

# E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai  
Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)  
NAGAPATTINAM – 611 002



## M.E. ENVIRONMENTAL ENGINEERING

### Full Time Curriculum and Syllabus

#### First Year – First Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
<b>Theory Course</b>								
1701EV101	Statistics For Environmental Engineers	3	2	0	4	40	60	100
1702EV102	Environmental Chemistry	3	0	0	3	40	60	100
1702EV103	Environmental Microbiology	3	0	0	3	40	60	100
1702EV104	Transport of Water and Waste Water	3	0	0	3	40	60	100
1702EV105	Principles and Design of Physico-Chemical Treatment Systems	3	0	0	3	40	60	100
	Elective-I	3	0	0	3	40	60	100
<b>Laboratory Course</b>								
1704EV106	Environmental Chemistry Laboratory	0	0	2	1	50	50	100
1704EV107	Environmental Microbiology Laboratory	0	0	2	1	50	50	100
1704EV108	Communication Skills Lab I	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

<b>1701EV101</b>	<b>STATISTICS FOR ENVIRONMENTAL ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

1. To introduce the basic concept of Stochastic Processes
2. To enable the students in handling Estimation and Testing of Hypothesis
3. To learn the Application of Statistics in Engineering Decision Making

**UNIT I PROBABILITY AND RANDOM VARIABLE 9 + 3 Hours**

Probability concepts – Random Variables – Moment generating function – Standard distributions - Binomial - Poisson - rectangular or Uniform – Normal - Exponential distributions - Functions of random variables – Two dimensional random variables.

**UNIT II STOCHASTIC PROCESSES 9 + 3 Hours**

Classification – Stationary and Random process – Markov process – Markov chains – Transition probability – Classification of Markov chain – Limiting distribution – First passage time – Poisson process – Birth and death process.

**UNIT III ESTIMATION THEORY 9 + 3 Hours**

Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size- unbiased Estimators- Maximum Likelihood Estimation-Curve Fitting by Principle of Least square

**UNIT IV TESTING OF HYPOTHESIS- PARAMETRIC TESTS 9 + 3 Hours**

Hypothesis testing: one sample and two sample tests for means and proportions of large samples z-test, one sample and two sample tests for means of small sample t-test, F-test for two sample standard deviations. ANOVA one and two way classification.

**UNIT V NON PARAMETRIC TESTS 9 + 3 Hours**

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Comparing two populations. Mann – Whitney U test and Kruskal Wallis test.

**TOTAL: 45 + 15 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

- CO1: To acquire knowledge in basic concepts of Probability
- CO2: To characterize phenomenon which evolve with respect to time in a probabilistic manner
- CO3: To estimate the sample size and prediction of unknown values
- CO4: To solve Parametric and non - parametric statistical problem
- CO5: To apply statistical techniques for solving Engineering problems

**REFERENCES:**

1. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”, Thomson and Duxbury, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice – Hall, Seventh Edition, 2007.
3. Gupta S.C. and Kapoor V.K.”Fundamentals of Mathematical Statistics”, Sultan an Sons, 2001.
4. Dallas E Johnson , “Applied Multivariate Methods for Data Analysis”, Thomson an Duxbury press,1998.
5. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”, Thomson and Duxbury, 2002.

<b>1702EV102</b>	<b>ENVIRONMENTAL CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To educate the students about water chemistry
2. To impart knowledge in the area of air and soil chemistry
3. To impart knowledge on the transformation of chemicals in the environment

**UNIT I INTRODUCTION 9 Hours**

Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp) ,heavy metal precipitation, amphoteric hydroxides,CO<sub>2</sub> solubility in water and species distribution – Chemical kinetics , First order- 12 Principles of green chemistry.

**UNIT II AQUATIC CHEMISTRY 11 Hours**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation– Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption-Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

**UNIT III ATMOSPHERIC CHEMISTRY 7 Hours**

Atmospheric structure –chemical and photochemical reactions – photochemical smog, Ozone layer depletion – greenhouse gases and global warming, CO<sub>2</sub> capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

**UNIT IV SOIL CHEMISTRY 9 Hours**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

**UNIT V ENVIRONMENTAL CHEMICALS 9 Hours**

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins, PCBs, PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

- CO1: Solve environmental issues of chemicals based Pollution
- CO2: Determine chemicals need calculations for treatment purpose
- CO3: Identify contaminating chemicals

**REFERENCES:**

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

<b>1702EV103</b>	<b>ENVIRONMENTAL MICROBIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To Understand the microbiology relevant to environmental engineering
2. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae
3. The microbiology of wastewater, sewage sludge and solid waste treatment processes
4. An exposure to toxicology due to industrial products and byproducts
5. Aspects on nutrient removal and the transmission of disease causing organisms

**UNIT I CLASSIFICATION AND CHARACTERISTICS 5 Hours**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

**UNIT II MICROBES AND NUTRIENT CYCLES 10 Hours**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaeobacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

**UNIT III METABOLISM OF MICROORGANISMS 10 Hours**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb’s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

**UNIT IV PATHOGENS IN WASTEWATER 10 Hours**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms- total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

**UNIT V TOXICOLOGY 10 Hours**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

- On the successful completion of the course, students will be able to
- CO1: Understand the basics of microbiology and their diversity and on the genetic material in the living cell.
  - CO2: Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
  - CO3: Understand the role microbial metabolism in a wastewater treatment plant.
  - CO4: Know the role of microorganisms in contaminated water and the diseases caused.
  - CO5: Conduct and test the toxicity due to various natural and synthetic products in the environment.

**References:**

1. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
3. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
4. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
5. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
6. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
7. Frank C. Lu and Sam Kacew, LU’s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

<b>1702EV104</b>	<b>TRANSPORT OF WATER AND WASTEWATER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
2. To educate the students in computer application on design.

**UNIT I GENERAL HYDRAULICS AND FLOW MEASUREMENT 8 Hours**

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

**UNIT II WATER TRANSMISSION AND DISTRIBUTION 10 Hours**

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

**UNIT III WASTEWATER COLLECTION AND CONVEYANCE 10 Hours**

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

**UNIT IV STORM WATER DRAINAGE 7 Hours**

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

**UNIT V CASE STUDIES AND SOFTWARE APPLICATIONS 10 Hours**

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

- CO1: Select various pipe materials for water supply main, distribution network and sewer
- CO2: Design water supply main, distribution network and sewer for various field conditions
- CO3: Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

**REFERENCES:**

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

<b>1702EV105</b>	<b>PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To educate the students on the principles and process designs of various treatment systems for water and wastewater.
2. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

**UNIT I INTRODUCTION 5 Hours**

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch- continuous type-kinetics

**UNIT II TREATMENT PRINCIPLES 10 Hours**

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

**UNIT III DESIGN OF MUNICIPAL WATER TREATMENT PLANTS 10 Hours**

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

**UNIT IV DESIGN OF INDUSTRIAL WATER TREATMENT PLANTS 10Hours**

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers – Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

**UNIT V DESIGN OF WASTEWATER TREATMENT PLANTS 10 Hours**

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

- CO1: Develop conceptual schematics required for the treatment of water and wastewater
- CO2: Translate pertinent forcing criteria into physical and chemical treatment system.

**REFERENCES:**

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shun dar Lin, Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.

<b>1704EV106</b>	<b>ENVIRONMENTAL CHEMISTRY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

1. To train in the analysis of physical parameters of water and waste water
2. To train in the analysis of chemical parameters of water and waste water

**LIST OF EXPERIMENTS:**

1. Good Laboratory Practices, Quality control, Calibration of Glassware
2. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride)
3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).
4. Sampling and analysis of air pollutants Ambient & Stack ( RSPM, SO<sub>2</sub> and NO<sub>x</sub> )
5. Sampling and characterization of soil (CEC & SAR, pH and K).

**TOTAL:45 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

CO1: Assess quality of environment

CO2: Conduct analysis on characteristics of water and waste water

**REFERENCES:**

1. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
2. Washington, 2005.
3. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
4. Second Edition, VCH, Germany, 1992.
5. Methods of air sampling & analysis, James P. Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

<b>1704EV107</b>	<b>ENVIRONMENTAL MICROBIOLOGY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

1. To train in the analysis of physical parameters of water and waste water
2. To train in the analysis of chemical parameters of water and waste water

**LIST OF EXPERIMENTS:**

1. Preparation of culture media
2. Isolation, culturing and Identification of Microorganisms
3. Microorganisms from polluted habitats (soil, water and air)
4. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
5. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
6. Staining of bacteria
7. Effect of pH, temperature on microbial growth
8. Pollutant removal using microbes from industrial effluent.
9. Effect of pesticides on soil microorganisms
10. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
11. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
12. Effect of Heavy metals on microbial growth
13. Detection of Anaerobic bacteria (Clostridium sp.)
14. Bioreactors

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

- CO1: Field oriented testing of water, wastewater and solid waste for microbial contamination.  
CO2: Perform toxicity test.

**REFERENCES:**

1. Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.
2. Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.
3. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.



<b>1704EV108</b>	<b>COMMUNICATION SKILLS LAB I</b> (Common to all M.E Programmes)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

1. To acquire skills for using English in workplace effectively.
2. To communicate for essential business needs.
3. To prepare students for taking BEC Vantage level examination which is an International Benchmark for English language proficiency of Cambridge English Language Assessment

**LIST OF EXPERIMENTS:**

**1. GRAMMAR AND VOCABULARY**

Forming asking complex questions – expressing purpose and function – modal verbs – impersonal passive voice– Reported speech – cause and effect – relative pronouns – expressions followed by – *ing* forms– acronyms – marketing terms / vocabulary – financial terms – collocations – discourse markers

**2. LISTENING**

Purposes of listening – features of listening texts – potential barriers to listening – specific listening skills – strategies to use when listening– distinguishing relevant from irrelevant information – gap filling exercise – multiple-choice options – note completion – matching and multiple choice questions – listening for specific information, gist, topic, context and function.

**3. SPEAKING**

Word and sentence stress – clear individual sounds – turn taking – initiating and responding - intonation patterns – pronunciation – mother tongue intrusion– conversation practice – turn-taking and sustaining the interaction by initiating and responding appropriately- Public Speech – Lectures.

**4. READING**

Purposes of reading – potential barriers to reading – paraphrasing – identifying facts and ideas – skimming and scanning for information – matching statements with texts– spotting reference words – understanding text structure – understanding the ideas in a text – distinguishing between the correct answer and the distracter – understanding cohesion in a text – deciphering contextual meaning of words and phrases – cloze – proof reading - transcoding.

**5. WRITING**

Paragraphing a text – using appropriate connectives – editing practice –Longer Documents: writing a proposal & Reports, Agenda – Minutes – Circular

**TOTAL: 30 HOURS**

**ADDITIONAL EXPERIMENTS:**

1. Body Language: Kinesics, Proxemics, Para linguistic, Nuances of Speech Delivery
2. Personality Development: Building self esteem
3. Team work

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

CO1: To enable students to get International recognition for work and study.

CO2: To use English confidently in the International business environments.

CO3: To be able to take part in business discussion, read company literature, write formal and informal business correspondences and listen and understand business conversations

**REFERENCES:**

1. Guy Brook-Hart, “BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student’s Book”, 1<sup>st</sup> Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, “Cambridge BEC VANTAGE – Self-study Edition”, Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising