

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**R - 2013**

**B. E. ENVIRONMENTAL ENGINEERING**  
**I TO VIII SEMESTERS CURRICULUM & SYLLABUS**  
**SEMESTER I**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	HS6151	Technical English - I	3	1	0	4
2.	MA6151	Mathematics – I	3	1	0	4
3.	PH6151	Engineering Physics – I	3	0	0	3
4.	CY6151	Engineering Chemistry – I	3	0	0	3
5.	GE6151	Computer Programming	3	0	0	3
6.	GE6152	Engineering Graphics	2	0	3	4
<b>PRACTICAL</b>						
7.	GE6161	Computer Practices Laboratory	0	0	3	2
8.	GE6162	Engineering Practices Laboratory	0	0	3	2
9.	GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
<b>TOTAL</b>			<b>17</b>	<b>2</b>	<b>11</b>	<b>26</b>

**SEMESTER II**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	HS6251	Technical English - II	3	1	0	4
2.	MA6251	Mathematics – II	3	1	0	4
3.	PH6251	Engineering Physics – II	3	0	0	3
4.	CY6251	Engineering Chemistry – II	3	0	0	3
5.	GE6252	Basic Electrical and Electronics Engineering	4	0	0	4
6.	GE6253	Engineering Mechanics	3	1	0	4
<b>PRACTICAL</b>						
7.	GE6261	Computer Aided Drafting and Modeling Laboratory	0	1	2	2
8.	GE6262	Physics and Chemistry Laboratory - II	0	0	2	1
<b>TOTAL</b>			<b>19</b>	<b>4</b>	<b>4</b>	<b>25</b>

**SEMESTER III**

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	MA6468	Probability and Statistics	3	1	0	4
2.	CE6302	Mechanics of Solids	3	1	0	4
3.	CE6303	Mechanics of Fluids	3	0	0	3
4.	GI6302	Surveying	2	2	0	4
5.	EN6301	Environmental Chemistry	3	0	0	3
6.	GE6351	Environmental Science and Engineering	3	0	0	3
<b>PRACTICAL</b>						
7.	CE6411	Strength of Materials Laboratory	0	0	3	2
8.	GI6312	Surveying Laboratory	0	0	4	2
9.	EN6311	Environmental Chemistry Laboratory	0	0	3	2
<b>TOTAL</b>			<b>17</b>	<b>4</b>	<b>10</b>	<b>27</b>

### SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	CE6401	Construction Materials	3	0	0	3
2.	CE6453	Soil Mechanics and Foundation Engineering	3	0	0	3
3.	CE6458	Applied Hydraulics and Fluid Machines	3	0	0	3
4.	EN6401	Environmental Microbiology	3	0	0	3
5.	EN6402	Water Supply Engineering	3	0	0	3
6.	CE6469	Basic Structural Analysis	3	0	0	3
<b>PRACTICAL</b>						
7.	CE6412	Hydraulic Engineering Laboratory	0	0	3	2
8.	EN6411	Microbiology Laboratory	0	0	3	2
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>6</b>	<b>22</b>

### SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	EN6501	Municipal Solid Waste Management	3	0	0	3
2.	EN6502	Air and Noise Pollution Control	3	0	0	3
3.	EN6503	Environmental Policy and Legislations	3	0	0	3
4.	EN6504	Basic Structural Design	2	0	3	4
5.	CE6567	Hydrology and Water Resources Engineering	3	0	0	3
6.	EN6505	Occupational Hazards and Industrial safety	3	0	0	3
<b>PRACTICAL</b>						
7.	EN6511	Air and Noise Pollution Laboratory	0	0	3	2
8.	GE6563	Communication Skills - Laboratory Based	0	0	4	2
<b>TOTAL</b>			<b>17</b>	<b>0</b>	<b>10</b>	<b>23</b>

### SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	EN6601	Wastewater Engineering	3	0	0	3
2.	EN6602	Environmental Instrumentation	3	0	0	3
3.	EN6603	GIS For Environmental Engineering	3	0	0	3
4.	MG6851	Principles of Management	3	0	0	3
5.	EN6604	Cleaner Production	3	0	0	3
6.		Elective I	3	0	0	3
<b>PRACTICAL</b>						
7.	EN6611	Environmental Instrumentation Laboratory	0	0	3	2
8.	EN6612	Environmental Engineering Design and Drawing	0	0	3	2
9.	EN6613	GIS Laboratory	0	0	3	2
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>9</b>	<b>24</b>

### SEMESTER VII

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	EN6701	Sustainable Development	3	0	0	3
2.	EN6702	Design of Environmental Engineering Structures	3	0	0	3
3.	EN6703	Hazardous Waste Management	3	0	0	3
4.	EN6704	Industrial Waste Management	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
<b>PRACTICAL</b>						
7.	EN6711	Plant Layout Design	0	0	3	2
8.	CE6611	Environmental Engineering Laboratory	0	0	3	2
9.	EN6712	Industrial Safety Laboratory	0	0	3	2
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>9</b>	<b>24</b>

### SEMESTER VIII

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	EN6801	Environmental Impact Assessment	3	0	0	3
2.		Elective IV	3	0	0	3
3.		Elective V	3	0	0	3
<b>PRACTICAL</b>						
4.	EN6811	Project Work	0	0	12	6
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**TOTAL NO OF CREDITS:186**

### ELECTIVE LIST

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>ELECTIVE I</b>						
1.	EN6001	Wealth from Waste	3	0	0	3
2.	EN6002	Green Building Design	2	0	2	3
3.	EN6003	Process Safety and Loss Prevention	3	0	0	3
4.	EN6004	Wind Power Engineering	3	0	0	3
<b>ELECTIVE II</b>						
5.	EN6005	Water Power Engineering	3	0	0	3
6.	EN6006	Tidal Engineering	3	0	0	3
7.	EN6007	Climate change	3	0	0	3
8.	EN6008	Groundwater Contamination	3	0	0	3
<b>ELECTIVE III</b>						
9.	EN6009	Epidemiology and Control of Communicable Diseases	3	0	0	3
10.	EN6010	Low Carbon Economy	3	0	0	3
11.	EN6011	Urban and Rural Sanitation	3	0	0	3
12.	EN6012	Urban and Rural Planning	3	0	0	3
13.	EN6013	Solar Energy	3	0	0	3

<b>ELECTIVE IV</b>						
14.	EN6014	Space Technology And Waste Disposal	3	0	0	3
15.	EN6015	Climatology and Meteorology	3	0	0	3
16.	EN6016	Site Assessment and Remediation	3	0	0	3
17.	EN6017	Nuclear Energy	3	0	0	3
<b>ELECTIVE V</b>						
18.	GE6757	Total Quality Management	3	0	0	3
19.	EN6018	Coastal Zone Management	3	0	0	3
20.	EN6019	Engineering Economics and Cost Benefit Analysis	3	0	0	3
21.	EN6020	Risk Analysis and Management	3	0	0	3
22.	EN6021	Geo- Thermal Engineering	3	0	0	3

**OBJECTIVES:**

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

**UNIT I****9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

**UNIT II****9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

**UNIT III****9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

**UNIT IV****9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

**UNIT V****9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files

having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

**TOTAL (L:45+T:15): 60 PERIODS**

### **OUTCOMES:**

Learners should be able to

- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents.

### **TEXTBOOKS:**

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai, 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011

### **REFERENCES:**

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008

### **EXTENSIVE Reading (Not for Examination)**

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

### **WEBSITES:**

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

### **TEACHING METHODS:**

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

### **EVALUATION PATTERN:**

#### **Internal assessment: 20%**

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews

- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

**End Semester Examination: 80%**

**MA6151**

**MATHEMATICS – I**

**L T P C**  
**3 1 0 4**

**OBJECTIVES:**

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I MATRICES**

**9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II SEQUENCES AND SERIES**

**9+3**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D’Alembert’s ratio test – Alternating series – Leibnitz’s test – Series of positive and negative terms – Absolute and conditional convergence.

**UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS**

**9+3**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

**UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**

**9+3**

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

**UNIT V MULTIPLE INTEGRALS****9+3**

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

**TEXT BOOKS:**

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41<sup>st</sup> Edition, Khanna Publications, Delhi, 2011.

**REFERENCES:**

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. GlynJames, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

**PH6151****ENGINEERING PHYSICS – I****L T P C  
3 0 0 3****OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT I CRYSTAL PHYSICS****9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)- Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

**UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS****9**

Elasticity- Hooke's law - Relationship between three moduli of elasticity (qualitative) – stress - strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders  
Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

**UNIT III QUANTUM PHYSICS****9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave



function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

#### **UNIT IV ACOUSTICS AND ULTRASONICS 9**

Classification of Sound- decibel- Weber–Fechner law – Sabine’s formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

#### **UNIT V PHOTONICS AND FIBRE OPTICS 9**

Spontaneous and stimulated emission- Population inversion -Einstein’s A and B coefficients - derivation. Types of lasers – Nd:YAG, CO<sub>2</sub>, Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

#### **TEXT BOOKS:**

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

#### **REFERENCES:**

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

**CY6151**

**ENGINEERING CHEMISTRY - I**

**L T P C  
3 0 0 3**

#### **OBJECTIVES:**

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

#### **UNIT I POLYMER CHEMISTRY 9**

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: T<sub>g</sub>, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

**UNIT II CHEMICAL THERMODYNAMICS****9**

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY****9**

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

**UNIT IV PHASE RULE AND ALLOYS****9**

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

**UNIT V NANOCHEMISTRY****9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications

**TOTAL :45 PERIODS****OUTCOMES:**

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

**TEXT BOOKS**

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

**REFERENCES**

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., "Nanotechnology: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

**GE6151****COMPUTER PROGRAMMING****L T P C  
3 0 0 3****OBJECTIVES:****The students should be made to:**

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.

- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

**UNIT I INTRODUCTION 8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

**UNIT II C PROGRAMMING BASICS 10**

Problem formulation – Problem Solving - Introduction to ‘ C ’ programming –fundamentals – structure of a ‘ C ’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘ C ’ – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

**UNIT III ARRAYS AND STRINGS 9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

**UNIT IV FUNCTIONS AND POINTERS 9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

**UNIT V STRUCTURES AND UNIONS 9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design C Programs for problems.
- Write and execute C programs for simple applications

**TEXTBOOKS:**

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. “ Let Us C”, BPB Publications, 2011.

**REFERENCES:**

1. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw Hill, 2006.
2. Dromey R.G., “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
3. Kernighan, B.W and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
4. Rajaram. M. and Uma Maheswari, “Computer Programming with C”, Pearson 2014.

**GE6152**

**ENGINEERING GRAPHICS**

**L T P C  
2 0 3 4**

**OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination) 1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREE HAND SKETCHING 5+9**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 5+9**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 5+9**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+9**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**COMPUTER AIDED DRAFTING (Demonstration Only) 3**

Introduction to drafting packages and demonstration of their use.

**TOTAL : 75 PERIODS**

**OUTCOMES:**

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

**TEXT BOOK:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.

**REFERENCES:**

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2<sup>nd</sup> Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

**Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

**GE6161**

**COMPUTER PRACTICES LABORATORY**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

**The student should be made to:**

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

**LIST OF EXPERIMENTS:**

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.

- Develop recursive programs.

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

Standalone desktops with C compiler            30 Nos.  
(or)

Server with C compiler supporting 30 terminals or more.

**GE6162**

**ENGINEERING PRACTICES LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)**

**I        CIVIL ENGINEERING PRACTICE**

**9**

**Buildings:**

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:  
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II        MECHANICAL ENGINEERING PRACTICE**

**13**

**Welding:**

- (a) Preparation of arc welding of butt joints, lap joints and tee joints.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making – Trays, funnels, etc.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

- (b) Foundry operations like mould preparation for gear and step cone pulley.  
 (c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)**

**III ELECTRICAL ENGINEERING PRACTICE 10**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE 13**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- ability to fabricate carpentry components and pipe connections including plumbing works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits.

**REFERENCES:**

1. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
2. Jeyapooan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas PUBLISHING House Pvt.Ltd, (2006)
3. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, (2007).
4. Rajendra Prasad A. & Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, (2002).
5. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, (1999).

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

**CIVIL**

- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools: (a) Rotary Hammer   | 2 Nos    |
| (b) Demolition Hammer   | 2 Nos    |
| (c) Circular Saw  | 2 Nos    |
| (d) Planer  | 2 Nos    |
| (e) Hand Drilling Machine   | 2 Nos    |
| (f) Jigsaw  | 2 Nos    |

**MECHANICAL**

- |  |        |
|--|--------|
| 1. Arc welding transformer with cables and holders | 5 Nos. |
|--|--------|

2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

#### **ELECTRICAL**

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos.
(b) Digital Live-wire detector	2 Nos.

#### **ELECTRONICS**

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

**GE6163**

**PHYSICS AND CHEMISTRY LABORATORY – I**

**L T P C**  
**0 0 2 1**

#### **PHYSICS LABORATORY – I**

#### **OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

#### **LIST OF EXPERIMENTS**

(Any FIVE Experiments)

- (a) Determination of Wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
- Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
- Determination of wavelength of mercury spectrum – spectrometer grating
- Determination of thermal conductivity of a bad conductor – Lee's Disc method.
- Determination of Young's modulus by Non uniform bending method
- Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

#### **OUTCOMES:**

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

#### **LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

- Diode laser, lycopodium powder, glass plate, optical fiber.
- Ultrasonic interferometer
- Spectrometer, mercury lamp, grating
- Lee's Disc experimental set up
- Traveling microscope, meter scale, knife edge, weights



6. Carey foster's bridge set up

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

**CHEMISTRY LABORATORY- I**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

**LIST OF EXPERIMENTS**

(Any FIVE Experiments)

- 1 Determination of DO content of water sample by Winkler's method.
- 2 Determination of chloride content of water sample by argentometric method.
- 3 Determination of strength of given hydrochloric acid using pH meter.
- 4 Determination of strength of acids in a mixture using conductivity meter.
- 5 Estimation of iron content of the water sample using spectrophotometer. (1,10- phenanthroline / thiocyanate method).
- 6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
- 7 Conductometric titration of strong acid vs strong base.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**REFERENCES:**

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Iodine flask	-	30 Nos
2. pH meter	-	5 Nos
3. Conductivity meter	-	5 Nos
4. Spectrophotometer	-	5 Nos
5. Ostwald Viscometer	-	10 Nos

**Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)**

**HS6251**

**TECHNICAL ENGLISH II**

**L T P C**

**3 1 0 4**

**OBJECTIVES:**

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

**UNIT I****9+3**

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

**UNIT II****9+3**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

**UNIT III****9+3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

**UNIT IV****9+3**

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

**UNIT V****9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions –

interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

**TOTAL (L:45+T:15): 60 PERIODS**

### **OUTCOMES:**

Learners should be able to

- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

### **TEXTBOOKS:**

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

### **REFERENCES:**

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

### **EXTENSIVE Reading (Not for Examination)**

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

### **Websites**

1. <http://www.englishclub.com>
2. <http://owl.english.purdue.edu>

### **TEACHING METHODS:**

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

### **EVALUATION PATTERN:**

#### **Internal assessment: 20%**

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment

- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

**End Semester Examination: 80%**

**MA6251**

**MATHEMATICS – II**

**L T P C**  
**3 1 0 4**

**OBJECTIVES:**

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

**UNIT I VECTOR CALCULUS**

**9+3**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

**UNIT II ORDINARY DIFFERENTIAL EQUATIONS**

**9+3**

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

**UNIT III LAPLACE TRANSFORM**

**9+3**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**UNIT IV ANALYTIC FUNCTIONS**

**9+3**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping:  $w = z+k$ ,  $kz$ ,  $1/z$ ,  $z^2$ ,  $e^z$  and bilinear transformation.

**UNIT V COMPLEX INTEGRATION**

**9+3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues –

Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

**TOTAL (L:45+T:15): 60 PERIODS**

**OUTCOMES:**

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

**TEXT BOOKS:**

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,(2011).
2. Grewal. B.S, "Higher Engineering Mathematics", 41<sup>st</sup> Edition, Khanna Publications, Delhi, (2011).

**REFERENCES:**

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics" Volume II, Second Edition, PEARSON Publishing, 2011.

**PH6251**

**ENGINEERING PHYSICS – II**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To enrich the understanding of various types of materials and their applications in engineering and technology.

**UNIT I CONDUCTING MATERIALS 9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

**UNIT II SEMICONDUCTING MATERIALS 9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors - direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

**UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9**

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications  
Superconductivity : properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High  $T_c$  superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

**UNIT IV DIELECTRIC MATERIALS 9**



Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion- differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor- solar energy conversion- solar cells- wind energy. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery- fuel cell  $H_2$  - $O_2$  fuel cell- applications.

**UNIT IV ENGINEERING MATERIALS 9**

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses. Glass - manufacture, types, properties and uses.

**UNIT V FUELS AND COMBUSTION 9**

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values- coal-analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) - petroleum- manufacture of synthetic petrol (Bergius process)- knocking-octane number - diesel oil- cetane number - natural gas- compressed natural gas(CNG)- liquefied petroleum gases(LPG)- producer gas- water gas. Power alcohol and bio diesel. Combustion of fuels: introduction- theoretical calculation of calorific value- calculation of stoichiometry of fuel and air ratio- ignition temperature- explosive range - flue gas analysis (ORSAT Method).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**TEXT BOOKS**

1. Vairam S, Kalyani P and SubaRamesh., “Engineering Chemistry”, Wiley India PvtLtd., New Delhi., 2011
2. DaraS.S, UmareS.S. “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi , 2010

**REFERENCES**

- 1 Kannan P. and Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009
2. AshimaSrivastava and Janhavi N N., “Concepts of Engineering Chemistry”, ACME Learning Private Limited., New Delhi., 2010.
3. RenuBapna and Renu Gupta., “Engineering Chemistry”, Macmillan India Publisher Ltd., 2010.
4. Pahari A and Chauhan B., “Engineering Chemistry”, Firewall Media., New Delhi., 2010

**GE6252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C  
4 0 0 4**

**OBJECTIVES:**

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

**UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 12**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

**UNIT II ELECTRICAL MECHANICS 12**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

**UNIT IV DIGITAL ELECTRONICS 12**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

**UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12**

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- ability to identify the electrical components explain the characteristics of electrical machines.
- ability to identify electronics components and use of them to design circuits.

**TEXT BOOKS:**

1. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

**REFERENCES:**

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2006.
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, 2003.

**GE6253**

**ENGINEERING MECHANICS**

**L T P C  
3 1 0 4**

**OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

**UNIT I BASICS AND STATICS OF PARTICLES 12**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .



**UNIT II EQUILIBRIUM OF RIGID BODIES 12**  
Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

**UNIT III PROPERTIES OF SURFACES AND SOLIDS 12**  
Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES 12**  
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton’s laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

**UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12**  
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve dynamics related problems

**TEXT BOOKS:**

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing company, New Delhi 2004.
2. Vela Murali, “Engineering Mechanics”, Oxford University Press 2010.

**REFERENCES:**

1. Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11<sup>th</sup> Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4<sup>th</sup> Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., “ Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2”, Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., “Engineering Mechanics”, 3<sup>rd</sup> Revised Edition, Tata McGraw-Hill Publishing company, New Delhi, 2008.

**OBJECTIVES:**

- To develop skill to use software to create 2D and 3D models.

**List of Exercises using software capable of Drafting and Modeling**

- Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
- Drawing of a Title Block with necessary text and projection symbol.
- Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
- Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
- Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
- Drawing of a plan of residential building ( Two bed rooms, kitchen, hall, etc.)
- Drawing of a simple steel truss.
- Drawing sectional views of prism, pyramid, cylinder, cone, etc,
- Drawing isometric projection of simple objects.
- Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

**TOTAL: 45 PERIODS****OUTCOMES:**

- ability to use the software packers for drafting and modeling
- ability to create 2D and 3D models of Engineering Components

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

Sl.No	Description of Equipment	Quantity
1.	Pentium IV computer or better hardware, with suitable graphics facility	30 No.
2.	Licensed software for Drafting and Modeling.	30 Licenses
3.	Laser Printer or Plotter to print / plot drawings	2 No.

**GE6262****PHYSICS AND CHEMISTRY LABORATORY – II****L T P C  
0 0 2 1****PHYSICS LABORATORY – II****OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

**LIST OF EXPERIMENTS  
(Any FIVE Experiments)**

- Determination of Young's modulus by uniform bending method
- Determination of band gap of a semiconductor
- Determination of Coefficient of viscosity of a liquid –Poiseuille's method
- Determination of Dispersive power of a prism - Spectrometer
- Determination of thickness of a thin wire – Air wedge method
- Determination of Rigidity modulus – Torsion pendulum

**OUTCOMES:**

- The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

#### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

- Traveling microscope, meter scale, Knife edge, weights
- Band gap experimental set up
- Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
- spectrometer, prism, sodium vapour lamp.
- Air-wedge experimental set up.
- Torsion pendulum set up.

(Vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

### CHEMISTRY LABORATORY -II

#### OBJECTIVES:

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

#### LIST OF EXPERIMENTS

##### (Any FIVE Experiments)

- Determination of alkalinity in water sample
- Determination of total, temporary & permanent hardness of water by EDTA method
- Estimation of copper content of the given solution by EDTA method
- Estimation of iron content of the given solution using potentiometer
- Estimation of sodium present in water using flame photometer
- Corrosion experiment – weight loss method
- Conductometric precipitation titration using  $\text{BaCl}_2$  and  $\text{Na}_2\text{SO}_4$
- Determination of CaO in Cement.

**TOTAL: 30 PERIODS**

#### OUTCOMES:

- The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis

#### REFERENCES:

- Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York, 2001.
- Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry, LBS Singapore, 1994.
- Jeffery G.H, Bassett J., Mendham J. and Denny R.C., "Vogel's Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
- Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, McMillan, Madras 1980

- Laboratory classes on alternate weeks for Physics and Chemistry.**

#### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

- |                       |   |       |
|-----------------------|---|-------|
| 1. Potentiometer      | - | 5 Nos |
| 2. Flame photo meter  | - | 5 Nos |
| 3. Weighing Balance   | - | 5 Nos |
| 4. Conductivity meter | - | 5 Nos |

**Common Apparatus : Pipette, Burette, conical flask, porcelain tile, dropper (30 Nos each)**

**OBJECTIVES:**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.

**UNIT I          RANDOM VARIABLES****9+3**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

**UNIT II          TWO - DIMENSIONAL RANDOM VARIABLES****9+3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

**UNIT III        TESTING OF HYPOTHESIS****9+3**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

**UNIT IV        DESIGN OF EXPERIMENTS****9+3**

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design -  $2^2$  factorial design.

**UNIT V        STATISTICAL QUALITY CONTROL****9+3**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

**TEXT BOOKS:**

- Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4<sup>th</sup> Edition, 2007.
- Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7<sup>th</sup> Edition, 2007.
- Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " McGraw Hill Education India , 4<sup>th</sup> Edition, New Delhi , 2010.

**REFERENCES:**

- Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2012.
- Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8<sup>th</sup> Edition, 2007.
- Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
- Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

**OBJECTIVES:**

- To learn fundamental concepts of stress, strain and deformation of solids with applications to bars, beams and thin cylinders.
- To know the mechanism of load transfer in beams, the induced stress resultants and deformations.
- To understand the effect of torsion on shafts and springs.
- To analyse a complex two dimensional state of stress and plane trusses

**UNIT I STRESS AND STRAIN****9**

Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law – Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses – Thin Cylinders and Shells – Strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load – Compound Bars.

**UNIT II SHEAR AND BENDING IN BEAMS****9**

Beams and Bending- Types of loads, supports – Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. Theory of Simple Bending – Analysis of Beams for Stresses – Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions - **Flitched Beams.**

**UNIT III DEFLECTION****9**

Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.

**UNIT IV TORSION****9**

Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs.

**UNIT V COMPLEX STRESSES AND PLANE TRUSSES****9**

2 D State of Stress – 2 D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle - Plane trusses: Analysis of plane trusses - method of joints - method of sections.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

The students will have

- Thorough understanding of the fundamental concepts of stress and strain in mechanics of solids and structures.
- the ability to analyse determinate beams and trusses to determine shearforces, bending moments and axial forces.
- a sufficient knowledge in designing shafts to transmit required power and also springs for its maximum energy storage capacities.

**TEXT BOOKS:**

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2007.
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.

**REFERENCES :**

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.

2. Timoshenko.S.B. and Gere.J.M, " Mechanics of Materials", Van Nos Reinhold, New Delhi 1995.
3. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi,1995.
4. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 1997.
5. Ugural. A.C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.

**CE6303**

**MECHANICS OF FLUIDS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyse and appreciate the complexities involved in solving the fluid flow problems.
- 

**UNIT I FLUID PROPERTIES AND FLUID STATICS 9**

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges- forces on planes – centre of pressure – buoyancy and floatation.

**UNIT II FLUID KINEMATICS AND DYNAMICS 9**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter and Pitot tube. Linear momentum equation and its application.

**UNIT III FLOW THROUGH PIPES 9**

Viscous flow - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseuille's) - Hydraulic and energy gradient - flow through pipes - Darcy -Weisbach's equation - pipe roughness -friction factor- Moody's diagram- Major and minor losses of flow in pipes - Pipes in series and in parallel.

**UNIT IV BOUNDARY LAYER 9**

Boundary layer – definition- boundary layer on a flat plate – thickness and classification – displacement , energy and momentum thickness – Boundary layer separation and control – drag in flat plate – drag and lift coefficients.

**UNIT V DIMENSIONAL ANALYSIS AND MODEL STUDIES 9**

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi-Theorem - Dimensionless parameters - Similitude and model studies - Distorted Models.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

**TEXT BOOKS:**

1. Modi P.N and Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi. 2003
2. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 2001.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5<sup>th</sup> edition, Laxmi publications Pvt. Ltd, New Delhi, 2008.

**REFERENCES:**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 2000.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 1995.
3. Jain A. K. "Fluid Mechanics", Khanna Publishers, 2010
4. Roberson J.A and Crowe C.T., "Engineering Fluid Mechanics", Jaico Books Mumbai, 2000.
5. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5<sup>th</sup> Edition, New Delhi, 2003.

**GI6302****SURVEYING****L T P C  
2 2 0 4****OBJECTIVES:**

- To introduce the rudiments of surveying principles.
- To learn the various methods of surveying to solve the real world problems.

**UNIT I FUNDAMENTALS AND CHAIN SURVEYING 6**

Definition- Classifications - Basic principles – Mistakes, errors and accuracy. Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles – Errors in linear measurement and their corrections - Obstacles - Traversing – Plotting - applications.

**UNIT II COMPASS SURVEYING AND PLANE TABLE SURVEYING 6**

Compass – Basic principles - Types - Bearing - Systems and conversions- Sources of errors - Local attraction - Magnetic declination-Dip-Traversing - Plotting - Adjustment of closing error – applications - Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection – Traversing- sources of errors – applications.

**UNIT III THEODOLITE SURVEYING 6**

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and permanent adjustments – Heights and distances– Tangential and Stadia Tacheometry – Subtense method - Stadia constants - Anallactic lens.

**UNIT IV ROUTE SURVEYING 6**

Reconnaissance - Route surveys for highways, railways and waterways - Simple curves – Compound and reverse curves - Setting out Methods – Transition curves - Functions and requirements - Setting out by offsets and angles - Vertical curves - Sight distances.

**UNIT V HYDROGRAPHIC AND MINE SURVEYING 6**

Tides - MSL - Sounding methods - Three-point problem - Strength of fix - Sextants and station pointer - River Surveys - Measurement of current and discharge – Mine Surveying Equipment - Weisbach triangle - Tunnel alignment and setting out - Transfer of azimuth - Gyro Theodolite - Shafts and Adits.

**TOTAL (L:30+T:30): 60 PERIODS****OUTCOMES:**

At the end of the course the student will be able to understand

- the use of various surveying instruments in mapping
- the error and adjustments procedures associated with surveying and mapping
- the applications of surveying in Route, Mine and Hydrography

**TEXT BOOKS :**

1. Chandra A.M., "Plane Surveying", New Age International Publishers 2002.
2. Alak De, "Plane Surveying", S. Chand & Company Ltd., 2000.

**REFERENCES:**

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7<sup>th</sup> Edition, McGraw Hill 2001.
2. Bannister and S. Raymond, Surveying, 7<sup>th</sup> Edition, Longman, 2004.
3. S.K. Roy, Fundamentals of Surveying, 2<sup>nd</sup> Edition, Prentice Hall of India, 2004.
4. Arora K.R., "Surveying Vol I & II", Standard Book house , 10<sup>th</sup> Edition Edition 2008.

EN6301

ENVIRONMENTAL CHEMISTRY

L T P C  
3 0 0 3

**OBJECTIVES:**

- The objectives of the course are to study the basics of environmental chemistry, chemical reactions involved in water and electro kinetic properties.

**UNIT I ENVIRONMENTAL CHEMISTRY: INTRODUCTION 9**

Oxidation state, redox potential – chemical equilibrium, Le-Chatlier Principle - heterogeneous equilibria - solubility product - common ion effect, - application in water treatment. Chemical kinetics - factors influencing the rate – order and molecularity (examples) – derivation of rate constant for first order reaction - time for half - change - nature of BOD reactions –Enzyme reactions, temperature dependence, catalyst.

**UNIT II CHEMICAL REACTIONS OF WATER 9**

Colloids, Classification – solids in liquids - hydrophilic and hydrophobic colloids – electrokinetic properties - chemical coagulation of water - Schulz Hardy rule - mechanism of coagulation electro dialysis - water purification – electro-osmosis - dewatering of sludges – electrophoresis – adsorption, Freundlich and Langmuir isotherms – Applications in pollution control.

**UNIT III ORGANIC COMPOUNDS AND STRUCTURES 9**

Functional groups in organic compounds and their structures (Preparation & Properties not required) - carbohydrates - classification – monosaccharides, pentoses (Xylose and arabinose) Hexoses (Glucose, galactose, mannose and fructose) – disaccharides (Sucrose, maltose and lactose) – Polysaccharides (Starch, cellulose and hemicellulose) - Structural formulae - ring structure and hydrolysis reaction only.

**UNIT IV ATMOSPHERIC CHEMISTRY 9**

Photochemical reactions in the atmosphere- Degradation of VOCs– Chemical process for the formation of inorganic and organic particulate matter –Photochemical smog.

**UNIT V SOIL CHEMISTRY 9**

Soil classification– Inorganic and organic components of soil –physical and chemical properties of soil- Acid -base and ion exchange reactions--Salt affected soil.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an insight into the chemical reactions in water, air and soil environment.
- the ability to apply chemistry principles in analysing pollution of water, air and soil environment.
- an understanding on the fate of chemicals on the environment and suggest relevant interventions.

**TEXT BOOKS:**

1. Stanley E.Manohar, Environmental Chemistry, Williard Grant, 1975.
2. De.A.K. "Environmental Chemistry ", New Age International Ltd., New Delhi, 1996.

**REFERENCES:**

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. "Chemistry for Environmental Engineers",3<sup>rd</sup> Edition. Tata McGraw Hill, New Delhi, 2013
2. Glasstone and Ceuris.D," Elements of Physical Chemistry", 1997.



3. Albaigo J., "Analytical Techniques in Environmental Chemistry", Pergamon Press, New York, 1980.

**GE6351**

**ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**12**

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION**

**10**

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO<sub>2</sub>, NO<sub>x</sub>, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies –

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources:

World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

#### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides.

Public awareness.

#### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

#### **TEXT BOOKS :**

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education,2004
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw Hill, New Delhi, 2006.

#### **REFERENCES :**

1. Trivedi R.K. 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P.Cooper., T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publishing House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan. R, 'Environmental Studies - From Crisis to Cure', Oxford University Press, 2005.

**OBJECTIVES:**

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

**LIST OF EXPERIMENTS**

- Tension test on mild steel rod
- Compression test on wood
- Double shear test on metal
- Torsion test on mild steel rod
- Impact test on metal specimen (Izod and Charpy)
- Hardness test on metals (Rockwell and Brinell Hardness Tests)
- Deflection test on metal beam
- Compression test on helical spring
- Deflection test on carriage spring
- Test on Cement

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students will gain knowledge in the area of testing of materials and components of structural elements experimentally.

**REFERENCES:**

- Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
- IS1786-2008 – Specification for cold worked steel high strength deformed bars for concrete reinforcement, 2008.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 KN capacity	1
2.	Torsion testing machine for steel rods	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker's } (any 2) Brinell	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9	Le Chatelier's apparatus	2
10	Vicat's apparatus	2
11	Mortar cube moulds	10

GI6312

SURVEYING LABORATORY

L T P C  
0 0 4 2**OBJECTIVES:**

- To familiarize with the various surveying instruments and methods.

**LIST OF EXPERIMENTS:****I CHAIN SURVEYING**

- Ranging, chaining and pacing

8

• Chain traversing		
<b>II COMPASS SURVEYING</b>		<b>8</b>
• Triangulation problem		
• Compass traversing		
<b>III PLANE TABLE SURVEYING</b>		<b>20</b>
• Radiation and Intersection: Resection - Three point problem		
• Mechanical and Graphical solution		
• Trial and error method		
• Resection - Two Point problem		
• Plane table traversing		
<b>IV THEODOLITE SURVEYING</b>		<b>16</b>
• Measurement of horizontal angles and vertical angles		
• Heights and Distances by		
• Triangulation problem		
• Single plane method		
• Stadia and Tangential method		
<b>V SETTING OUT WORKS</b>		<b>8</b>
• Simple curve using chain and tape only		
• Simple curve by Rankine's method		
		<b>TOTAL: 60 PERIODS</b>

**OUTCOMES:**

At the end of the course the student will be able to

- Use various surveying instruments like chain, compass, plane table, theodolite for mapping
- Set the curves for highway or railway projects

**REFERENCES:**

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7<sup>th</sup> Edition, McGraw Hill, 2001.
2. Bannister and S. Raymond, "Surveying", 7<sup>th</sup> Edition, Longman, 2004.
3. S.K. Roy, "Fundamentals of Surveying", 2<sup>nd</sup> Edition, Prentice Hall of India 2004.
4. Arora K.R., "Surveying Vol I & II", Standard Book house, 10<sup>th</sup> Edition, 2008.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

SI. No.	Description of Equipment	Quantity
1.	Chain and its accessories	1 set for 4 students
2.	Compass with tripod	1 set for 4 students
3.	Plane table and its accessories	1 set for 4 students
4.	Dumpy level and its accessories	1 set for 4 students
5.	Theodolite and its accessories	1 set for 4 students

EN6311

ENVIRONMENTAL CHEMISTRY LABORATORY

L T P C  
0 0 3 2

**OBJECTIVES:**

- To familiarise with the physico chemical characterisation of water and wastewater.

**LIST OF EXPERIMENTS:**

1. Measurement of pH, Electrical conductivity and Turbidity of water samples
2. Determination of Chlorides in water.
3. Determination of iron and Fluoride in water

4. Determination of acidity and Alkalinity of water.
5. Determination of Sulphate in water.
6. Determination of hardness of water
7. Determination of nitrate & TKN in water (demo)
8. Determination of residual chlorine of water
9. Determination of total dissolved solids
10. Determination of optimum coagulant dosage

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students completing the course will have the ability to use the techniques, skills and modern instruments to determine the quality of water and wastewater.

**REFERENCE:**

1. Standards Methods for the Examination of Water and Wastewater, 17<sup>th</sup> Edition, WPCF, APHA and AWWA, USA, 1989.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	pH meter	2
2.	Turbidity meter	2
3.	UV visible spectro photo meter	1
4.	Electrical conductivity meter	1
5.	Jartus apparatus meter	3
6.	Glasswares such as pipette, Burette etc	1 for each student

**CE6401**

**CONSTRUCTION MATERIALS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce students to various materials commonly used in civil engineering construction and their properties.

**UNIT I STONES – BRICKS – CONCRETE BLOCKS 9**

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Light weight concrete blocks.

**UNIT II LIME – CEMENT – AGGREGATES – MORTAR 9**

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Industrial byproducts – Fly ash – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.

**UNIT III CONCRETE 9**

Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete.

**UNIT IV TIMBER AND OTHER MATERIALS 9**

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates –

Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.

**UNIT V MODERN MATERIALS**

**9**

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geomembranes and Geotextiles for earth reinforcement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**On completion of this course the students will be able to**

- compare the properties of most common and advanced building materials.
- understand the typical and potential applications of these materials
- understand the relationship between material properties and structural form
- understand the importance of experimental verification of material properties.

**TEXT BOOKS:**

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput.R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Shetty.M.S., "Concrete Technology (Theory and Practice)", S. Chand and Company Ltd., 2008.
4. Gambhir.M.L., "Concrete Technology", 3<sup>rd</sup> Edition, Tata McGraw Hill Education, 2004
5. Duggal.S.K., "Building Materials", 4<sup>th</sup> Edition, New Age International , 2008.

**REFERENCES:**

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems"., Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3. IS456 – 2000: Indian Standard specification for plain and reinforced concrete, 2011
4. IS4926–2003 : Indian Standard specification for ready–mixed concrete, 2012
5. IS383–1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011
6. IS1542–1992: Indian standard specification for sand for plaster, 2009

**CE6453 SOIL MECHANICS AND FOUNDATION ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the basic properties and strength nature of various soils and their settlement behaviour in foundations.

**UNIT I SOIL PROPERTIES AND COMPACTION OF SOIL**

**9**

Nature of Soil - Problems with soil - phase relation – particle size distribution – Atterberg limits - classification for engineering purposes - BIS Classification system – Soil compaction - factors affecting compaction – laboratory and field compaction methods and monitoring - Clay Minerology.

**UNIT II SOIL MOISTURE – PERMEABILITY, STRESSES IN SOILS**

**9**

Soil water – Various forms –Capillary rise – Suction - Effective stress concepts in soil – Total, neutral and effective stress distribution in soil - Permeability – Darcy’s Law- Permeability measurement in the laboratory – quick sand condition - Stress distribution in soil media – Boussinesq’s formula – stress due to line load, Circular and rectangular loaded area - approximate methods - Use of influence charts – Westerguard equation for point load.

**UNIT III SHEAR STRENGTH AND SLOPE STABILITY**

**9**

Shear strength of cohesive and cohesionless soil – Mohr, Coulomb failure theory –Measurement of shear strength - direct shear, Triaxial compression, UCC and Vane shear tests –Types of shear tests based on drainage and their applicability - Drained and undrained behaviour of clay and

sand. Slope failure mechanisms - Modes - Infinite slopes - Finite slopes – Total and effective stress analysis - Stability analysis for purely cohesive and  $C \Phi$  soils - Method of slices – Modified Bishop’s method - Friction circle method - stability number.

**UNIT IV SOIL EXPLORATION**

**9**

Scope and objectives – Methods of exploration - averaging and boring – Wash boring and rotary drilling – Depth of boring – Spacing of bore hole - Sampling – Representative and undisturbed sampling – sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler – Bore log report – Penetration tests (SPT and SCPT) – Data interpretation (Strength parameters and Liquefaction potential).

**UNIT V FOUNDATION – BEARING CAPACITY AND SETTLEMENT**

**9**

Introduction – Location and depth of foundation – Selection of foundation based on soil condition - codal provisions – bearing capacity of shallow foundation on homogeneous deposits –Terzaghi’s formula and BIS formula – factors affecting bearing capacity – problems - Bearing Capacity from insitu tests (SPT, SCPT and plate load) – Allowable bearing pressure, Settlement – Components of settlement – Determination of settlement of foundations on granular and clay deposits - Allowable settlements – Codal provision – Methods of minimising settlement, differential settlement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will

- have an insight into the structure and engineering properties of soil
- demonstrate an understanding of the processes leading to the formation of soils
- describe the properties of rocks and soils that affect their ability to support any imposed loads
- design simple foundation elements for varying soil conditions and carryout bearing capacity/settlement analysis
- specify appropriate excavation and retaining methods for soils and rocks

**TEXT BOOKS:**

1. Punmia P.C, Soil Mechanics and Foundations, Laximi Publications Pvt. Ltd, New Delhi, 1995.
2. Murthy, V.N.S, “Soil Mechanics and Foundation Engineering”, UBS Publishers Distribution Ltd, New Delhi, 1999.
3. Purushothama Raj. P., “Soil Mechanics and Foundation Engineering”, 2<sup>nd</sup> Edition, Pearson Education, 2013

**REFERENCES:**

1. Coduto, D.P, Geotechnical Engineering Principles and Practices, Prentice Hall of India Private Limited, New Delhi, 2002.
2. McCarthy D.F, Essentials of Soil Mechanics and Foundations Basic Geotechniques, Sixth Edition, Prentice-Hall, New Jersey, 2002.
3. Bowles J.E, “Foundation analysis and design”, McGraw-Hill, 1996.

**CE6458**

**APPLIED HYDRAULICS AND FLUID MACHINES**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- The objective of the course is to understand the types of flow in open channel, dimensional analysis, momentum principle and application of various turbines and pumps in fluid problems.

**UNIT I UNIFORM FLOW**

**9**

Properties of open channel- types of flow - Uniform flow – Chezy's and Manning's equations – determination of roughness coefficients – hydraulically best sections –specific energy – critical depth – Uniform flow in mild, steep and critical slopes.

**UNIT II VARIED FLOWS 9**

Dynamic equation for gradually varied flow – free surface profiles in various slopes – specific force – rapidly varied flow – hydraulic jump – classification – unsteady flow – types of surges.

**UNIT III MOMENTUM PRINCIPLE 9**

Impulse momentum equation – Application of linear momentum principle – Impact of Jet- Force exerted by a jet on normal, inclined and curved surfaces for stationary and moving cases – Angular momentum principle – construction of velocity vector diagrams.

**UNIT IV HYDRAULIC TURBINES 9**

Classification – working principles - design of Pelton wheel, Francis and Kaplan Turbines – Head, losses, work done and efficiency – Draft tube – theory and types – similarity laws – specific speed – operating characteristics – Governing of turbines - Selection of turbines.

**UNIT V HYDRAULIC PUMPS 9**

Classification – centrifugal pump - working principle – head, discharge and efficiencies – minimum starting speed – Net positive suction head – performance curves - specific speed – Reciprocating pump – components and working - slip – indicator diagram – air vessel – selection of pumps.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will

- have an insight into the uniform and varied flow of fluids, momentum principle and its application to hydraulic turbines and pumps
- be able to perform calculations relevant and applicable to flow in open channel, dimensional analysis, momentum principle and its application to turbines and pumps

**TEXT BOOKS:**

1. Subramanya K., "Flow in open channels", Tata McGraw Hill, New Delhi, 2000.
2. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2002.
3. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2008.

**REFERENCES:**

1. Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
2. Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi, 2008.
3. Jain. A.K., "Fluid Mechanics", Khanna Publishers, Delhi, 2010.

**EN6401 ENVIRONMENTAL MICROBIOLOGY L T P C  
3 0 0 3**

**OBJECTIVES:**

- The objective of the course is to study the basics of environmental microbiology involved in water, soil and air.

**UNIT I MICROBIOLOGY: INTRODUCTION 9**

Classification of living organisms with special emphasis on micro-organisms - characteristics - application in environmental engineering - DNA & RNA.

**UNIT II METHODS OF STUDY 9**

Culture of micro-organisms - media preparation - sterilization, pure culture - maintenance of cultures – stains and staining - estimation of bacterial numbers.



<b>UNIT III</b>	<b>GROWTH AND METABOLISM OF MICRO-ORGANISMS</b>	<b>9</b>
Growth curves - factors affecting growth - nutritional requirements of micro-organisms - metabolism of micro-organisms - carbohydrates, proteins, fat metabolisms and the role of enzymes.		
<b>UNIT IV</b>	<b>RESPIRATIONS</b>	<b>9</b>
Aerobic and anaerobic - role of enzymes - bacterial respiration - fermentation and saprogenic action - basic concepts of molecular biology.		
<b>UNIT V</b>	<b>BIODEGRADATION AND BIOLOGICAL TREATMENT</b>	<b>9</b>
Microbiology of wastewater treatment (domestic and industrial), indicator microorganisms, biodegradation of xenobiotics, bioaugmentation, microbial leaching of heavy metals.		
		<b>TOTAL:45 PERIODS</b>

**OUTCOMES:**

The students completing the course will have

- an insight into type, growth metabolism and culturing techniques of micro organisms and their application to environmental engineering
- the ability to perform estimation of bacterial numbers
- the ability to apply micro morganisms for the treatment of wastes, bioleaching and bioaugmentation

**TEXT BOOKS :**

1. McKinney R.E. and Gall M. "Microbiology for Sanitary Engineers", McGraw Hill Book Co.Inc. New York, 1962
2. Gainey and Lord, "Microbiology of Water and Sewage", Prentice Hall Inc., New York, 1975

**REFERENCES:**

1. Raina, M.Maier, Ian L. Pepper, Charles P. Gerba. "Environmental Microbiology", Academic Press, 2000.
2. Bhatia, S.C., "Handbook of Environmental Microbiology", Vol. I, II & III, Atlantic Publ. & Dist. Ltd., 2008.

<b>EN6402</b>	<b>WATER SUPPLY ENGINEERING</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- The course objective is to identify the sources and quantity of surface and ground water bodies and their demand for the public and also to study the quality of water and their treatment techniques.

**UNIT I PUBLIC WATER SUPPLY SCHEMES AND QUANTITY OF WATER 8**  
 Necessary and objectives of public water supply schemes – planning and financing – Quantity of water – water requirements – continuous and intermittent supply – water demand – variations in rate of demand- its effect on design – design period – population growth and forecast – estimating the quantity of water required.

**UNIT II HYDROLOGICAL CONCEPTS AND SOURCES OF WATER 8**  
 Hydrological concepts – hydrological cycle – Sources of water – Intakes – types of intakes – infiltration galleries – infiltration well – storage reservoirs – storage capacity by analytical method and mass curve method – types of wells – sanitary protection of wells – tests for yield of a well.

**UNIT III QUALITY OF WATER AND TRANSPORTATION OF WATER 8**  
 Quality of water – portable water and mineral water – contamination of water – sampling techniques– analysis of water – Bacteriological analysis- water borne diseases – water quality standards. Transportation of water – Hydraulics of pipe flow – pipes & its types – design of pipes – Joints – pipe appurtenances – pumps – types of pumps – selection of pumps.

**UNIT IV PURIFICATION OF WATER 12**  
 Treatment of water- working principles of all the unit process of water treatment, Purpose and its design – screening – plain sedimentation – coagulation sedimentation – filtration – disinfection – water softening and Desalination– Operation & Maintenance aspects of all the unit process.

**UNIT V OTHER TREATMENTS AND DISTRIBUTION OF WATER 9**  
 Removal of Iron and Manganese – Fluoridation and Defluoridation– distribution of water – Planning – Methods of distribution – Service Reservoirs – purpose – types – locations and height – Design aspects – requirements of good distribution system – layout of distribution system- Net work analysis – preventive methods to reduce wastage of water – pipe appurtenances – house service connection.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an insight into the structure of drinking water supply systems, including water transport, treatment and distribution
- an understanding of water quality criteria and standards, and their relation to public health,
- the ability to design and evaluate water supply project alternatives on basis of chosen selection criteria

**TEXT BOOKS :**

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2001
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 1998.
3. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 1991.

**REFERENCES :**

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3. Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.
5. Mark J. Hammer & Mark J. Hammer Jr., "Water and Waste Water Technology", Prentice Hall of India Pvt. Ltd., New Delhi, 2008.

**CE6469 BASIC STRUCTURAL ANALYSIS L T P C  
3 0 0 3**

**OBJECTIVES:**

- To learn the modern method of analysis of beams and frames.

**UNIT I ENERGY PRINCIPLES 9**

Strain energy and strain energy density – strain energy due to axial load, shear, flexure and torsion – castigliano’s theorems – principle of virtual work – application of energy theorems for computing deflections in beams and trusses – Maxwell’s reciprocal theorems

**UNIT II DEFLECTION OF DETERMINATE STRUCTURES 9**

Principles of virtual work for deflections - Deflections of pin-jointed plane frames and rigid plane frames –Williott’s diagram.

**UNIT III SLOPE DEFLECTION METHOD 9**

Slope deflection equations- Analysis of continuous beams and rigid frames - Support settlements.

**UNIT IV MOMENT DISTRIBUTION METHOD 9**

Stiffness and carry over factors – Distribution and carry over of moments - Analysis of continuous Beams - Plane rigid frames with and without sway – Support settlement.

**UNIT V COLUMNS AND CYLINDER****9**

Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core section – Thick cylinders – Compound cylinders.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have

- an insight into the stress strain energy principles, slope deflection method and moment distribution method
- ability to model loads on structures and analyse structural elements including beams, columns and cylinders
- ability to determine deflections of beams and frames using classical methods

**TEXT BOOKS:**

1. Bhavikatti,S.S, "Structural Analysis", Vol.1 and 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
2. Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", Laxmi Publications, New Delhi, 1999.
3. Hibbeler, R.C., "Structural Analysis", 7<sup>th</sup> Edition, Prentice Hall, 2008.

**REFERENCES:**

1. William Weaver, Jr & James M.Gere, "Matrix analysis of framed structures", CBS Publishers & Distributors, Delhi, 1995
2. Vaidyanathan,R & Perumal P, "Structural Analysis, Vol.1 & 2", Laxmi Publications, New Delhi, 2004
3. Ashok K.Jain, "Advanced Structural Analysis", Nem Chand & Sons, 1996
4. Pandit G.S. and Gupta S.P., "Structural Analysis – A Matrix Approach", Tata McGraw Hill Publishing Company Ltd., 2006
3. Reddy .C.S, "Basic Structural Analysis", Tata McGraw Hill Publishing Company, 2005.

**CE6412****HYDRAULIC ENGINEERING LABORATORY****L T P C  
0 0 3 2****OBJECTIVES:**

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

**LIST OF EXPERIMENTS****17****A. Flow Measurement**

1. Calibration of Rotometer
2. Flow through Venturimeter Orificemeter
3. Flow through variable duct area - Bernoulli's Experiment
4. Flow through Orifice, Mouthpiece and Notches

**B. Losses in Pipes****4**

5. Determination of friction coefficient in pipes
6. Determination of loss coefficients for pipe fittings

**C. Pumps****12**

7. Characteristics of Centrifugal pumps

8. Characteristics of Gear pump	
9. Characteristics of Submersible pump	
10. Characteristics of Reciprocating pump	
<b>D. Turbines</b>	<b>9</b>
11. Characteristics of Pelton wheel turbine	
12. Characteristics of Francis turbine	
13. Characteristics of Kaplan turbine	
<b>E. Determination of Metacentric height</b>	<b>3</b>
14. Determination of Metacentric height (Demonstration)	

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines.

**REFERENCES:**

1. Sarbjit Singh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited, Delhi, 2009.
2. "Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, 2004.
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2000.
4. Subramanya, K. "Flow in open channels", Tata McGraw Hill Publishing. Company, 2001

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	Bernoulli's theorem – Verification Apparatus	1 No.
2.	Calculation of Metacentric height water tank Ship model with accessories	1 No.
3.	Measurement of velocity Pitot tube assembly	1 No.
4.	<b>Flow measurement open channel flow</b> (i) Channel with provision for fixing notches (rectangular, triangular & trapezoidal forms)	1 Unit
	(ii) Flume assembly with provisions for conducting experiments on Hydraulic jumps, generation of surges etc.	1 Unit
5.	<b>Flow measurement in pipes</b> (i) Venturimeter,U tube manometer fixtures like Valves, collecting tank	1 Unit
	(ii) Orifice meter, with all necessary fittings in pipe lines of different diameters	1 Unit
	(iii) Calibration of flow through orifice tank with Provisions for fixing orifices of different shapes, collecting tank	1 Unit

	(iv) Calibration of flow through mouth piece Tank with provisions for fixing mouth pieces Viz external mouth pieces & internal mouth piece Borda's mouth piece	1 Unit
6.	<b>Losses in Pipes</b> <b>Major loss – Friction loss</b> Pipe lengths (min. 3m) of different diameters with Valves and pressure rapping & collecting tank	1 Unit
7.	<b>Minor Losses</b> Pipe line assembly with provisions for having Sudden contractions in diameter, expansions Bends, elbow fitting, etc.	1 Unit
8.	<b>Pumps</b> (i) Centrifugal pump assembly with accessories (single stage)	1 Unit
	(ii) Centrifugal pump assembly with accessories (multi stage)	1 Unit
	(iii) Reciprocating pump assembly with accessories	1 Unit
	(iv) Deep well pump assembly set with accessories	1 Unit
9.	<b>Turbine</b> (i) Impulse turbine assembly with fittings & accessories	1 Unit
	(ii) Francis turbine assembly with fittings & accessories	1 Unit
	(iii) Kaplan turbine assembly with fittings & accessories	1 Unit

EN6411

MICROBIOLOGY LABORATORY

L T P C  
0 0 3 2

**OBJECTIVES:**

- To understand the experimental procedures involved in the study of micro-organisms and the method of testing their presence.

**LIST OF EXPERIMENTS**

1. Sampling Techniques
2. Sterilization Techniques
3. Preparation of culture media
4. Isolation of micro-organisms (Air, water, soil, sediment)
5. Isolation of anaerobic sediments (Sewage sediments)
6. Isolation of yeast (Sediment)
7. Purification of micro-organisms
8. Cultural characteristics of bacteria
9. Simple staining
10. Negative staining

11. Differential staining
12. Acid-fast staining
13. Coliform test
14. MPN test

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to collect water samples for microbial analysis
- ability to prepare bacterial culture, do sterilization, isolate and culture microorganisms
- ability to determine cultural characteristics of bacteria

**REFERENCES:**

1. "Standard methods for the examination of water and wastewater", American Public Health Association 21<sup>st</sup> edition, 2005.
2. Charles P. Gerba, "Environmental Microbiology: A laboratory manual". Elsevier Publications, 2012.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	Incubator	1 No
2.	Incubator Shaker	3 Nos
3.	Microscopes	5 Nos
4.	Micropipettes	3 in each volume
5.	Colony counter	1 No
6.	Anaerobic jar	2 Nos
7.	Laminar hood	1 No
8.	Chemicals	1 lot
9.	Petty dishes	5 Nos
10.	Innoculum loops	5 Nos
11.	Glass slides	5 Nos
12.	China dish	10 Nos
13.	Staining Kit	5 Nos
14.	Refrigerator	1 No

**EN6501**

**MUNICIPAL SOLID WASTE MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

**UNIT I SOURCES AND TYPES**

**8**

Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – Municipal solid waste (M&H) rules – integrated management-Public awareness; Role of NGO's.

**UNIT II ON-SITE STORAGE AND PROCESSING**

**8**

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling.

**UNIT III COLLECTION AND TRANSFER 8**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.

**UNIT IV OFF-SITE PROCESSING 12**

Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.

**UNIT V DISPOSAL 9**

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management
- ability to plan waste minimisation and design storage, collection, transport, processing and disposal of municipal solid waste

**TEXTBOOKS:**

1. Tchobanoglous.G., Theisen, H. M., and Eliassen, R. Solid. Wastes: Engineering Principles and Management Issues. New York: McGraw Hill, 1977.
2. Vesilind, P.A. and Rimer, A.E., "Unit Operations in Resource Recovery Engineering", Prentice Hall, Inc., 1981
3. Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000

**REFERENCES:**

1. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
2. Bhide A.D. and Sundaresan, B.B. Solid Waste Management Collection, Processing and Disposal, 2001
3. Manser A.G.R. and Keeling A.A, "Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996
4. George Tchobanoglous and Frank Kreith, Handbook of "Solid waste Management", McGraw Hill, New York, 2002

**EN6502 AIR AND NOISE POLLUTION CONTROL L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.

**UNIT I GENERAL 9**

Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices - Air quality management in India.

**UNIT II SOURCES, CLASSIFICATION AND EFFECTS 9**

Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods.

Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale.

### **UNIT III SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING 9**

Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Plume behaviour - Dispersion of air pollutants- Air Quality Modeling.

### **UNIT IV AIR POLLUTION CONTROL MEASURES 9**

Control - Source correction methods - Control equipments - Particulate control methods – Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices (Theory and working of equipments only).

### **UNIT V NOISE POLLUTION AND ITS CONTROL 9**

Sources of noise – Units and Measurements of Noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects. Noise Menace– Prevention and Control of Noise Pollution – Control of noise at source, control of transmission, protection of exposed person - Control of other types of Noise Sound Absorbent

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

The students completing the course will have

- an understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- ability to identify, formulate and solve air and noise pollution problems
- ability to design stacks and particulate air pollution control devices to meet applicable laws.

#### **TEXT BOOKS:**

1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2000.
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 1993
3. Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt. Ltd., 2002.

#### **REFERENCES:**

1. Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000.
2. Air Pollution act, India, 1981
3. Peterson and E.Gross Jr., "Hand Book of Noise Measurement", 5<sup>th</sup> Edition, 1963
4. Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986
5. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 1979.
6. Kenneth wark, Cecil F.Warner, "Air Pollution its Origin and Control", Harper and Row Publishers, New York, 1981.

**EN6503**

**ENVIRONMENTAL POLICY AND LEGISLATIONS**

**L T P C  
3 0 0 3**

#### **OBJECTIVES:**



- To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF)		
<b>UNIT II</b>	<b>WATER (P&amp;CP) ACT, 1974</b>	<b>8</b>
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.		
<b>UNIT III</b>	<b>AIR (P&amp;CP) ACT, 1981</b>	<b>8</b>
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.		
<b>UNIT IV</b>	<b>ENVIRONMENT (PROTECTION) ACT 1986</b>	<b>13</b>
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards		
<b>UNIT V</b>	<b>OTHER TOPICS</b>	<b>7</b>
Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.		
		<b>TOTAL : 45 PERIODS</b>

**OUTCOMES:**

The students completing the course will have

- an understanding of the Indian policies and legislations pertaining to prevention and control of water pollution, air pollution and waste management
- an insight into the Environmental Protection Act and the associated Rules knowledge on the Institutional setup for Environmental management and pollution control.

**TEXT BOOKS:**

1. Shyam Divan and Armin Roseneranz “Environmental law and policy in India “Oxford University Press, New Delhi, 2001.
2. Greger I. Megregor, “Environmental law and enforcement”, Lewis Publishers, London. 1994.

**REFERENCE:**

1. CPCB, “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.

**OBJECTIVES:**

- This course aims at providing students with a solid background on the principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels.

**UNIT I INTRODUCTION AND PLANNING 9**

Introduction - Planning and Design Process – Design Philosophies-Structural Safety, Allowable Stress Design, Limit State Design – Types of Loading – Dead , Live, Wind and Earthquake loads - Fabrication Drawing of Simple Riveted, Bolted and Welded Connections.

**UNIT II LIMIT STATE DESIGN FOR FLEXURE 9**

Analysis and design of singly and doubly reinforced rectangular and flanged beams - Analysis and design of one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions.

**UNIT III LIQUID STORAGE STRUCTURES 9**

RC Water Tanks- Circular and Rectangular – Design and Drawing –Hemispherical Bottomed Steel Water Tank – Design and Drawing.

**UNIT IV RETAINING WALLS 9**

Design and Detailing of RC Cantilever and Counterfort Retaining Walls – Horizontal Backfill with Surcharge – Design of Shear Key.

**UNIT V INDUSTRIAL STRUCTURES 9**

Steel Roof Trusses – Design and Drawing of Roofing Elements – Purlins – Design and Drawing of Self supported Chimney.

**TOTAL (L:30+P:45): 75 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of the structural design fundamentals and limit state design for flexure
- ability to design and detail liquid storage structures, retaining walls and industrial structures

**TEXT BOOKS:**

1. Krishnaraju N, "Structural Design and Drawing", Universities Press, 2009.
2. Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, "Comprehensive Design of Steel Structures", Laxmi Publications Pvt. Ltd., 2003.
3. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete",Laxmi Publication Pvt. Ltd., New Delhi, 2007.

**CE6567 HYDROLOGY AND WATER RESOURCES ENGINEERING L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

**UNIT I PRECIPITATION AND ABSTRACTIONS 10**

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods- Interception - Evaporation. Horton's equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton's equation - double ring infiltrometer, infiltration indices.

**UNIT II RUNOFF 8**

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical - Strange's table and SCS methods – Stage discharge relationships- flow

measurements- Hydrograph – Unit Hydrograph – IUH

**UNIT III FLOOD AND DROUGHT 9**

Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Definitions of droughts- Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP)

**UNIT IV RESERVOIRS 8**

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve

**UNIT V GROUNDWATER AND MANAGEMENT 10**

Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of the key drivers on water resources, hydrological processes and their integrated behaviour in catchments,
- ability to construct and apply a range of hydrological models to surface water and groundwater problems including Hydrograph, Flood/Drought management, artificial recharge
- ability to conduct Spatial analysis of rainfall data and design water storage reservoirs

**TEXT BOOKS:**

1. Subramanya .K. "Engineering Hydrology"- Tata McGraw Hill, 2010
2. Jayarami Reddy .P. "Hydrology", Tata McGraw Hill, 2008.
3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.

**REFERENCES:**

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998.

**EN6505 OCCUPATIONAL HAZARDS AND INDUSTRIAL SAFETY L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the occupational hazards, industrial safety issues, control measures and emergency procedures.

**UNIT I INDUSTRIAL ATMOSPHERIC CONTAMINANTS AND HEALTH HAZARDS 9**

Industrial atmospheric contaminants – types. Industrial Health Hazards - effects of pressure, humidity, temperature - radiation, light, noise, electricity - accidents, occupational diseases, infections.

**UNIT II INDUSTRIAL TOXICOLOGY AND INDUSTRIAL HYGIENE SURVEY 9**

Modes of entry of toxic substances into the human body - long term and short term effects - industrial toxicology. Threshold Limit Values, kinds of exposure standards, pollutant concentrations, Industrial Hygiene Survey – Diagnosis – Remedial measures – Occupational Health and Safety Management System (OHSMS) - BS OSHAS 18001.

<b>UNIT III</b>	<b>INDUSTRIAL VENTILATION</b>	<b>9</b>
Industrial Ventilation - general principles of air flow - general dilution ventilation - comfort ventilation. Local exhaust ventilation - principles of hood and duct design - duct system design - fans.		
<b>UNIT IV</b>	<b>CONTROL MEASURES</b>	<b>9</b>
Air cleaning Devices - relative efficiencies - Testing of local exhaust ventilation systems. 25 Industrial Noise Control - general engineering principles of control - standards		
<b>UNIT V</b>	<b>INDUSTRIAL ILLUMINATION AND INDUSTRIAL PLANT SANITATION</b>	<b>9</b>
Industrial illumination - glare – types & levels of illumination. Industrial plant sanitation - housekeeping - worker facilities.		
		<b>TOTAL: 45 PERIODS</b>

**OUTCOMES:**

The students completing the course will have

- an understanding of industrial toxicology, health hazards of industrial environment and control measures
- ability to recognise and report industrial hazards, follow safe work practices and participate in hazard inspection
- Understanding of emergency procedures, safety law and employer and employee responsibilities

**TEXT BOOKS:**

1. Patty, "Industrial Hygiene and Toxicology", Wiley Inter science, 1979.
2. John.V .Grimaldi and Rollin. H Simonds, "Safety Management", All India traveler book seller, New Delhi, 1989.
3. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.

**REFERENCE:**

1. Industrial Ventilation Manual, American Conference of Government Industrial Hygienists, 1993

<b>EN6511</b>	<b>AIR AND NOISE POLLUTION LABORATORY</b>	<b>L T P C</b>
		<b>0 0 3 2</b>

**OBJECTIVES:**

- To expose the students to the methods for monitoring of ambient air quality, ambient noise and demonstration of stack monitoring.

**LIST OF EXPERIMENTS**

1. Particulate Sampling – Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using High Volume Sampler / Respirable Dust Sampler.
2. Experiment on Respirable Dust – Estimating RPM.
3. Estimating Sulphur Dioxide, NO<sub>x</sub> in Ambient Air Using High Volume Air Sampler.
4. Stack Sampling Techniques and Demonstration of Stack Monitoring.
5. Exercises on Ambient Gas Monitoring including CO & VOC.
6. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.
7. Exercises on Auto Exhaust Analyser for Petrol Vehicle and Diesel Vehicle Smoke test for Diesel Vehicle.
8. Exercises on Noise Measuring Instruments.
9. Exercises on Luxmeter ( Light Intensity measuring Instrument)
10. Demonstration on Wind Monitoring and Analysis of Data for Windrose Diagrams.
11. Demonstration of Rain Gauges.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to conduct ambient air quality survey including the use of high volume air sampler, Respirable Dust Sampler, wind monitoring and noise monitoring
- ability to demonstrate stack sampling, auto exhaust monitoring, use of rain gauges and Light Intensity measurements

**REFERENCES:**

1. Henry C Perkins, "Air pollution and Control", Mc Graw Hill Pvt Ltd, New Delhi, 1974.
2. Stern A. C., "Air Pollution" (vol. I), "Air Pollution and its effects" (vol. II), "Analysis, Monitoring and Surveying" (vol. III), "Sources of Air Pollution and their control", Academic press, New York, 1968.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	High volume sampler with impinger attachments facility	2
2.	Fine particulate sampler	1
3.	Stac monitoring kit	1
4.	CO and VOC analyser	1
5.	Flue gas analyser	1
6.	Noise level meter	3
7.	Lux meter	2

**GE6563**

**COMMUNICATION SKILLS – LABORATORY BASED**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To provide opportunities to learners to practice their communicative skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

**UNIT I LISTENING/VIEWING**

**10**

Listening and note-taking – Listening to telephonic conversations – Ted talks – Inspiring Speeches – Watching documentaries on personalities, places, socio-cultural events, TV news programmes and discussions to answer different kinds questions, viz., identifying key idea and comprehension questions... so on.

**UNIT II SPEAKING**

**12**

Conversation practice – Interview – Group Discussion – Introducing oneself and others – Role play – Debate – Presentation – Panel discussion – Neutral accent.

**UNIT III READING**

**10**

Different genres of text (literature, media, technical) for comprehension – Reading strategies like note-making – reading graphs, charts and graphic organizer – Sequencing sentences – reading online sources like e-books, e-journals and e-newspapers.

**UNIT IV WRITING**

**12**

Blogs – Tweets – Online resume/ – e-mails – SMS and Online texting – Report writing – Describing charts and tables – Writing for media on current events.

**UNIT V VOCABULARY**

**8**

Idioms and Phrases – Proverbs – Collocations – Chunks of language.

**UNIT VI GRAMMAR**

**8**

Sentence structures – Subject-Verb agreement – Pronoun-Antecedent agreement – Tense forms – Active and passive voices – Direct and Indirect speeches – Cohesive devices.

**TOTAL: 60 PERIODS**

**TEACHING METHODS:**

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

**Lab Infrastructure:**

Sl. No.	Description of Equipment (Minimum configuration)	Qty Required
<b>1</b>	<b>Server</b>	1 No.
	PIV System	
	1 GB RAM / 40 GB HDD	
	OS: Win 2000 server	
	Audio card with headphones	
	JRE 1.3	
<b>2</b>	<b>Client Systems</b>	60 Nos.
	PIII System	
	256 or 512 MB RAM / 40 GB HDD	
	OS: Win 2000	
	Audio card with headphones	
	JRE 1.3	
<b>3</b>	Handicam	1 No.
<b>4</b>	Television 46"	1 No.
<b>5</b>	Collar mike	1 No.
<b>6</b>	Cordless mike	1 No.
<b>7</b>	Audio Mixer	1 No.
<b>8</b>	DVD recorder/player	1 No.
<b>9</b>	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

**Evaluation:**

**Internal: 20 marks**

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

**External: 80 marks**

- Online Test - 35 marks
- Interview - 15 marks
- Presentation - 15 marks
- Group Discussion - 15 marks

**Note on Internal and External Evaluation:**

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
  - a. Marketing engineer convincing a customer to buy his product.
  - b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics
4. Discussion – topics of different kinds; general topics, case studies and abstract concept

**OUTCOMES:**

**At the end of the course, learners should be able to**

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

**REFERENCES:**

1. Barker, A. **Improve Your Communication Skills**. New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. Craven, Miles. **Listening Extra – A resource book of multi-level skills activities**. Cambridge University Press, 2004.
3. Gammidge, Mick. **Speaking Extra - A resource book of multi-level skills activities**. Cambridge University Press, 2004.
4. Hartley, Peter. **Group Communication**. London: Routledge, 2004.
5. John Seely. **The Oxford Guide to Writing and Speaking**. New Delhi: Oxford University Press, 2004.
6. Naterop, Jean & Rod Revell. **Telephoning in English**. Cambridge University Press, 1987.
7. Ramesh, Gopalswamy and Mahadevan Ramesh. **The ACE of Soft Skills**. New Delhi: Pearson, 2010.

**Web Sources:**

[www.humanresources.about.com](http://www.humanresources.about.com)  
[www.careerride.com](http://www.careerride.com)

**EN6601**

**WASTEWATER ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on characteristics of sewage, primary and secondary treatment of sewage as well as disposal of sludge and treated wastewater.

**UNIT I QUANTITY, COLLECTIONS AND CONVEYANCE 9**

Necessity and objectives of sanitary engineering projects - Definitions - systems of sewerage - quantity of sewage - Fluctuations in flow pattern - Estimation of storm runoff - DWF and WWF - Design flow for separate and combined systems - Hydraulics of sewers - Self cleansing velocities - full flow / partial flow conditions - sewer sections - sewer appurtenances - Design principles and procedures - materials for sewers - sewer joints - sewer laying - sewer cleaning and maintenance - sewage pumping - types of pumps.

**UNIT II QUALITY OF SEWAGE AND PRIMARY TREATMENT 8**

Characteristics and composition of sewage - physical and chemical analysis - DO, BOD, COD and their significance - cycles of decomposition - Objectives and basic principles of sewage treatment - primary treatment - screens - Grit chamber - settling tank - principles of sedimentations - Design of settling tanks.

**UNIT III BIOLOGICAL TREATMENT OF SEWAGE 12**

Basic principles of biological treatment - trickling filters - Description and principles of operation of standard / high rate filters - recirculation - activated sludge process - diffuser / Mechanical aeration - Conventional, high rate and extended aeration process - oxidation pond - stabilization ponds - aerated lagoons - SBR, MBR, MBBR.

**UNIT IV SLUDGE MANAGMENT 8**

Objectives of sludge treatment - properties and characteristics of sludge - Thickening - sludge digestion - drying beds - conditioning and dewatering - sludge disposal - elutriation.

**UNIT V SEWAGE DISPOSAL AND HOUSE DRAINAGE 8**

Methods - dilution method - self purification of streams - oxygen sag curve - water quality modeling - land disposal - Eutrophication - recycle & reuse of waste effluents. House drainage - Sanitary fixtures / fittings - one pipe sysem, two pipe system, etc. - General layout of house drainage - street connections. Septic tanks and effluent disposal system

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to estimate sewage generation and design sewer system including sewage pumping stations
- an understanding on the characteristics and composition of sewage , self purification of streams
- ability to perform basic design of the unit operations and processes that are used in sewage treatment
- ability to plan house drainage including onsite wastewater treatment and disposal

**TEXT BOOKS:**

1. Garg. S.K., "Environmental Engineering", Vol II, Khannah Publishers, New Delhi, 1994.
2. Duggal. K.N., "Elements of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.
3. Punmia B.C, Arun K.Jain, Ashok K.Jain, "Wastewater Engineering" Lakshmi publication Pvt. Ltd, New Delhi, 1998.

**REFERENCES:**

1. Manual on wastewater and treatment CPHEECO, Ministry of Urban Affairs and Employment, Govt. of India, New Delhi, 1990.
2. Shah.C. S., "Water supply and Sanitation", Galgotia publishing company, New Delhi, 1994.
3. Metcalf and Eddy, "Waste Water Engineering – Treatment and reuse", Tata McGraw-Hill, New Delhi, 2003.
4. Mark J. Hammer, Mark J. Hammer Jr, "Water and Waste Water Technology", Prentice hall of India, 5<sup>th</sup> Edition, 2007.

**EN6602**

**ENVIRONMENTAL INSTRUMENTATION**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the principles and application of different instruments used for performance monitoring and testing of equipment in wastewater treatment, air pollution control, effluent analysis and emission monitoring.

**UNIT I GENERAL 9**

Study of machinery, electric motors types and characteristics, other prime covers, pumps, capacity, operation and maintenance of pumping machinery, air compressors preventive



maintenance, break-down maintenance, schedules – Factors to be considered in the selection of the equipments.

**UNIT II INSTRUMENTATION 9**

pH meter - Flame Emission Spectrometry. Absorption spectrometry - Nephelometry - Atomic Absorption Spectrometry - Gas chromatography – working principle and components. Total carbon analyser – Mercury Analyser polar graph for metal estimation and organic compounds - Ion selective Electrode -SO<sub>2</sub> and CO analyser – Instrument components and its working principle.

**UNIT III WATER SUPPLY MACHINERY AND WASTEWATER MACHINERY 9**

Drilling equipment, pumping equipment for wells. Machinery required for primary and secondary treatment, sewage pumps, sludge pumps, vacuum filtration equipment.

**UNIT IV EQUIPMENTS FOR TREATMENT UNITS 9**

Equipment for treatment unit - electrically and mechanically operated agitators, mixers, aerators, chlorinators, Surface aerators. Meters for measurement of flow, head, electricity.

**UNIT V AIR POLLUTION CONTROL EQUIPMENTS 9**

Working principles of electrostatic precipitator – cyclone separators – settling chamber – operation and Maintenance. Machinery for solid waste collection and disposal incineration – compactors – magnetic separators- incinerators.

**TOTAL:45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of various instruments and equipments used in measurement and monitoring for environmental engineering applications
- ability to describe the operation of a range of sensors and transducers with particular reference to monitoring of water and air quality

**TEXT BOOKS:**

1. Trivedy R. K. & Goel P.K., Chemical and Biological methods for water pollution studies, Environmental publication, Karat, 1986.
2. Cox C.R., Operation and Control of Water Treatment Processes, World Health Organisation, Geneva, 1964.

**REFERENCES**

1. Course Manual on Preventive Maintenance of Water Distribution System, NEERI, 1973.
2. Standards Methods for the Examination of Water and Waste Water, 17<sup>th</sup> Edition, WPCF, APHA and AWWA, USA, 1989.

**EN6603 GIS FOR ENVIRONMENTAL ENGINEERING L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the fundamentals of remote sensing and its applications in the field of environmental engineering.

**UNIT I FUNDAMENTALS OF REMOTE SENSING 9**

Introduction to remote sensing – Principles of Electro – Magnetic Radiation – Energy /Matter interaction with Atmosphere and land surface – spectral reflectance of earth materials and vegetation – Data products.

**UNIT II AERIAL PHOTOGRAPHY AND SATELLITE REMOTE SENSING 9**

Aerial Photography – Photogrammetry And Visual Image Interpretation. Various satellites in orbit and their sensors – Resolutions – Multispectral Remote Sensing system (MSS) and

design – VISIBLE - NIR remote sensing - Thermal IR Radiation properties, systems and application – Microwave and LIDAR remote sensing – Principles and applications.

**UNIT III DATA ANALYSIS AND GIS 9**

Data Analysis – Visual interpretation and digital image processing – Classification. Introduction to GIS, concepts and data base structure, various GIS software.

**UNIT IV REMOTE SENSING AND GIS APPLICATIONS 9**

Applications of Remote sensing and GIS – Management and Monitoring of Land, air, water and pollution studies – conservation of resources – coastal zone management – Limitations.

**UNIT V LABORATORY PRACTICES 9**

Data sources – Visual interpretation - digital image processing – Introduction to ENVI image processing software – GIS / Data Analysis in ARC GIS.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an understanding of the fundamentals of remote sensing, aerial photography and digital image processing
- ability to carryout data analysis using GIS for management and monitoring of land, air, water and pollution studies including conservation of resources
- ability to use image processing software and analysis in ARC GIS

**TEXT BOOKS:**

1. Anji Reddy, "Remote Sensing and Geographical Information system", B S publications 2001.
2. Srinivas M.G. "Remote sensing applications", Narosa publishing house, 2001.
3. Chandra. A M and Ghosh S.K. "Remote Sensing and Geographical Information System", Narosa Publishing House, 2006.

**REFERENCES:**

1. Lintz, J.and Simonet, Remote Sensing of Environment, Addison Wesley Publishing Company, 1994.
2. Burroughs P.A, Principles of Geographical Information System, Oxford University Press, 1998.
3. Thomas M Lille sand, Rupiah W. Kiefer & Jonathan W. Chip man "Remote sensing and Image Interpretation" John Wiley Sons, 2004.
4. Kumar S. , Basics of Remote Sensing and GIS, Firewall Media, 2005

**MG6851**

**PRINCIPLES OF MANAGEMENT**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

**UNIT II PLANNING 9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

**UNIT III ORGANISING 9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

**UNIT IV DIRECTING 9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

**UNIT V CONTROLLING 9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXTBOOKS:**

1. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall India Pvt. Ltd., 10<sup>th</sup> Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6<sup>th</sup> Edition, 2004.

**REFERENCES:**

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7<sup>th</sup> Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Wehrich "Essentials of management" Tata McGraw Hill, 1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

**EN6604**

**CLEANER PRODUCTION**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the importance, and different approaches of cleaner production in industries and to impart knowledge on environmental management tools applying cleaner production principle.

**UNIT I INTRODUCTION 9**

Sustainable development – Indicators of Sustainability – Sustainability Strategies - Barriers to Sustainability – Industrial activities and Environment – Industrialization and sustainable development – Industrial Ecology – Cleaner Production (CP) in Achieving Sustainability – Prevention versus Control of Industrial Pollution – Environmental Policies and Legislations – Regulation to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market Based Approaches.

**UNIT II CLEANER PRODUCTION 9**

Definition – methodology – Historical evolution – Benefits – Promotion – Barriers – Role of Industry, Government and Institutions – Environmental Management Hierarchy – Relation of CP and EMS – Integrated prevention and pollution limitation – Best Available Technology concept (BAT) – Internet information & Other CP Resources.

**UNIT III CLEANER PRODUCTION PROJECT DEVELOPMENT & IMPLEMENTATION 9**

Overview of CP - Assessment Steps and Skills - Preparing for the Site, Visit, Information gathering, and Process Flow Diagram - Material Balance - CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Establishing a Program – Organizing a Program – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan.

**UNIT IV SUPPORT INSTRUMENTS OF PREVENTION METHODS 9**

Life cycle analysis - Elements of LCA – Life Cycle Costing – Eco Labelling – Design for the Environment – International Environmental Standards – ISO 14001 – Environmental audit – Environmental statement.

**UNIT V CASE STUDIES 9**

Industrial Applications of CP, LCA, EMS and Environmental Audits.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to describe and comment the evolution of corporate environmental management strategies and its relation to the concept of sustainable development
- ability to describe Cleaner Production measures applicable to different industries
- ability to conduct energy and material balances for processes as part of a Cleaner Production assessment

**TEXT BOOKS:**

1. Paul L. Bishop, 'Pollution Prevention: Fundamentals and Practice', McGraw Hill International, 2000.
2. Prasad modak C. Visvanathan and Mandar parasnis , 'Cleaner Production Audit', Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.

**REFERENCES:**

1. World Bank Group 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production', World Bank and UNEP, Washington D. C., 1998.

**Web Sources**

1. [www.environmentalexpert.com](http://www.environmentalexpert.com).
2. [www.Cleaner production.com](http://www.Cleaner production.com).

**EN6611 ENVIRONMENTAL INSTRUMENTATION LABORATORY**

**LT P C  
0 0 3 2**

**OBJECTIVES:**

- To train the students on the use of different instruments used for performance monitoring and testing of equipment in wastewater treatment, air pollution control, effluent analysis and emission monitoring.

**LIST OF EXPERIMENTS:**

**A. Sample Collection, Handling and Preservation**

- Sampling Protocol: Planning a Sampling Strategy
- The Representative Sample: Random vs. Judgmental Sampling
- Sampling Equipment: Devices and Containers for soil, air and water.
- Sampling Techniques: soil and water
- Sampling Techniques: gases and vapors
- Sample Documentation and Preservation, Chain of Custody (COC)

**B. Methods of Analysis**

- Sample Preparation: Interferences and Detection Limits
- Quality Control
- Field Quality Control: Duplicate Samples
- Quality Control in the Laboratory: Equipment Calibration, Matrix spike and Blank samples.

**C. Electrode (potentiometric) Methods:**

- Use of bench top and field model pH meters
- Use of Dissolved Oxygen Meters.
- Use of TDS Meters.

**D. Spectrophotometry**

- Estimation of Phosphate.
- Estimation of Hydrocarbon.
- Estimation of Nitrogen.
- Estimation of Heavy Metals.

**E. Chromatography**

- Liquid/Gas Chromatography.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to collect, handle, preserve and analyse water, wastewater and solid samples
- ability to conduct potentiometric measurements
- ability to use spectrophotometer, liquid/gas chromatograph for analysis of environmental samples

**REFERENCES:**

1. Douglas A. Skoog and Donald M. West, Analytical chemistry: An introduction, CBS publishing Japan Ltd. New York, 1986.
2. Sawyer.C.N.and McCarty P. L. Chemistry for environmental engineering, McGraw Hill Publications, 4<sup>th</sup> edition, 1994.
3. Standards Methods for the Examination of Water and Waste Water, 17<sup>th</sup> Edition, WPCF, APHA and AWWA, USA, 1989.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	Sampling devices for water, wastewater and soil	1
2.	pH meter	3
3.	DO meter	1
4.	EC meter	2
5.	UV - Visible spectrophotometer	1
6.	HPLC	1
7.	GC	1
8.	Glasswares such as Pipette, Burette etc	1 for each student

EN6612

ENVIRONMENTAL ENGINEERING DESIGN AND DRAWING

L T P C  
0 0 3 2

**OBJECTIVES:**

- To train the students on preparing layout of water and wastewater treatment plants as well as general arrangement diagrams for units in water and wastewater treatment.

**LIST OF EXPERIMENTS:**

1. Layout of Water treatment plant
2. Sedimentation tank
3. Clariflocculator
4. Slow and rapid sand filters
5. Primary and secondary settling tanks
6. Trickling filter
7. Activated sludge process
8. Sludge digestion tank
9. Septic tank with dispersion trench and soak pit.
10. Infiltration gallery and pumping station.
11. Flow chart of ETP for selected Industries.
12. Flow Chart for CETP.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to prepare flow charts and layouts of water and wastewater treatment plants
- ability to design and detail structures and reactors required for water and wastewater treatment

**REFERENCES**

1. Birde.G.S and Birde. J.S,“Water supply and sanitary Engineering”, Dhanpat Rai Publications Pvt.Ltd New Delhi, 2001.
2. Rangwala.S.C, “Fundamentals of water supply and sewerage engineering”, Charotar Publishing, 2000.
3. Mannual on wastewater and treatment CPHEECO, Ministry of Urban Affairs and Eemployment, Govt. of India, New Delhi, 1990.
4. Shah.C. S., “Water supply and Sanitation”, Galgotia publishing company, New Delhi, 1994.
5. Metcalf and Eddy, “WasteWater Engineering – Treatment and reuse”, Tata McGraw-Hill, New Delhi, 2003.

**EN6613**

**G I S LABORATORY**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

- To train the students on using GIS softwares for simple applications in environmental engineering and water resources engineering.

**GIS SOFTWARES :**

- Arc GIS 9.02.
- ERDAS 8.73.
- Mapinfo 6.5
- Open source.

**LIST OF EXPERIMENTS:**

- Digitization of Map/Toposheet
- Creation of thematic maps.
- Study of features estimation
- Developing Digital Elevation model
- Simple applications of GIS in Environmental Engineering.
- Simple applications of GIS in water Resources Engineering.

- Simple applications of GIS in Ground water Engineering.
- Simple applications of GIS in Air Pollution.
- Simple applications of GIS in water Quality Management.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to carryout digitization of maps, create thematic maps and apply them for applications to Environmental Engineering, water quality management and air pollution control

**REFERENCE:**

1. Albert C.P.L.O, Yong K.W. "Concept and Techniques of GIS", Prentice Hall Publishers, 2006

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
1.	Computer	1 system for 2 students
2.	GIS software	minimum 5 user license
3.	A4 / A3 size	Scanner – 1 no
4.	A4/A3 size	Printer / Plotter – 1 no

**EN6701**

**SUSTAINABLE DEVELOPMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on the principles for balancing social, economic and environmental dimensions of development and the associated international and national frameworks

**UNIT I INTRODUCTION 9**

Status of environment – Environmental, Social and Economical issues – Need for sustainability – Nine ways to achieve sustainability – population, resources, development and environment.

**UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT AND GLOBAL ENVIRONMENTAL ISSUES 9**

Concept of sustainability – Factors governing sustainable development – Linkages among sustainable development- Environment and poverty – Determinants of sustainable development – Case studies on sustainable development - Population, income and urbanization – Health care – Food, fisheries and agriculture – Materials and energy flows.

**UNIT III SUSTAINABLE DEVELOPMENT INDICATORS 9**

Need for indicators – Statistical procedures – Aggregating indicators – Use of principal component analysis – Three environmental quality indices.

**UNIT IV ENVIRONMENTAL ASSESSMENT 9**

National environmental policy act of 1969 – Environmental Impact Assessment – Project categories based on environmental impacts – Impact identification methods – Environmental impact assessment process.

**UNIT V ENVIRONMENTAL MANAGEMENT AND SOCIAL DIMENSIONS 9**

Revisiting complex issues – Sector policies concerning the environment – Institutional framework for environmental management - Achievements in environmental management - People's





Design of masonry walls, pillars and footings as per NBC and IS Codes -Structural design of underground reservoirs and swimming pools, Intake towers - effect of earth pressure and uplift considerations – design of - Cyclone separator – Scrubber

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to apply the principle of limit state design.
- Ability to do structural design of concrete and steel pipes
- Ability to do the structural design of a complete water and wastewater treatment plant.
- Ability to do air pollution control devices design
- Ability to design underground water storage structures

**TEXT BOOKS:**

1. Krishna Raju, "Prestressed Concrete" Tata McGraw Hill Publishing Co. 2<sup>nd</sup> Edition, 1988.
2. Sinha N.C. & Roy S.K "Reinforced Concrete" S.Chand and Co., 1985
3. Ramaswamy, G.S., "Design and Construction of Concrete shell roofs", CBS Publishers, India, 1986.

**REFERENCES:**

1. Green, J.K. and Perkins, P.H., "Concrete liquid retaining structures", Applied Science Publishers, 1981.
2. Rajagopalan K., "Storage structures", Tata McGraw Hill, New Delhi, 1989.
3. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributors, New Delhi, 1988

**EN6703**

**HAZARDOUS WASTE MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on the identification, characterization, source reduction, storage, transport, processing and safe disposal of hazardous wastes.

**UNIT I WASTE IDENTIFICATION AND CHARACTERISATION 9**

Hazardous waste definition - Physical and Health hazards wastes – Hazardous Waste Management and Handling Rules – Characterization of hazardous wastes - Analytical– Analytical methods –Hazardous waste inventory- Source reduction of hazardous wastes

**UNIT II STORAGE, TRANSPORT AND PROCESSING OF WASTES 10**

Handling and storage of Hazardous wastes –Waste Compatibility Chart - Hazardous Waste Transport- Manifest system – Transboundary movement of wastes – Basal Convention - Hazardous waste treatment technologies - Physical, chemical and thermal treatment of hazardous waste – Solidification - Chemical fixation – Encapsulation - Incineration

**UNIT III SECURE LANDFILLS 9**

Hazardous waste landfills - Site selections – landfill design and operation - Regulatory aspects – Liner System- Cover system- Leachate Collection and Management – Environmental Monitoring System- Landfill Closure and post closure care

**UNIT IV REMEDIATION OF CONTAMINATED SITES 8**

Contaminated sites – Site Assessment – Remediation Technologies – Onsite and off site remediation techniques - Bioremediation- Phytoremediation- Physico chemical techniques, Soil flushing - Pump and treat systems – restoration of remediated sites

**UNIT V SPECIAL HAZARDOUS WASTES 9**

Biomedical waste – Definition – Sources – Classification – Collection - Segregation Treatment and disposal – National Regulatory framework

Radioactive waste: Definition – Sources - Low level and high level radioactive wastes and their management - Radiation standard by ICRP and AERB.- National Regulatory framework  
Electronic Wastes : Waste characteristics - Generation - Collection - Recycling and disposal- National Regulatory framework  
Lead Acid Batteries : Generation, impacts and management - National Regulatory framework

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- an insight into the characterization of hazardous wastes and the role of different stakeholders under the national legal framework
- ability to plan minimization of hazardous wastes
- ability to design facilities for the storage, transport, processing and disposal of hazardous wastes

**TEXT BOOKS:**

1. Hazardous waste management Charles A. Wentz. Second edition 1995. McGraw Hill International.
2. Environmental Sciences by Daniel B. Botkin and Edward A. Keller, Wiley student, 6<sup>th</sup> edition- 2009.
3. Harry M. Freeman, Standard handbook of Hazardous waste treatment and disposal McGraw Hill 1997.

**REFERENCES:**

1. Hazardous Waste (Management and Transboundary Movement) Rules, Ministry of Environment and Forests, Government of India, New Delhi, 1989
2. Biomedical Waste (Management and Handling) Rules, Ministry of Environment and Forests, Government of India, New Delhi, 1998
3. Electronic Waste Management and Handling Rules, Ministry of Environment and Forests, Government of India, New Delhi, 2011
4. Guidelines and criteria for hazardous waste landfills and hazardous waste treatment disposal facilities, Central Pollution Control Board, New Delhi, 2010

**EN6704**

**INDUSTRIAL WASTE MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control

**UNIT I INTRODUCTION**

**8**

Sources and characteristics of various industrial, process and wastes – Population equivalent – Effects of industrial effluents on streams, sewer, land, sewage treatment plants and on human health – Environmental legislations and standards related to prevention and control of industrial pollution and hazardous wastes.

**UNIT II CLEANER PRODUCTION**

**8**

Volume reduction - Strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery – Applications – Waste minimization

**UNIT III TREATMENT TECHNOLOGIES**

**11**

Equalisation - Neutralisation - Removal of suspended, floating and dissolved organic solids - Chemical oxidation - Adsorption - Removal of dissolved inorganic - Combined treatment of industrial and municipal wastes - Residue management - Dewatering – Disposal.

**UNIT IV POLLUTION FROM MAJOR INDUSTRIES****9**

Sources - Characteristics - Waste treatment flow charts for selected industries such as Textiles - Tanneries - Pharmaceuticals - Electroplating industries - Dairy - Sugar - Paper - distilleries - Steel plants – Refineries – Fertilizer - thermal power plants - Wastewater reclamation and reuse concepts.

**UNIT V HAZARDOUS WASTE MANAGEMENT****9**

Hazardous wastes – Types – Sources - Collection - Physico chemical treatment – Solidification – Incineration – Secured landfills.

**TOTAL : 45 PERIODS****OUTCOMES:**

The students completing the course will have

- an insight into the pollution from major industries including the sources and characteristics of pollutants
- ability to plan minimization of industrial wastes
- ability to design facilities for the processing and reclamation of industrial wastewater

**TEXT BOOKS:**

1. M.N. Rao & A. K. Dutta, "Wastewater Treatment", Oxford - IBH Publication, 1995.
2. Eckenfelder W.W. Jr., "Industrial Water Pollution Control", McGraw Hill Book Company, New Delhi, 2000.
3. Patwardhan. A.D., "Industrial Wastewater Treatment", Prentice Hall of India, 2010.

**REFERENCES:**

1. Shen T.T., "Industrial Pollution Prevention", Springer, 1999.
2. Stephenson R.L and Blackburn J.B, Jr., "Industrial Wastewater Systems Hand book", Lewis Publisher, New York, 1998
3. Freeman H.M., "Industrial Pollution Prevention Hand Book", McGraw Hill Inc., New Delhi, 1995.
4. Bishop P.L., "Pollution Prevention: Fundamental & Practice", McGraw Hill, 2000.
5. Pandey, "Environmental Management" Vikas Publications, 2010.
6. Industrial Wastewater Management, Treatment and Disposal", (WEF Manual of practice - FD3) McGraw Hill, 2008.

**EN6711****PLANT LAY OUT DESIGN****L T P C  
0 0 3 2****OBJECTIVES:**

- To develop skills in design and layouts for various environmental engineering projects.

**LIST OF EXPERIMENTS:**

1. Layout design for water treatment plants including HFD and PID
2. Layout design for sewage treatment plants including HFD and PID
3. Layout of effluent treatment plant for Textile industry water
4. Layout of effluent treatment plant for Sugar mill waste
5. Layout of effluent treatment plant for distilleries industry waste
6. Layout of effluent treatment plant for Dairy industry waste
7. Layout of effluent treatment plant for Tanning industry waste
8. Layout of effluent treatment plant for Pulp and paper mill waste
9. Layout of effluent treatment plant for pharmaceutical industry waste
10. Layout of effluent treatment plant for Metal finishing industry waste+
11. Fertilizer industrial waste
12. Common Effluent Treatment Plants including reclamation for textile industry

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- ability to design layouts for various environmental engineering projects for wastewater and effluent treatment

**REFERENCES:**

1. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
2. Manual on Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 1993
3. Hand book on Water Supply and Drainage, SP35, B.I.S., New Delhi, 1987
4. Qasim, S.R. Water works Engineering Prentice Hall, 2006
5. Qasim, S.R. Waste water Engineering, CRC Dress, 2011

**CE6611**

**ENVIRONMENTAL ENGINEERING LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To understand the sampling and preservation methods and significance of characterization of wastewater.

**LIST OF EXPERIMENTS:**

1. Determination of Ammonia Nitrogen in wastewater.
2. Coagulation and Precipitation process for treating waste water
3. Determination of suspended, volatile, fixed and settleable solids in wastewater.
4. B.O.D. test
5. C.O.D. test
6. Nitrate in wastewater.
7. Phosphate in wastewater.
8. Determination of Calcium, Potassium and Sodium.
9. Heavy metals determination - Chromium, Lead and Zinc.  
(Demonstration only)

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>Sl. No.</b>	<b>Description of Equipment</b>	<b>Quantity</b>
1.	Oxygen analyzer	1
2.	Spectrophotometer	1
3.	Ion – selective electrode	1
4.	Sodium Potassium Analyzer – Flame Photometer	1
5.	Gas Chromatography	1
6.	Atomic absorption spectroscopy (Ni, Zn, Pb)	1
7.	Nephlo - turbidimeter	1
8.	BOD Analyser	1
9.	COD Analyser	1
10.	Jar Test Apparatus	1

**OUTCOMES:**

- The students completing the course will have ability to conduct characterization of wastewater and able to do treatability studies.

**REFERENCE :**

- Standards Methods for the Examination of Water and Waste Water, 17<sup>th</sup> Edition, WPCF, APHA and AWWA, USA, 1989.

**EN6712**

**INDUSTRIAL SAFETY LABORATORY**

**L T P C  
0 0 3 2**

**OBJECTIVES:**

- To impart knowledge on measurement and analysis of noise, ambient air pollution, exhaust gas, as well as on the use of personal protective equipment and fire extinguishers.

**UNIT I NOISE LEVEL MEASUREMENT AND ANALYSIS 9**

Measurement of noise level - Instrument – Precision type of Noise level meter with frequency and spectrum analyzer - Various sources – Continuous and intermittent noises – Impact identification - Frequency and spectrum analysis of noise - Measurement of whole body vibration for various acceleration- Instrument – vibration simulator and vibration analyzer.

**UNIT II AMBIENT AIR POLLUTION AND EXHAUST GAS MEASUREMENT AND ANALYSIS 10**

Measurement of Exhaust gas measurement of IC engines: Instrument – Gas analyzer  
Measurement of breathing zone concentration of dust and fumes: Instrument – Personal air sampler  
Measurement of respirable and non-respirable dust in ambient air - Measurement of gaseous pollutants in ambient air: Instrument – High volume sampler - Soft computing skills on developing effects of fire & explosion and dispersion: Software – PHAST 1 and ALOHA.

**UNIT III STUDY ON PERFORMANCE MONITORING OF WATER AND WASTEWATER TREATMENT PLANTS 9**

Study of performance monitoring in wastewater treatment plants – CETPs of industrial units – domestic wastewater treatment plant.

**UNIT IV STUDY OF PERSONAL PROTECTIVE EQUIPMENT 8**

Safety helmet – Belt - hand gloves – Goggles - Safety shoe - Gum boots - Ankle shoes - Face shield - Nose mask - Ear plug - ear muff - Apron and leg guard.

**UNIT V STUDY OF FIRE EXTINGUISHERS 9**

Selection and demonstration of first-aid fire extinguishers: soda acid, foam, carbon dioxide (CO<sub>2</sub>), dry chemical powder, halon.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- conduct noise level measurement and exhaust gas measurement
- assess the performance of wastewater treatment plants
- identify and use appropriate personal protective equipments
- use first aid and fire extinguishers

**REFERENCES:**

- “Accident Prevention Manual for Industrial Operations” NSC, Chicago, 1982. 4. GREEN, A.E., “High Risk Safety Technology”, John Wiley and Sons,. 1984.
- Petroleum Act and Rules, Government of India, 1934
- Carbide of Calcium Rules, Government of India, 1987

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

Sl. No.	Description of Equipment	Quantity
---------	--------------------------	----------

1.	Noise level meter	2
2.	High volume sampler with impinger attachment facility	1
3.	Lab scale fire extinguishers	1 in each type
4.	Personal protective equipment	1 in each type for demo
5.	Gas analyser	1

EN6801

**ENVIRONMENTAL IMPACT ASSESSMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on Environmental management and Environmental Impact Assessment.

**UNIT I INTRODUCTION 8**

Impact of development projects – Sustainable development- Need for Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA-Stages of EIA, Types of EIA

**UNIT II METHODOLOGIES 9**

Methods of EIA – Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives

**UNIT III PREDICTION AND ASSESSMENT 9**

Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna- Mathematical models- Public participation

**UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9**

Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the issues related to the Project Affected People. Post project monitoring

**UNIT V CASE STUDIES 10**

EIA for infrastructure projects – Dams – Highways – Multi-storey Buildings – Water Supply and Drainage Projects – Waste water treatment plants.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- carry out scoping and screening of developmental projects for environmental and social assessments
- explain different methodologies for environmental impact prediction and assessment
- plan environmental impact assessments and environmental management plans
- evaluate environmental impact assessment reports

**TEXT BOOKS:**

- Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
- Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.

**REFERENCES:**

- John G. Rau and David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.
- "Environmental Assessment Source book", Vol. I, II & III. The World Bank, Washington, D.C.,1991.
- Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 1999.

EN6811

**PROJECT WORK**

**L T P C**  
**0 0 12 6**

**OBJECTIVES:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 180 PERIODS**

**OUTCOMES:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

EN6001

**WEALTH FROM WASTE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on waste recycling and resource recovery from wastes.

**UNIT I INTRODUCTION**

**9**

Solid waste – Sources – Domestic, industrial and agriculture sources- Industrial wastes- Mineral wastes - Identification waste - Minimizing options -Recovery and Recycle-Composting- Vermi composting - Incineration - Energy from waste- Pyrolysis, chemical processing- Legislative measures for garbage disposal.

**UNIT II FLY ASH**

**9**

Introduction- Nature- Direct Replacement of Cement- Waste Land Development- Soil Amendment to grow Crops- Utilization of Flyash In Afforestation, Limitation of Land Application of Fly Ash.

**UNIT III PLASTIC WASTE, INDUSTRIAL WASTE**

**9**

Introduction – Amount and types of plastic waste – Recycling of plastic waste-cement manufacture from industrial solid waste - Paper industry waste - Calcium carbide industry waste.

**UNIT IV BIO FUELS & BIO ETHANOL**

**9**

Bio ethanol production technologies- Bio hydrogen- its application - Methanogenesis from agro-industrial residues- Bio mass – Gasifier based power plants.

**UNIT V WASTE WATER**

**9**

Introduction reuse- Quality, the basic treatment processes - Benefits of reuse in agriculture - The costs of reuse projects and economic justification - Factors essential for the success of reuse projects- Case study.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- discuss issues related to recycling and resource recovery from wastes and wastewater

- develop management plans for fly ash, plastic wastes
- recover biofuel from wastes and biomass

**TEXT BOOK:**

1. Agarwal S.K. "Wealth from Waste", Kul Bhushan Nangia, APH Publishing Corporation, New Delhi, 2005

**REFERENCES:**

1. Nemerow N.L., "Industrial Water Pollution", Addison – Wesley Publishing Company inc., USA, 1978
2. Wesley Eckenfelder Jr. W, Industrial water pollution control, McGraw Hill book Co, New Delhi, 1989.
3. Mahajan S.P. "Pollution Control in process industries", Tata McGraw Hill Publishing Co Ltd., New Delhi, 1989.

**EN6002**

**GREEN BUILDING DESIGN**

**L T P C  
2 0 2 3**

**OBJECTIVES:**

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project

**UNIT I INTRODUCTION**

**8**

Life Cycle impacts of materials and products - sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind - Solar radiation and solar temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings - Thermal properties of building materials.

**UNIT II ENERGY EFFICIENT BUILDINGS**

**7**

Passive cooling and day lighting - Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency - Energy audit and energy targeting- Technological options for energy management.

**UNIT III INDOOR ENVIRONMENTAL QUALITY MANAGEMENT**

**8**

Psychrometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement- Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation.

**UNIT IV GREEN BUILDING CONCEPTS**

**7**

green building concept- Green building rating tools- Leeds and IGBC codes. - Material selection- Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation- Water treatment systems- Water efficiency- Building economics

**UNIT V GREEN BUILDING DESIGN CASE STUDY**

**30**

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget-Students will research green construction and design in a particular -construction context and report their results to the class.

**TOTAL (L:30+P:30): 60 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the concepts of sustainable design and green building techniques including energy efficiency and indoor environmental quality management
- create drawings and models of their own personal green building project



**TEXT BOOKS:**

- 1 Kibert, C. "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2005
- 2 Edward G Pita, "An Energy Approach- Air-conditioning Principles and Systems", Pearson Education, 2003.

**REFERENCES:**

1. Colin Porteous, "The New Eco-Architecture", Spon Press, 2002.
2. Energy Conservation Building Codes: www.bee-india.nic.in
3. Lever More G J, "Building Energy Management Systems", E and FN Spon, London, 2000.
4. Ganesan T P, "Energy Conservation in Buildings", ISTE Professional Center, Chennai, 1999.
5. John Littler and Randall Thomas, "Design with Energy: The Conservation and Use of Energy in Buildings", Cambridge University Press, 1984.

**EN6003****PROCESS SAFETY AND LOSS PREVENTION****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the different occupational hazards, safety issues, safety management, regulation and accident prevention technique.

**UNIT I OCCUPATIONAL HEALTH HAZARD****9**

Occupation, Health and Hazards- Safety Health and Management- Occupational Health Hazards- Ergonomics- Importance of Industrial Safety- Radiation and Industrial Hazards- Types and effects- Vibration- Industrial Hygiene- Different air pollutants in industries and their effects- Electrical, fire and Other Hazards- General causes- Machine Guards and its types- Automation.

**UNIT II OCCUPATIONAL SAFETY****9**

Safety at Workplace- Safe use of Machines and Tools- Safety in use of different types of unit operations- Ergonomics of Machine guarding- Working in different workplaces- Operation- Inspection and maintenance- Plant Design and Housekeeping- Industrial lighting- Vibration and Noise.

**UNIT III ACCIDENT PREVENTION****9**

Accident Prevention Techniques- Principles of accident prevention- Definitions, Theories, Principles- Hazard identification and analysis- Event tree analysis- Hazop studies- Job safety analysis- Theories and Principles of Accident causation- First Aid- Body structure and functions- Fracture and Dislocation- Injuries to various body parts.

**UNIT IV SAFETY MANAGEMENT SYSTEMS LEGISLATIONS****9**

Safety Management System and Law- Legislative measures in Industrial Safety- Various acts involved in Detail- Occupational safety- Health and Environment Management- Bureau of Indian Standards on Health and Safety, 14489, 15001-OSHA- Process safety management (PSM) and its principles- EPA standards- Safety Management- Organisational & Safety Committee- Its structure and functions

**UNIT V SAFETY MEASURES****9**

Plant Layout for Safety- Design and location- Distance between hazardous units- Lighting- colour coding- Pilot plant studies- Housekeeping- Accidents Related with Maintenance of Machines- Work Permit System- Significance of Documentation Directing Safety- Definition- Process- Principles and Techniques Leadership- Role, function and attribution of a leader Case studies- Involving implementation of health and safety measures in Industries.

**TOTAL : 45 PERIODS****OUTCOMES:**

The students completing the course will have ability to

- describe the different occupational safety issues and safety management system requirements
- develop safety management plans incorporating safety measures and accident prevention techniques

**TEXT BOOKS:**

1. R.K. Jain and Sunil S. Rao, Industrial safety, Health and Environment Management, Khanna publishers, New Delhi, 2006
2. Frank P. Lees - Loss of Prevention in Process Industries, Vol 1 and 2, Butterworth - Heinemann Ltd., London, 1991

**REFERENCES:**

1. Industrial Safety - National Council of India, 2013
2. Factories Act with Amendments, Govt. of India Publications DGFASLI, Mumbai, 1987

**EN6004**

**WIND POWER ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart an understanding of windpower measurements, wind data analysis, wind turbine specifications, engineering and economic analysis of wind turbine power plants.

**UNIT I INTRODUCTION**

**9**

Forces influencing Wind - Wind Speeds and scales - Wind Mechanics - Pressure gradient force and Coriolis force - Atmospheric Boundary Layer - Atmospheric Stability - Turbulence - Surface Wind-Potential of wind electricity generation in India and its current growth rate.

**UNIT II MEASUREMENTS AND ANALYSIS**

**10**

Instrumentation for wind measurements-Wind data analysis-Wind resource estimation-Wind sensing systems-Recording systems-Power extracted from wind -Power curve -Velocity duration curve-wind characteristics and site selection -linear momentum theory-power coefficient- Betz limit.

**UNIT III AERODYNAMICS AND COMPONENTS**

**10**

Aerofoil-Lift and drag curves Asymmetrical-Symmetrical foil-Pitch angle-Pitch control-Tip speed ratio Balancing technique (Rotor & Blade)-Solidity-Hub-Nacelle-Yaw control-Layout and operation of wind turbine-Wind turbine specifications.

**UNIT IV WIND TURBINES AND GENERATING SYSTEM**

**9**

HAWT-VAWT-Savonius turbines-Darrieus turbines-Off shores turbines-Merits and demerits of wind power generation-CSCF-VSCF-VSVF-Combined wind and solar plant-Combined wind and diesel plant.

**UNIT V ECONOMIC ANALYSIS**

**7**

Wind resource assessment and R & D costs- Fixed and variable costs- Value of wind Energy -Life cycle costing and cash flow of wind power projects-Wind energy market - General Principles, guidelines and acceptable limits-Noise and Electro Magnetic Interference due to wind mills.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the concepts of atmospheric stability and wind mechanics
- measure and analyse wind patterns
- specify the aerodynamics and engineering components of wind turbines and power systems
- conduct economic and environmental assessment of wind power plants

**TEXT BOOKS:**

1. Freris L.L., "Wind Energy Conversion Systems", Prentice Hall, 1990.
2. Johnson G.L., "Wind Energy Systems", Prentice Hall Inc, New Jersey, 1985

**REFERENCES:**

1. Erich Hau, "Wind Turbines- Fundamentals: Technologies, Application, Economics, Springer - Verlag Berlin -Heidelberg, 2006
2. Hansen, Martin, O, L, "Aerodynamics of Wind Turbine", James and James Science Publishers Ltd, London 2000

**EN6005**

**WATER POWER ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart an understanding of hydropower measurements, hydrograph analysis, hydraulic turbine specifications, engineering and economic analysis of hydro power plants.

**UNIT I BASIC HYDRO POWER CONCEPTS**

**9**

Hydrological cycle - Selection of site-Run off - Factors affecting runoff - Hydrograph and flow duration curve - Mass curve - Storage and pondage - Advantages and disadvantages of water power - Potential of hydropower in India- Its development and future prospect.

**UNIT II LAYOUT**

**9**

Operation and selection of hydro plant – Layout - Essential elements - Catchment area-Reservoir – Dams -Selection of site - Gravity dams - Earth dams - Rock fill dams – Spillways –Types – Conduits - Surge tanks –Types -Water hammer - Draft tubes.

**UNIT III HYDRAULIC TURBINES**

**9**

Types - Selection factors -Turbine size - Pelton wheel - Francis turbine - Propeller turbine-Kaplan turbine - Bulb turbine - Scale ratio - Comparison of turbines - Governing of hydraulic turbines.

**UNIT IV TYPES OF HYDRO POWER PLANTS**

**9**

Classification of hydro plants - Run-of - River plants -Valley dam plants - High head diversion plants - Diversion Canal Plants - Pumped storage plants -Tidal power plants - Small and Mini hydro power system: Introduction - Site development - Generation and electrical equipment-System of regulation of hydroelectric power in India.

**UNIT V ECONOMIC ANALYSIS**

**9**

Cost of hydro plants - Combined hydro and steam plant - Plant selection-Equipment selection - Economic factors -National water grid - Case studies - Potential of small hydro power in North East India -Hydro power projects in Western Himalayas.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the different concepts relevant to hydropower engineering
- design essential elements of hydropower plant
- conduct economic and environmental assessment of hydro power plants

**TEXT BOOKS:**

1. Nag P.K., "Power Plant Engineering" Tata McGraw Hill, 2<sup>nd</sup> Edition, 4<sup>th</sup> Fourth reprint 2003.
2. Rai-Khanna. G.D., "An introduction to power plant technology" Publishers, Delhi, 2013

**REFERENCES:**

1. Dr.Sharma P.C, Kataria S. K. & Sons, "Power Plant Engineering" 2009
2. Small and mini Hydropower system by Tata McGraw Hill, 1984

**OBJECTIVES:**

- To understand and solve tidal hydraulic problems related to estuarine dynamics, environmental issues and tidal power generation.

**UNIT I INTRODUCTION TO ESTUARIES 9**

Definition and classification of estuaries. Topographic classification. Classification by salinity structures. Stratification numbers. Salinity effects on shoaling. Tides and tides predictions. Tidal constituents. Wind and wind generated waves. Wave forms, wind set-up and set-down. Seiche, storm surge.

**UNIT II HYDRODYNAMIC ANALYSIS OF ESTUARIES 9**

Factors influencing hydrodynamics. Tides, freshwater inflow, salinity, Coriolis's force. Solution methods – analytical methods, numerical and physical models, hybrid methods.

**UNIT III SEDIMENTATION OF ESTUARIES 9**

Sediment sources, sediment classification. Coarse and cohesive sediment transport. Impact of tidal flow and geometry. Sediment Characterization. Transport parameters. Numerical and physical models. Analytical and hybrid methods. Navigation safety. Maintenance and dredging.

**UNIT IV ENVIRONMENTAL CONSIDERATIONS 9**

Water quality, biological considerations. Dredging effects. Environmental data collection and analysis. Mitigation decision analysis.

**UNIT V TIDAL POWER 9**

Basic principles. Location of tidal power plant. Difficulties in tidal power generation. Components of tidal power plants. Single and Double Basin Systems. Constructional aspects. Estimate of Energy and Power. Regulation of Power Output. Economic Feasibility. Potential Tidal power sites.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have ability to

- describe the different concepts relevant to tidal power engineering
- design essential elements of tidal power plant
- conduct economic and environmental assessment of tidal power plants

**TEXT BOOKS:**

- EM 1110-2-1607, "Tidal Hydraulics", US Army Corps of Engineers, Washington, 1991.
- Dandekar M.M. and Sharma K.N. " Water Power Engineering". Vikas Publishing House Pvt. Ltd. 2<sup>nd</sup> Reprint, Noida, 2010.

**REFERENCES:**

- Reeve D., Chadwick A. and Flemming C. "Coastal Engineering: Processes, Theory and Design Practice." 2<sup>nd</sup> Ed. Spon Press, 2012.
- Novak P., Moffat A.I.B., Nalluri C. and Narayanan R. "Hydraulic Structures". Unwin Hyman Ltd., London, 1989.

**OBJECTIVES:**

- To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle		
<b>UNIT II</b>	<b>ELEMENTS RELATED TO CLIMATE CHANGE</b>	<b>7</b>
Green house gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect		
<b>UNIT III</b>	<b>IMPACTS OF CLIMATE CHANGE</b>	<b>10</b>
Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas		
<b>UNIT IV</b>	<b>MITIGATING CLIMATE CHANGE</b>	<b>9</b>
IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.		
<b>UNIT V</b>	<b>ALTERNATE FUELS AND RENEWABLE ENERGY</b>	<b>10</b>
Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit.		
		<b>TOTAL: 45 PERIODS</b>

**OUTCOMES:**

The students completing the course will have

- an insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change
- understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties
- ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy

**TEXT BOOKS:**

1. Ruddiman W.F, freeman W.H. and Company, “Earth’s Climate Past and Future”, 2001
2. Velma. I. Grover “Global Warming and Climate” Change. Vol I an II. Science Publishers, 2005.
3. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

**REFERENCES:**

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2005
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

**OBJECTIVES:**

- To impart knowledge on groundwater movement, development of ground water resources hydro chemical behaviour of contaminants and the principles involved in contaminant transport through groundwater.

**UNIT I INTRODUCTION****8**

Ground water and the hydrologic cycles- Ground water as a resource- Ground water contamination- Ground water as a geotechnical problem- Ground water and geologic processes- Physical properties and principles- Darcy's law- Hydraulic head and fluid potential- Piezometers and nests.

**UNIT II OCCURANCE AND MOVEMENT OF GROUND WATER****9**

Hydraulic conductivity and permeability- Homogeneity and anisotropy- Porosity and voids ratio- Unsaturated flow and the water table- Steady state flow and transient flow- Compressibility and effective stress- Transmissivity and storativity- Equations of ground water flow - Limitations of Darcian Approach- Hydro dynamic dispersion.

**UNIT III RESOURCE EVALUATION****9**

Development of ground water resources- Exploration of Aquifers- The response of ideal aquifers to pumping- Measurement of parameters- Laboratory tests- Numerical simulation for aquifer yield prediction- Artificial recharge and induced infiltration- Land subsidence- Sea water intrusion.

**UNIT IV CHEMICAL PROPERTIES AND PRINCIPLES****10**

Constituents- Chemical equilibrium- Association and dissociation of dissolved species- Effects of concentration gradients- Mineral dissolution and solubility- Oxidation and reduction process-Ion exchange and adsorption- Environmental isotopes- Field measurement of index parameters- Chemical evolution- Ground water in carbonate terrain- Ground water in crystalline rocks- Ground water in complex sedimentary systems- Geotechnical interpretation of <sup>14</sup>C dates- Process rates and molecular diffusion.

**UNIT V SOLUTE TRANSPORT****9**

Water quality standards- Transport process- Non reactive constituents in homogeneous media- Transport in fracture media- Hydrochemical behaviour of contaminants- Trace metals- Nitrogen- Trace non metals- Organic substances- Measurement of parameters- Velocity- Dispersivity- Chemical partitioning- Sources of contamination- Land disposal of solid waste- Sewage disposal on land. USGS- Moc model: Modeling principles- MOC modeling.

**TOTAL : 45 PERIODS****OUTCOMES:**

The students completing the course will have the ability to

- explain the different hydro dynamic principles of groundwater flow, contamination and solute transport
- evaluate groundwater resources
- apply groundwater contaminations models

**TEXT BOOKS:**

1. Randall J. Charbeneau-Ground water Hydraulics and Pollutant Transport, Prentice Hall. Inc, 1999
2. Remson I.,Hornberger G.M. and Moltz F.J., "Numerical Methods in Subsurface Hydrology", Wiley, New York, 1971

**REFERENCES:**

1. Allen Freeze R. and John A. Cherry "Ground water. Prentice Hall. Inc, 1979
2. Raghunath, H.M., Ground Water, 2<sup>nd</sup> edition, Wiley Eastern Ltd., New Delhi, 1987.
3. Rushton K.R., "Groundwater Hydrology" Conceptual and Computational Models, Wiley, 2003
4. Elango L. and Jayakumar, R. "Modelling in Hydrology", Allied Publishers Ltd., 2001

**EN6009**                      **EPIDEMIOLOGY AND CONTROL OF COMMUNICABLE DISEASES**                      **L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on diseases transmitted through air, water, food, vectors and pollution sources as well as major components of health services

**UNIT I                      GENERAL**                      **9**

Definitions - Dynamics of disease Transmission - Investigation of disasters - Survey - Chain of transmission of diseases - disease control - control of source - control of mode of transmission - susceptible host - typical epidemic control - Investigations.

**UNIT II                      RESPIRATORY, WATER, AND FOOD BORNE DISEASES**                      **9**

Respiratory diseases - Definition - Group - control of source. Water and Food borne diseases - General reservoir of infection – agents - food decomposition - vehicle or transmission of diseases - control of water and food-borne diseases.

**UNIT III                      INSECT BORNE DISEASES**                      **9**

Insect borne diseases and Zoonoses – Infections from mosquitoes, house flies, rats, louse, pubic louse and other insects - General, insect borne diseases, zoonoses and their spread - control at source - control of mode of transmission.

**UNIT IV                      MISCELLANEOUS DISEASES AND ILLNESSES**                      **9**

Miscellaneous diseases and illnesses - Ringworm, hookworm infections, ancylostomiasis, tetanus, amoebiasis.

Other illnesses associated with environment and food - Lead poisoning, carbon monoxide poisoning - mercury poisoning - illnesses associated with air pollution - nutritional deficiency diseases – Illness associated with building materials.

**UNIT V                      ASPECTS OF HEALTH SERVICES**                      **9**

The Organization of Health services – Tasks for the health services - the major components of health services (curative, preventive, special services, statistics and health education) - resources for the health services – community participation in health services. Declaration of Alma-Ata.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- explain the different types of diseases transmitted through air, water, food, vectors and other diseases associated with pollution.
- outline the dynamics of disease transmission and different aspects of health services

**TEXT BOOK:**

1. Park J. E. and Park K., "Text Book of Preventive and Social Medicine", X Edition, 1989

**REFERENCES:**

1. Rieman Hans, "Food borne infections and intoxications", Academic Press, New York, 1969.
2. Roger Y. Stanier, John L. Ingraham, Mark. L. Wheelis and Pagn. R. Painter, General Microbiology, MacMillan Press Ltd., 1995
3. Dubey, R. C and Maheswari, D.K, "A Text Book of Microbiology" S. Chand and Company Ltd., New Delhi, 2002.

**EN6010**                      **LOW CARBON ECONOMY**                      **L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on different sources of carbon emission, carbon reduction opportunities, low carbon technologies and Indian Missions on Climate Change

**UNIT I CARBON EMISSION 9**

Sources – Primary sectors – Agriculture, Livestock, Forestry – Mining, Secondary sectors – metal processing – non metallic product processing, wood processing – paper and pulp making – food processing, Tertiary sectors – Transportation services, health services

**UNIT II CARBON REDUCTION OPPORTUNITIES 9**

Energy efficiency – Energy conservation – Fuel switching – Energy policy - Energy storage- Smart grid- Methane cycle- Nuclear power and Carbon Capture and Storage- green house gas balances and mitigation costs.

**UNIT III LOW CARBON TECHNOLOGIES 9**

Green home – sustainable energy sources – bio energy, solar, hydro, geothermal – Fuel cells and hydrogen – Electric vehicles

**UNIT IV ENERGY EFFICIENT PROGRAMMES 9**

Good housekeeping practices – Regulation and/standards – Industrial cogeneration – Fiscal policies – Agreement/targets – Energy audits – Research and Development

**UNIT V INTEGRATED ENERGY POLICY 9**

Policy for renewable and non-conventional energy sources – Household energy security – Energy – environment linkages – Energy supply-side and demand-side environment concern – Environmental impacts of renewable energy – India’s approach to climate change

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- Identify sources of carbon emissions and outline the carbon reduction opportunities, low carbon technologies
- Develop energy efficient programmes and integrated energy policy in line with national and global approach to climate change mitigation.

**TEXT BOOKS:**

- Tom Tietenberg, “Environmental and Natural Resource Economics’, 5<sup>th</sup> Edition, Harper Collins College Publishers, 2000.
- Perman R, Y. Ma, J. McGilvray and M. Common, Natural Resource and Environmental Economics, 3<sup>rd</sup> edition, Pearson Education, Harlow, 2003.

**REFERENCES:**

- Bertz Metz etal., “IPCC Special Report on Carbon dioxide capture and storage, Cambridge University Press, 2005.
- “Integrated Energy Policy” – Report of the Expert Committee, Government of India, Planning Commission, New Delhi, 2006

**EN6011**

**URBAN AND RURAL SANITATION**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To expose the students the various aspects of urban and rural sanitation.

**UNIT I PRINCIPLES OF HEALTHFUL HOUSING 9**

Control of environment – Engineering methods - Modes of transmission of diseases – Mosquitoes and Flies - Life cycle, important characteristics and control measures of carriers.



Basic principles of healthful housing - heating - ventilation - lighting - air conditioning – noise control in residential buildings.

**UNIT II PLUMBING AND SWIMMING POOL SANITATION 9**

Scope of plumbing - definition of plumbing terms - general principles of good plumbing system – water seal - types of traps, siphonage – design of plumbing system for multistory buildings - plumbing codes and standards.

Transmission of diseases in swimming pools - quality standards of pool water - design features of pools and their appurtenances.

**UNIT III REFUSE AND FOOD SANITATION 9**

Refuse characteristics in urban and rural areas - conditions and factors affecting collection, quantity and conveyance of solid waste - disposal methods - incineration - design of incinerators sanitary landfill - composting - waste recycling - biogas and gobar gas plants.

Food borne and food caused diseases – food poisoning - food preservation – precautions in the design of kitchen - bactericidal treatment of kitchen utensils - Bacteriological contents of milk borne diseases - essential of milk sanitation - dairy barn sanitation - pasteurization methods - milk tests.

**UNIT IV URBAN AND RURAL WATER SUPPLY SYSTEM 9**

Water supply arrangements in urban buildings - design of water supply systems for multistoried buildings - consideration in the development of water supply programmes for rural areas - health and economical aspects in the design and installation of rural water supply systems - methods of construction and development of different types of wells - sanitation of rural wells - pumps for rural wells - treatment methods for rural water supply.

**UNIT V RURAL SANITATION 9**

Layout of drainage systems in urban domestic areas - methods of disposal of night soil in rural areas - different privies - Twinpit pourflush toilets, VIP latrines - water carriage method of sewage disposal - cesspools and seepage pits - septic tank systems - oxidation ponds - aerated lagoons.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- describe basic principles of healthful housing, plumbing systems, rural water supply and sanitation
- plan appropriate water supply and sanitation systems for multistoried buildings and rural areas

**TEXT BOOKS:**

1. Salvato, "Environmental Sanitation", John Wiley & Sons, New York, 1982.
2. Ehler and Steel, "Municipal Rural Sanitation", McGraw Hill Book Co., New York, 1964.
3. Wagner E.G. and Lanoix J.N., "Water supply for rural areas and small communities", World Health Organisation Publication, Geneva, 1958.

**REFERENCES:**

1. Babbitt H.E and Donald J.J., Water supply Engineering, McGraw Hill Book Co., New York, 1962.

**EN6012**

**URBAN AND RURAL PLANNING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To expose the students the various aspects of urban and rural planning.

**UNIT I BASIC ISSUE IN URBAN PLANNING**

**8**

Urban planning and development- Definition of terms- Explanation of concepts- National Policies and strategies on issues related to urban planning- Trends of Urbanization- International, National and Regional level- Positive and Negative impacts of Urban development.

**UNIT II PLANNING PROCESS 7**

Principles of planning- Types and levels of Urban plans- Stages in planning Process- Goals- Objective- delineation of planning areas- Surveys and Analysis.

**UNIT III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUTION 10**

Scopes and content of regional plan- Master plan- Detailed development plans- Structure plans- Sub regional Plan- Planning of Industrial Estates Development strategies- Formulation and Evaluation.

**UNIT IV INTRODUCTION TO RURAL PLANNING 10**

The basic concept of rural development- History of Rural Development in India- Current issues in development- Different perspectives on Planning & Development- Different approaches to planning- Rural Development Policy.

**UNIT V SOCIO ECONOMIC ASPECTS OF RURAL PLANNING 10**

The nature of rural economy- Agricultural change and restructuring- The role of agriculture in the rural economy- Rural households- Resources- Activities and Income- Services- Infrastructure and investments in rural areas- Water and Sanitation facilities- Planning and Financial analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- describe basic issues in urban planning
- formulate plans for urban and rural development
- plan and analyse socio economic aspects of urban and rural planning

**TEXT BOOKS:**

1. Karat Singh, "Rural development, principles, Policies and Management stages", Sage publication India Pvt.Ltd, 2009
2. Goel.S.L 'Urban Development and Management', Deep and Deep Publications, New Delhi, 2002.
3. Khanna B.S., Rural Development in South Asia Volume, India. Deep and Deep Publications, 1991

**REFERENCES:**

1. Edwin S.Mills and Chares M. Becker, "Studies in Urban development", A world Bank publication,1986.
2. Singh.V.B. Revitalized, "Urban administration in India", Kalpaz publication, Delhi, 2001
3. George Chanwick, "A system view planning", Pergamon Press,Oxford1978
4. Participatory Rural Appraisal: "Principle, Methods and applications", Sage publication India Pvt Ltd, 2009
5. Vasant desai, Rural development (Vol. I to VI) in the seventh plan, Himalaya Publishing Co. 1988

**EN6013**

**SOLAR ENERGY**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To expose the students with the different aspects of measurement, harvesting and utilization of solar energy.

**UNIT I INTRODUCTION 9**

Basic Heat Transfer Principles- Availability of Solar Energy- Nature of Solar Energy- Solar Energy & Environment- Sun as the source of radiation- Solar radiation- Measurement of solar radiation-

Irradiance- Solar constant- Insolation- Radiosity- Emissive power- Earth's equator- Meridian- Longitude- Sun earth angles- Sunrise, sun set and day length- Solar time- Equation of time- Various Methods of using solar energy- Photo thermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

**UNIT II SOLAR CELLS 10**

Various generations- Semiconductor materials- Doping- Fermi level- PN junction and characteristics- Photovoltaic effect- Photovoltaic material- Parameters of solar cells- Effects of cell temperature on cell efficiency- Types of solar cells- Solar modules and arrays- Advantages and limitations of solar energy system- Solar cell power plant- Silicon, thin film and polymer processing- Silicon wafer based solar cells.

**UNIT III SOLAR THERMAL ENERGY 10**

Stationary collectors- FPC- CPC- ETC- Sun tracking concentrating collectors- PTC- PDR- HFC- Fresnel collectors- Solar thermal power plants- Solar chimney power plant- Solar pond- Solar water heater- Solar cooker- Types- SODIS- Thermal energy storage- Solar cooling- Limitations of solar thermal energy.

**UNIT IV SOLAR PHOTOVOLTAICS 9**

Photovoltaic cell function- Types of PV system- Design of PV system- Grid connected PV system- Stand alone PV system- Efficiency of PV module- MPPT- Applications of PV system- SPV lighting system- Solar water pumping system- Solar vehicles- Solar dryer- BIPV- Features of SPV system- Case study- Solar water pumping system in Punjab- Performance study on solar drying system in Nepal.

**UNIT V ECONOMIC ANALYSIS 7**

Life cycle analysis of Solar Energy Systems - Time Value of Money - Evaluation of Carbon Credit of Solar Energy Systems.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- assess solar energy potential
- describe different direct and indirect solar energy tapping systems including Solar Photovoltaic's, solar cells and solar thermal power plants

**TEXT BOOKS:**

1. Soteris A. Kalogirou, 'Solar Energy Engineering: Processes and Systems', Academic Press, London, 2009
2. Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.

**REFERENCES:**

1. John W. Twidell & Anthony D.Weir, 'Renewable Energy Resources,2005
2. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4<sup>th</sup> Edition, John Wiley and Sons, 2013
3. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

**EN6014 SPACE TECHNOLOGY AND WASTE DISPOSAL L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on environmental controls, life support systems, shielding strategies and waste management systems during space exploration missions

**UNIT I RISK IN HUMAN SPACE EXPLORATION MISSIONS 9**

Mission success: maintaining crew safety, health, and performance; carrying out key scientific goals; returning selected specimens or data; and completing public outreach activities-Cost risk-

risk from budgetary issues, including unplanned expenditures or inadequate funding. Programmatic risk: risk created by political, management, or technical challenges - Biomedical risk: crew safety, health – Risk management schemes

**UNIT II ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM OF SPACE STATIONS 9**

Space Environment - Human-rated vehicle requirements - Crew health and safety- emergency provisions- oxygen regeneration for metabolic consumption- Oxygen Generation Assembly – maintenance of cabin partial pressure, temperature and humidity - air purification for particulates and VOCs– carbon dioxide reduction assembly- Fire detection and suppression subsystem- case studies

**UNIT III SHIELDING STRATEGIES FOR HUMAN SPACE EXPLORATION 9**

Ionosphere - Space radiation sources, models, and environmental uncertainty- Human risk models and risk uncertainty- Biological response to heavy ion exposure - human factors implications for shielding- Radiation shielding design issues- assessment of current shielding issues - integrated shield design methodologies- case studies

**UNIT IV WATER RECOVERY SYSTEM FOR SPACE STATIONS 9**

water recovery from crewmember urine, cabin humidity condensate and Extra Vehicular Activity (EVA) wastes - electrolysis systems for water– low pressure vacuum distillation process - Urine Processor Assembly (UPA) and a Water Processor Assembly

**UNIT V WASTE MANAGEMENT FOR SPACE STATIONS 9**

Types of waste (solid, liquid, gas) (organic and non-organic) - Sources of waste products (biological {human & animal} and non-biological) – Launch wastes - Combustion residue- operational wastes - Collection, storage, and processing/disposal of waste products - Mineralization, microbial control, hazard reduction- Compaction - Super Critical Water Oxidation process – microwave freeze drying –lyophilisation - Hydrothermal oxidation – pyrolysis - gasification – radioactive waste management –nuclear waste disposal in space.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have the ability to

- discuss issues related to waste management and environmental controls in space exploration
- outline life support systems, shielding strategies and waste management systems during space exploration missions

**TEXT BOOKS:**

1. Stine GH. Living in Space: A Handbook for Work and Exploration Stations Beyond the Earth’s Atmosphere. M. Evans and Company, New York, 1997
- NASA, “Guidelines and Capabilities for Designing Human Missions”, NASA Exploration Team Human Subsystem Working Group, 2003

**REFERENCES:**

1. Wilson J W, Miller J. A. Konradi, and Cucinotta F. A. “Shielding strategies for Human space explorations”, Ed: NASA Conference Publication, NASA 1997
2. Robin des Bois "Space Waste, environmental Non Governmental Organization, 2011

**EN6015 CLIMATOLOGY AND METEOROLOGY L T P C  
3 0 0 3**

**OBJECTIVES:**

- To expose the students the various aspects of Climatology and Meteorology.

**UNIT I EARTH’S CLIMATE SYSTEM 9**

Introduction- Climate in the spotlight- The Earth's Climate Machine- Climate Classification- Global Wind Systems- Trade Winds and the Hadley Cell- The Westerlies- Cloud Formation and Monsoon Rains- Storms and Hurricanes- The Hydrological Cycle- Global Ocean Circulation- El Nino and its Effect- Solar Radiation- The Earth's Natural Green House Effect- Green House Gases and Global Warming- Carbon Cycle.

**UNIT II OBSERVED CHANGES AND ITS CAUSES 9**

Observation of Climate Change- Changes in patterns of temperature- Precipitation and sea level rise- Observed effects of Climate Changes- Patterns of Large scale Variability- Drivers of Climate change- Climate Sensitivity and Feedbacks- The Montreal Protocol- UNFCCC- IPCC- Evidences of changes in Climate and Environment- On a Global Scale and in Indian.

**UNIT III IMPACTS OF CLIMATE CHANGE 9**

Impacts of Climate Change on Various sectors- Agriculture, Forestry and Ecosystem- Water Resources- Human Health- Industry, Settlement and Society- Methods and Scenarios- Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate change- Risk of Irreversible Changes.

**UNIT IV METEOROLOGY 9**

Importance of the atmosphere- composition of atmosphere Regions and Stratification of atmosphere- Energy transfer in the atmosphere- Atmosphere mass transfer- Meteorology and weather meteorological parameters- Inversion and air pollution- Microclimate- Global aspect of Weather and Climate.

**UNIT V PLUME BEHAVIOR AND POLLUTANT DISPERSION 9**

Temperature Lapse rate- Atmospheric stability- Maximum Mixing Depth- Ventilation Coefficient- Meteorology influence on Plume Behavior- Effect of topography on Pollutant dispersion- Effect of air pollutants on meteorology- Effective stack height- Gaussian plume model.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe earth's climate system, meteorology, observed changes in climate and its impacts
- predict plume behavior and pollutant dispersion

**TEXT BOOKS:**

1. Stanley E. Manahan, "Environmental Science and Technology", Lewis Publisher, 1997
2. KVSA, Muralikrishna, "Air Pollution and control", published by Kanshal and co – Kakinada, 1997

**REFERENCES:**

1. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press 2003
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press Indian Pvt.Ltd, 2007
3. Anjaneyulu.Y 'Air pollution and Control Technology' Allied Publishers (P) Ltd, India 2002.
4. IPCC, Fourth Assessment Report- the AR4 synthesis report.

**EN6016**

**SITE ASSESSMENT AND REMEDIATION**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the fundamentals of Geo-Environmental Engineering, soil – water – contaminant interaction, waste containment system and remediation of contaminated sites.

**UNIT I FUNDAMENTALS OF GEO- ENVIRONMENTAL ENGINEERING 9**

Scope of Geoenvironmental engineering- Multiphase behavior of soil- Role of soil in geoenvironmental applications- Importance of soil physics, soil chemistry, hydrogeology-

Biological process- Sources and type of ground contamination- Impact of ground contamination on geo-environment- Case histories on geoenvironmental problems.

**UNIT II SOIL-WATER-CONTAMINANT INTERACTION 9**

Soil mineralogy characterization and its significance in determining soil behavior- Soil-water interaction and concepts of double layer- Forces of interaction between soil particles- Concepts of unsaturated soil- Importance of unsaturated soil in geoenvironmental problems- Measurement of soil suction- Water retention curves- Water flow in saturated and unsaturated zone- Soil-water contaminant interactions and its implications- Characterization of retention and transport.

**UNIT III WASTE CONTAINMENT SYSTEM 9**

Site selection based on environmental impact assessment- Evolution of waste containment facilities and disposal practices- Different role of soil in waste containment- Different components of waste containment system and its stability issues- Property evaluation for checking soil suitability for waste containment- Design of waste containment facilities.

**UNIT IV CONTAMINANT SITE REMEDIATION 9**

Site characterization - Risk assessment of contaminated site - Remediation methods for soil and groundwater - Selection and planning of remediation methods - Some examples of in-situ remediation.

**UNIT V ADVANCED SOIL CHARACTERIZATION 9**

Contaminant analysis- Water content and permeability measurements- Electrical and thermal property evaluation- Use of GPR for site evaluation- Introduction to geotechnical centrifuge modeling.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the fundamentals of Geo-environmental engineering and waste soil interactions
- carryout advanced soil characterisation
- apply soil-water-contaminant interactions in the design of waste containment systems and contaminated site remediation

**TEXT BOOKS:**

1. Martin N. Sara., Site Assessment and Remediation Handbook, Second Edition, Lewis Publishers, 2003.
2. Edward J. Calabrese, Paul T. Kostecki, James Dragun., Contaminated Soils, Sediments and Water: Successes and Challenges, Birkhäuser publications, 2005

**REFERENCES:**

1. Hiremath K. G., Recent Advances in Environmental Science, Discovery Publishing House, 2003
2. Ramachandra T.V., Soil and Ground Water Pollution from Agricultural Activities. TERI Press, New Delhi, 2009.
3. Gary M. Pierzynski, J. Thomas Sims, George F.Vence. Soil and Environmental Quality.III Edition. CRC Press, Taylor and Francis Group, UK., 2005
4. William J. Deutsch. Ground Water Geochemistry. Fundamentals and Applications to Contamination. Lewis Publishers, New York, 1997.
5. Evan K. Nyer, Sami Fam, Donald F. Kidd, Frank J. Johns II, Peter L. Palmer, Gary Baettcher. Tom L. Crossman, Suthan S. Suthersan, Insitu Treatment Technology, Lewis Publishers, New York, 1996.

**OBJECTIVES:**

- To expose the students the various aspects of Nuclear energy.

**UNIT I NUCLEAR REACTIONS**

**9**

Mechanism of Nuclear Fission- Nuclides- Radioactivity- Decay Chains- Neutron Reactions- The Fission Process- Reactors- Types of Fast Breeding- Reactor- Design and Construction of Nuclear reactors- Heat Transfer Techniques in Nuclear Reactors- Reactor Shielding.

**UNIT II REACTOR MATERIALS**

**9**

Nuclear Fuel Cycles- Characteristics of Nuclear Fuels- Uranium- Production and Purification of Uranium- Conversion to UF<sub>4</sub> and UF<sub>6</sub>- Other Fuels like Zirconium, Thorium and Beryllium.

**UNIT III REPROCESSING**

**9**

Nuclear Fuel Cycles- Spent Fuel Characteristics- Role of Solvent Extraction in Reprocessing- Solvent Extraction Equipment.

**UNIT IV SEPARATION OF REACTOR PRODUCTS**

**9**

Processes to be Considered - 'Fuel Element' Dissolution - Precipitation Process - Ion Exchange- Redox - Purex - TTA- Chelation - U235- Hexone - TBP and Thorax Processes - Oxidative Slaging and Electro – Refining – Isotopes - Principles of Isotope Separation.

**UNIT V WASTE DISPOSAL AND RADIATION PROTECTION**

**9**

Types of Nuclear Wastes - Safety Control and Pollution Control and Abatement - International Convention on Safety Aspects - Radiation Hazards Prevention.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the nuclear reactions, design and construction of nuclear reactors and nuclear waste management practices
- choose nuclear reactor materials
- design systems to separate nuclear reactor products and dispose nuclear wastes

**TEXT BOOKS:**

1. Thomas J.Cannoly,"Fundamentals of nuclear Engineering" John Wiley 1978.
2. Collier J.G., and Hewitt G.F,"introduction to Nuclear power", Hemisphere publishing, New York,1987.

**REFERENCES:**

1. Lamarsh J.R., "Introduction to Nuclear Reactor" Theroy, Wesley, 1966.
2. Duderstadt J.J and Hamiition L.J., "Nuclear Reactor Analysis" John Wiley 1976.
3. Walter A.E.and Reynolds A.B., Fast Breeder Reactor, Pergamon Press,1981.
4. Glasstone S. and Sesonske A., Nuclear Reactor Engineering, 3<sup>rd</sup> Edition, Von Nostrand, 1981.
5. Winterton R.H.S., Thermal Design of Nuclear Reactors - Pergamon Press,1981.
6. Wakil M.M.El., "Power Plant Technology", McGraw Hill International, 1984.

**GE6757**

**TOTAL QUALITY MANAGEMENT**

**L T P C**

**3 0 0 3**

**OBJECTIVES :**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION**

**9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran

and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

**UNIT II TQM PRINCIPLES 9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I 9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II 9**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY SYSTEMS 9**

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

**TOTAL: 45 PERIODS**

**OUTCOMES :**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXTBOOK:**

1. Dale H. Besterfield, et al., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

**EN6018**

**COASTAL ZONE MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES :**

- At the end of the semester, the student shall be able to understand the coastal processes, coastal dynamics, impacts of structures like docks, harbours and quays leading to simple management perspectives along the coastal zone.

**UNIT I COASTAL ZONE 9**

Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Non living resources.

**UNIT II WAVE DYNAMICS 10**

Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.



<b>UNIT III</b>	<b>WAVE FORECASTING AND TIDES</b>	<b>9</b>
Need for forecasting - SMB and PNJ methods of wave forecasting – Classification of tides – Darwin’s equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.		
<b>UNIT IV</b>	<b>COASTAL PROCESSES</b>	<b>8</b>
Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.		
<b>UNIT V</b>	<b>HARBOURS</b>	<b>9</b>
Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore forest.		

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe the Coastal zone regulations, coastal processes and wave dynamics
- forecast waves and tides and plan coastal structures including harbours

**TEXT BOOKS:**

1. Richard Sylvester, “Coastal Engineering, Volume I and II”, Elseiner Scientific Publishing Co., 1999
2. Quinn, A.D., “Design & Construction of Ports and Marine Structures”, McGraw Hill Book Co., 1999

**REFERENCES:**

1. Ed. A.T. Ippen, “Coastline Hydrodynamics”, McGraw-Hill Inc., New York, 1993
2. Dwivedi, S.N., Natarajan, R and Ramachandran, S., “Coastal Zone Management in Tamilnadu”, Madras, 1991

<b>EN6019</b>	<b>ENGINEERING ECONOMICS AND COST BENEFIT ANALYSIS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To impart knowledge on economic principles, project financing and cost benefit analysis

**UNIT I BASIC ECONOMICS 9**  
 Definition of Economics - Nature and scope of economic science - Nature and scope of managerial economics - Basic terms and concepts- Goods - Utility - Value- Wealth- Factors of production - Land - Its peculiarities- Labour- Economics of large and small scale- Consumption wants - Its characteristics and classification- Law of diminishing marginal utility - Relation between economic decision and technical decision.

**UNIT II DEMAND AND SCHEDULE 9**  
 Demand - Demand schedule - Demand curve - Law of demand - Elasticity of demand - Types of elasticity - Factors determining elasticity - Measurement- Its significance- Supply- Supply schedule - Supply curve - Law of supply- Elasticity of supply- Time element in determination of value- Market price and normal price- perfect competition- Monopoly- Monopolistic competition.

**UNIT III ORGANISATION 9**  
 Forms of business - Proprietorship - Partnership- Joint stock company - Cooperative organization - State enterprise - Mixed economy - Money and banking- Banking - kinds - Commercial banks - Central banking functions- Control of credit- Monetary policy- Credit instrument.

**UNIT IV FINANCING 9**  
 Types of financing - Short term borrowing - Long term borrowing- Internal generation of funds- External commercial borrowings- Assistance from government budgeting support and international

finance corporations- Analysis of financial statement - Balance sheet - Profit and loss account - Funds flow statement.

## **UNIT V COST AND BREAK EVEN ANALYSES**

**9**

Types of costing- Traditional costing approach- Activity based costing- Fixed cost- Variable cost- Marginal cost- Cost output relationship in the short run and in long run- Pricing practice- Full cost pricing- Marginal cost pricing - Going rate pricing- Bid pricing- picking for a rate of return- Appraising project profitability - Internal rate of return- Payback period- Net present value- Cost benefit analysis- Feasibility reports- Appraisal process- Technical feasibility- Economic feasibility- Financial feasibility- Break even analysis- Basic assumptions- Break even chart- Managerial uses of break even analysis.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

The students completing the course will have ability to

- describe the basic concepts and terms in economics, supply demand theory, project financing options and reporting
- carry out economic feasibility analysis of projects

### **TEXT BOOKS:**

1. Dewett K K and Varma J D 'Elementary Economic Theory', S Chand & Co. Publications, 2006.
2. Khan MY and Jain PK, 'Financial Management' McGraw – Hill Publishing Co Ltd., 2006.

### **REFERENCES:**

1. Satya Prakashan 'Sharma J C "Construction Management and Accounts' New Delhi, 2004.
2. Bhide A D and Sunderaeson B B, 'Solid Waste Management in developing countries' INSDOC, 2001.
3. Barthwal R R 'Industrial Economics – An Introductory Textbook', New Age Publications, 2000.
4. Samuelson P A, 'Economics – An Introductory Analysis' McGraw – Hill Publications, 2000.
5. Varshney R.L and Maheshwary K.L 'Managerial Economics' S, Chand and Co Publications, New Delhi, 2001.

**EN6020**

**RISK ANALYSIS AND MANAGEMENT**

**L T P C  
3 0 0 3**

### **OBJECTIVES:**

- To impart knowledge on environmental risk assessment and risk management

## **UNIT I INTRODUCTION**

**8**

Sources of Environmental hazards- Types of Risk-Environmental, Safety and ecological risks- Risk assessment framework- Regulatory perspectives and requirements- Risk Analysis and Management - Social benefit Vs technological risks- Path to risk analysis- Perception of risk- Risk assessment in different disciplines.

## **UNIT II ELEMENTS OF ENVIRONMENTAL RISK ASSESSMENT**

**9**

Hazard identification and accounting - Properties, processes and parameters that control fate and transport of contaminants - - Dose Response Evaluation - Slope Factors- Dose Response calculations and Dose Conversion Factors - Risk Characterization and consequence determination- Estimation of carcinogenic and non carcinogenic risks to human health- - Exposure Assessment - Exposure Factors -Multimedia and multipathway exposure modeling of contaminant concentrations in air, water, soils and vegetation

**UNIT III TOOLS AND METHODS FOR RISK ASSESSMENT 10**

HAZOP and FEMA methods- Cause failure analysis - Event tree and fault tree modeling and analysis - Vulnerability assessment - Uncertainty analysis - Methods in Ecological risk assessment - Probabilistic risk assessments- Radiation risk assessment- Data sources and evaluation.

**UNIT IV RISK MANAGEMENT 10**

Risk communication and Risk Perception- Comparative risks- Risk based decision making- Risk based environmental standard setting- Emergency Preparedness Plans- Emergency planning for chemical agent release- Design of risk management programs- Adaptive management- Precaution and stake holder involvement.

**UNIT V APPLICATIONS 9**

Case studies on risk assessment and management for hazardous chemical storage - Chemical industries - Tanneries - Textile industries- Mineral processing and Petrochemical plants - Hazardous waste disposal facilities - Nuclear power plants- contaminated site remediation - Case histories on Bhopal, Chernobyl, Seveso and Three Mile Island.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- carryout hazard identification and accounting, risk characterization and consequence determination, event tree and fault tree modeling and Probabilistic risk assessments.
- develop management plans including risk communication and emergency preparedness planning
- plan environmental risk assessment of industries and hazardous activities

**TEXT BOOKS:**

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.

**REFERENCES:**

1. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
2. Mark Burman, Risks and Decisions for Conservation and environmental management, Cambridge University Press, 2005

**EN6021**

**GEO-THERMAL ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on Geo-Thermal Resources and Geo thermal power generating systems

**UNIT I INTRODUCTION 9**

Thermal structure of earth-Heat flow and temperature distribution-heat and storage-Heat conduction, radiation and convection –Geo thermal gradient-Thermal conductivity-Potential Sites-Estimations of Geothermal Power-Nature of Geothermal Sites-Basic geo thermal power plant

**UNIT II RESOURCES 9**

Hydro geothermal-Dry steam fields-Wet steam fields-Hot water fields-Geo pressure resources-Hot dry rocks-Magma resources-Volcanoes- Prospects of geothermal energy in India -Total flow power unit

**UNIT III HOT SPRINGS 9**

Hot spring system structure-Warm spring-Flow rates-High flow hot springs-Therapeutic uses-Infections-Hot springs around the world- Merits and demerits of geothermal energy- Applications of geothermal energy

**UNIT IV      POWER GENERATING SYSTEMS      9**

Single flash steam plant-Double flash steam plant-Dry steam plants-Binary cycle power plants-Advanced geothermal energy conversion systems-Environmental effects

**UNIT V      ADVANCEMENTS      9**

Advanced concepts-R&D challenges and activities-Recent progress-Commercialization and deployment activities-Market context-Case study-Larderello dry steam power plant, Italy-Mutnovsky flash steam power plant, Russia

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The students completing the course will have ability to

- describe earth-heat flow and temperature distribution and geo thermal resources
- plan geo thermal power plants

**TEXT BOOKS:**

1. Harsh K. Gupta, Sukanta Roy, Elsevier, "Geothermal Energy: An Alternative Resource for the 21<sup>st</sup> Century, first edition, 2006
2. G.D. Rai "Non Conventional Energy Sources" Khanna Publishers, New Delhi, 1<sup>st</sup> edition, 2010.

**REFERENCE:**

1. Ronald Dipippo, Elsevier Geothermal Power Plants Principles, Applications and Case Studies, 2<sup>nd</sup> edition, 2007