

**Revised**  
**Scheme for Teaching and Examination**  
**With**  
**New Syllabus**  
**(Based on syllabus revision Workshop on 08/02/2014)**

**of**

**M.Tech. (Civil) in Environmental Engineering**  
**(Discuss in 33<sup>rd</sup> Senate Meeting dated 01/06/2014)**  
**(Approved in 27<sup>th</sup> Standing Executive committee of**  
**Senate dated 14/08/2014)**



**CIVIL ENGINEERING DEPARTMENT**  
**S V NATIONAL INSTITUTE OF TECHNOLOGY, SURAT**

## M. TECH. (CIVIL) ENVIRONMENTAL ENGINEERING

### SEMESTER – I

| Sr. No.                                  | Course                                  | Course Code | Teaching Scheme Hours per Week |          |          | Credits                  | Examination Scheme |                |                |             |
|--|---|-------------|--------------------------------|----------|----------|--------------------------|--------------------|----------------|----------------|-------------|
|  |   |             | L                              | TU       | PR       |                          | Theory Marks       | P/T (Internal) | P/T (External) | Total Marks |
|  |   |             |                                |          |          |                          |                    |                |                |             |
| 1  | Environmental Chemistry & Micro Biology | CE-601      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 2  | Physico Chemical Processes              | CE-603      | 3                              | 0        | 0        | 3                        | 100                | -              | -              | 100         |
| 3  | Biological Processes                    | CE-605      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 4  | Applied Statistics For Engineers        | CE-607      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 5  | <b>Elective – I</b>                     |             | 3                              | 0        | 0        | 3                        | 100                | -              | -              | 100         |
| 6  | Environmental Engg. Lab                 | CE-609      | 0                              | 0        | 4        | 2                        | -                  | 40             | 60             | 100         |
| 7  | Seminar – I                             | CE-611      | 0                              | 0        | 2        | 1                        | -                  | 20             | 30             | 50          |
|  | <b>Total</b>                            |             | <b>15</b>                      | <b>3</b> | <b>6</b> | <b>21&lt;24</b>          |                    |                |                |             |
| <b>Total contact hours per week = 24</b> |   |             | <b>Total Credit = 21&lt;24</b> |          |          | <b>Total Marks = 725</b> |                    |                |                |             |

### SEMESTER – II

| Sr. No.                                  | Course                               | Course Code | Teaching Scheme Hours per Week |          |          | Credits                  | Examination Scheme |                |                |             |
|--|--------------------------------------|-------------|--------------------------------|----------|----------|--------------------------|--------------------|----------------|----------------|-------------|
|  |                                      |             | L                              | TU       | PR       |                          | Theory Marks       | P/T (Internal) | P/T (External) | Total Marks |
|  |                                      |             |                                |          |          |                          |                    |                |                |             |
| 1  | Solid and Hazardous Waste Management | CE-602      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 2  | Environmental Impact Assessment      | CE-604      | 3                              | 0        | 0        | 3                        | 100                | -              | -              | 100         |
| 3  | Industrial Waste Management          | CE-606      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 4  | Air Pollution and Control            | CE-608      | 3                              | 1        | 0        | 4                        | 100                | 25             | -              | 125         |
| 5  | <b>Elective –II</b>                  |             | 3                              | 0        | 0        | 3                        | 100                | -              | -              | 100         |
| 6  | Adv. Environmental Eng. Lab          | CE-612      | 0                              | 0        | 4        | 2                        | -                  | 40             | 60             | 100         |
| 7  | Seminar-II                           | CE-614      | 0                              | 0        | 2        | 1                        | 0                  | 20             | 30             | 50          |
|  | <b>Total</b>                         |             | <b>15</b>                      | <b>3</b> | <b>6</b> | <b>21&lt;24</b>          |                    |                |                |             |
| <b>Total contact hours per week = 24</b> |                                      |             | <b>Total Credit = 21&lt;24</b> |          |          | <b>Total Marks = 725</b> |                    |                |                |             |

### Elective – I

| Sr. No. | Course  | Course Code | Teaching Scheme |    |    | Credits | Examination Scheme |                |                |             |
|---------|---|-------------|-----------------|----|----|---------|--------------------|----------------|----------------|-------------|
|         |   |             | Hours per Week  |    |    |         | Theory Marks       | P/T (Internal) | P/T (External) | Total Marks |
|         |   |             | L               | TU | PR |         |                    |                |                |             |
| 1       | Environmental Ethics Law & Policy               | CE-613      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 2       | Environmental Health & Risk Management          | CE-615      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 3       | Env. Hydraulics                                 | CE-617      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 4       | Sustainable Waste Management System             | CE-619      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 5.      | Global Climatic Changes and Disaster Management | CE-621      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |

### Elective – II

| Sr. No. | Course  | Course Code | Teaching Scheme |    |    | Credits | Examination Scheme |                |                |             |
|---------|---|-------------|-----------------|----|----|---------|--------------------|----------------|----------------|-------------|
|         |   |             | Hours per Week  |    |    |         | Theory Marks       | P/T (Internal) | P/T (External) | Total Marks |
|         |   |             | L               | TU | PR |         |                    |                |                |             |
| 1       | Environmental System Modeling                               | CE-616      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 2       | Advanced Water and Waste Water Treatment System             | CE-618      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 3       | Industrial safety and Environment                           | CE-622      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 4       | Application of GIS and Remote Sensing in Env. Engg          | CE-624      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |
| 5.      | Cleaner Production and Environmental Sustainable Management | CE-626      | 3               | 0  | 0  | 3       | 100                | -              | -              | 100         |

### SEMESTER – III

| Sr. No.                                  | Course                     | Course Code | Teaching Scheme Hours per Week |    |           | Credits  | Examination Scheme       |                |                |             |
|--|----------------------------|-------------|--------------------------------|----|-----------|----------|--------------------------|----------------|----------------|-------------|
|  |                            |             | L                              | TU | PR        |          | Theory Marks             | P/T (Internal) | P/T (External) | Total Marks |
|  |                            |             |                                |    |           |          |                          |                |                |             |
| 1  | (*) Summer training Report | CE-801      | 0                              | 0  | 0         | 1        | —                        | 40             | 60             | 100         |
| 2  | Project                    | CE-803      | 0                              | 0  | 6         | 3        | —                        | 40             | 60             | 100         |
| 3  | Dissertation Preliminary   | CE-805      | 0                              | 0  | 8         | 4        | —                        | 80             | 120            | 200         |
| <b>Total</b>                             |                            |             |                                |    | <b>14</b> | <b>8</b> |                          |                |                |             |
| <b>Total contact hours per week = 14</b> |                            |             | <b>Total Credit = 08</b>       |    |           |          | <b>Total Marks = 400</b> |                |                |             |

(\* ) Summer training will be undergone by students after the completion of 2<sup>nd</sup> semester in summer vacation and evaluation of the report will be done in the next i.e. 3<sup>rd</sup> semester.

### SEMESTER – IV

| Sr. No.                                  | Course       | Course Code | Teaching Scheme Hours per Week |          |           | Credits   | Examination Scheme       |                |                |             |
|--|--------------|-------------|--------------------------------|----------|-----------|-----------|--------------------------|----------------|----------------|-------------|
|  |              |             | L                              | TU       | PR        |           | Theory Marks             | P/T (Internal) | P/T (External) | Total Marks |
|  |              |             |                                |          |           |           |                          |                |                |             |
| 1  | Dissertation | CE-802      | 0                              | 0        | 20        | 10        | —                        | 160            | 240            | 400         |
| <b>Total</b>                             |              |             | <b>0</b>                       | <b>0</b> | <b>20</b> | <b>10</b> |                          |                |                |             |
| <b>Total contact hours per week = 20</b> |              |             | <b>Total Credit = 10</b>       |          |           |           | <b>Total Marks = 400</b> |                |                |             |

**Summary:**

|                                  |                              |
|----------------------------------|------------------------------|
| <b>Total Contact hours /week</b> | <b>24 + 23 + 14 + 20 =81</b> |
| <b>Total Credit</b>              | <b>21 + 21 + 08+ 10 =60</b>  |

## SEMESTER – I

|  |          |          |          |          |
|--|----------|----------|----------|----------|
| <b>M. Tech. I (Civil) Environmental Engineering Semester – I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-601: ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY</b>          | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

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### **Environmental Chemistry (15 Hours)**

- **BASIC PRINCIPLES (05 Hours)**  
Physical and chemical properties of water and their significance in environmental engineering – Types of chemical reactions – stoichiometric calculations – solutions – chemical equilibrium. Acid-base equilibria – alkalinity, acidity, buffers and buffer index - Chemical thermodynamics – Oxidation–Reduction– Mass transfer and transport of impurities in water and air –diffusion, dispersion – Physical and chemical interactions due to various forces, suspensions and dispersions.
- **ANALYSIS (10 Hours)**  
Basic concepts of quantitative analytical chemistry – Instrumental methods of analysis – Determination of turbidity, colour, pH, acidity, alkalinity, hardness, residual chlorine and chlorine demand, chlorides, dissolved oxygen demand, nitrogen, solids, iron and manganese, fluoride, sulphate, phosphorous and phosphate, grease, volatile acids, gas analysis – Preparation of standard solutions – Drinking water and wastewater standards – Trace organics and inorganics

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### **Environmental Microbiology (30 hours)**

- **INTRODUCTION (12 Hours)**  
Microorganisms – Classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, Viruses, their detection and quantification – Microscopy – Measurements and Isolation of Microorganism – Different Cultures – Media and Techniques of Staining and Enumeration of microorganism
- **MICROBIAL METABOLISM AND GROWTH (06 Hours)**  
Enzyme and enzyme kinetics – Metabolism – Respiration – Fermentation – Glycolysis – Krebs cycle – Carbohydrate – Protein, lipids, significance of energetic – Chemical composition of cell and nature of organic matter used by microorganisms – Metabolic classification of microorganisms: phototrops, chemotrops, applications in environmental engineering.
- **MICROBIOLOGY OF WATER AND WASTEWATER (12 Hours)**  
Distribution of microorganisms in natural water – Indicator organisms – Coliforms – Faecal coliforms – *E.coli*, *Streptococcus faecalis* – Differentiation of coliforms – Significance – MPN – M.F. techniques – Microbiology of wastewater treatment processes such as activated sludge process – Trickling filter – Anaerobic processes. – Introduction to Microbiology of Soil and Air and Industrial Microbiology – Microbiology of bioremediation and solid waste treatment.

**(Total Contact Time: 45 Hours)**

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### **References**

1. Maier R.M, Pepper I.L and Gerba C.P. Environmental Microbiology, Elsevier– AP, New York 2009.
2. Pelczar Jr, M.J., Chan E.C.S., Krieg R.N., and Pelczar M.F, Microbiology, Tata McGraw–Hill, New Delhi, 1996.
3. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
4. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall , New Delhi.1996.
5. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw–Hill, New Delhi, 2000.

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| <b>M. Tech. I (Civil) Environmental Engineering, Semester – I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE–603 PHYSICO CHEMICAL PROCESSES</b>                          | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **SEDIMENTATION AND COAGULATION** **(10 Hours)**  
 Types of settling and their mathematical analysis – Coagulation: mechanism of coagulation – Colloid chemistry – Modeling coagulation process – Effect of turbidity and alkalinity – Chemistry of coagulants – Design of coagulation process.
  - **FLOW THROUGH BEDS OF SOLIDS** **(08 Hours)**  
 Type of filters – Modelling filtration process – Mechanism– Ion exchange units – Contacting towers – Flow through expanded beds – Flow through porous plates and membranes.
  - **GAS TRANSFER AND DISINFECTION** **(08 Hours)**  
 Mechanism of gas transfer – Film coefficients and equilibrium relationship – Gas disperses – Packed columns – Tray columns – Spray units – Applications in environmental engineering – Disinfection – Mechanism – Different agents.
  - **ADVANCED TREATMENT OPERATIONS** **(14 Hours)**  
 Adsorption – Isotherms – Advance Oxidation Process- Membrane processes – Reverse osmosis – Electro dialysis – Desalination – Softening – Ion exchange – Removal of specific chemical contaminants such as fluorides, arsenic, nitrates and organics.
  - **DESIGN CONCEPTS** **(05 Hours)**  
 Design concepts of Unit operations and processes in Water and Wastewater Treatment
- (Total Contact Time: 45 Hours)**

**References**

1. Benefield L.D. and Randall C.D., Biological Process Designs for Wastewater Treatment, Prentice Hall, New Delhi, 1980.
2. Metcalf and Eddy, Wastewater Engineering - Collection, Treatment, Disposal and Reuse, McGraw Hill, New Delhi 2003.
3. Udo Wiesmann, In Su Choi and Eva-Maria Dombrowski, Fundamentals of Biological Wastewater Treatment, Wiley, New York, 2007.
4. Weber W. Physicochemical Processes for Water Quality Control, Wiley–Interscience, New York, 1972.
5. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
6. Hendricks, D. 'Water Treatment Unit Processes – Physical and Chemical' CRC Press, New York 2006.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-605 BIOLOGICAL PROCESSES</b>                             | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

- **REACTORS AND REACTOR ANALYSIS** **(10 Hours)**  
 Reactions and reaction kinetics – Types of reactors and their analysis – Hydraulic characteristics of reactors.
  - **KINETICS OF BIOLOGICAL GROWTH** **(07 Hours)**  
 Nutrition and growth conditions – Effect of environmental conditions–Bacterial growth in terms of numbers and mass – Growth curve – Interpretation of curve – Substrate limited growth – Monod's expression – Substrate utilization and cell growth – Effect of Endogenous metabolism – Inhibition – Effect of temperature – Application of growth and substrate removal kinetics to biological treatment.
  - **AEROBIC PROCESSES** **(12 Hours)**  
 Suspended and attached growth systems – Modelling suspended growth – Activated sludge process – Types and their design concepts – Different attached growth systems and their design concepts. – Advanced Membrane Biological Processes
  - **ANAEROBIC TREATMENT PROCESSES** **(06 Hours)**  
 Microbiology – Different types – Design considerations of UASB and attached growth systems.
  - **NUTRIENT REMOVAL AND POND TREATMENT PROCESSES** **(06 Hours)**  
 Biological processes for nitrogen and phosphorus removal – Nitrification and Denitrification processes and their design concepts – Different pond treatment systems
  - **BIOLOGICAL PROCESSES FOR SLUDGE PROCESSING** **(04 Hours)**  
 Anaerobic and aerobic digestion
- (Total Contact Time: 45 Hours)**

#### References

1. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill, New Delhi, 2007.
2. Benefield L.D. and Randall C.W. Biological Process Design for Wastewater Treatment, Prentice Hall, New Delhi, 1980.
3. Schroeder E.D. , Water and Wastewater Treatment, 4<sup>th</sup> edition ,McGraw–Hill, New Delhi, 1997
4. Karia G.L. and Christian R.A. Wastewater Treatment: Concepts and Design Approach, Prentice Hall, New Delhi, 2013.
5. Hendricks, D. 'Water Treatment Unit Processes – Physical and Chemical' CRC Press, New York , 2006

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| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-607 APPLIED STATISTICS FOR ENGINEERS</b>                 | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

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- **INTRODUCTION** **(08 Hours)**  
 Graphical presentation of data: dot and scatter plots – Frequency distribution and histogram – Box plot and time plots – Numerical distribution of data: Measures of Central tendency – Dispersion – Skewness and kurtosis – Measuring association – Grouped data.
  - **SAMPLING DISTRIBUTIONS** **(10 Hours)**  
 Random variables and expectation – Discrete and continuous random variables – Sampling distributions – Important discrete distributions – Binomial – Poisson and geometric distributions – Normal distribution – Central limit theorem.
  - **PARAMETER ESTIMATION** **(05 Hours)**  
 Point estimation – Confidence interval estimation.
  - **TESTS OF HYPOTHESIS** **(08 Hours)**  
 Tests of hypothesis on single sample and two samples – Goodness of fit – Tests based on Normal – t – Chi-square – F distributions.
  - **SIMPLE LINEAR REGRESSION AND CORRELATION** **(05 Hours)**  
 One way and two way classification
  - **DESIGN OF EXPERIMENTS** **(09 Hours)**  
 Completely randomized single factor experiment – Analysis of variance – Randomized block design – Latin square design –  $2^2$  factorial design.
- (Total Contact Time: 45Hours)**
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#### References

1. Box G.E.P, Hunter J.S. and Hunter W.G. Statistics for Experimenters, John Wiley and Sons, 2005
2. Berthouex P.M and Brown L.C. Statistics for Environmental Engineers, CRC Press, 2002.
3. Freund J.E. and Miller I.R., Probability and Statistics for Engineers, Prentice-Hall of India, 1994.
4. Walpole R.E. Myers R.H., Myers S.L. and Ye K. Probability and Statistics for Engineers and Scientists, Pearson Education, New Delhi, 2002.
5. Dallan E Johnson, Applied multivariate methods for data analysis, Thomson & Duxbburg Press, Singapore, 2002

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| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-609 ENVIRONMENTAL ENGINEERING LABORATORY</b>             | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

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- **CHEMISTRY PRACTICAL** **(30 Hours)**
  1. Determination of Physical characteristics of water (pH, Turbidity, electrical conductivity, Solids)
  2. Determination of Total Hardness, Calcium Hardness, Magnesium Hardness of water sample
  3. Determination of Chlorides, Nitrates, Phosphate and Sulphate of water sample.
  4. Determination of Residual chlorine of water sample
  5. Study of Jar test for different coagulant dose.
  6. Determination of physical characteristics of waste water (pH, Turbidity, colour, solids, temp.)
  7. Determination of DO, BOD and COD of waste water sample
  8. Determination of oil and grease of waste water sample
  9. Determination of Nitates and Sulphates of waste water sample
  10. Determination of Heavy metals from industrial waste
  
- **MICROBIOLOGY PRACTICAL** **(30 Hours)**
  1. Study of Compound and Phase Microscope.
  2. Study of staining technique.
  3. Study of isolation techniques for bacteria.
  4. Determination of Residual chlorine of water sample.
  5. Study of MPN test and multiple tube technique.
  6. Application of Plate count method for bacterial growth.
  7. Effects of pH on growth of bacteria.
  8. Effects of Osmotic Pressure on growth of bacteria.

**(Total Contact Time: 60 Hours)**

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### References

1. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
2. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall, New Delhi, 1980.
3. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw-Hill, 2000.
4. De. A.K., "Environmental Chemistry", New Age International Ltd., New Delhi, 1995.
5. Standards Methods for the Examination of Water & Waste water", American Public health Association, Washington. D.C. 2005.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-611 SEMINAR - I</b>                                      | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

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Each candidate is required to present one seminar on any chosen topic connected with the field of specialization. The topic shall be chosen in consultation with the concerned faculty. Preparation and Presentation of a seminar is intended to investigate an in-depth review of literature; to prepare a critical review and to develop confidence for making a good presentation. Assessment is based on the presentation and contents of the seminar report prepared. A report has to be submitted in the prescribed format and seminar shall be evaluated by the respective department committee.

Expert Lectures can be arranged from various Environmental Consultants so that can student can get the exposure to field related problem

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## ELECTIVE – I

|  |          |          |          |          |
|--|----------|----------|----------|----------|
| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-613 ENVIRONMENTAL ETHICS, LAW AND POLICY</b>             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

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- **CURRENT PERSPECTIVES OF ENVIRONMENTAL PROTECTION (09 Hours)**  
Present perspectives on practical environmental issues; – Current practices of environmental solutions through engineering, technology, legislation etc; – Need for environmental ethics in today's scenario; – Introduction to Environmental Ethics; – Pollution – The scientific vs. philosophical view;
  
- **ETHICS vs. LAW, POLICY & MANAGEMENT (12 Hours)**  
Moral Psychology, the environment and ethics; – Religious and cultural views; – Ethics and policy, ethics and management, ethics and law; – Important Indian environmental legislation and acts such as Water Act-1974, Air Act-1981; – Important rules under Environment Protection Act (EPA) – 1986 such as Biomedical Waste Rules-1998, EIA Rules-1994, Coastal Regulation Zone-1999, Municipal Solid waste rules, Hazardous Waste Rules-2008 etc.
  
- **INTERNATIONAL ISSUES AND ETHICS & LAWS (14 Hours)**  
Solution of international global and local issues through environmental ethics; – Ethics & Social Responsibility; – Global Ecology and the Shadow of Development; – The Global Ecological Crisis; – Holistic Environmental Ethics; – Towards Global Justice and Planetary Health  
  
International environmental laws and protocols such as Stockholm Conference, Montreal Protocol, Rio Earth Summit, Kyoto Summit; – Role of UN authorities in protection of global environment; – Global environmental issues and environmental laws to control global warming, ozone depletion, acid rain, hazardous waste;
  
- **ENVIRONMENTAL POLICY (10 Hours)**  
National Environmental policy; – Environmental guidelines and regulations; – Environmental auditing, monitoring and reporting, environmental labeling studies by Central / State bodies; – Theory of corporate strategies; – Beyond environmentalism and sustainability issues

**(Total Contact Time: 45 Hours)**

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### References

1. Gurdip Singh, Environmental law in India, Macmillan India, New Delhi. 2005
2. Thakur Kailash, Environmental protection law and policy in India, Deep and Deep publishers. Simla, 2007.
3. Ministry of Environment and forest, Government of India Environmental Impact Assessment Notification, New Delhi, 2006.
4. Holmes Rolston, A New Environmental Ethics: The Next Millennium for Life on Earth, Routledge 2011
5. Paul Pojman & Louis P. Pojman, Environmental Ethics, Cengage Learning 2011.

| M. Tech (Civil) Environmental Engineering, Semester - I | L        | T        | P        | C        |
|---|----------|----------|----------|----------|
| <b>CE-615 ENVIRONMENTAL HEALTH AND RISK MANAGEMENT</b>  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **INTRODUCTION** **(12 Hours)**  
 Dimensions of environmental health – Causative agents of diseases – Social factors – Urban problems – Housing and health – Economy and health – Climate and other atmospheric elements – Violence – Chronic and communicable diseases – Occupational health – Epidemiological data – Occupational health hazards – Environmental exposure and diseases – industrial toxicants – Ergonomics – Controlling stress of life.
- **ASSESSMENT ENVIRONMENT HEALTH** **(09 Hours)**  
 Epidemiology – Out break Epidemiology – Disease control – disease prevention – morbidity and mortality – Foodborne and waterborne diseases outbreaks – Integrated Approach to Health and Sanitation.
- **ELEMENTS OF ENVIRONMENTAL RISK ASSESSMENT** **(12 Hours)**  
 Hazard identification and accounting – Fate and Behaviour of toxics and persistent substances in the environment – Receptor exposure to Environmental Contaminants – Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope Factors – Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination – Vulnerability assessment – Uncertainty analysis – Event tree and fault tree modelling and analysis.
- **TOOLS FOR RISK MANAGEMENT** **(12 Hours)**  
 HAZOP and FEMA methods – Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Design of risk management programs – Case studies on risk assessment and management programme.

**(Total Contact Time: 45 Hours)**

**References**

- 1 Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kofi Asante Duah, "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
3. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
4. Mark Burman, Risks and Decisions for Conservation and environmental management, Cambridge University Press. London
5. Susan L Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi, 1999.
6. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis Fundamentals with applications, Prentice Hall, New Jersey, 1997.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - I</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-617 ENVIRONMENTAL HYDRAULICS</b>                         | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **FUNDAMENTALS** **(05 Hours)**  
Basic equations for fluid flow analyses including Reynolds transport theorem – Basic concepts of flow through pipes.
- **WATER DISTRIBUTION SYSTEM DESIGN** **(10 Hours)**  
General design requirements – Methods of analyses – Control of water hammer in long distance transmission. – Introduction to optimization of water distribution system.
- **URBAN STORM DRAINAGE DESIGN** **(10 Hours)**  
Introduction to drainage problems in difficult climates. – Planning concepts, Rainfall intensity-duration – Frequency curves. – Design of drainage system elements, – Control of storm water pollution.
- **SEWERAGE SYSTEM DESIGN :** **(10 Hours)**  
General design principles of sewers, Recent Development in sewerage system design. – Application of Software
- **GROUND WATER DEVELOPMENT** **(10 Hours)**  
Well development – Artificial recharge – Salinity of Ground water – Ground water pollution – Infiltration Galleries.

**(Total Contact Time: 45 Hours)**

### References

1. Chow V.T., Flow through open channel, McGraw–Hill Book Company, International editions, New Delhi.1973.
2. Ranga Raju K.G., Flow through Open Channels, Tata McGraw–Hill, New Delhi,1997.
3. Bhave P.R, Analysis of Flow in Water Distribution Network, Technomic Publishing Co., Lancaster, USA, 1996.
4. Bear, Jacob. Hydraulics of ground water, McGraw Hill Inc.1979.
5. Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
6. Manual on Sewerage and Sewage Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

| M. Tech (Civil) Environmental Engineering, Semester - I | L        | T        | P        | C        |
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| <b>CE-619 SUSTAINABLE WASTE MANAGEMENT SYSTEM</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **INTRODUCTION** **(06 Hours)**  
Concept of sustainability in water and waste management – Environmental indices-Bio remediation
- **WATER CONSERVATION** **(12 Hours)**  
Rainwater Harvesting – Roof water harvesting – Technology – Quality – Health issues – Groundwater recharge – Techniques – Case studies – Wastewater reuse and reclamation.
- **NATURAL WASTEWATER TREATMENT SYSTEMS** **(10 Hours)**  
Centralized Vs decentralized – Natural and constructed wetlands – Different types – Mechanisms – Performance – Design – Case studies – Land treatment systems.
- **LOW-COST SANITATION** **(08 Hours)**  
Dry sanitation methods – Pit latrines – VIP latrines – Aquaprivy – Septic tank
- **ORGANIC SOLID WASTE MANAGEMENT TECHNIQUES** **(09 Hours)**  
Composting/vermicomposting – Biogas technology – Plasma technology.

**(Total Contact Time: 45 Hours)**

#### References

1. Cites R.W., Middlebrooks E.J., Reed S.C., Natural wastewater Treatment Systems, CRC Taylor and Francis, 2006.
2. Cairncross S., Feachem R. Environmental Health Engineering in the Tropics; John Wiley & Sons 1993.
3. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Simla, 2003.
4. White, I.D, Mottershed, D.N and Harrison, S.L., Environmental Systems – An Introductory Text, Chapman Hall, London, 1994.
5. Martin, A.M., Biological Degradation of Wastes, Elsevier Appl. Science, New York, 1991.

| M. Tech (Civil) Environmental Engineering, Semester - I       | L        | T        | P        | C        |
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| <b>CE-621 GLOBAL CLIMATIC CHANGES AND DISASTER MANAGEMENT</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **BASICS OF CLIMATE CHANGE STUDY** **(12 Hours)**  
 Climate, weather and Climate Change; – Overview of Earth's Atmosphere; Layers of Atmosphere; – Temperature, Radiation and Variation; – Heat- Balance of Earth Atmosphere System; – Temporal Variation of Air temperature; – Temperature Change in Soil; – Thermal Time and Temperature Extremes, – Hydrologic cycle. – Climate Variability like Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes Causes of Climate Change; – Modelling of Climate Change, Kyoto Protocol Montreal protocol and IPCC Scenarios, difference between climate change and climate variability Carbon trading and clean development mechanism Role of countries and citizens in containing in global warming
- **INTRODUCTION TO DISASTER** **(09 Hours)**  
 Overview of disaster, major natural disasters – flood, tropical cyclone, droughts, landslides, heat waves, earthquakes, fire hazards, tsunami, etc. – Factors for disaster – climatic change and global sea rise, erosion, environmental degradation, large dams and earthquakes, road building and landslides, Chemical and Biological weapons – case studies.
- **DISASTER MANAGEMENT AND ITS MITIGATION** **(12 Hours)**  
 Techniques of monitoring and design against the disasters. – Management issues related to disaster; – Mitigation through capacity building, legislative responsibilities of disaster management; – Disaster mapping, assessment, pre-disaster risk and vulnerability reduction, post disaster recovery and rehabilitation; disaster related infrastructure development. – Disaster management plan, national crisis management committee, state crisis management group.
- **EMERGENCY WATER SUPPLY AND SANITATION** **(12 Hours)**  
 Water supply preparedness and protection, emergency water supply strategy, rural and urban emergencies. – Assessment of damage. – Emergency water supply schemes – Sources, quality, treatment, storage and distribution, operation and maintenance. Sanitation – Human waste and health, strategy for excreta disposal in emergencies, techniques for excreta disposal, disposal of wastewater, management of refuse.

**(Total Contact Time: 45 Hours)**

#### References

1. Alexander D, Principles of emergency planning and management, Oxford University Press, 2002.
2. Hallow G. and Bullock J. Introduction to Emergency Management: Elsevier, 2002.
3. Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.
4. Jepma, C.J., and Munasinghe, M., Climate Change Policy - Facts, Issues and Analysis, Cambridge University Press, 1998.
5. R.B. Singh, Disaster Management, Rawat Publication, New Delhi, 2000
6. H.K. Gupta, Disaster Management, Universiters Press, India, 2003
7. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001

## SEMESTER – II

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-602 SOLID AND HAZARDOUS WASTE MANAGEMENT</b>              | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

- **INTRODUCTION (05 Hours)**  
Solid waste sources – Nature and characteristics – Quantities and Qualities – Generation rates – Potential of disease – Nuisance and other problems.
- **COLLECTION AND STORAGE (10 Hours)**  
Solid waste management – Functional elements of solid waste–on–site storage –Collection and separation – Containers and its location – Collection systems and its example – physical , chemical and microbiological characteristics of waste – Vehicle routing – Route balance – Transfer station – Processing – Recovery and reuse.
- **PROCESSING OF MUNICIPAL SOLID WASTE (10 Hours)**  
Conveying and compacting waste – Shredding – Types of shredders – Shredders Design– Material separation – Types – Devices for material separation – Thermal processing of municipal solid waste – incinerator and pyrolysis – Refuse Drived fuel – Biological process like composting , vermi composting and biomethanation
- **DISPOSAL (08 Hours)**  
Disposal methods – Sanitary land filling – Planning – Site selection – Design – Landfill Process – Monitoring Closure – Post closure monitoring – Other methods like incineration, pyrolysis, and composting, biological digestion.
- **HAZARDOUS WASTE MANAGEMENT (12 Hours)**  
Introduction to hazardous waste – Definition – Characterization and composition – TCLP test – Storage and transportation of hazardous waste – Labeling of hazardous waste – Physical, Chemical and Biological treatment of hazardous waste – Bioremediation of hazardous waste – Treatment of Bio medical – Nuclear waste and Radio – Active waste – Fly ash management and E-waste management

**(Total Contact Time: 45 Hours)**

### References

1. David Rimbers, Municipal Solid Waste Management: Pollution Technologies Review, Noyes Data Corporation, London. 1990.
2. Charles A. Wentz, Hazardous Waste Management, McGraw Hill, New York. 1995.
3. Tchobanoglous G., Solid Wastes: Engineering principles and Management issues, McGraw Hill Book Company, Delhi. 1977.
4. Michael D. Lagrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous Waste Management McGraw Hill, New York. 1994
5. Gaynor W. Dawson, Basil W. Mercer, "Hazardous Waste Management" Wiley Interscience, New York. 1986
6. Solid Waste Management –CPHEEO Manual, New Delhi, 2006

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-604 ENVIRONMENT IMPACT ASSESSMENT</b>                     | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

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- **EIA: INTRODUCTION AND PLANNING** **(15 Hours)**  
 Evolution of EIA – EIA at project – Regional and policy levels – EIA legislative and Environmental clearance procedures in India – EIA methodologies – Screening and scoping criteria – Rapid and Comprehensive EIA – Environmental health impact assessment – Significance of public participation / hearing in EIA – Resettlement and rehabilitation issues.
  - **EIA: METHODOLOGIES AND STRATEGIES** **(20 Hours)**  
 Baseline collection of data – Significant impacts – Assessment of impacts of physical, biological and socio – economic environment – Impact prediction tools / techniques such as Adhoc method, checklist method etc – Development of environment management plan – Post project monitoring – EIA report and EIS – Review process – EIA case studies / histories for industrial projects – water resources and irrigation projects – ports and harbours – mining – transportation and other projects sectors.
  - **ENVIRONMENTAL MANAGEMENT** **(10 Hours)**  
 Environmental Management plan – Disaster Management – Post project monitoring – Environmental Audit – Life cycle assessment – ISO –14000.
- (Total Contact Time: 45 Hours)**
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#### References

1. Larry W. Canter, "Environmental Impact Assessment", Tata Mcgraw Hill Co, Singapore, 1996.
2. Munn R.E., "Environmental Impact Assessment", John Wiley & Sons, Toronto, 1979
3. Suresh K. Dhameja, "Environmental Engineering and Management", S. K. Kataria & Sons, Delhi. 2004.
4. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules. New Delhi, 2006.
5. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, New York, 1997.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-606 INDUSTRIAL WASTE MANAGEMENT</b>                       | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

- **INTRODUCTION** **(05 Hours)**  
 Sources of wastes – Industrial and domestic – Nature and characteristics of wastewater – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Toxicity of industrial effluents and Bioassay tests – Quality and quantity of industrial wastes.
- **INDUSTRIAL POLLUTION PREVENTION** **(10 Hours)**  
 Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Waste minimization – Source reduction – Techniques – Waste Audit – Mass balance – Evaluation of pollution prevention options – waste volume reduction – Waste strength reduction – Neutralization – Removal of suspended and colloidal solids – Removal of inorganic and dissolved solids – Disposal of sludge solids.
- **WASTEWATER REUSE AND RESIDUAL MANAGEMENT** **(10 Hours)**  
 Individual and common effluent treatment plants – Zero effluent discharge systems – Wastewater quality requirements for its reuse – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and sludge disposal.
- **CASE STUDIES** **(20 Hours)**  
 Industrial manufacturing process description– Wastewater characteristics– Source reduction options and waste treatment flow sheet for Textiles, Tanneries, Pulp and paper, metal finishing, Petroleum Refining, Pharmaceuticals, Sugar and Distilleries, Food Processing, fertilizers, Thermal Power Plants and Industrial Estates.

**(Total Contact Time: 45 Hours)**

**References**

1. Frank Woodard, Industrial Waste Treatment Handbook, Butterworth–Heinemann, 2001.
2. Rao M.N. and Datta A.K., Wastewater Treatment, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Nemerow N.L., Industrial Waste Treatment, Elsevier Science & Technology Books, 2006.
4. Eckenfelder- "Industrial Water pollution Control"- McGraw hill Company, New Delhi, 2001.
5. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001.

| M. Tech (Civil) Environmental Engineering, Semester - II | L        | T        | P        | C        |
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| <b>CE-608 AIR POLLUTION AND CONTROL</b>                  | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

- **AIR QUALITY AND STANDARDS (09 Hours)**  
 Air Pollution – Definition – Sources and classification – Pollutant emission – Its effect on Health, vegetation, materials and atmosphere – Reactions of pollutants and their effects – Smoke–smog and ozone layer disturbance – Greenhouse effect – Ambient air and stack sampling – pollutant measurement methods– Principles and instruments – Air quality standards – Air pollution case studies.
  - **AIR POLLUTION METEOROLOGY AND DIFFUSION/DISPERSION MODELS (15 Hours)**  
 An introduction to air pollution meteorology – Atmospheric motion – Lapse rates – Atmospheric stability – Inversions and its effects on pollutants – Atmospheric diffusion of pollutants – Transport – Transformation and deposition of air contaminants – Removal processes– Maximum Mixing Depths – Plume rise – Types of dispersion models.
  - **AIR POLLUTION CONTROL TECHNOLOGY (03 Hours)**  
 Air pollution control principles – Control of particulate and gaseous emissions.
  - **PARTICULATE CONTROL (08 Hours)**  
 Settling chambers, cyclone separation – Wet collectors – Fabric filters, electrostatic precipitators and other removal methods like absorption – Adsorption and precipitation.
  - **GASEOUS CONTROL (05 Hours)**  
 Removal of gaseous pollutants by adsorption, absorption, reactions and other methods.
  - **AUTOMOBILE POLLUTION (05 Hours)**  
 Motor vehicle emissions – Combustion – Air fuel ratio – Emissions, engine modification for emission control – Catalytic converters.
- (Total Contact Time: 45 Hours)**

**References**

1. Wark Kenneth and Warner C.F., Air pollution its origin and control. Harper and Row Publishers, New York, 1997.
2. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New Delhi, 1995.
3. De Nevers H. Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
4. Griffin R.D., Principles of Air Quality Management. CRC Press Boca Raton, USA, 2000.
5. Richard W. Boubel , Fundamentals of Air pollution, Academic Press, New York, 1994.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-612 ADVANCE ENVIRONMENTAL ENGINEERING<br/>LABORATORY</b>  | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

### **Practical**

1. Determination of optimum dosage of coagulants with Coagulation and flocculation Process
2. Determination of BOD rate constant
3. Filtration Performance Studies
4. Adsorption kinetics and equilibrium
5. Settling characteristics of solids
6. Removal of heavy metals by precipitation
7. pH Buffers and Buffering capacity
8. Study of Wastewater Disinfection
9. Study of Water Softening Process
10. Aeration and Coefficient of Aeration
11. Determination of MLSS and MLVSS
12. Study of Activated sludge Process
13. Analysis of solid wastes
14. Characterization of wastes from different industries
15. Study of Stack monitoring kit
16. Measurement of SPM, SO<sub>x</sub> and NO<sub>x</sub>

**(Total Contact Time: 60 Hours)**

### **REFERENCE**

1. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
2. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw-Hill, 2000.
3. De. A.K., "Environmental Chemistry", New Age International Ltd., New Delhi, 1995.
4. Standards Methods for the Examination of Water & Waste water", American Public health Association, Washington. D.C. 2005.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-614 SEMINAR – II</b>                                      | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

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Each candidate is required to present one seminar on any chosen topic connected with the field of specialization. The topic shall be chosen in consultation with the concerned faculty. Preparation and Presentation of a seminar is intended to investigate an in–depth review of literature; to prepare a critical review and to develop confidence for making a good presentation. Assessment is based on the presentation and contents of the seminar report prepared. A report has to be submitted in the prescribed format and seminar shall be evaluated by the respective department committee.

Expert Lectures can be arranged from various Environmental Consultants so that can student can get the exposure to field related problem

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## ELECTIVE – II

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-616 ENVIRONMENTAL SYSTEMS MODELLING</b>                   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

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- **INTRODUCTION** **(10 Hours)**  
Mathematical modelling and simulation – Defining systems and its components – Types of models and their applications – Evaluation of models – Graphical analysis – Quantitative analysis – Sensitivity analysis – Uncertainty analysis.
  
- **MODELS FOR TRANSPORT AND FATE OF CONTAMINANTS** **(25 Hours)**  
Mass and energy balance – Advection – Molecular diffusion – Dispersion – Their application in modelling of rivers-lakes, sediments, wetlands, subsurface flow and transport – Air pollution modelling.  
  
Modelling of volatilization, Chemical transformations, sorption/desorption, Photochemical transformations and Biological transformations.  
  
Models for activated sludge process – Anaerobic processes – Aquasim – Ginfat.
  
- **INTRODUCTION TO SOFT COMPUTING TECHNIQUES** **(10 Hours)**  
Analytic hierarchy process – Fuzzy set theory, Neural networks, Simple applications in environmental engineering.

**(Total Contact Time: 45 Hours)**

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### References

1. Ramaswami A., Milford J.B., Small M.J., Integrated Environmental Modeling – Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons, 2005.
2. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, 1998.
3. Snape J.B., Dunn I.J., Ingham J. and Prenosil J., Dynamics of environmental bioprocesses, modelling and simulation Weinheim: VCH, 1995.
4. International Water Association – Activated sludge modelling ASM1 and ASM2
5. Chapra S.C., Surface Water Quality Modeling, McGraw-Hill, Inc., New York, 1997.

| M. Tech (Civil) Environmental Engineering, Semester - II     | L        | T        | P        | C        |
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| <b>CE-618 ADVANCED WATER AND WASTEWATER TREATMENT SYSTEM</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **WATER SUPPLY AND WASTEWATER COLLECTION SYSTEM (15 Hours)**  
 Environmental engineering hydraulic design – Water distribution systems – Design of distribution systems – Hydraulic analysis – Distribution system components – Wastewater collection – Types of collection systems – Types of sewers – Design of urban sanitary and storm water sewers – Structural requirements of sewer under various conditions – Corrosion protection in sewers – Design of surface and subsurface drainage – Roadways and airport drainage – Design of water and wastewater pumping systems.
  
  - **WATER TREATMENT SYSTEMS (15 Hours)**  
 Design of intake structure – Detailed design of water treatment plant – Design of physicochemical unit operations – Screening – Grit – Removal equalization – Sedimentation – Flotation – Coagulation – Flocculation – Filtration – Disinfection – Membrane processes– Desalination – Ion–exchange – Aeration/gas transfer – Precipitation – Adsorption.

Hydraulics of treatment plant – Flow measurement and hydraulic control points – Hydraulic analysis of unit operations – Hydraulic profile through the treatment plant.
  
  - **DESIGN OF WASTEWATER TREATMENT SYSTEMS (15 Hours)**  
 Design of screens – Grit chamber – Skimming tank – Flotation tank – Design of equalization tank – Design of plug flow and complete mix activated sludge process – Secondary settling tank – Trickling filter – Bio tower, Rotating biological contactors – Sequencing batch reactor – oxidation ditch – Aerated lagoon.

Design of oxidation ponds – Inhoff tank – Septic tank – Design of sludge digestion – Sludge thickening unit – Sludge trying bed – Incinerators – Design of anaerobic reactor – Design of anaerobic filter – UASB reactor – Design of disposal system.
- (Total Contact Time: 45 Hours)**

## References

1. Qasim S.R., Motley E.M. and Zhu G., Water Works Engineering, Prentice–Hall India, 2006.
2. Montgomery – Water Treatment Principles and Design, John Wiley and Sons.
3. Metcalf and Eddy Inc – Wastewater Engineering: Treatment, and Reuse, Tata McGraw Hill, 2007.
4. Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
5. Manual on Sewerage and Sewage Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-622 INDUSTRIAL SAFETY AND ENVIRONMENT</b>                 | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

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- **INTRODUCTION TO SAFETY STANDARDS** **(07 Hours)**  
 Safety – Safety and Productivity – Role of Government – National Safety Council – Standards – ILO Model code of safety regulation / legislation – Factory Act – Boiler Act – Electricity Act – Workman’s compensation act
  - **PLANNING FOR SAFETY** **(05 Hours)**  
 Purpose for planning – planning procedure – Range of plans – Safety policies – Elements of safety policy – Implementation
  - **ACCIDENT AND INCIDENT INVESTIGATION** **(06 Hours)**  
 Reporting and Analysis – Accident and Incident Investigation – Identifying the key factors and the immediate and basic causes. Corrective Action – Agencies investigating accident. Accident reporting: Report forms, writing reports, essential elements. Accident and Incident Analysis Standard classification of factors associated with accident – Record keeping.
  - **PERSONAL PROTECTIVE EQUIPMENT** **(03 Hours)**  
 Need for personal protection equipment – selection, applicable standards, supply, use, care & maintenance respiratory and non-respiratory personal protective equipment. – Classification and selection
  - **OCCUPATIONAL HEALTH AND ERGONOMICS** **(12 Hours)**  
 Ergonomics – Human-body – Health – Posture – Workplace or office ergonomics – Ergonomics for women at work – physical work and environment – Anthropometry – Work related stress – Causes of stress – Signs of stress – Measurement of stress – Stress management systems – Prevention – Stress health and productivity – Occupational safety and health Act – Health program – First Aid
  - **SAFETY IN CHEMICAL INDUSTRY** **(06 Hours)**  
 U.N Classification of Hazardous materials – Criteria for siting and layout of Chemical and Petrochemical Plants. Instrumentation for safe plant operations – Hazards in Unit Processes and Unit Operations, Control, precautions and prevention, specific safety measures for certain chemical industry like fertiliser, insecticide, pesticides-choler-alkali, explosives, polymer plants. pharmaceuticals, petro-chemical.
  - **TRANSPORTATION OF HAZARDOUS MATERIALS** **(02 Hours)**  
 Safety Precautions for transporting hazardous, toxic, flammable, explosive, radioactive substances by all modes.
  - **FIRE ENGINEERING** **(04 Hours)**  
 Chemistry of fire – Factors contributing towards fire – Classification of fires – Common causes of industrial fires – Determination of fire load – Design of building exists, etc. for fire safety – Fire resistance of building materials Prevention of fire – Portable extinguishers – Hydrant system, sprinkler system, introduction to Carbon-dioxide systems – Foam extinguisher system – Dry Chemical Extinguishing systems Halon replacement of fire fighting products – Fire detection and alarms system.
- (Total Contact Time: 45 Hours)**
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**References**

1. Anupama Prashar & Bansal, “Industrial Safety and Environment”, S.K. Kataria & sons, New Delhi, 2005.
2. Agrawal S. K. “Industrial Environment Assessment and Strategy”, APH Publishing Corporation, New Delhi, 1996.
3. Safety- Health and working conditions: Training Manual, National Safety Council, Mumbai, 2000.
4. Suresh K. Dhameja, “Environmental Engineering and Management”, S. K. Kataria & Sons, New Delhi. 2004.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b>                       | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-624 APPLICATIONS OF GIS AND REMOTE SENSING<br/>IN ENVIRONMENTAL ENGINEERING</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **INTRODUCTION (04 Hours)**  
Introduction to GIS and Remote Sensing – Usefulness in Environmental Engineering
- **FUNDAMENTAL OF REMOTE SENSING AND ELECTRO MAGNETIC RADIATION(EMR) (06 Hours)**  
Definition – Components of Remote Sensing – Principles of Remote Sensing Energy Sources – Active and Passive Remote Sensing – Electro Magnetic Radiation (EMR) and the Electromagnetic Spectrum – Interaction of EMR With the Earth’s Surface – Interactions with the Atmosphere
- **IMAGE INTERPRETATION AND DIGITAL IMAGE PROCESSING (07 Hours)**  
Interpretation Procedure – Strategies – Keys – Equipments – Digital Image Processing – Rectification and Restoration – Enhancement of Image – Image Transformation, Classification and Analysis
- **GEOGRAPHIC INFORMATION SYSTEM (07 Hours)**  
Components of GIS – GIS Data – Georeferenced data – Data input and output – Data Models – DBMS
- **SPATIAL DATA ANALYSIS (07 Hours)**  
GIS analysis functions – Retrieval – Reclassification -- Buffering and Neighbourhood – Overlaying – Data Output – Implementation of GIS
- **SOFTWARE (07 Hours)**  
GIS and Image interpretation Software – Salient features – Capabilities and Limitations
- **APPLICATIONS (07 Hours)**  
Application of Remote Sensing / GIS in Environmental Engineering – Case studies – Integration of GIS and Remote Sensing – Management and Monitoring of land, air, water pollution – conservation of resources and coastal zone management

**(Total Contact Time: 45 Hours)**

**References**

1. Lilliesand T.M. and Kiefer R.W., Remote Sensing and image Interpretation , John Wiley and Sons, 1994.
2. Burrrough P.A and McDonnel R.A., Principles of Geographic Information Systems, Oxford university press, 1998
3. A.M. Chandra and S.K. Ghosh, Remote Sensing and Geographical information System, Narosa Publishing House, New Delhi, 2006
4. Bhatta B., Remote Sensing and GIS, Oxford University Press, New Delhi, 2008
5. Stan Aronoff, “Geographical Information Systems”, WDL Publications, Ottawa, Canada, 1989.

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| <b>M. Tech (Civil) Environmental Engineering, Semester - II</b>           | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>CE-626 CLEANER PRODUCTION AND ENVIRONMENTAL SUSTAINABLE MANAGEMENT</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

- **ENVIRONMENT AND SUSTAINABLE MANAGEMENT (08 Hours)**  
 Concepts of Sustainable Development – Indicators of Sustainability – Sustainability Strategies, Barriers to Sustainability – Resource degradation – Industrialization and Sustainable development – Socio economic policies for sustainable development
- **CLEANER PRODUCTION (08 Hours)**  
 Clean development mechanism, cleaner Production (CP) in Achieving Sustainability – Principles and concepts of Cleaner Production – Role of Industry, Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-Based Approaches
- **ENVIRONMENTAL MANAGEMENT SYSTEM IN INDUSTRY (12 Hours)**  
 Source Reduction Techniques – Process and equipment optimization, reuse, recovery, recycle, raw material substitution – Preparing for the Site visits – Data and Information collection –Process Flow Diagram – Material Balance – CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement – Green house gases and carbon credit – Carbon sequestration – Sustainable development through trade – carbon trading.
- **ENVIRONMENTAL MANAGEMENT TECHNIQUES (12 Hours)**  
 Elements of Life Cycle Assessment (LCA) – Life Cycle Costing – Eco Labeling – Design for the Environment – International Environmental Standards – ISO 14001 – Environmental audit, Green building & green energy concepts and management – Industrial applications of CP, LCA, EMS and Environmental Audits – Green energy and green process management in Pharmaceutical, Construction, Textiles, Petroleum Refineries, Iron and Steel
- **ENVIRONMENTAL ECONOMICS (05 Hours)**  
 Introduction – economic tools for evaluation – Economic development and social welfare consideration in socio economic developmental policies and planning.

**(Total Contact Time: 45 Hours)**

**References**

1. Paul L Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill International New York, 2000.
2. World Bank Group, Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank and UNEP, Washington D.C, 1998
3. Prasad Modak, C.Visvanathan and Mandar Parasnis ,Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok.1995
4. Kirkby, J., O' Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London, 1996.
5. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
6. Bowers, J., Sustainability and Environmental Economics – an alternative text, Longman, London, 1997.

### **SEMESTER – III**

| <b>M. Tech. II (Civil) Environmental Engineering Semester – III</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---|----------|----------|----------|----------|
| <b>CE–801 Summer Training</b>                                       | <b>0</b> | <b>0</b> | <b>0</b> | <b>1</b> |

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The intention of summer training is to develop the effective skills of the student and to expose them with actual problems faced in the industry. The students have to undergo the summer training during the period of summer vacation after completion of first year. The minimum duration of training is at least 6 weeks.

Students are desire to identify a suitable industry /consultant firm with consultation with the faculty advisor. The students are required to identify a real time problem in the industry and come up with the possible solution or the strength and weakness of the methods.

The student has to submit the training report with the certificate of the industry where the training/practical/experimental work has been carried out. The evaluation of the report will be carried out by the department level committee chaired by PG in charge, coordinator of industrial training and other faculty member of the department.

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| <b>M. Tech. II (Civil) Environmental Engineering Semester – III</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---|----------|----------|----------|----------|
| <b>CE–803 Project</b>   | <b>0</b> | <b>0</b> | <b>6</b> | <b>3</b> |

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The faculty adviser will decide a specific problem and the students are required to study and analyse the assigned problem. They are required to submit a project report in consultation with faculty adviser. Project will be internally assessed by the faculty adviser and the department committee.

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| <b>M. Tech. II (Civil) Environmental Engineering Semester – III</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---|----------|----------|----------|----------|
| <b>CE–805 DISSERTATION PRELIMINARY</b>                              | <b>0</b> | <b>0</b> | <b>8</b> | <b>4</b> |

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It will be taken up by the student at the end of the second semester and the duration would be six months. This is aimed at training the students to analyze independently any problem posed to them. The work may be analytical, experimental, design or combination of these.

The dissertation Preliminary report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and /or experimental or design skill.

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## **SEMESTER – IV**

|  |          |          |           |           |
|--|----------|----------|-----------|-----------|
| <b>M. Tech. II (Civil in Environmental Engineering), Semester – IV</b> | <b>L</b> | <b>T</b> | <b>P</b>  | <b>C</b>  |
| <b>CE–802 DISSERTATION</b>   | <b>0</b> | <b>0</b> | <b>20</b> | <b>10</b> |

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It is the continuation of the dissertation Preliminary. The Dissertation report is to be submitted at the end of the fourth semester. The evaluation of dissertation will be based on continuous internal assessment comprising presentation of the work proceed and external viva –voce examination.

The main objective of dissertation work is to provide scope for original and independent study/research, to develop a theme and to demonstrate ability of using analytical approach independently. The theme or topic of dissertation should be within the framework of P.G. Programme.

Thesis is prepared by each student under the supervision of the faculty advisor and to be submitted as per the specified time and the student has to defend his/her work at the viva-voce examination fixed by the Institute.

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