Syllabus - 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	Environmental Chemistry and Microbiology	3-0-0-6
CE 503	Waste Treatment Systems	3-0-0-6
CE 505	Geospatial Applications	3-0-2-8
CE 507	Hydrologic Elements & Applied Hydrology	3-0-0-6
CE 531	Environmental Engineering Lab	0-0-3-3
		12-0-5-29
	Semester 2	
CE 502	Solid waste management & EIA	3-0-0-6
CE 504	Hydrological & Hydraulic Modelling	3-0-2-8
CE 506	Spatial Modeling and Assessment	3-0-2-8
CE 508	Elective subject (can be selected from the list of electives)	3-0-0-6
		12-0-4-28
	2nd Year	
CE 601	M Tech Project	0-0-24-24
CE 602	M Tech Project – II	0-0-24-24

List of Electives:

SN	Course Name	L-T-P-C
1	Digital Image Processing and Applications	3-0-0-6
2	Principles of Photogrammetry	3-0-0-6
3	Channel & Fluvial Hydraulics	3-0-0-6
4	Hydrometry and Instrumentation	3-0-0-6
5	Geospatial Applications in Hydrology	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	Air Pollution and Control	3-0-0-6

Or any other course as approved by DPPC.

Elective Group

CE 661 Air Quality Modeling 3-1-0-8

CE 662 Environmental Systems Engineering Laboratory 1-0-4-6

CE 568 Environmental Management 3-0-0-6

CE 663 Principles of Water Quality and Legislations 3-0-0-6

CE 664 Industrial Wastewater Pollution Control 3-0-0-6

CE 665 Water Distribution and Wastewater Collection System Design 3-0-0-6

Or any other course as approved by DPPC

Detailed Curriculum

Semester – I

CE 501 Environmental Chemistry and Microbiology (3-0-0-6)
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: Waste Treatment Systems (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: Fundamental of Remote sensing, GIS and GPS

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 Boltezman 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 Hydrologic Elements & Applied Hydrology

Basic concepts of hydrology; structure and composition of atmosphere, air mass, cold and warm fronts; atmospheric temperature and it 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-531 Environmental Engineering Lab (0-0-3-3)

Estimation of Solids, Acidity, Alkalinity, Hardness, Chlorides and Fluorides
Determination of pH and Conductivity
Estimation of Biochemical Oxygen Demand
Estimation of Chemical Oxygen Demand

Estimation of Nitrogen (Different Forms like Ammonia, Nitrite, Nitrate)
Estimation of Phosphates and Sulphates
Estimation of Residual Chlorine Determination of Available Chlorine in bleaching powder
Conducting Break Point Chlorination Test
Determination of Residual ChlorineDetermination of Dissolved Oxygen
Atomic Absorption Spectrophotometric Determination of Heavy Metals
Determination of Biochemical Oxygen Demand
Conducting Jar test for determining optimum dosage of coagulant
Estimation of Organic Compounds Using HPLC
Estimation of biological parameters
Batch studies on heavy metal removal and their analysis Using Ion Analyser

Text Book

1. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002
3. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007

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. eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_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 Photogrammetr, Interpretation techniques and tools, Input of data from photogrammetry for GIS database, photogrammetric applications in GIS.

Text Book:

1. 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 Photgrammetry. 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.