

**M. Tech. Programme
Environmental and Water Resource Engineering
Department of Civil Engineering
Course structure of**

Semester – I

Subject Code	Subject Name	L-T-P-C
Semester 1		
CE 501	Process Chemistry for Water and Wastewater Treatment	3-0-2-8
CE 503	Physico-chemical Processes in Environmental Engineering	3-0-0-6
CE 505	Geospatial Applications	3-0-2-8
CE 507	Applied Hydrology	3-1-0-8
		12-1-4-30
Semester 2		
CE 502	Solid waste management & EIA	3-0-0-6
CE 504	Elective I: Water Distribution and Wastewater Collection System Design	3-0-0-6
CE 506	Spatial Modeling and Assessment	(3-0-2-8)
CE 508	Electives II: Advance Hydraulic Engineering	(3-0-2-8)
2nd Year		
CE 601	M Tech Project	0-0-24-24
CE 602	M Tech Project – II	0-0-24-24

List of Electives:

ELECTIVES I

SN	Course Name	L-T-P-C
1	Industrial Wastewater Pollution Control	3-0-0-6
2	Air Pollution and Control	3-0-0-6
3	Biological Process in Environmental Engineering	3-0-0-6
4	Environmental Management	3-0-0-6
5	Principles of Water Quality and Legislations	3-0-0-6
6	Water Distribution and Wastewater Collection System Design	3-0-0-6

ELECTIVES II

SN	Course Name	L-T-P-C
1	Advance Hydraulic Engineering	(3-0-2-8)
2	Digital Image Processing and Applications	3-0-0-6
3	Principles of Photogrammetry	3-0-0-6
4	Channel & Fluvial Hydraulics	3-0-2-8
5	Hydrometry and Instrumentation	3-0-0-6
6	Hydro Informatics (AI, ANN, ANFIS, etc)	3-0-0-6
7	River and Lake Conservation	3-0-0-6
8	Flood Modelling and Forecasting	3-0-0-6

9	Hydro-Meteorology (external expert reqd.)	3-0-0-6
10	Flood Modelling and Forecasting	3-0-0-6
11	Hydrological & Hydraulic Modelling	3-1-0-8

Detailed Curriculum Semester

CE 501 Process Chemistry for Water and Wastewater Treatment (3-0-2-8)

General Chemistry:-Basic principles – chemical equations – types of chemical reactions - calculations from chemical equations; gas laws; Equilibrium and Le Chatelier's Principle – factors affecting chemical equilibrium - activity and activity coefficient - ionic strength.

Physical Chemistry:- Thermodynamics – heat and work – enthalpy – entropy – free energy – temperature dependence of equilibrium constant; membrane processes; principles of solvent extraction; ; electrochemistry; chemical kinetics; adsorption.

Equilibrium Chemistry:-Variations of Equilibrium relationships; ways of shifting chemical equilibrium; solutions to equilibrium problems - acid base equilibrium – solubility equilibrium – oxidation reduction equilibrium.

Organic Chemistry And Biochemistry:-Organic compounds of interest to environmental engineers, general properties of the functional groups of organic compounds; Enzymes, classification enzymes catalyzed reaction, energy considerations coupling of reaction; Breakdown and synthesis of carbohydrates, fats, proteins under aerobic and anaerobic reactions; CNP cycles under aerobic and anaerobic reactions;. Concepts of BOD, COD, TOC.

Environmental Chemistry:-Fundamentals of surface and colloidal chemistry; chemistry involved in water treatment procedure like coagulations – softening - fluoridation, defluoridation - iron and manganese removal – demineralization - analysis of pesticide and heavy metals; Atmospheric chemistry; soil chemistry Environmental Microbiology:- Introduction of microbiology, classification and characterization of microorganisms, viruses; Morphology and structure of bacteria, nutrient requirement, growth of bacteria; Basic microbiology of water and sewage; Basic principals involved in the analysis of fecal indicator bacteria – coli forms and streptococci, plankton analysis, analysis of pseudomonas & streptococci; Pathways of aerobic and anaerobic metabolism, Energy transfer in metabolism; Kinetics of microbial growth.

Text books:

1. Benefield D. L., Judkins F. J., Weand L. B., Process Chemistry for Water and Wastewater Treatment, 1st Edition, Prentice Hall, 1982
2. Bitton, G., Wastewater Microbiology, 3rd Ed., Wiley, 2005
3. Mitchell, R., and Gu, J.D., Environmental Microbiology, 2nd Ed., Wiley-Blackwell, 2010
4. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002

CE 503: Physico-chemical Processes in Environmental Engineering (3-0-0-6)

Introduction: Wastewater Characteristics, Standards of Disposal, Treatment Objective and, Strategies, Layouts of Primary, Secondary and Advanced Treatment Units.

Design Of Preliminary And Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary and Secondary Sedimentation Tanks.

Biological Treatment Processes: Types, Kinetics of Plug Flow and Completely Mixed Systems. Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors.

Suspended Growth Processes: Activated Sludge Process, Modifications and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements - Classification and Design of Oxidation Ponds, Lagoons. Sludge Treatment And Disposal.

Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment.

Text books

1. Benefield L.D. and Randall C.D., Biological Process Designs for Wastewater Treatment, Prentice Hall Pub. Co., 1980 .
2. Metcalf and Eddy, Wastewater Engineering – Collection, Treatment, Disposal and Reuse, 4 th Ed., McGraw Hill Pub. Co., 2003 .
3. Udo Wiesmann, In Su Choi and Eva-Maria Dombrowski, Fundamentals of Biological Wastewater Treatment, 1st Ed., Wiley, 2007.

CE 505 Physico-chemical Processes in Environmental Engineering

Basics of Remote Sensing and History, Remote sensing in India, Electromagnetic Radiation (EMR) and atmospheric considerations, Types of remote sensing w.r.t. wavelength regions, active and passive remote sensing, Thermal Emission of Radiation, Black body radiation, Radiation Principles: Plank's Law, Stephen Boltzman law, Wien's displacement law, Kirchoffs Law, Spectral signatures, Reflectance characteristics of Earths cover types, Satellite platforms and sensors, Thermal Imaging,

Introduction to GIS - Data formats and Models, Data acquisition, Data Manipulation and Spatial Analysis, Introduction to GIS software, Principles of GPS- its instruments and applications

Text Book

1. Remote Sensing and Image Interpretation, 6th edition, T. Lillesand, R. Kiefer and J. Chipman, John Wiley.
2. GPS Satellite Surveying, John Wiley & Sons, use. New York.

Reference Book:

1. Introductory Digital Image Processing – A Remote Sensing Perspective, 3rd edition, J. Jensen, Prentice Hall.
2. Introduction to Remote Sensing, 5th edition, Campbell, J. B, New York, The Guilford Press.
3. Remote Sensing: Principles and Interpretation, 3rd edition, by: F. F. Sabins (W. H. Freeman & Co.; 1996, ISBN: 0-71-672442-1).

4. Burrough, P.A. and McDonnell, R.A., 1998: Principles of Geographic Information System, Oxford University Press, Oxford.

CE 507 Applied Hydrology

Basic concepts of hydrology; structure and composition of atmosphere, air mass, cold and warm fronts; atmospheric temperature and its variations; vapor pressure and relative humidity; evaporation and evapo-transpiration; types and forms of precipitation; measurement of precipitation and other atmospheric parameters; hydrograph analysis; probability, risk and uncertainty analysis for hydrologic and hydraulic design; flood routing –hydrologic and hydraulic routing - developing algorithms; hydrologic real time forecasting; urban hydrology; time series analysis.

Texts:

1. Chow, V.T., Maidment, D.R., Mays, L.W., Applied Hydrology, McGraw Hill, 1988.
2. Todd, D.K., Ground Water Hydrology, Wiley, New York, 1998.

References:

1. Mays, L.W., Water Resources Engineering, John Willey and Sons, US, 2001.
2. Haan, C. T., Statistical Methods in Hydrology, Iowa State University Press, 1977.
3. Maidment, D. R., Handbook of Hydrology, McGraw Hill, 1993.

CE 502: Solid Waste Management & EIA (3-0-0-6)

Solid Waste: Origin, characteristics, Quantity and Analysis; Effects of Solid Wastes; Storage, Collection, Transportation of Solid wastes; Solid waste transformation; Product recovery processes; Sanitary landfills; Legislation in solid waste. Hazardous waste: definition, generation, classification; Magnitude of problem; Risk assessment; Environmental Legislation; Characterization and site assessment; Waste minimization and resource recovery; Storage and Transportation of Hazardous wastes; Hazard in processing and treatment; Physical, Chemical, Thermal and Biological processes; Hazardous waste disposal; Landfill disposal and land storage; Ground water contamination; Containment; remedial alternatives. Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, sustainable development, Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India.

Text Books:

1. Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993
2. LaGrega, M. D., Buckingham, P. L. and Evans, J. C., Hazardous Waste Management, 2nd Ed., McGraw Hill, 2001.
3. Larry W Canter, Environmental Impact Assessment, 2nd Ed, McGraw-Hill, 1997.

Reference Books:

1. Bagchi, A., Design, Construction and Monitoring of Landfills, Wiley Interscience, 1994.
2. Haas, C. N. and Vamos, R. J., Hazardous and Industrial Waste Treatment, Prentice Hall, 1995.
3. Martin, E.J. and Johnson, J.H., Hazardous Waste Management Engineering, Van Nostrand, 1987.
4. Wentz, C. A., Hazardous Waste Management, 2nd Ed., McGraw Hill, 1995.

CE 504: Advance Hydraulic Engineering (3-0-2-8)

Open channel hydraulics, uniform flow, critical flow and GVF with special reference to compound channel, rapidly varied flow in prismatic and non-prismatic channel, channel design- erodible and non-erodible channels, silt theories, sediment transport; river mechanics, river erosion, river training works; dam engineering and related environmental issues; concept of hydraulic models.

Laboratory: Experiment on Uniform flow, Hydraulic Jump, Unsteady Flow, Experiment on Two Phased Motion, Experiment on Weirs, Notch, Mouthpieces.

Texts:

1. Ranga Raju, K.G., Flow through Open Channel, Tata McGraw Hill, New Delhi, 1996.
2. Chow, V.T, Open Channel Hydraulics, McGraw Hill, New York, 1959.
3. Hendersen, F.M., Open Channel Flow, McGraw Hill, New York, 1966.

References:

1. Chaudhry, M. H., Open Channel Flow, Prentice Hall of India, 1998.
2. River Behavior Management and Training, Vol. I & II, CBIP, New Delhi, 1994.
3. Andre Rober, River processes: An Introduction to Alluvial dynamics, ARNOLD, London, 1995.

CE 506: Spatial Modeling and Assessment (3-0-2-8)

Introduction: Introduction to geospatial modeling and interpretation, Applications of GIS models, Case Exercise. Topographic Analysis, Vector data Analysis. Spatial Modeling, Spatial Data Editing (Errors in Geospatial Data, Topological Editing, Concept of Geodatabase). Raster/GRID data analysis and Visualization techniques (Hill shades, Contour, Fly through generation/animation, Network Analysis, Utility mapping, Spatial Modeling (Regression: OLS, GWR, Weighted Overlay), 3D GIS, Spatial Decision Support System and thematic areas (Application of MCDM/AHP in spatial modeling). Introduction to various open source modelling software and tool.

Text Book:

1. Burrough, P.A. and McDonnell, R.A., 1998: Principles of Geographic Information System, Oxford University Press, Oxford.
2. A.M. Chandra and S.K. Ghosh 2000. Remote Sensing and GIS. Narosa Publishing House, New Delhi.

Reference Books:

1. Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
2. A practical guide to Geostatistical Mapping by Tomislav Hengl | 291 p. | ISBN 978-90-9024981-0. eussoils.jrc.ec.europa.eu/esdb_archive/eussoils_docs/.../eur22904en.pdf

Elective Course:

CE 531: Digital Image Processing and Applications (3:0:2:8)

Image Interpretation, Principles of Image Interpretation, Types of Imaging, Elements of image Interpretation, Techniques of visual Interpretation, Generations of Thematic maps. Digital Image Data Format: Band sequential format (BSQ), Band interleaved by Line (BIL), Color composites: Generation of B/W and False Colour Composites (FCC). Image Rectification and Restoration, Radiometric and Geometric distortions, Geometric and Radiometric corrections, atmospheric corrections, illumination and view angle effects, Interpolation techniques: nearest neighbour, bilinear and cubic convolution, Image Enhancement, Image Classification, Unsupervised classification, Supervised classification: Parallelepiped, Minimum Distance to Means, Gaussian Maximum Likelihood, Hybrid Methods and Decision Tree classifiers, classification accuracy assessment.

Text Book:

1. Remote Sensing and Image Interpretation, 6th edition, T. Lillesand, R. Kiefer and J. Chipman, John Wiley.
2. Introductory Digital Image Processing – A Remote Sensing Perspective, 3rd edition, J. Jensen, Prentice Hall.

Reference Book

1. Remote Sensing of the Environment – An Earth Resource Perspective, 2nd edition, J. Jensen, Prentice Hall.
2. Pratt, William K. (1978). Digital Image Processing. ISBN 0-471-01888-0.
3. Campbell, J.B. (2002). Introduction to remote sensing, 3rd ed., The Guilford Press. ISBN 1-57230-640-8.

CE 532: Principles of Photogrammetry (3:0:0:6)

Introduction, Definition and terms, history of photogrammetry, Uses of photogrammetry, principles and types of photogrammetry, Types of aerial photographs, Geometry of aerial photographs, Scale determination, distortions, displacements and their corrections, Digital image: Creation of digital image and their characteristics, advantages over other analogue cameras, Flight planning and Elements, Stereo Photogrammetry, Digital Photogrammetry, Interpretation techniques and tools, Input of data from photogrammetry for GIS database, photogrammetric applications in GIS.

Text Book:

Paul R Wolf and Bon A. Dewitt (2004). Elements of Photogrammetry with applications in GIS 3rd edition, ISBN 007-123689-9. 2. Wolf, P. R. (2000). Elements of Photogrammetry. McGraw-Hill, NY.

Reference Book:

1. David P paine, and James D Kiser (2003), Aerial Photography and Image interpretation second edition, John Wiley and Sons Inc. ISBN 0-471-20489-7.
2. Zorn, H. C. (1980). Introductory Course in Photogrammetry. 6th Ed. ITC, Netherlands.

CE 510: Biological Processes in Environmental Engineering (3-0-0-6)

Microbiological concepts: cells, classification and characteristics of living organisms, reproduction, metabolism – basic metabolic models, microbial growth kinetics; Chemistry of carbohydrates, proteins, fats and lipids; Theory and design of biological unit operations: aerobic suspended growth systems – activated sludge processes and its modifications, ponds and lagoons; aerobic attached growth systems; anaerobic suspended and attached systems; Biological nutrient removal; Sequential Batch Reactors; Theory and design of sludge treatment; Wastewater disposal systems.

Text Books:

1. Pelczar, M. J. (Jr), Chan, E C S and Krief, N. R., Microbiology, 5 th Ed., McGraw-Hill, 1996.
2. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4 th Edition, 2003.
3. Henze, M., Harremoes, P., Jansen, J. C. and Arvin, E., Wastewater Treatment: Biological and Chemical Processes, 3 rd Ed., Springer Verlag, 2002.

Reference Books:

1. Heritage, J., Evans, E. G. V. and Killington, R. A., Introductory Microbiology, Cambridge Univ. Press, 1996.
2. Benefield, L. D. and Randall, C. W., Biological Principles in Wastewater Treatment, PrenticeHall, 1980.
3. Grady, C. P. L., Daigger, G. T. and Lim, H. C., Biological Wastewater Treatment, Marcel Dekker, Inc., New York, 2 nd Edition, 1999.
4. Arceivala, S. J., Wastewater Treatment for Pollution Control, Tata McGraw Hill, 1999.

CE 512: Environmental Systems Engineering Laboratory (1-0-4-6)

Detailed laboratory exercises related with physico-chemical and biological processes in Environmental Engineering: Sedimentation, Jar Test, Filtration, Chlorination, Adsorption and

Ion Exchange (Batch and Column), Gas Transfer, Reaction Kinetics; Activated Sludge, Batch Anaerobic Reactor etc.

Texts/References:

1. Clesceri, L. S., Greenberg, A. E. and Eaton, A. D. (Eds), Standard Methods for the Examination of Water and Wastewater, Washington, D.C., 1998, 20 th Ed.
2. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4 th Edition, 2003.
3. Droste, R. L., Theory and Practice of Water and Wastewater Treatment, John Wiley & Sons, 1996.
4. Benefield, L. D., Judkins, J. F. and Weand, B. L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, 1982.
5. Drum, D. A., Bauman, S. L. and Shugar, G. J., Environmental Field Testing and Analysis Ready Reference Handbook, McGraw Hill, 2000.

CE 514: Industrial Wastewater Pollution Control (3-0-0-6)

Industrial wastewater versus municipal wastewater; Effects of industrial wastewater on receiving water bodies and municipal wastewater treatment plant; Bioassay test; Sampling techniques; Stream protection measures; Volume reduction, strength reduction, Neutralization, Equalization, Proportioning; Combined treatment of raw industrial wastewater with domestic sewage; Zero discharge concepts; Removal of specific pollutants in industrial effluents, e.g. oil & grease, phenol, cyanide, toxic organics, heavy metals; Characteristics and treatment of various industrial effluents.

Text Books:

1. Nemerow, N. L and Dasgupta, A., Industrial and Hazardous Waste Treatment, Van Nostrand Reinhold (New York), 1988.
2. Eckenfelder, W. W., Industrial Water Pollution Control, McGraw-Hill, 2000.
3. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4 th Edition, 2003.

Reference Books:

1. Nemerow, N. L., Zero Pollution for Industry: Waste Minimization through Industrial Complexes, John Wiley & Sons, 1995.
2. Clesceri, L. S., Greenberg, A. E. and Eaton, A. D., Standard Methods for the Examination of Water and Wastewater, Washington, D.C., 20 th Ed., 1998.