

**ANNA UNIVERSITY, CHENNAI**  
**REGULATIONS 2009**  
**CURRICULUM**  
**M.E. ENVIRONMENTAL ENGINEERING**  
**SEMESTER I**

<b>S.No.</b>	<b>Subject Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Theory</b>						
1	<b>MA9318</b>	Applied Statistics and Probability	4	0	0	4
2	<b>EN9311</b>	Environmental Chemistry	3	0	0	3
3	<b>EN9312</b>	Environmental Microbiology	3	0	0	3
4	<b>EN9313</b>	Air Pollution and Control	3	0	0	3
5	<b>EN9314</b>	Water and Sewage Conveyance	3	0	0	3
<b>Practical</b>						
6	<b>EN9317</b>	Environmental Engineering Laboratory	0	0	4	2
<b>Total</b>						<b>18</b>

**UNIT I EMPIRICAL STATISTICS 8**

Measures of central tendency, dispersion, skewness and kurtosis – Principle of least squares – Correlation and regression – Rank correlation.

**UNIT II SAMPLING DISTRIBUTIONS AND ESTIMATION 8**

Sampling distributions – Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method – Method of moments.

**UNIT III TESTING OF HYPOTHESIS 9**

Basic definitions of statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions – Analysis of variance – One way and Two way Classifications.

**UNIT IV DESIGN OF EXPERIMENTS 9**

Completely randomized design – Randomised block design – Latin square design –  $2^2$  factorial design.

**UNIT V PROBABILITY AND RANDOM VARIABLES 11**

Probability – Random Variables – Moments – Standard Distributions – Moment Generating Function – Functions of random variables – Two dimensional random variables – Multiple and partial correlation and Regression.

**L: 45 T: 15 Total: 60****REFERENCES**

1. Brethouex, P.U., “Statistics for Environmental Engineers”, Lewis Publ./, 1994.
2. Johnson, R.J. “Miller and Freund’s Probability and Statistical for Engineers“ 6<sup>th</sup> Edition, Prentice – Hall of India, Private Ltd., 2002.
3. Ang, A.H.S. and Tang W.H., “Probability concepts in Engineering Planning and Design” – Basic principles Vol. John Wiley and Sons, Inc. 1975.
4. Gupta, S.C. and Kapoor, V.K. “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 2001.
5. Taha, H.A., “Operations Research: An Introduction”, Seventh Edition, Pearson Education Edition, 2002.

**UNIT I FUNDAMENTALS 15**

Colloids – Redox potentials – Partition co-efficient – Beer – Lambert’s Law – Limitations – UV visible spectroscopy – Basic principles – Application – Atomic absorption spectroscopy – Principles – Applications Gas chromatograph – Principles and applications – Principles of green chemistry – Error analysis of environmental data.

<b>UNIT II</b>	<b>DEGRADATION</b>	<b>8</b>
Transport and transformation of chemicals – DO, BOD and COD – Photo catalysis – Degradation of food stuffs, detergents, pesticides and hydrocarbons.		
<b>UNIT III</b>	<b>AQUATIC CHEMISTRY</b>	<b>7</b>
Metals, complex formation, oxidation and reduction and sorption – E <sup>h</sup> – p <sup>H</sup> diagrams – chemical speciation – QSAR – Risk evaluation of chemicals.		
<b>UNIT IV</b>	<b>ATMOSPHERIC CHEMISTRY</b>	<b>8</b>
Regions of atmosphere – Chemical and photochemical reactions – Photochemical smog, ozone layer depletion – Green house gases and global warming – Acid rain.		
<b>UNIT V</b>	<b>SOIL CHEMISTRY</b>	<b>7</b>
Soil properties, clay minerals – Acid-base and ion-exchange reactions in soil – Salt affected soil and its remediation.		
		<b>Total: 45</b>

**REFERENCES**

1. C.N. Sawyer, P.L. MacCarty and G.F. Parkin, “Chemistry for Environmental Engineering and Science”, 5th Edition, Tata McGraw-Hill, , 2003.
2. G.W. Vanloon and S.J. Duffy “Environmental Chemistry – a Global Perspective”, Oxford University Press, 2000.
3. Connell, D.W., “Basic concepts of Environmental Chemistry”, Lewis publishers, 1997.
4. Colin Baird, “Environmental Chemistry”, Freeman and Company, 1997.
5. Manahan, S.E., “Environmental Chemistry”, 6th Edition, Lewis Publishers, 1994.

<b>EN9312</b>	<b>ENVIRONMENTAL MICROBIOLOGY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>5</b>
Classification of microorganisms—prokaryotic, eukaryotic, structure, characteristics, nucleic acids – DNA, RNA, replication. Culturing of microorganisms, Recombinant DNA technology.		
<b>UNIT II</b>	<b>MICROBIOLOGY OF ENVIRONMENT</b>	<b>10</b>
Distribution of microorganisms—Water, Air and Soil, Indicator organisms, coliforms—fecal coliforms, E. coli, Streptococcus, Clostridium, Significance in water. Algae in water supplies—problems and control. Concentration and detection of virus, Transmissible diseases.		
<b>UNIT III</b>	<b>METABOLISM OF MICROORGANISMS</b>	<b>10</b>
Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – Aerobic and anaerobic-respiration, fermentation, glycolysis, Kreb’s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.		
<b>UNIT IV</b>	<b>ROLE OF MICROORGANISMS IN WASTEWATER TREATMENT</b>	<b>10</b>
Microbiology of biological treatment processes—aerobic and anaerobic, Biodegradation of toxic pollutants—mechanism – □-oxidation, □-oxidation, nitrification and denitrification, eutrophication.		

**UNIT V TOXICOLOGY****10**

Ecotoxicology—toxics and toxicity, factors influencing toxicity, effects—acute, chronic, concentration response relationships, test organisms, toxicity testing, bioconcentration, bioaccumulation, biomagnification, bioassay, biomonitoring.

**Total: 45****REFERENCES**

1. Maier, R.M., Pepper, I.L. and Gerba, C.P., “Environmental Microbiology”, Academic Press, 1999.
2. Tortora. G.J, B.R. Furke, and C.L. Case, “Microbiology-An Introduction” 4th Edition, Benjamin/Cummings Publications, 1992.
3. Frank C. Lu and Sam Kacew, “LU’s “Basic Toxicology”, Taylor and Francis, 4th Edition, 2002
4. Baker. K.H. and Herson, D.S., “Bioremediation”, McGraw-Hill Inc., 1994.

**EN9313****AIR POLLUTION AND CONTROL****L T P C****3 0 0 3****UNIT I INTRODUCTION****10**

Air resource management system – Air quality management – Scales of air pollution problem – Sources and classification of pollutants and their effect on human health vegetation and property – Global implications of air pollution – Meteorology Fundamentals – Atmospheric stability – Micrometeorology – Atmospheric turbulence – Mechanical and thermal turbulence – Wind profiles – Atmospheric diffusion – Atmospheric diffusion theories – Steady-state atmospheric diffusion equation – Plume rise – Diffusion models – Software applications – Ambient air quality and emission standards – Air pollution indices – Indoor air pollutants – Models – Air quality sampling and monitoring.

**UNIT II CONTROL OF PARTICULATE CONTAMINANTS****12**

Settling chambers – Filters, gravitational, Centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory – ESP design – Operational Considerations – Process Control and Monitoring – Case Studies.

**UNIT III CONTROL OF GASEOUS CONTAMINANTS****13**

Absorption – Principles – Description of equipment-packed and plate columns – Design and performance equations – Adsorption – Principal adsorbents – Equipment descriptions – Design and performance equations – Condensation – Design and performance equation – Incineration – Equipment description – Design and performance equations – Biological air pollution control technologies – Bio-Scrubbers, Biofilters – Operational considerations – Process control and monitoring – Case studies.

**UNIT IV EMERGING TRENDS****6**

Process modification – Automobile air pollution and its control – Fuel modification – Mechanical particulate collectors – Entrainment separation – Internal combustion engines – Membrane process – Ultraviolet photolysis – High efficiency particulate air filters – Technical and economic feasibility of selected emerging technologies for air pollution control – Control of indoor air quality – Radio active pollution and its control.

**UNIT V NOISE CONTROL****4**

Noise Standards – Measurement – Modeling – Control and preventive measures.

**Total: 45****REFERENCES**

1. Lawrence K.Wang, Norman C Perelra, Yung-Tse Hung, “Air Pollution Control Engineering”, 2004.
2. Noel de Nevers, “Air Pollution Control Engineering”, McGraw-Hill, 1995.
3. David H.F Liu, Bela G.Liptak “Air Pollution”, Lewis Publishers, 2000.
4. Anjaneyulu, Y, “Air Pollution and Control Technologies”, Allied Publishers (P) Ltd, 2002.

**EN9314****WATER AND SEWAGE CONVEYANCE****L T P C****3 0 0 3****UNIT I PRINCIPLES OF HYDRAULICS****10**

Fluid properties; fluid flow – Continuity principle, energy principle and momentum principle – Frictional head loss in free and pressure flow, major and minor heads loss, formula for estimation of head loss – pumping of fluids – Selection of pumps – Flow measurement.

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

Planning factors – Water transmission main design – Pipe material – Economics – Water hammer analysis – Water distribution pipe networks – Methods for analysis and optimisation – Laying and maintenance, insitu lining – Appurtenances – Corrosion prevention – Minimization of water losses – Leak detection.

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

Planning factors – Design of sanitary sewer – Partial flow in sewers – Economics of sewer design – Sewer appurtenances – Material, construction, inspection and maintenance of sewers – Design of sewer outfalls – Mixing conditions – Conveyance of corrosive wastewaters.

**UNIT IV STORM WATER DRAINAGE****5**

Planning – Run-off estimation – Rainfall data analysis – Storm water drain design – Rain water harvesting

**UNIT V CASE STUDIES AND COMPUTER APPLICATIONS****10**

Computer applications for water transmission – Water distribution and sewer design.

**Total: 45****REFERENCES**

1. Bajwa, G.S., “Practical Handbook on Public Health Engineering”, Deep Publishers, 2003.
2. Anonymous, “Manual on Water Supply and Treatment”, CPHEEO, Ministry of Urban Development, Government of India, 1999.
3. Anonymous, “Manual on Sewerage and Sewage Treatment”, CPHEEO, Ministry of Urban Development, Government of India, 1993.
4. Hauser, B.A., “Practical Hydraulics Handbook”, Lewis Publishers, 1991.

**ENVIRONMENTAL CHEMISTRY LABORATORY**

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|----|--|----|
| 1. | PHYSICAL AND CHEMICAL ANALYSIS OF WATER<br>pH, Conductivity, Turbidity, Solids, Chlorides, Sulphates, Alkalinity, Fluorides, Nitrate and heavy metals. | 12 |
| 2. | PHYSICAL AND CHEMICAL ANALYSIS OF WASTEWATER<br>Phosphate, COD, BOD, Organic and ammonical nitrogen, Oil and grease.                                   | 8  |
| 3. | AIR QUALITY ANALYSIS<br>SPM, SO <sub>2</sub> , CO, NO <sub>x</sub>   | 6  |
| 4. | SOIL ANALYSIS<br>pH, Conductivity, Cation exchange capacity, Sodium Absorption ratio   | 4  |

**ENVIRONMENTAL MICROBIOLOGY LABORATORY**

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|----|--|----|
| 1. | Preparation of media, serial dilution and plating, Growth curve  | 6  |
| 2. | Sampling of Microorganisms from air, water and soil, staining – simple and gram staining                     | 6  |
| 3. | Effect of pH, temperatures and nutrients on growth of bacteria   | 2  |
| 4. | Bacteriological analysis of water Coliforms and streptococcus fecalis by -MPN and membrane filter techniques | 10 |
| 5. | Study of aquatic organisms – Algae, protozoa and fungi   | 6  |