. Dry chemical Extinguishing systems Halon replacement of fire fighting products. Fire detection and alarms system. Special safety precautionary measures for control of fire and explosion in handling / processing flammable liquids, gases, vapors, mists and dusts etc. BLEVE (Boiling liquids expanding vapor Explosion , Vapor Cloud Explosion) including pesticides. Fire emergency action plan. Deflagration and detonation.

References:

1. Accident Prevention Manual for Industrial Operations National Safety Council, 444, North Michigan Avenue, Chicago, I 11 – 60611
2. Safety code for Scaffolds and Ladders, (Part II) – Ladders IS : 3696 , (Part II) - 1966
3. Safety in Construction Work : Scaffolding H.M.S.O London, 1977.