

**Syllabus of**  
**Master of Engineering -Civil (M.E. Civil)**  
**with specialization in**  
**Environmental Engineering**  
**w. e. f. 2017-2018**

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (Civil) (Environmental Engineering)**  
**COURSE STRUCTURE (2017 Course)**  
**(w.e.f. June – 2017)**

**SAVITRIBAI PHULE PUNE UNIVERSITY , Document on Rules and Regulation for P. G. Courses be referred for the detailed information.**  
**1Credit =2 Units**

**SEMESTER-I**

Code	Subject	Teaching Scheme	Examination Scheme					Credits	
			Lect. / Pr.	Paper		TW	Oral / Presentation		Total
			In sem. Assessment	End sem. Assessment					
501061	Environmental Legislation and Management Systems	4	50	50	--	--	100	4	
501062	Environmental Chemistry & Micro-Biology	4	50	50	--	--	100	4	
501063	Physico-Chemical Process for Water and Waste Water Treatment	4	50	50	--	--	100	4	
501064	Environmental Sanitation	4	50	50	--	--	100	4	
501065	*Elective I	5	50	50	--	--	100	5	
501066	Lab Practice-I	4	--	--	50	50	100	4	
<b>TOTAL</b>			<b>25</b>	<b>250</b>	<b>250</b>	<b>50</b>	<b>50</b>	<b>600</b>	<b>25</b>

**501 065 Elective I**

Code	4 Credits Course <i>L</i>	Code	1 Credit Course	Code	Audit Course (No Credit Course)
501065A	Engineering Biotechnology and Design of Environmental Structures	501065 C	Economics & Finance For Engineers	501065G	Mass communication, Photography and Videography
		501065 D	Foreign Language –I	501065H	Yoga and Meditation
501065B	Water and Air Quality Modeling	501065 E	Engineering Ethics		
		501065 F	Intellectual Property Rights		

**SEMESTER—II**

Code	Subject	Teaching Scheme Lect. / Pr.	Examination Scheme					Credits
			Paper		TW	Oral/ Presentation	Total	
			In sem. Assessment	End sem. Assessment				
501067	Industrial Waste Water Management	4	50	50	--	--	100	4
501068	Air pollution & Control	4	50	50	--	--	100	4
501069	Solid waste and Hazardous Waste Management	4	50	50	--	--	100	4
501070	**Elective-II	5	50	50	--	--	100	5
501071	Lab Practice-II	4	--	--	50	50	100	4
501072	Seminar-I	4	--	--	50	50	100	4
<b>TOTAL</b>		<b>25</b>	<b>200</b>	<b>200</b>	<b>100</b>	<b>100</b>	<b>600</b>	<b>25</b>

**501 070 Elective II**

<b>Code</b>	<b>4 Credits Course</b>	<b>Code</b>	<b>1 Credit Course</b>	<b>Code</b>	<b>Audit Course (No Credit Course)</b>
501070 A	Agricultural Pollution Control Site Remediation	501070 C	Human Rights	501070G	Performing Arts-Music and Dance
501070 B	Environmental Audit and Green Building Design & Construction	501070 D	Foreign Language II	501070 H	Principle Centered Leadership
		501070 E	Building Services and Maintenance		
		501070 F	Environmental Disaster Management		

**SEMESTER—III**

<b>Code</b>	<b>Subject</b>	<b>Teaching Scheme</b>	<b>Examination Scheme</b>					<b>Credits</b>
			<b>Lect. / Pr.</b>	<b>Paper</b>	<b>TW</b>	<b>Oral/ Presentation</b>	<b>Total</b>	
			<b>In sem. Assessment</b>	<b>End sem. Assessment</b>				
601073	Environmental Impact Assessment	4	50	50	--	--	100	4
601074	Research Methodology	4	50	50	--	--	100	4
601075	*** Open Elective	5	50	50	--	--	100	5
601076	Seminar-II	4	--	--	50	50	100	4
601077	Project Stage – I	8	--	--	50	50	100	8
<b>TOTAL</b>		<b>25</b>	<b>150</b>	<b>150</b>	<b>100</b>	<b>100</b>	<b>500</b>	<b>25</b>

**601074 Open Elective III**

<b>Code</b>	<b>4 Credits Course</b>	<b>Code</b>	<b>1 Credit Course</b>	<b>Code</b>	<b>Audit Course (No Credit Course)</b>
601075A	Climate change	601075E	Project Proposal Writing and Funding	601075H	Chess
601075B	Marine Pollution	601075F	Foreign Language-III	601075I	Abacus
601075C	Nano technology for water and wastewater treatment	601075G	Rural Engineering-I		
601075D	Geo-environmental Engineering				

**SEMESTER—IV**

<b>Code No.</b>	<b>Course Title</b>	<b>Teaching Scheme</b>	<b>Examination SchemeMarks</b>				<b>Credits</b>
			<b>Lect / Pr</b>	<b>Paper</b>	<b>TW</b>	<b>Oral/Presentation</b>	
501 078	Seminar-III	5	--	50	50	100	5
501 079	Project Work Stage -II	20	--	150	50	200	20
	<b>TOTAL</b>	<b>25</b>	<b>--</b>	<b>200</b>	<b>100</b>	<b>300</b>	<b>25</b>

## EXAMINATION SCHEME

### A) Compulsory Subjects: Credits 4

**Total marks: 100**

To be done at Institute Level		University Exam	
In semester assessment Units 1-4		End-semester assessment	
Class tests	30 Marks	Units 1-4	18Marks
Assignments /Mini Project	20 Marks	Unit 5	16 Marks
		Unit 6	19 Marks
Total	50 Marks	Total	50 Marks

### B) Elective Subjects: Credits 5

**Total marks: 100**

Module 1 (Credits-4)			
In semester assessment Units 1-4		End-semester assessment	
Class tests	15 Marks	Units 1 & 2	12Marks
Assignments	10 Marks	Unit 3& 4	14Marks
		Unit 5	12 Marks
		Unit 6	12 Marks
Total	25 Marks	Total	50 Marks

Module 2 (Credit 1)	
In semester assessment	Units 1 - 2
Class Tests/ Assignments	25 Marks

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**501 061 - Environmental Legislation and Management System**

**Teaching Scheme**

**Lectures: 4 hours/week**  
**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**  
**Credits: 4**  
**In Semester Assessment: 50 Marks**  
**End Semester Assessment: 50 Marks**  
**Duration of end sem. exam. : 3 hrs**

**Unit - 1**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration, Functions and Constitutions of SPCB and CPCB. Fundamentals of Environmental Management and ISO 14000 series: Background and development of ISO 14000 series. Environmental Management Plans (EMP), principles and elements. The ISO 14001- Environmental Management Systems (EMS) standard. Environmental law in India: Environmental policy and laws.

**Unit -2**

Water (P & CP) Act, 1974: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Air (P & CP) Act, 1981: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

**Unit - 3**

Environment (Protection) Act 1986: Genesis of the Act – delegation of powers – Role of Central Government - Latest EIA Notification – Siting of Industries – Coastal Zone Regulation - Responsibilities of local bodies, mitigation scheme etc.,

**Unit 4**

Role of Judiciary and NGO: International concern for environment, Role of judiciary in environmental protection, Environmental audit, ISO certification, Environmental management system, International and national efforts at environmental protection; Environmental policy. Relevant Provisions of Indian Forest Act, Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

**Unit 5**

Important powers and functions of the MPC board under both the water and air acts, Role of SPCB in implementation of various notifications issued by Central Govt. under Environment (Protection) Act, 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-

Medical Waste (M & H) Rules, 2016, Notifications issued by Govt. of Maharashtra for the protection and improvement of environment.

**Unit – 6**

Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – responsibilities of generators and role of Pollution Control Boards, Procedure of public hearing for obtaining Environmental Clearance. Role of NGO in Nature Conservation.

**Reference Books:**

1. CPCB, “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
  2. Shyam Divan and Armin Roseneranz “Environmental law and policy in India “Oxford University Press, New Delhi, 2001.
  3. Greger I. Megregor, “Environmental law and enforcement”, Lewis Publishers, London1994.
  4. Constitution of India [ Referred articles from part-III, part-IV and part-IV A]
  5. Pares Distn. Environmental Laws in India (Deep, Latest edition.)
  6. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
  7. The ISO 14000 Handbook: Joseph Cascio.
  8. ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).
  9. ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001:1996b (E)) ( International organization for standardization-Switzerland).
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering )**  
**Semester I**  
**501 062 - Environmental Chemistry & Micro-Biology**

**Teaching Scheme**

**Lectures: 4 hours/week**

**Examination Scheme**

**Theory Paper: 100 Marks**

**Credits: 4**

**In Semester Assessment: 50 Marks**

**End Semester Assessment: 50 Marks**

**Duration of end sem. exam. : 3 hrs**

**Unit – 1**

**Fundamentals of Chemistry for Environmental Engineering:** Introduction, Basic Concepts from General Chemistry, Physical Chemistry, Equilibrium Chemistry, Organic, Biochemistry, Colloid Chemistry and Nuclear Chemistry.

**Unit – 2**

**Chemistry of pollutants:** Chemistry of pollutants in the Atmosphere, Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind current on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics,

**Unit – 3**

**Chemistry of Various Organic and Inorganic Compounds:** Carcinogenic compounds and their effects. Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms.

**Surfactants:** Cationic, anionic and nonionic detergents, modified detergents.

**Pesticides:** Classification, degradation, analysis, pollution due to pesticides and DDT problems.

**Unit – 4**

**Synthetic Polymers:** Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.

**Lead and its compounds:** Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity.

**Unit – 5**

**Optical Methods:** Principles of Optical Methods such as Absorption, Spectrophotometer, Flame photometry, Fluorometry. Principles of Chromatographic Methods such as Gas chromatography, High Performance Liquid Chromatography and Ion Chromatography.

**Environmental Microbiology:** Scope and Areas of Environmental Microbiology, Cell and its Structure, Introduction to Enzyme and Metabolic Reactions, Aerobic and anaerobic respiration, Classification.

**Unit – 6**

**Microscopy and Micrometry:** Observations, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism.

**Applied Microbiology:** of Soil, Air, Water and Biological Processes of Wastewater Treatments, Industrial Microbiology.

### Reference Books:

1. C.N. Sawyer, P.L. McCarty and G. F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
2. G.W. Vanloon and S.J. Duffy 'Environmental chemistry – a global perspective, Oxford University press, New York., 2000.
3. Tortora. G.J, B.R. Furke, and C.L. Case, "Microbiology-An Introduction" (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.
4. Pelczar, M. J.Chan E.C.S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi,1993
5. Benefield L. D., Judkins J.F. and Weaned R.L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, Inc. London, 1987.
6. R.E. McKinney, "Microbiology for Sanitary Engineers", McGraw Hill Book Company, 1962.
7. W.G. Walter and R.H. McBee, "General Microbiology", East West Edition, 1969.
8. Botkin, "Environmental Science" 8<sup>th</sup> ed.—Wiley, India.

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering )**  
**Semester I**

**501 063 Physico-Chemical Process for Water and Waste Water Treatment**

**Teaching Scheme**

**Lectures: 4 hours/week**

**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**

**Credits: 4**

**In Semester Assessment: 50 Marks**

**End Semester Assessment: 50 Marks**

**Duration of end sem. exam. : 3 hrs.**

#### **Unit – 1**

**Process Dynamics, Reactions and Reactors:** Reactors Used for the Treatment of Wastewater, Mass transport processes, The Mass-Balance Principle, Reactions kinetics and reaction rates, Configurations of ideal and non-ideal reactors, Principle of ideal reactor design, Completely mixed batch reactors, Completely mixed flow reactors, Determination of rate parameters in CMF reactors, Plug Flow Reactors.

#### **Unit – 2**

**Gas Transfer, Coagulation, Flocculation & settling:** Concept and design of aeration and gas transfer. Coagulation Process, Stability of colloids, Repulsive and Attractive Potentials, destabilization of Colloids, Transport of colloidal particles, Orthokinetic and Perikinetic flocculation, Destabilization in Water and Wastewater Treatment by Al(III) and Fe(III).

Synthetic Organic polymers, Activated Silica, Selection of a coagulant, Sedimentation Processes, Zone Settling, Compression, Sedimentation tank design for water and wastewater, Design of tube settlers.

#### **Unit – 3**

**Filtration:** Filtration process; Principle Mechanisms of filtration, Filter Hydraulics backwash hydraulics, Rate control Patterns and Methods, Head loss patterns at Constant Rate, Slow sand and Rapid sand Filtration and their performances, Design of Gravity filters, Design and Operating variables for deep Granular Filters: Filter media, Fluidization and bed expansion in backwashing, Under drainage systems with design, operational problems.

**Disinfection:** History and modes of disinfection, rates of disinfection, disinfection concentration Factors affecting disinfection such as temperature, pH and organic matter, Chemical Disinfectants – chlorine and Chlorine derivatives; Non Chemical Methods for Disinfection : Ozonation; UV radiation.

#### **Unit – 4**

Introduction to conventional wastewater treatment systems including design. Activated Sludge Process & its modifications, Trickling Filter & its modifications. Introduction to package, compact, mobile sewage treatment plants.

#### **Unit – 5**

Theory & Design of Anaerobic Digestion (Low & High Rate), Theory of Sludge Dewatering (sludge drying beds & mechanical methods), Theory & Design of Up-flow Anaerobic Sludge Blanket Reactor (UASB), Sludge Disposal Methods.

#### **Unit – 6**

**Chemical Oxidation:** Limitation of Oxidative Processes and Oxidizing agents in Water and Wastewater Treatment, Principle and Theories of Chemical Oxidation, Concept and definition, Thermodynamic and kinetic consideration, Role of pH in Chemical Oxidation, Balancing Redox reaction

**Reverse Osmosis:** Osmosis and Osmotic Pressure, Water and Solute Diffusion, Properties of Cellulose Acetate Membranes, Feed temperature and pH, Solute rejection, System Design, Pretreatment and Flux Maintenance, Application.

**Adsorption processes:** types of adsorption, factors influencing, adsorption equilibrium and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of Granular Activated carbon columns, Concept of Break Through Index and PAC contactors.

**Miscellaneous methods: Ion Exchange:** Exchange processes, Exchange Materials, Synthetic Exchange resins, Exchange reaction, Equilibria, Exchange Isotherm.

#### **Reference Books:**

1. Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.
  2. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
  3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill Publication, New Delhi, 2003.
  4. Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water Treatment Plants, Narosa Publishing House, Bombay, 1996.
  5. CPHEEO Manual (Water & Wastewater)
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER – I**

**501 064 Environmental Sanitation**

**Teaching Scheme**

**Lectures: 4 hours/week**

**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**

**Credits: 4**

**In Semester Assessment: 50 Marks**

**End Semester Assessment: 50 Marks**

**Duration of end sem. exam. : 3 hrs.**

**Unit – 1**

**Epidemiology:** Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control.

**Unit – 2**

**Insects and Rodent Control:** Mosquitoes, life cycles, factors of diseases control methods – natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC).

**Unit – 3**

**Industrial sanitation:** Schools, Public Buildings, Hospitals, Eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort.

**Industrial Hygiene:** Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations and shocks- Industrial plant sanitation.

**Unit – 4**

**Rural Sanitation:** Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems.

Rural sanitation improvement schemes. Case studies on sanitation. Emergency Sanitation practices during Natural calamity.

**Unit – 5**

**Water supply in buildings:** Plumbing terminology. Definitions, Water supply in building. The water connection, The water storage, Storage tanks-domestic storage tanks, Flushing Storage Tanks. Principles Governing Design of Water supply in buildings, Lay out. Estimating Requirements, Design of Water pipes.

**Unit – 6**

**Building Drainage:** Traps, Gully Traps, Intercepting Traps or Interceptors. Sanitary Fittings—Water Closets. Flushing Cistern: Wash Basin or Lavatory Basin, Sink, Urinals. The Plumbing System of Drainage—Single Stack System, One-Pipe System. Choice of System, Principles governing Design of Building Drainage, Layout. Quantity of Flow. Pipes for drainage, Drainage design of high rise buildings.

**Reference books:**

1. Victor Ehalers & Earnest W Steel, Municipal and Rural sanitation.
  2. Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi.
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**SAVITRIBAI PHULE PUNE  
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M.E. (CIVIL) (Environmental Engineering )  
Semester I**

**501 065 : Elective –I**

**Teaching Scheme**  
Lectures: 5 hours/week  
Credits 5

**Examination Scheme**  
In semester Exam: 50 Marks  
End Sem. Exam. : 50 marks  
Duration of end sem. exam. : 3 hrs

**\* Elective I - Select any combination having total of 5 credits from following technical / interdisciplinary courses**

**501064 Elective I**

Code	4 Credits Course L	Code	1 Credit Course	Code	Audit Course (No Credit Course)
501065 A	Engineering Biotechnology & Design of Environmental Structures	501065 C	Economics & Finance for Engineers	501065 G	Mass Communication Photography and Videography
		501065 D	Foreign Language-I	501065 H	Yoga and Meditation
501065 B	Water and Air Quality Modeling	501065 E	Environmental Ethics		
		501065 F	Intellectual Property Rights		

**501 065 –A-Elective I - Environmental Biotechnology and Design of  
Environmental Structures (4 Credits course)**

**Unit - 1:**

Environmental Biotechnology - Principles and concepts - scope and importance, usefulness to mankind. Biotechnological remedies for environmental pollution - decontamination of groundwater – Bioremediation - Production of proteins – biofertilizers - Physical, chemical and microbiological factors of composting – health risk – pathogens – odor management Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis, Biotechnological remedies for environmental pollution, decontamination of groundwater – bioremediation. Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology.

**Unit - 2**

Concept of DNA technology – expression vectors – cloning of DNA – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications.

Environmental effects and ethics of microbial technology – genetically engineered organisms- Microbial containment-Risk assessment.

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. biofertilizers , Physical, chemical and microbiological factors of composting

### **Unit - 3**

Structural Design of Elevated Service Reservoirs: Rectangular, Circular type. Design of staging for wind and earthquake forces, container with flat base and domed bottom. Membrane analysis, Effect of Joint reactions due to continuity.

Structural design of water retaining structures like Primary Clarifier (Circular & Rectangular) for WTP & STP; Biological Reactors (Circular & Rectangular) for STP for worst load conditions;

### **Unit – 4**

Structural design of various components of WTP & STP (Underground / partially below & above ground).

Design considerations including loads such as traffic load, backfill load, live load etc. for Appurtenances like man-holes, concrete bedding and thrust blocks for sewers, rising mains etc.

### **Reference Books :**

1. T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication
2. N. Krishna Raju – Prestressed Concrete, Tata McGraw Hill Publication Co
3. Edward Nawy – Prestressed Concrete – A Fundamental Approach, Prentice Hall International
4. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
5. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi.
6. P.C. Varghese – Advanced Reinforced Concrete Design , Prentice Hall of India Pvt. Ltd., New Delhi
7. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
8. IS: 1343: Indian Standard code of practice for Prestressed concrete, Bureau of Indian Standards, New Delhi.
9. IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, Bureau of Indian Standards, New Delhi.
10. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.
- 11.

### **Reference Books:**

1. Microbial Biotechnology : A. N. Glazer and H. Nikaido .
2. Molecular Biotechnology : Gleck and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Prescott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.
6. T.V.Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI
7. Biological degradation and Bioremediation of toxic chemicals: Chaudhury, G.R., Dioscorides Press,Oregon, 1994.
8. Biological degradation of wastes: Martin. A.M, Elsevier Applied Science, London, 1991.
9. Soil Microbiology Ecology: Blaine Metting. F (Jr.,) Marcel Dekker Inc., 1993.

## 501 064 –B-Elective I - Water and Air Quality Modeling (4 Credits course)

### Unit – 1

**Modeling Concepts :** Casual and statistical models-Characteristics- Steps in model development - Importance of model building.- conservation of mass and mass balance – calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles

**Water Quality Modeling:** Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries;

### Unit - 2:

**Water Quality Models:** Surface and sub surface water quality models, Lake Water Quality Models: Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods.

**Water Quality Index:** Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

### Unit - 3

**Air Pollution Modeling:** Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants – Meteorological settling for dispersal of air pollutants-vertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

**Air Quality Models:** Types modeling technique, modeling for non reactive pollutants, single source, short term impact, multiple sources and area sources, fixed box models- diffusion models –

### Unit - 4

Gaussian plume derivative- modification of Gaussian plume equation- long term average-multiple cell model – receptor oriented and source oriented air pollution models- model performance, accuracy and utilization.

Air quality index: categories of air quality index, determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.

### Reference Books:

1. J. L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
2. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I, Academic Press, 2006.

### Reference Books:

1. Thomann and Muller, Principles of surface water quality modelling and control
2. Chapra, Surface water quality modelling
3. Steven C. Chapra, Surface Water Quality Modelling, Tata McGraw-Hill Companies, Inc., New Delhi, 1997.
4. J.L. Schnoor, Environmental Modelling Fate and Transport of Pollutants in Water, Air and Soil, 4.John Wiley & Sons Inc., New York, 1996.
5. E.V. Thomson, Principles of Surface Water Quality Modelling and Control, Happer and Row Publishers New York, 1987.
6. M.D. Palmer, Water Quality Modelling, the World Bank Washington DC.

### **501 065 –C-Elective –I Economics and Finance for Engineers (1Credit Course)**

#### **Unit1:**

**Introduction & Basics of Economics & Finance:** Meaning & necessity of: Economics, Costing & Finance, History & fundamentals of Economics, Basics of Finance & Accounting, rates of interest, Basics of Financial Statement, Financial Analysis, Inflation, etc.

#### **Unit2:**

**Principles of Costing, Estimation & Valuation:** Basics of Costing, activity based costing & case studies, Basics of Estimation & Valuation, present & future values of properties, Profitability & Financial Decisions, Inventory Management

#### **Reference**

1. As specified by the instructor
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### **501 065 –D- Elective –I Foreign Language -I (French-I) (1Credit Course)**

#### **Unit1:**

**Introduction:** Glimpse of France, life of French people (Culture, food, etc.), French alphabets, accent, etc., Unit zero of the Text Book (Grammar, Vocabulary, and Lesson), Exercise of Unit zero of Text Book & workbook

#### **Unit2:**

**French Lessons:** Brief revision, Unit-1 of the Text Book (Grammar, vocabulary), Unit-1, Lesson 1 of the Text Book, Exercise of Unit-1, Lesson 1 of the Text book & workbook

#### **Reference**

1. Jumelage-I Text Book by Manjiri Khandekar & Roopa Luktuke (Latest edition)
  2. Jumelage-I workbook by Roopa Luktuke
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### **501 065 --E-- Elective –I Engineering Ethics (1Credit Course)**

#### **Unit1:**

**Introduction :** Meaning & scope of Ethics in general & for engineers in particular, Moral obligations and rules in engineering, Categories of moral, Work Culture, Corporate, local & global issues, Rights & responsibilities of Engineers, Conflicts in the profession, Mental Stresses & Emotional Intelligence

#### **Unit2:**

**Code of Ethics for Engineers:** First principles of Engineering Ethics & Ethical terminology, Social Values, Character, considerations for general Individuals, Engineers & the Society, Recommendations of the Professional bodies (Code of Conduct), Introduction to Copyright, IPR (Intellectual Property Right), Plagiarism & Legal issues

#### **Reference**

1. Ethics in Engineering Practice and Research---Carolyn Whitbeck—Cambridge University Press—ISBN—978-1-107-66847-8
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## 501 065 -F-Elective –I Intellectual Property Rights (1Credit Course)

### Unit 1

#### **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.

### Unit 2

#### **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 Software etc. Traditional knowledge Case Studies,

#### **Reference Books**

- 1 Prabuddha Ganguly, “ Intellectual Property Rights” ,Tata Mc-Graw Hill.
  - 2 Halbert, “Resisting Intellectual Property”, Tay lor & Francis Ltd, 2007
  - 3 Robert P. Merges, Peter S. Menell, Mark A. Lemley “Intellectual Property in New”,
- 

## 501 065 K-Elective –G Mass communication, Photography and Videography (Audit Course—No Credits)

### Unit 1: Mass Communication - Theories & methods

Concepts and Theories, Communication concepts, Process and Function, Interpersonal & Intra personal, Group behaviour, need for Mass Communication. Relevance of Communication Theories to Practice, Models of Communication, Impact and Effect of Communication Old and new media, Communication Techniques, - Feedback and Evaluation of Communication Effect, Interview and Questionnaires- Method of Data Analysis, use of Information Technology, various methods of mass communication like seminars, conferences, print and digital media, internet, CDs, DVD, movies, U-tube, video conferencing.

### Unit 2 : Photography and Videography

Camera Basics, Still Photography, Lenses, Exposure, Composition, Colour. Shot Angle, Camera Movement, Light techniques and final printing.

Videography Basics – Video camera –types, mounting. Sound Basics, Film Sound appreciation, Sound Track analysis, Editing Basics, Fragmentation

Juxtaposition: Frame, Shot, Sequence, Scene Time, Pace, Rhythm. Learning basic editing software and primary editing on available/given materials.

#### Books

1. Richard Dimpleby and Graeme Burton, 1995, More than words: An introduction to communication, London: Routledge.
2. Melvin L. DeFleur and Everette E. Dennis, 1991, Understanding mass communication, New Delhi: Goyal Saab.
3. Marshall McLuhan, 1964, Understanding Media, New York: McGraw –Hill
4. Wilbur Schramm, 1964, Mass media and national development, the role of information in developing countries, Stanford: Stanford University Press.

5. Holman, Tomlinson, Sound for film and television, Focal Press
  6. McCormick, Tim and Rumsey, Francis, Sound and recording: An introduction, Focal Press
  7. Talbot-Smith, Michael, Sound engineering explained, Focal Press
  8. Talbot-Smith, Michael, Sound assistance, Focal Press
  9. Altman, Rick, ed., Sound theory sound practice, Routledge Talbot-Smith, Michael, Sound engineer's pocket book, Focal Press
  10. Truebitt, Rudy and David, Trubitt, Live sound for musicians,
  11. Hal Leonard Nathan, Julian, Back to basic audio,
  12. Newnes Yewdall, Lewis, David, Practical art of motion picture sound, Focal Press
  13. Leider, N., Colby, Digital audio workstation, McGraw-Hill
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**501 065 --H--Elective II Yoga and Meditation (Audit course--Non Credit course)**

**Unit 1**

**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, Ardachandrasan, Padmasan, Akarnadhanurasan, Ardhamatsendrasan, Vajrasan, Pachhimottanasan, Bhujangasan, Shalbhasan, Dhanurasan, Naukasan, Makrasan, Pawanmuktasan, Halasan, Sarvangasan, Shavasan, Suryanamaskar( Sun Salutation), Yoga and Food.

**Unit 2**

**Meditation:** Breathing Technique, Pranayam, Benefits of Pranayam, Precautions for Pranayam, Kumbhak, Bandh(Locks), Chakras, Mudra, Technique of Pranayam, Anulom-Vilom Pranayam, Ujjayi Pranayam, Bhramari Pranayam, Bhastrika Pranayam, Agnisar Pranayam, Kapalbhathi Pranayam, Meditation(Dhyan).

**References Books:**

- Light on Yoga: by B.K.S. Iyengar, Harper Collins Publishers India
1. Light on Pranayama: by B.K.S. Iyengar, Harper Collins Publishers India
  2. Yoga for Dummies by Georg Feuerstein and Larry Payne, Wiley India publishing
  3. Yoga, Pilates, Meditation & Stress Relief By Parragon Books Ltd
  4. The Yoga Sutras by Patanjali, Swami Satchidananda, Integral Yoga Publications
  5. Meditation - Science and Practice by N. C. Panda, D. K. Printworld Publisher
  6. Yog Pravesha by Vishwas V Mandlik, Yogchaitanya Prakashan
  7. Asanand Yog Vigyan, Bhartiya Yog Sansthan, Delhi
  8. Pranayam Vigyan, Bhartiya Yog Sansthan, Delhi

**Reference Web Sites:**

1. <http://www.artofliving.org/in-en/yoga>
  2. <http://www.artofliving.org/in-en/yoga/sri-sri-yoga/sukshma-yoga-relaxation>
  3. <http://www.yogsansthan.org/>
  4. <http://www.yogapoint.com/>
  5. <http://www.divyayoga.com/>
  6. <http://www.yogaville.org/about-us/swami-satchidananda/>
  7. <http://www.yogaVision.net>
  8. <http://www.swamij.com>
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering )**  
**Semester II**  
**501 067- Industrial Waste Water Treatment and Management**

**Teaching Scheme**

**Lectures: 4 hours/week**  
**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**  
**Credits: 4**  
**In Semester Assessment: 50 Marks**  
**End Semester Assessment: 50 Marks**  
**Duration of end sem. exam. : 3 hrs**

**UNIT – 1**

**Sources of Pollution:**– Sources and Characteristics of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates —Prevention vs Control of Industrial Pollution– Toxicity and Bioassay tests , Source reduction techniques – Waste Audit -Evaluation of pollution prevention options.

**Wastewater Treatment:** Waste minimization - Equalization - Neutralization – Oil separation – Flotation –Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological Treatment – Sequencing batch reactors – High Rate reactors .

**UNIT – 2**

**Treatment Methods:** Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes. Treatment Methods Chemical oxidation –Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal Disposal of Treated Waste.

**UNIT – 3**

**Industrial Waste Study:** Manufacturing processes and sources of effluents, characteristics and composition of effluent and different methods of treatment & disposal of effluent from the process of industries like chemical, fertilizer, petroleum, petro-chemical, paper, sugar, distillery, tannery, food processing, dairy and steel manufacturing.

**UNIT – 4**

**Industrial Waste Management:** Manufacturing processes and sources, Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries:

Pharmaceutical, Petroleum, Refineries, Tanneries, Atomic Energy Plants and other Mineral Processing Industries.

**UNIT – 5**

**Common Effluent Treatment Plants (CETPs):** Location, Need, General Design considerations and principles, Operation & Maintenance Problems, Zero effluent discharge systems, Wastewater reuse. Common problems encountered in management of CETPs.

**UNIT – 6**

Complete design of wastewater treatment plant of any industry listed above with all components, details, drawings and cost estimation.

Dye stuff and dye manufacturing industries with method of treatment—adsorption, Treatment with polymer coagulation.

**Reference Books:**

1. W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.

3. Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
  4. M. N. Rao & Datta, Waste water treatment.
  5. N. L. Nemerow, Liquid waste of Industry, Addison Wesley. 1996
  6. Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stoughton. 1988
  7. Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.
  8. Indian standards: IS: 2490 (1963), IS: 3306 (1065).
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**Semester II**  
**501 078 - Air Pollution and Control**

**Teaching Scheme**

**Lectures: 4 hours/week**  
**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**  
**Credits: 4**  
**In Semester Assessment: 50 Marks**  
**End Semester Assessment: 50 Marks**  
**Duration of end sem. exam. : 3 hrs.**

**Unit – 1**

**Introduction:** Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution, Air Pollution Episodes.

**Meteorology:** The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutants on meteorology, Air pollution modeling, Minimum stack height as per CPCB norms.

**Unit – 2**

**Modeling of Dispersion of Air Pollutants:** Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian model etc. Equations of the estimation of pollutant concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths.

**Unit – 3**

**Particulate Pollution Control Methods:** Dilution, Source control, Control by using equipments such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators Wet Scrubbers/Wet Collectors, design and principle of these air pollution control units.

**Unit – 4**

**Gaseous pollution control:** Types of gaseous pollution control methods – absorption, adsorption and combustion processes. SO<sub>x</sub> Control Technology, Desulfurization of flue gas emissions, NO<sub>x</sub> Control Technology,

**Unit – 5**

**Air pollution Monitoring and Management:**

Existing & Revised Environmental guidelines for siting of Industries, Environment Management plan, stack emission standard, ambient air quality standards, stack emission monitoring, ambient air quality monitoring, ambient air quality survey. Introduction to National Air Quality Monitoring Programme.

**Unit – 6**

**Automobile Pollution:** Vehicular emissions, Motor fuel combustion, Automobile emission control.

**Odour pollution:** Theory of Odour, Sources of Odour, Measurement of Odour, Odour control method.

**Indoor Air Pollution:** Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke.

**Reference Books:**

1. H. C. Perkins, Air Pollution.
2. Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication.
3. N.D. Nevers, Air Pollution Control Engineering, Mc-Graw Hill Publication.
4. M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication.

5. Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York.
  6. Richard W. Boubel et al., Fundamentals of Air Pollution, Academic Press, New York.
  7. KVSG Murali Krishna. Air pollution and control, Kaushal and Company, Jagannaickpur, Kakinada-2.
  8. Davis. Environmental Engineering, Mc-Graw Hill Publication.
  9. C.S. Rao., Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi (1991).
  10. John H. Seinfeld, Air Pollution: Physical and Chemical Fundamental, Mc-Graw Hill book Co. 1988.
  11. Paul N. Cheremisinoff, Richard A. Young, Air Pollution Control and Design Handbook, Part-I, Marcel Dekker Inc., New York 1977).
  12. Paul N. Cheremisinoff (ed.), Encyclopedia of Environmental Control Technology, Vol. 2, Air Pollution Control, Guld Publishing Company. (1989).
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering )**  
**Semester II**  
**501 069- Solid and Hazardous Waste Management**

**Teaching Scheme**

**Lectures: 4 hours/week**  
**8 Hours / Unit**

**Examination Scheme**

**Theory Paper: 100 Marks**  
**Credits: 4**  
**In Semester Assessment: 50 Marks**  
**End Semester Assessment: 50 Marks**  
**Duration of end sem. exam. : 3 hrs.**

**Unit – 1**

**Solid waste management:** Objective, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, types, Composition, Quantities, Physical, chemical and Biological properties.

**Unit – 2**

**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. Numericals on Stationary Container & Hauled Container Collection System, Transfer station: Meaning, Necessity, Location and Economic analysis, Transportation of solid waste: Means and Methods, Routing of vehicles & optimisation.

**Unit – 3**

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

**Unit – 4**

**Landfills:** Definition, Essential components, Site selection, Land filling methods, Leachate analysis, treatment & disposal, landfill gas estimation & management. Determination of capacity of landfill disposal site.

**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.

Economy and financial aspects of solid waste management. Disposal options for Biomedical waste, Other Waste Types: Nuclear and Radio Active Wastes.

**Unit – 5**

**Sorting and Material Recovery:** Objectives, Stages of sorting, sorting operations, Guidelines for sorting for materials recovery, typical material recovery facility for a commingled solid waste. Kinetics & interpretation of data (NPK, Gas production), E waste management, Biomedical waste management.

**Unit – 6**

**Hazardous waste management:** Problems and issues of hazardous waste management, Need for hazardous waste management—Legislations on management and handling of HW, Toxicology and risk assessment, Hazardous Characteristics – TCLP tests – waste sampling-reduction of wastes at source – Recycling and reuse, labeling and handling of hazardous wastes, incineration – solidification and stabilization of hazardous wastes.

**Reference Books:**

1. Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid Waste Management, McGraw- Hill, New York, 1993



2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
  3. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. Evans and Environmental
  4. Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
  5. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
  6. Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.
  7. Solid waste management –A. D. Bhide.
  8. Solid waste management handbook – Pavoni.
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER II**

**501 070 : ELECTIVE –II**

**Teaching Scheme**

**Lectures: 5 hours/week**

**Credits 5**

**Examination Scheme**

**In semester Exam: 50 marks**

**End Sem. Exam. : 50 marks**

**Duration of End Sem.Exam:3Hrs**

**Select any combination having total of 5 credits from following technical / interdisciplinary courses**

**501 069 Elective II**

Code	4 Credits Course	Code	1 Credit Course	Code	Audit Course (No Credit Course)
501070 A	Agricultural Pollution Control Site Remediation	501070 C	Human Rights	501070G	Performing Arts-Music and Dance
501070 B	Environmental Audit and Green Building Design & Construction	501070 D	Foreign Language II	501070 H	Principle Centered Leadership
		501070 E	Building Services and Maintenance		
		501070 F	Environmental Disaster Management		

## **501 070 –A - Elective II - Agricultural Pollution Control and Contaminated Site Remediation ( 4 Credits course)**

### **Unit – 1**

**Environmental issues in agriculture:** Types of farming systems, agro meteorology, water and nutrients requirement.

**Agricultural Activities and Environmental Impacts:** Major Agricultural Practices, Irrigation Drainage Systems, Impact of Agricultural Activities on Environment, Crops, Diseases, Nutrients and its Control. Irrigation practices its negative impacts on Soil (land degradation)

**Fertilizers:** types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices.

Environmental Impacts of Fertilizers: Different types of Fertilizers Inorganic, Organic and Synthetic fertilizers. Effects on Environment due to use of fertilizers, Environmental Impacts of Pesticides Properties of Pesticides: Adsorption solubility in Water and Volatilization Soil Conservation; Vegetative practices And Mechanical Practices. Ground water Characterization and suitable remedial measures for avoiding its Contamination Pollution control monitoring strategies and plans.

### **Unit 2**

**Water logging and salinity:** Water logging: Its effects, Water logging control, Environmental effects due to water logging Remedial Measures Preventive and Curative Water logging measures.

Soil Salinity: Classes of Saline and Alkali Soil, Improvement of Saline and Alkaline Soil Leaching and Reclaiming Saline soil.

### **Unit 3**

**Wastewater reuse in agriculture:** management and control of agricultural waste; recycling and reuse. Waste water Reuse in Agriculture: Types of Reuse, Reuse of urban waste water in Agriculture and horticulture from skewered area. Reuse considering techno economic aspect Preliminary Primary and secondary treatment and tertiary treatment to removed residual pollutants. Mechanized and Physicochemical Processes

**Agricultural air pollution control:** Odorous emissions related to storage and handling of animal wastes .Biotechnology in reduction of CO<sub>2</sub> emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

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

### **Unit 4**

Subsurface Contamination: Sources, Contaminants, Regulations and Remedial Approach, Sources of Contamination, Types of Contaminants, Relevant Regulations, Other Considerations, Remediation Approach

### **Unit 5**

**Contaminated Site Characterization:** General Methodology, Preliminary Site Assessment, Exploratory Site Investigation, Detailed Site Investigation, Expedited or Accelerated Site Characterization

**In-Situ Waste Containment:** Vertical Barriers, Bottom Barriers, Surface Caps or Covers, Groundwater Pumping Systems, Subsurface Drains

### **Unit 6**

**Soil Remediation Technologies:** Soil Vapor Extraction, Soil Washing, Stabilization/Solidification, Electro kinetic Remediation, Thermal Desorption, Vitrification, Bioremediation, Phytoremediation, Soil Fracturing.

**Groundwater Remediation Technologies:** Pump and Treat, In-Situ Flushing, Permeable Reactive Barriers, In-Situ Air Sparging, Monitored Natural Attenuation, Bioremediation.

**Reference Books:**

1. Microbial Biotechnology : A. N. Glazer and H. Nikaido .
2. Molecular Biotechnology : Gleck and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Prescott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.
6. T.V. Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI
7. Sharma, H. D., and Reddy, K. R., "Geo-environmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies," John Wiley & Sons, Inc., 2004 (ISBN: 0-471-21599-6); See:  
<http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471215996.html>.
8. Sharma, H.D.& Lewis, S. P. Waste Containment Systems, Waste Stabilization and Landfills Wiley 1994.
9. Evans, D. & Jefferies, S. A. Remedial Processes for Contaminated Land: Principles and Practice (Ciria Report C549) Ciria 2001
10. [http://www.enr.gov.nt.ca/\\_live/documents/content/siteremediation.pdf](http://www.enr.gov.nt.ca/_live/documents/content/siteremediation.pdf)

**501 070 – B n-Elective II - Environmental Audit and Green Building Design  
&Construction (4Credits course)**

**Unit 1**

**Environmental Audit:** Definition of Environment Audit and its importance for industries. Environmental management system audits Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance. Concept of ISO14000

Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary.

**Unit 2****Pre-audit Activities for the Manager**

Selecting the audit team, planning the audit

**Pre-audit Activities for the Auditor**

Drawing up the audit specification, obtaining information before the audit, Checklists, Case studies of red category industries.

**Unit 3****Conducting the Audit**

The opening meeting, Evaluation of the EMS, Interviewing, Site tour and observations

**Evaluating the Audit Results**

Evaluation of the audit results, the closing meeting, Recommendations, the audit report

**Environmental Reporting**

Purpose of producing an environmental report, writing the report, Independent validation

**Unit 4****Principles of Sustainability, Energy Conservation and Water Conservation**

Introduction to Course, Sustainability, Major Environmental Challenges, Global Warming, Introduction to Green Buildings; LEED, Sustainable Urban Development.

Building energy system strategies, Energy Conservation in Buildings, HVAC Systems, Energy and Atmosphere - LEED Credits, e Quest Energy Simulations, Conducting an Energy Audit, Fossil Fuels vs. Renewable Energy.

Water Conservation in Buildings, Storm Water Harvesting and Management, Water cycle strategies

#### Unit 5

#### **Green Materials and Green building codes**

Green Construction Materials, Materials and Resources - LEED Credits, GRIHA, Building Deconstruction, C&D Recycling, Indoor Environmental Quality – Basic, IEQ - LEED Credits, Building Commissioning, Materials selection strategies Green building codes and standards, International Green Construction Code, Carbon accounting, Green Building Specifications

#### Unit 6

Possibilities of conversion of Existing Buildings to Green Buildings, CDM, Energy conservation building code, Case study of Platinum rated Green Building in India.

#### **References Books:**

6. Larry W. Canter," Environment Impact Assessment ", McGraw-Hill Book Company, New York.
7. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
8. Vijay Kulkarni and T V Ramchandra. "Environmenta l management" Capital Publishing Co.
9. Mhaskar A.K., "Environmental Audit" Enviro Media Publications.
10. S.K. Dhameja, "Environmental Engineering and Management" S.K. Kalaria and Sons Publishers.

11. C.J. Kibert (2008) "Sustainable Construction: Gre en Building Design and Delivery", 3rd Ed., John Wiley, Hoboken, New Jersey

12. G.T. Miller Jr. (2004) "Living in the Environment : Principles, Connections, and Solutions", 14th Ed., Brooks Cole, Pacific Grove, California

13. Energy Conservation Building Code (ECBC)

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## 501 070 C- Elective II - Human Rights (1 Credits course)

### Unit 1

#### **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

#### **-Unit 2:**

#### **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.(2 hrs)

- UN Documents
- International Mechanisms (UN & Regional)
- International Criminal Court

#### **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 , .**
- 4.Information, by **Toby Mendel - UNESCO , 2008**

#### **Internal assessment :**

- i) Assignments based on topics from syllabus and case studies as applicable to relevant discipline of Engineering.
- ii) Power point and oral presentation based on of selected topic from syllabus.

## **501 070-D- Elective II Foreign Language –II French-II (1 C redit course)**

### **Unit 1**

French Grammar and Vocabulary: Unit-1, Lesson 2 of the Text Book (Grammar & Vocabulary), Unit-1, Lesson 1 of the Text Book, Exercise of Unit-1, Lesson 2 of the Text Book & workbook

### **Unit 2**

Advance Vocabulary, Writing & Speaking: Unit-1, Lesson 3 of the Text Book (Grammar & Vocabulary), Unit-1, Lesson 3 of the Text Book, Exercise of Unit-1, Lesson 3 of the Text Book & workbook, Revision & speaking practice

### **Reference**

1. Jumelage-I Text Book by Manjiri Khandekar & Roopa Luktuke (Latest edition)
2. Jumelage-I workbook by Roopa Luktuke

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## **501 070 –E- Elective II Building Services And Maintenance (1 Credit course)**

### **Unit 1**

Integrated design: factors affecting selection of services/systems, Provision of space in the building to accommodate building services, Structural integrity of building services equipment. Sound and vibration attenuation features, Provisions for safe operation and maintenance.

Building services engineering system for intelligent buildings: Introduction to information transmission systems, communication and protection system, call systems, public address system and Building automation/management systems.

### **Unit 2**

The concepts and importance of energy conservation and energy efficiency for environmental protection, environmental protection and maintenance of building services systems, selection of environmentally friendly products and materials used in building services systems.

Co-ordination and management of design and installation of various building services systems during the design and construction stages in particular the builder's works. Computer-aided design and installations of building services. Testing and commissioning of building services systems: fire safety systems, vertical transportation equipment ventilation systems, etc. Sick building syndrome. The impacts of life-cycle-cost on planning and implementation. An appreciation of capital and operating costs. Implication of low cost, inefficient equipment, poor installation, inadequate access for maintenance.

### **Reference books**

1. Buiding Services—S.M.Patil---(ISBN-978-81-7525-980- 5), 1-C,102,Saamana Pariwar Society,Gen A.K.Vaidya Marg, Goregaon (E),Mumbai-65
2. Building Maintenance Management, 2ed,---Chanter, Wiley India
3. Miantenance of Buildings—A.C.Panchodhari—New Age International Publishers.

**Unit 1****Environmental Hazards & Disasters.**

- a) Meaning of Environmental hazards, Environmental Disasters and Environmental stress.
- b) Concept of Environmental Hazards, Environmental stress & Environmental Disasters.
- c) Different approaches & relation with human Ecology (i) Landscape Approach (ii) Ecosystem Approach (iii) Perception approach d) Human ecology & its application in geographical researches.

Natural disasters -Cyclones, earthquakes, tsunami, volcanoes, Forest fires, etc.

Manmade disasters - oil spills, nuclear power plant explosion, building & industrial fires, chemical spills, soil & ground water contamination, structural collapse etc.

**Unit 2**

Disaster management cells & plans at international, national, state & district levels. Disaster management cycle. Role players in Disaster management

Prevention & mitigation of disasters. Tools- planning, regulations incentives, public education & awareness, insurance, immunization campaigns, environmental management, ect. Application of GIS & RS in Disaster management. Case studies

**References Books:**

1. R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990.
  2. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
  3. Kates, B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
  4. R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000.
  5. H. K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.
  6. R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
  7. Dr. Satender , Disaster Management t in Hills, Concept Publishing Co., New Delhi, 2003.
  8. A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.
  9. R. K. Bhandani an overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi.
  - 10.M. C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.
  - 11.Reference <http://www.du.ac.in/>
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**501 070 - G --Elective II Performing Arts – Music and Dance****(Audit course--Non Credit course)****Unit 1 :****Indian Music**

Vocal, Instrumental, Sur, Laya, Tal. Ragas and their classification based on time and “Raasa-Nirmitee”. Seasons and Ragas. Various “Bandi shes” and “Gharanas” or styles. Light Indian Music-different types.

Experiencing ethos and bliss by listening to performances of various reputed artists.

Experiencing oneness with nature and the super power by performing individually or in a group.



## Unit 2 : Indian Classical Dance

Types –Kathak, Bharatnatyam, Kuchipudi, Odissy etc. Importance of “Abhinaya” (acting) in dance. Role of “Taala” and “Laya” in dance. Various dance form. Various gharanas in traditional dance types Fusion with other dance styles. Experiencing the Indian cultural power through individual and group performances.

### Books/Audio CD

1. Hindustani Sangeet Paddhati by Pt.Vishnu Narayan Bhatkhande publ. Swarganga Foundation.
2. Jivi Jivai (Golden Voice Golden Years) Pt.Jasraj, Publ. Bandishes with notations composed by the author.
3. Pranav Bharati, by Pt.Ompraksh Thakur, publ. Swarganga foundation.
4. Rasa Gunjan by Pt.Birju Maharaj, Publ. Swarganag foundation
5. Anup Rag Vilas by Pt.Kumar Gandharava, Bandishes composed and sung by author mostly available on cassettes Swarganga Foundation.
6. The dance Orissi – Mohan Khokar published by (2010) Abhinav Publications, New Delhi
7. Introduction to Bharata’s Natyashastra by Adya Rangacharya, Munshiram Manoharlal publication.
8. Art of Dancing classing and folk dance by priyabala Shah, Parimal publication
9. Tantra Mantra Yantra in Dance: An Exposition of Kathaka, by Ranjana Shrivastava, D.K.Prinword Pvt. Ltd.

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## 501 070 –H--Elective II -- Principle Centered Leadership (Audit course--Non Credit course)

### Unit 1:

#### Motivation, Leadership and Competency

##### a) Motivation:--

Necessity, types, means of providing extrinsic motivation. Leadership. Qualities of a leader. Types of Leadership viz. Laissez Fairre, transactional, transformational. Principle centered leadership based on Stephen Covey habits.

##### b) Competency Mapping:-

Definition of competency. Generic, functional and Strategic Competencies. Importance of developing competencies. Identification of competency gaps at managerial cadre level through benchmarking requirements based on role, mapping and assessment. Training and Developmental programs for competency gap closure.

### Unit 2 :

#### Entrepreneurship and strategic Management

a) **Entrepreneurship:** - Qualities of an entrepreneur. Business ideas generation methods—creative imagination, brainstorming, newspa per exercise activity. Ideas evaluation based on John Mullion’s 7 point test concept of a B—plan.

##### b)Strategic Management: --

Necessity in the context of global challenges. Objectives of strategic management. Forecasting abilities and methods. Developing organizations for the achievement of strategic objectives. Dealing with uncertainties.

## Reference Books

1. Seven habits of highly effective people—Stephen Covey—Franklin Covey Publications
  2. Living the seven habits Stephen Covey—Franklin Covey Publications
  3. 8<sup>th</sup> Habit – from effectiveness to greatness Stephen Covey—Franklin Covey Publications
  4. Human Resource Development In The Building Industry, Vinita Shah, published by NICMAR
  5. Human Resources Management & Human Relations , V P Michael , Himalaya
  6. Human Resource Management Biswajeet Pattanayak published by Prentice Hall
  7. Construction project Management, integrated approach—Feedings First Indian Reprint 2011—Yesdee publications
  8. Cases in Strategic Management, Amita Mital , Tata Mcgraw Hill
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER – II**  
**501 071 Lab Practice II**

### Teaching Scheme

Lect./Pr. : 4 hours/week

### Examination Scheme

Term work: 50 Marks

Oral / Presentation: 50 Marks

Credits: 4

### Lab Practice II

The lab. practice-II will be based on completion of assignments / practicals / reports of site visits, confined to the courses in that semester.

The term work will consist of --

**Part A:** Treatability Studies

**Part B: Heavy Metal and Toxic Metal Analysis from Industrial wastewater using Atomic Adsorption Spectrophotometer**

(1) Arsenic (2) Nickel (3) Chromium

**Part C:** Visits, Detailed Study, and report submission of any two of the following Industries with respect to Total water consumption, Sources of Wastewater generation its characteristics and Treatment methods-----

Dairy, Fertilizer, Distillery, Sugar, Pulp & Paper, Iron & Steel, Metal Plating, Oil Refinery

**Part D:** Visit to Air Polluting Industries like Thermal Power plant /Cement Manufacturing Industry etc. and Detailed Study with report submission on Air Pollution Control Devices with their design principles.

**Part E:** Study of stack monitoring.

**Part F :** Bioassay Test

**Part G :** Assignment on Advanced Equipment (at least 03) alongwith their application in Environmental engineering.

**Part H:** Study of application procedure for patents.

**Part I:** Site visit of any one solid waste management facility.

**Part J:** Determination of calorific value of solid waste using bomb calorimeter.

**Part K:** Assignment on Environmental Management in Smart City.

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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**Semester II**  
**501 072 Seminar – I**

Teaching Scheme  
Pract. 4 hrs./week

Examination Scheme  
Oral : 50 Marks,  
TW :: 50 Marks  
Credits 4

Term work of the seminar should consist of spiral bound report printed on both the sides of pages on any technical topic of interest associated with the post graduate course and should be submitted in a standard format having the following contents .

- i. Introduction
- ii. Literature Survey
- iii. Theoretical contents
- iv. Relevance to the present national and global scenario of construction industry
- v. Strengths and weaknesses of the particular area of seminar
- vi. R & D in the particular area
- vii. Field Applications / case studies / Experimental work / software application / Benefit cost studies – feasibility studies
- viii. Vendors associated
- ix. Conclusions
- x. References

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

It is desired that based on the seminar work, a paper be prepared and presented in a state / national conference.

**At the end of first year, the students are required to undergo through a field training of minimum 2 weeks duration. The presentation and separate report of the vocational training will be submitted along with report of seminar II.**

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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER – III**  
**601 073 - Environmental Impact Assessment**

Teaching Scheme  
Lectures: 4 hours/week  
8 Hours / Unit

Examination Scheme  
Theory Paper: 100 Marks  
Credits: 4  
In Semester Assessment: 50 Marks  
End Semester Assessment: 50 Marks  
Duration of end sem. exam. : 3 hrs.

## **Unit – 1**

**Evolution of EIA:** Environmental Impact Assessment: Introduction, Stages Of EIA, Origin of EIA, Establishments of Procedure: Legislative Option, Project Screening for EIA, Methods, Projects thresholds, Sensitive area criteria Matrices. Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS.

## **Unit – 2**

**Methods for impact assessment:** Background information, interaction matrix methodologies, network methodologies, environmental setting, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment.

## **Unit – 3**

**Prediction and assessment of impact for air and noise environment:** Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

## **Unit – 4**

**Prediction and assessment of impact for water and soil environment:** Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.

## **Unit – 5**

**Prediction and assessment of impact on cultural and socioeconomic environment:** Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

**Decision Methods for Evaluation of Alternative:** Public participation in environmental decision making, Regulatory requirements, environmental impact assessment process, objectives of public participation, techniques for conflict management and dispute resolution, verbal communication in EIA studies.

## **Unit – 6**

Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring.

Latest EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Procedure for public hearing, post environmental monitoring, Procedure for obtaining Environmental clearance for construction projects.

### **Reference Books :**

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Peter Watten (Eds.) - 'Environmental Impact Assessment Theory and Practice', Unwin Hyman, London ( 1988).
4. Environmental Impact Assessment By R.RBarthwal ( New Age International Publishers)
5. Environmental Impact Assessment By Abbasi

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering )**  
**Semester III**  
**601 074 - Research Methodology**

**Teaching Scheme**

**Lectures: 4 hours/week**

**Credits: 4**

**Examination Scheme**

**In semester Exam. : 50 marks**

**End Semester Exam. : 50 marks**

**Duration of End term. Exam: 3 hrs**

**Unit 1: Introduction to Research**

Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses. Search for causation. Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning

**Unit 2: Literature survey**

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.

**Unit 3: Data collection, Measuring, Sampling and Scaling**

Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.

**Unit 4: Preliminary data analysis**

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.

**Unit 5: Advanced data analysis techniques**

Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, Multi-dimensional measurement and factor analysis

**Unit 6: Report writing**

Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of

presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure.

### **References**

1. Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd.
  2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India.
  3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.
  4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor & Francis Group)/ Cambridge University Press India Pvt. Ltd.
  5. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.
  6. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar
  7. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.
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**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER – III**  
**601 075 Elective -III**

**Teaching Scheme**  
**Lectures: 5 hours/week**

**Examination Scheme**  
**Theory Paper: 100 Marks**  
**Credits: 5**  
**In Semester Assessment: 100 Marks**

Code	4 Credits Course	Code	1 Credit Course	Code	Audit Course (No Credit Course)
601075 A	Climate Change	601075 E	Project Proposal Writing and Funding	601075 H	Chess
601075 B	Marine Pollution	601075 F	Foreign Language-II	601075 I	Abacus
601075 C	Nano Technology For Water and Wastewater Treatment	601075 G	Rural Engineering-I		
601075 D	Geo-Environmental Engineering				

**601 075 –A -Elective III- Climate Change (4 Credits course)**

**Unit 1**

Atmosphere and its constituents, Synoptic observations- surface and upper air, Tropical meteorology: Easterly Waves, ET-ITCZ, Inversion. Monsoon – Onset, Activity, Withdrawal, Breaks, Depressions, Easterly Jet Stream. Post Monsoon - Cyclones in the Indian Seas, N. E. Monsoon

**Unit 2**

Global Climatology - Global distribution of pressure and temperature at m.s.l. in winter and summer, distribution of annual rainfall and its variability, distribution of moisture and clouds. Vertical distribution of temperature. General circulation of atmosphere, Development of monsoons, Major categories of world climates

**Unit 3**

Indian Climatology - Different seasons, Distribution of Means Sea level pressure/temperature in different seasons, Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons, Indian rainfall in different seasons, Indian summer monsoon, onset, withdrawal, rainfall distribution, inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons

**Unit 4**

Climate Change & Variability -Overview of the climatic history of the earth. Long term changes (Climate of Past century, past millennium, past glacial period), Methods of determining past climate. Possible causes of climate change- External (Milankovitch variation and Solar activity) and Internal (natural and anthropogenic ). General idea of internal dynamical processes of the atmosphere, oceanic processes, Cryospheric processes, land processes. Man's impact on climate, Greenhouse gases and global warming, basic radiation processes, Climate feedback mechanism, Climate predictability, future climate, potential consequences, International efforts to minimize climate change and their effects. Indian scenario

## Reference Books

1. Atmosphere, Weather and Climate R.J. Barry and R.G. Chorley (Methuen Publication)
  2. South West Monsoon” by Y.P. Rao (IMD Publication ) .
  3. An Introduction to Meteorology by S. Pettersen
  4. Elements of meteorology by Miller, Thompson and Paterson
  5. General Meteorology by H.R. Byer
  6. Monsoon by P.K. Das
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## 601 075 -B-Elective III Marine Pollution (4 Credits course)

### Unit – 1

**Marine Pollution:** Definition, categories of additions, Pollutant and its classification. Organic wastes: BOD, COD, dilution factor, Fluctuations in DO, Consequences of organic discharges to estuaries with examples; Thames and Mersey estuary; Consequences of sludge dumping at sea with reference to Thames and Firth of Clyde. Sewage treatment: Primary, Secondary and Tertiary treatment processes. Solid waste pollution: Classification and disposal of solid wastes.

### Unit – 2

**Industrial pollution:** sources, nature and their treatment processes with reference to wastes from paper and pulp and soap manufacturing industries.

Marine corrosion: Definition, corrosion reactions, classification of corrosion, factors affecting corrosion of metals in sea water and prevention of marine corrosion. The state of some seas in the world (pollution aspect); The North Sea, the Mediterranean Sea and the Baltic Sea.

### Unit – 3

**Oil spills and cleanup:** sources, major accidental spills, fate of spilled oil on the sea, consequences of oil spills and treatment of oil spills. Pesticide pollution: inputs, fate in the sea, factors affecting the bioaccumulation of pesticides, DDTthe most wide spread molecule, Impact of pesticides on the Environment, Mode of poisoning of pesticides, Methods to minimize pesticide pollution.

**Conservative pollutants:** Measures of contamination, toxicity, measurement of toxicity, acute and chronic exposure, Detoxification. Metal pollution in coastal waters (Hg, Pb, Cd, Cu, Zn and Fe). The present status of coastal pollution in India and future strategies.

**Radioactive Pollution:** Sources, Classification and effects of radiation; Protection and control from radiation: Maximum permissible dose concept, dose limits, Disposal of radioactive wastes; Beneficial aspects of radiation and food safety.

### Unit – 4

**Indicator organisms:** Criteria for selection of indicator organism: Quantitation of pollution load, basic pre-requisites, response to different pollution load and time integration capacity, Macro algae, crustaceans and mollusks as indicator organisms for monitoring of trace metal pollution;

**Red tides:** distribution, types of poisoning, effects and methods to minimize red tides in the sea. Monitoring strategies of marine pollution: Critical pathway approach and Mass balance approach.

**Standards in water quality:** Assessment of pollution damage: The need, seriousness of damage, assessment of damage and problems of measuring impact.

## Reference Books:-

1. Chemical Oceanography (Vol: 3) 1975- Riley J.P and Skirrow, G.
2. The health of the oceans. 1976 Goldberg, E.D
3. Marine Pollution. 1986 Clark, R.B.
4. Quantitative aquatic biological indicators. 1980 Phillips J.D.H.
5. T hermal and radioactive pollution. 1994. Sharma, B.K and Kaur, H.
6. Water Pollution. 1994. Sharma, B. K and Kaur, H.
7. Marine and offshore corrosion. 1985. Chandler, K. A.



**601 075 –C- Elective III Nano -technology for water and wastewater treatment  
(4 Credits course)**

**Unit – 1**

**Introduction:**

Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nanodots, self-assembly, Dip pen nanolithography, Simple details of characterization tools- SEM, TEM, STM, AFM.

**Unit – 2**

**Characterisation of Nano materials:**

Nan particles and water, Responsible use of nano materials: an industry point of view, Policy aspects of innovation, Analytical techniques for characterisation of nano materials.

**Unit – 3**

**Effective, High-Performance Water and Wastewater Purification Systems:**

Nano and micro engineered membrane technology, Applications of nanotechnology for drinking water, Biocatalysts for reductive treatment of water contaminated with priority pollutants, Video conferencing with Asian Institute of Technology nanotechnology laboratory.

**Unit –4**

**Bionanotechnology and Nonmanufacturing:**

Virus-based single-enzyme nanoreactors, Measurement of bacterial-particle interactions with atomic force microscopy, Bioremediation: from environmental processes to production of functional bionanominerals, Microbial manufacture of silver nano particles for water disinfection, Microbial manufacture of chalcogen nanoparticles and quantum dots.

**Reference Books:-**

1. Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.
2. Nanotechnology-A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall
3. Nanotechnology: Rebecca L Johnson, Lerner Publications.
4. Introduction to Nanotechnology: Charles P. Poole Jr., Chapman and Hall/CR
5. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.
6. Charles P. Poole Jr and Frank J. Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.
7. Mark A. Ratner, Daniel Ratner, “Nanotechnology: A gentle introduction to the next Big idea”, Pearson Education, 2003.
8. Hari Singh Nalwa, “Nanostructured materials and Nanotechnology”, Academic press, 2001.
9. Alexei Nabok, “Organic and Inorganic Nanostructures”, Artech House Publishers, 2005.

**601 075 - D- Elective III Geo-environmental Engineering (4 Credits course)**

**Unit – 1**

**Fundamentals of Geoenvironmental Engineering:** Scope of geoenvironmental engineering - multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process, sources and type of ground contamination – impact of ground contamination on geoenvironment - case histories on geoenvironmental problems.

## **Unit – 2**

**Soil-Water-Contaminant Interaction:** Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles.

Concepts of unsaturated soil – importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.

## **Unit – 3**

**Contaminant Site Remediation:** Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.

## **Unit –4**

**Advanced Soil Characterization:** Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

## **References Books:**

1. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
  2. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
  3. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
  4. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
  5. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
  6. Hillel D., "Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
  7. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
  8. Sparks, D.L., "Environmental Soil Chemistry" Academic Press, New York, 2002.
  9. Berkowitz, B. Dror, I. and Yaron, B., "Contaminant Geochemistry" Springer, Germany, 2008.
- 

## **601 075 –E- Elective III- Project Proposal writing and funding (1 Credit course)**

### **Unit 1**

Introduction to grants and their place in the development of organizations, planning skills needed for strong proposals. Components of an application, Helpful tools and resources, Strategies for developing a proposal, How to identify potential funding sources, How to read and understand proposal guidelines and requests for proposals (RFP), Writing objectives, Preparation and justification of budgets, Protocols for use of animal and human subjects in research, Cost sharing and sub-contracts, Procedures for grants submission and grants start up, The grant review process, Writing cover letters, Preparing a curriculum vitae.

### **Unit 2**

Study a proposal or a dummy proposal written for sanctioning of grant for BCUD, AICTE etc. Develop and submit a draft a proposal for a grant sanctioning authority (related to a particular project) with the following main points:

- a. Identify a fundable topic, based on a need or a problem you've identified
- b. Identify a potential funder
- c. Obtain their program description and application forms
- d. Develop a draft proposal that meets the funder's requirements.

The proposal may include:

1. Problem statement
  2. Research design / work plan
  3. Time line
  4. Budget
  5. Project personnel
  6. Other supporting documents **Reference:**  
As specified by the instructor
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### **601 075 – F-Elective III -- Foreign Language ---French-III (1 Credit course)**

**Unit 1: French Grammar and Vocabulary:** Unit-1, Lesson 4 of the Text Book (Grammar & Vocabulary), Unit-1, Lesson 4 of the Text Book, Revision & speaking practice

**Unit 2:** Advance Vocabulary, Writing & Speaking, Exercise of Unit-1, Lesson 4 of the Text Book & workbook , Practicing Simple conversation in French, Revision & practice of conversation (Simple questions & answers)

**Reference:** Jumelage-I Text Book by Manjiri Khandekar & Roopa Luktuke  
Jumelage-I workbook by Roopa Luktuke

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### **601 075 -G -Elective III-- Rural Engineering-I (1 Credit course)**

**Unit 1:**

**Rural Development and Infrastructure development.**

Introduction to rural engineering, elements of rural engineering , productivity, animal husbandry and agriculture, rural art and craft, Infrastructure development such as irrigation, communication, village betterment, transportation, education such as educational institute, Financial assistance from Z.P. and other sources.

Human Resources and development.,Health care center, rural sanitation, combined program for women and pre school children. Employment generation, integrated rural development programme, landless employment guarantee program , present rural status, role of NGO and corporate sector.

**Unit 2:**

**Socio Economic Development**

Rural population growth rate, rural literacy, manpower, cultivators, agriculture, industrial worker, manufacture worker, rural poverty. Five years plan for rural development.

**Govt. Policy and schemes for rural development.**

Various policies for rural development, various schemes such as micro finance and rural banking, integrated village development model, Swarnajayanti Gram Swarozgar Yojana, Sampran Grammen Rozgar Yojana, Micro finance and rural banking **Reference:** As specified by the instructor

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**601 075 - H- Elective III Chess (Audit Course---No Credit course) Unit 1**

Introduction of chess game, What is chess board, the place of chess board , Chess pieces position & its moves, The concept of attacking, , The concept check with different pieces,

Mate/Checkmate, Castling, Pawn Promotion, Notation, Stalemate, Pointing

**Unit 2**

End game, attacking a piece, Opening principles, Piece exchange, Pin, Defining the draws in

Chess

**Reference:** As specified by the instructor

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**601 075 -I-Elective III Abacus (Audit Course---No Credit course)**

**Unit 1**

Introduction of Abacus, addition & subtraction with help of help of small friends, big friends

& big family, Concept of visualization, Multiplication & Division

**Unit 2**

Additional & Subtraction with decimal concept, Determine cube root & square root

**Reference:** As specified by the instructor

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**SAVITRIBAI PHULE PUNE UNIVERSITY**

**M.E. (CIVIL) (Environmental Engineering)  
SEMESTER III**

**601 076 Seminar – II**

Teaching Scheme  
Pract. 4 hrs./week

Examination Scheme  
Oral : 50 Marks,  
TW :: 50 Marks  
Credits 4

Term work should consist of ---

- I)** Spiral bound report preferably, printed on both the sides of paper on the topic of dissertation work and should be submitted in a standard format having the following contents.
- i) A report on training undergone on a construction project site/organization/for a period of minimum 15 days, including the data collection necessary for the project work.
  - ii) A report on the topic of dissertation, containing the following:
    - a) Literature review and problem statement formulation.
    - b) Research Methodology and proposed schedule of completion of project work.  
Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.
- II)** Spiral bound report preferably, printed on both the sides of paper on vocational training of 2 weeks

**SAVITRIBAI PHULE PUNE UNIVERSITY**

**M.E. (CIVIL) (Environmental Engineering)  
SEMESTER III**

**601 077 Project Stage I**

Teaching Scheme  
Pract. 8 hr./week

Examination Scheme  
Oral: 50 Marks  
TW ; 50 marks  
Credits 8

The project work will start in semester III, and should preferably be a live problem in the industry or macro-issue having a bearing on performance of the construction industry and should involve scientific research, design, collection, and analysis of data, determining solutions and must preferably bring out the individuals contribution.

The dissertation stage I report should be presented in a standard format, in a spiral bound hard copy, preferably printed on both the sides of paper ,containing the following contents.

- i. Introduction including objectives, limitations of study.
- ii. Literature Survey, background to the research.
- iii. Problem statement and methodology of work
- iv. Theoretical contents associated with topic of research
- v. Field Applications, case studies
- vi. Data collection from field/organizations or details of experimental work/analytical work

- vii. Part analysis / inferences
- viii. Details of remaining work to be completed during the project work stage II
- ix. References

Students should prepare a power point presentation to be delivered in 25 minutes and should be able to answer questions asked in remaining five minutes.(It is preferred that at least one paper on the research area be presented in a conference or published in a referred journal.)

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER IV**  
**501 078 Seminar – III**

Teaching Scheme  
 Pract. 5 hrs./week

Examination Scheme  
 TW :50 marks  
 Oral / Presentation-50 marks  
 Credits : -5

Term work should consist of a spiral bound report on the topic of dissertation work,preferably typed on both the sides of pages and should be submitted in a standard format.

Seminar III will be assessed based on the requirements of completion of project work for the project stage II.

Students should prepare a power point presentation to be delivered in 15 minutes and should be able to answer questions asked in remaining five minutes.

**SAVITRIBAI PHULE PUNE UNIVERSITY**  
**M.E. (CIVIL) (Environmental Engineering)**  
**SEMESTER IV**  
**501 079 Project work Stage II**

Teaching Scheme  
 Pract. 20 hrs./week

Examination Scheme  
 Oral/Presentation : 50 Marks  
 TW : 150 Marks  
 Credits : - 20

The final dissertation should be submitted in black bound hard copy preferably typed on both the sides of pages as well as a soft copy on CD.

(The due weight will be given for the paper(s) on topic of project presented in a conferences or published in referred journals.)

The Term Work of Dissertation of semester IV will be assessed jointly by the pair of internal and external examiners, along with oral examination of the same.