# NATIONAL ENGINEERING COLLEGE

*(An Autonomous Institution, Affiliated to Anna University, Chennai)*

## K.R.NAGAR, KOVILPATTI – 628 503

# REGULATIONS – 2013

## DEPARTMENT OF

# CIVIL ENGINEERING

# CURRICULUM AND SYLLABI OF

# B.E. – CIVIL ENGINEERING

## DEPARTMENT OF CIVIL ENGINEERING

## VISION

- Producing outstanding Civil Engineering Professionals with human values to face future challenges.

## MISSION

- To provide with excellent teaching and research ambience.
- To prepare student for leadership roles in civil engineering.
- To facilitate student with lifetime skills and human values.
- To collaborate with industries to meet the ever challenging environment.

## Program Educational Objectives (PEO)

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

1. Will have a successful career in civil engineering.
2. Pursue advanced degrees in support of their chosen profession.

## Program Outcomes (PO)

At the time of graduation graduates of our CIVIL programme are expected to have

1. An ability to apply fundamental knowledge of mathematics, science and civil engineering in real-world problems.

2.  An ability to identify, formulate and provide solution for engineering problems.

3.  An ability to design and evaluate the desired needs.

4.  An ability to conduct test and interpret the results.

5.  An ability to use the skills, modern tools and techniques.

6.  An ability to analyze the local and global impact of civil engineering.

7.  Awareness of environment, innovations and sustainable development.

8.  An ability to display their professional responsibilities meeting ethical standards.

9.  An ability to have an idea of contemporary issues and an ability to function on multidisciplinary teams.

10. An ability to communicate effectively both in written and oral.

11. Recognition of the need for and an ability to engage in professional development and life-long learning.

12. An ability to lead a project team for the successful completion.

# REGULATIONS 2013 – CURRICULUM AND SYLLABI

## B.E. CIVIL ENGINEERING

**SEMESTER I** (Common to all B.E. / B.Tech., Degree Programmes)

| Sl. No. | Course Code | Course Title | L | T | P | C |
|---------|-------------|--------------|---|---|---|---|
| *THEORY* | | | | | | |
| 1. | SH100 | Technical English – I | 3 | 1 | 0 | 4 |
| 2. | SH101 | Matrices and Differential Calculus | 3 | 1 | 0 | 4 |
| 3. | SH102 | Applied Physics | 3 | 0 | 0 | 3 |
| 4. | SH103 | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 5. | SH104 | Fundamentals of Computing and Programming in C | 3 | 0 | 0 | 3 |
| 6. | SH105 | Engineering Graphics | 2 | 3 | 0 | 4 |
| *PRACTICAL* | | | | | | |
| 7. | SH106 | C Programming Laboratory | 0 | 0 | 3 | 2 |
| 8. | SH107 | Physics and Chemistry Laboratory – I  Part A – Physics Laboratory – I  Part B – Chemistry Laboratory – I | 0 | 0 | 3 | 2 |
| 9. | SH108 | Engineering Practices Laboratory  Part A – Mechanical and Civil Engineering Practices  Part B – Electrical and Electronics Engineering      Practices | 0 | 0 | 3 | 2 |
| **Total Number of Credits :** | | | | | **27** | |

# SEMESTER II

| S.No. | Course Code | Course Title | L | T | P | C |
|-------|-------------|--------------|---|---|---|---|
| *THEORY* | | | | | | |
| 1. | 13F20 | Technical English – II (***Common to all***) | 3 | 0 | 0 | 3 |
| 2. | 13F21 | Integral Calculus and Transforms (***Common to all***) | 3 | 1 | 0 | 4 |
| 3. | 13F22 | Materials Science (***Common to Mechanical and Civil***) | 3 | 0 | 0 | 3 |
| 4. | 13F23 | Chemistry for Civil Engineering | 3 | 0 | 0 | 3 |
| 5. | 13F24 | Engineering Mechanics (***Common to Mechanical and Civil***) | 3 | 1 | 0 | 4 |
| 6. | 13F25 | Basic Electrical and Electronics Engineering (***Common to Mechanical and Civil***) | 3 | 1 | 0 | 4 |
| *PRACTICAL* | | | | | | |
| 7. | 13F26 | Computer Programming Laboratory (***Common to all***) | 0 | 1 | 2 | 2 |
| 8. | 13F27 | Physics and Chemistry Laboratory – II (***Common to all***) Part A – Physics Laboratory – II Part B – Chemistry Laboratory – II | 0 | 0 | 3 | 2 |
| 9. | 13F28 | Computer Aided Drafting and Modeling Laboratory (***Common to Mechanical and Civil***) | 0 | 1 | 2 | 2 |
| 10. | 13F29 | English Language Skill Laboratory (***Common to all***) | 0 | 0 | 3 | 2 |
| **Total Number of Credits :** | | | | **29** | | |

## SEMESTER III

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|-------|-------------|--------------|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | 13CE31 | Fourier Transforms and Complex Analysis | 3 | 1 | 0 | 4 |
| 2 | 13CE32 | Environmental Science and Engineering | 3 | 0 | 0 | 3 |
| 3 | 13CE33 | Mechanics of Solids | 3 | 1 | 0 | 4 |
| 4 | 13CE34 | Mechanics of Fluids | 3 | 1 | 0 | 4 |
| 5 | 13CE35 | Surveying – I | 3 | 1 | 0 | 4 |
| 6 | 13CE36 | Engineering Geology | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | |
| 7 | 13CE37 | Survey Practical – I | 0 | 0 | 3 | 2 |
| 8 | 13CE38 | Computer Aided Building Drawing | 0 | 0 | 3 | 2 |
| 9 | 13CE39 | Communication Skills and Technical Seminar | 0 | 0 | 3 | 2 |
| | | | **18** | **4** | **9** | **28** |
| | | **Total  Number of Credits** | | | | **28** |

## SEMESTER IV

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|-------|-------------|--------------|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | 13CE41 | Probability, Statistics and Numerical Methods | 3 | 1 | 0 | 4 |
| 2 | 13CE42 | Strength of Materials | 3 | 1 | 0 | 4 |
| 3 | 13CE43 | Applied Hydraulic Engineering | 3 | 1 | 0 | 4 |
| 4 | 13CE44 | Surveying – II | 3 | 1 | 0 | 4 |
| 5 | 13CE45 | Construction Materials and Practice | 3 | 0 | 0 | 3 |
| 6 | 13CE46 | Highway Engineering | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | |
| 7 | 13CE47 | Hydraulic Engineering Laboratory | 0 | 0 | 3 | 2 |
| 8 | 13CE48 | Survey Practical – II | 0 | 0 | 3 | 2 |
| | | | **18** | **4** | **6** | **26** |
| | | **Total  Number of Credits** | | | | **26** |

**SEMESTER V**

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | 13CE51 | Structural Analysis – I | 3 | 1 | 0 | 4 |
| 2 | 13CE52 | Soil Mechanics | 3 | 1 | 0 | 4 |
| 3 | 13CE53 | Design of Reinforced Concrete Elements | 3 | 1 | 0 | 4 |
| 4 | 13CE54 | Water supply treatment and management | 3 | 0 | 0 | 3 |
| 5 | 13CE55 | Professional Ethics and Human Values | 3 | 0 | 0 | 3 |
| 6 | 13CE56 | Concrete Technology | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7 | 13CE57 | Strength of Materials Laboratory | 0 | 0 | 3 | 2 |
| 8 | 13CE58 | Soil Mechanics Laboratory | 0 | 0 | 3 | 2 |
| 9 | 13CE59 | Concrete and Highway Engineering Laboratory | 0 | 0 | 3 | 2 |
| | | | **18** | **3** | **9** | **27** |
| | | **Total  Number of Credits** | | | | **27** |

**SEMESTER VI**

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | 13CE61 | Design of Reinforced Concrete and Brick Masonry Structures | 3 | 1 | 0 | 4 |
| 2 | 13CE62 | Structural Analysis – II | 3 | 1 | 0 | 4 |
| 3 | 13CE63 | Design of Steel Structures | 3 | 1 | 0 | 4 |
| 4 | 13CE64 | Foundation Engineering | 3 | 0 | 0 | 3 |
| 5 | 13CE65 | Waste water  treatment and management | 3 | 0 | 0 | 3 |
| 6 | 13CE66 | Irrigation Engineering | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7 | 13CE67 | Environmental  Engineering Laboratory | 0 | 0 | 3 | 2 |
| 8 | 13CE68 | Computer Aided Design and Drafting Laboratory | 0 | 0 | 3 | 2 |
| | | | **18** | **3** | **6** | **25** |
| | | **Total  Number of Credits** | | | | **25** |

## SEMESTER VII

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| THEORY | | | | | | |
| 1 | 13CE71 | Prestressed Concrete Structures | 3 | 1 | 0 | 4 |
| 2 | 13CE72 | Basics of Dynamics and Aseismic Design | 3 | 0 | 0 | 3 |
| 3 | 13CE73 | Estimation and Quantity Surveying | 3 | 0 | 0 | 3 |
| 4 | 13CE74 | Railways, Airports and Harbour Engineering | 3 | 0 | 0 | 3 |
| 5 | | Elective – I | 3 | 0 | 0 | 3 |
| 6 | | Elective – II | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | |
| 7 | 13CE77 | Civil Software Application Laboratory | 0 | 0 | 4 | 2 |
| 8 | 13CE78 | Design Project | 0 | 0 | 4 | 2 |
| 9 | 13CE79 | Comprehension | 0 | 0 | 3 | 1 |
| | | | 18 | 1 | 11 | 24 |
| | | Total Number of Credits | | | | 24 |

## SEMESTER VIII

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| THEORY | | | | | | |
| 1 | 13CE81 | Principles of Management | 3 | 0 | 0 | 3 |
| 2 | | Elective – III | 3 | 0 | 0 | 3 |
| 3 | | Elective – IV | 3 | 0 | 0 | 3 |
| 4 | | Elective – V | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | |
| 5 | 13CE87 | Project Work | 0 | 0 | 12 | 6 |
| | | | 12 | 0 | 12 | 18 |
| | | Total Number of Credits | | | | 18 |

## LIST OF ELECTIVES

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| STRUCTURAL ENGINEERING | | | | | | |
| 1 | 13CEAA | Bridge Structures | 3 | 0 | 0 | 3 |
| 2 | 13CEAB | Storage Structures | 3 | 0 | 0 | 3 |
| 3 | 13CEAC | Design of Plate and Shell Structures | 3 | 0 | 0 | 3 |
| 4 | 13CEAD | Tall Buildings | 3 | 0 | 0 | 3 |
| 5 | 13CEAE | Prefabricated structures | 3 | 0 | 0 | 3 |

| 6 | 13CEAF | Computer Aided Design of Structures | 3 | 0 | 0 | 3 |
|---|--------|-------------------------------------|---|---|---|---|
| 7 | 13CEAG | Industrial Structures | 3 | 0 | 0 | 3 |
| 8 | 13CEAH | Smart Structures and Smart Materials | 3 | 0 | 0 | 3 |
| 9 | 13CEAJ | Repair and Rehabilitation of Structures | 3 | 0 | 0 | 3 |
| 10 | 13CEAK | Finite Element Techniques | 3 | 0 | 0 | 3 |
| **GEOTECHNICAL ENGINEERING** | | | | | | |
| 11 | 13CEBA | Rock Engineering | 3 | 0 | 0 | 3 |
| 12 | 13CEBB | Ground Improvement Techniques | 3 | 0 | 0 | 3 |
| 13 | 13CEBC | Introduction to Soil Dynamics and Machine Foundations | 3 | 0 | 0 | 3 |
| 14 | 13CEBD | Earthquake Geotechnical Engineering | 3 | 0 | 0 | 3 |
| **SURVEY AND TRANSPORTATION ENGINEERING** | | | | | | |
| 15 | 13CECA | Remote Sensing Techniques and Geographic Information System | 3 | 0 | 0 | 3 |
| 16 | 13CECB | Pavement Engineering | 3 | 0 | 0 | 3 |
| 17 | 13CECC | Traffic Engineering and Management | 3 | 0 | 0 | 3 |
| **ENVIRONMENTAL ENGINEERING** | | | | | | |
| 18 | 13CEDA | Environmental Impact Assessment | 3 | 0 | 0 | 3 |
| 19 | 13CEDB | Industrial Waste Management | 3 | 0 | 0 | 3 |
| 20 | 13CEDC | Air Pollution Management | 3 | 0 | 0 | 3 |
| 21 | 13CEDD | Municipal Solid Waste Management | 3 | 0 | 0 | 3 |
| 22 | 13CEDE | Ecological Engineering | 3 | 0 | 0 | 3 |
| **IRRIGATION AND WATER RESOURSES ENGINEERING** | | | | | | |
| 23 | 13CEEA | Hydrology | 3 | 0 | 0 | 3 |
| 24 | 13CEEB | Ground Water Engineering | 3 | 0 | 0 | 3 |
| 25 | 13CEEC | Coastal Zone Management | 3 | 0 | 0 | 3 |
| 26 | 13CEED | Water Resources Engineering | 3 | 0 | 0 | 3 |
| **CIVIL ENGINEERING MANAGEMENT** | | | | | | |
| 27 | 13CEFA | Total Quality Management | 3 | 0 | 0 | 3 |
| 28 | 13CEFB | Housing Planning and Management | 3 | 0 | 0 | 3 |
| 29 | 13CEFC | Construction Planning and Scheduling | 3 | 0 | 0 | 3 |
| 30 | 13CEFD | Construction Management | 3 | 0 | 0 | 3 |
| 31 | 13CEFE | Architecture and Town Planning | 3 | 0 | 0 | 3 |
| 32 | 13CEFF | Engineering Economics and Cost Analysis | 3 | 0 | 0 | 3 |
| 33 | 13CEFG | Intellectual Property Rights | 3 | 0 | 0 | 3 |
| 34 | 13CEFH | Management of Irrigation Systems | 3 | 0 | 0 | 3 |

## INTER DISCIPLINARY COURSES

| S. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | 13CEHA | Energy Conscious in Buildings (Common to Civil & Mech) | 3 | 0 | 0 | 3 |
| 2 | 13CEHB | Heating Ventilation and Air Conditioning of Buildings (Common to Civil & Mech) | 3 | 0 | 0 | 3 |
| 3 | 13CEHC | Non Destructive Testing Techniques and Applications (Common to Civil & EIE) | 3 | 0 | 0 | 3 |
| 4 | 13CEHD | Environmental Instrumentation (Common to Civil & EIE) | 3 | 0 | 0 | 3 |
| 5 | 13CEHE | Experimental Stress Analysis (Common to Civil & EIE) | 3 | 0 | 0 | 3 |
| 6 | 13CEHF | Electronic Surveying (Common to Civil & ECE) | 3 | 0 | 0 | 3 |

## TRANS DISCIPLINIARY ELECTIVES

| S. No. | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **Any one of the following course is compulsory** | | | | | | |
| 1. | 13TD01 | Indian Business Laws | 0 | 0 | 0 | 3 |
| 2. | 13TD02 | Leadership and Personality Development | 0 | 0 | 0 | 3 |
| 3. | 13TD03 | International Business Management | 0 | 0 | 0 | 3 |
| 4. | 13TD04 | Basics of Marketing | 0 | 0 | 0 | 3 |
| 5. | 13TD05 | Retailing and Distribution management | 0 | 0 | 0 | 3 |
| 6. | 13TD06 | International Economics | 0 | 0 | 0 | 3 |
| 7. | 13TD07 | Indian Economy | 0 | 0 | 0 | 3 |
| 8. | 13TD08 | Rural Economics | 0 | 0 | 0 | 3 |
| 9. | 13TD09 | International Trade | 0 | 0 | 0 | 3 |
| 10. | 13TD10 | Global Challenges and issues | 0 | 0 | 0 | 3 |
| 11. | 13TD11 | Indian Culture and Heritage | 0 | 0 | 0 | 3 |
| 12. | 13TD12 | Indian History | 0 | 0 | 0 | 3 |
| 13. | 13TD13 | Sustainable Development and Practices | 0 | 0 | 0 | 3 |
| 14. | 13TD14 | Women in Indian Society | 0 | 0 | 0 | 3 |
| 15. | 13TD15 | Indian Constitution | 0 | 0 | 0 | 3 |
| 16. | 13TD16 | Bio Mechanics in Sports | 0 | 0 | 0 | 3 |

**SH100**              **TECHNICAL ENGLISH – I**
**(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
The Student will

- apply basic grammar in Writing and Speaking.
- prepare formal Letter Writings.
- come out with proper pronunciation.
- speak confidently in interactions.
- develop interest to read any article.

**UNIT I**                                                                                           **12**
**Language Focus**: Technical Vocabulary, Word Formation, Concord, Tense (Present).
**Writing:** Leave Application Letter, Paragraph writing.
**Listening:** Listening to correct pronunciation of words.
**Speaking:** Self - Introduction, Greetings.

**UNIT II**                                                                                          **12**
**Language Focus**: Words often misspelled, Articles, Tense (Past)
**Writing:** Permission letters (In-plant training/Seminar/Workshop), Chart description.
**Listening:** Listening to the Sentences with correct stress and Intonation.
**Speaking:** Situational Conversations.

**UNIT III**                                                                                        **12**
**Language Focus**: Compound nouns, Tense (Future), Preposition, Comparative Adjectives.
**Writing:** Invitation Letter, Acceptance Letter, Declining Letter.
**Listening:** Listening to the conversations.
**Speaking:** One minute speech.

**UNIT IV**                                                                                         **12**
**Language Focus:** Modal verbs, Gerund, Infinitives, Voice.
**Writing:** Writing Instructions, Letters to Editor.
**Listening:** Listening to the different Tonal Expressions.
**Speaking:** Giving Opinions.

**UNIT V**                                                                                          **12**
**Language Focus:** 'If' Conditionals, 'Wh' questions, Question Tags.
**Writing:** Reading and Note - taking
**Speaking:** Group Discussion.
**Reading:** ERC, one word questions from the suggested book.

**SUGGESTED ACTIVITIES**
1. Matching words and meanings – Using words in context – Making sentences.
2. Exercises on gap filling and correction of errors on Concord (Subject – Verb Agreement).
3. Gap filling exercises using the appropriate Tense forms.
4. Exercises on transferring information from Graph to Text – Bar charts, Flow charts.
5. Making sentences using Modal verbs to express probability, compulsion, etc.
6. Exercises on Writing Instructions.
7. Exercises on framing Questions.
8. Other relevant classroom activities.

**L: 45 T: 15  TOTAL: 60 PERIODS**

**BOOK SUGGESTED FOR READING**
1. R.K.Narayanan, "Malgudi Days", Indian Thought Publications, 1943.

**REFERENCES**
1. Rizvi. M. Ashraf, "Effective Technical Communication", McGraw Hill Companies, 2005.
2. P.K.Dutt, G.Rajeevan and C.L.N. Prakash, "A Course in Communication Skills", Cambridge University Press India, 2007.
3. Andrea.J.Rutherford, "Basic Communication Skills for Technology", Pearson Education, 2nd Edition, 2007.

**SH101        MATRICES AND DIFFERENTIAL CALCULUS**
**(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
- Ability to find inverse and integral powers of matrices and to perform transformations of matrices.
- Ability to find the evolutes of various curves.
- Ability to solve ordinary and partial differential equations.
- Ability to obtain constrained maxima and minima.

**UNIT I        MATRICES                                                                12**
Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties (excluding proofs); Cayley – Hamilton theorem (excluding proof) – Inverse and integral powers of a matrix using Cayley – Hamilton theorem; Diagonalisation of a matrix by orthogonal transformation; Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT II        DIFFERENTIAL CALCULUS                                        12**
Curvature in cartesian, parametric and polar forms; Centre, radius and circle of curvature; Evolutes.

**UNIT III        FUNCTIONS OF SEVERAL VARIABLES                        12**
Partial derivatives; Total derivatives; Differentiation of implicit functions; Jacobians; Maxima and Minima - Method of Lagrangian multipliers.

**UNIT IV        ORDINARY DIFFERENTIAL EQUATIONS                        12**
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 V        PARTIAL DIFFERENTIAL EQUATIONS                        12**
Formation of partial differential equations; Lagrange's linear equations; Solutions of standard types of first order partial differential equations; Linear partial differential equations of second and higher order with constant coefficients.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi, 40th Edition, 2007.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 8th Edition, Reprint 2011.

**REFERENCES**
1. Bali N. P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, Reprint, 2010.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", Narosa Publishing House Private Limited, 3rd Edition, 2007.
4. Veerarajan.T., "Engineering Mathematics for semester I and II", Tata McGraw Hill Education Private Limited, New Delhi, 3rd Edition, 2012.
5. Veerarajan.T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Private Limited, New Delhi, 2012.

SH102                                    **APPLIED PHYSICS**
**(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
The students will be able to
- gain knowledge on the properties of matter and hydrodynamics.
- study and apply the ultrasonic methods for industrial and medical field.
- understand Lasers and to identify the appropriate Laser technique for industrial and medical field.
- understand the different types, fabrication, losses of optical fibers and the applications of fiber optics in communication and instrumentation.
- understand the physical properties of photons and electrons and to study the different Electron Microscopes.

**UNIT I        PROPERTIES OF MATTER AND HYDRODYNAMICS                9**
**Properties of Matter**
Stress, Strain, Hooke's law; Types of moduli of elasticity; Torsional pendulum – Determination of Rigidity modulus of a wire; Bending of beams – Expression for bending moment – Measurement of Young's modulus by uniform and Non- uniform bending – I Shaped girders.
**Hydrodynamics**
Stream line flow, Turbulent flow, Poiseuille's formula for flow of liquid through a capillary tube, Determination of coefficient of viscosity of a liquid.

**UNIT II        ULTRASONICS                                                9**
Production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezoelectric generator; Detection of ultrasonic waves; Properties – Cavitations – Velocity measurement – acoustic grating; Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes – A,B and C scan displays; Medical applications – Sonograms.

**UNIT III        LASERS                                                        9**
Principle of spontaneous emission and stimulated emission, Population inversion, Pumping, Einstein's A and B coefficients – derivation; Types of Lasers - $CO_2$ Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction); Determination of wavelength of Laser using grating and Particle size; Applications of Lasers: Industrial applications – Welding, Cutting and Heat treatment; Medical applications; Holography (construction and reconstruction).

**UNIT IV        FIBER OPTICS AND ITS APPLICATIONS                        9**
Principle and propagation of light in optical fibers; Numerical aperture and Acceptance angle; Types of optical fibers – material, refractive index and mode; Double crucible technique of fiber drawing; Splicing – fusion splicing; Loss in optical fiber – attenuation, dispersion and bending; Fiber optical communication system (Block diagram); Advantages and Applications of optical fiber; Fiber optic sensors – temperature and displacement; Endoscope.

**UNIT V        QUANTUM PHYSICS AND MICROSCOPY                        9**
Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh Jean's Law from Planck's theory; Photoelectric effect – Law of Photoelectric effect – Photoelectric equation; Matter Waves – De Broglie wavelength - Schrodinger's wave equation – time independent and time dependent equations – Particle in one dimensional box; Heisenberg's Uncertainty principle; Linear Harmonic oscillator; Electron microscope – scanning electron microscope – transmission electron microscope.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. R.K.Gaur and S.C.Gupta, "Engineering Physics", Dhanpat Rai Publications, New Delhi, 2009.
2. M.Arumugam, "Engineering Physics", Anuradha Publishers, 2010.

**REFERENCES**
1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", John Wiley and Sons, Inc., USA, 9th Edition, 2013.
2. Arthur Beiser, "Concepts of Modern Physics", McGraw Hill Publications Private Limited, 5th Edition, 2008.
3. Richard P.Feynmann, Robert B.Leighton and Mathew Sands, "Feynmann's Lectures on Physics", Addison Wesley Publication, USA, 2010.
4. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, "Schaum's Outline of Quantum Mechanics", McGraw Hill Companies Limited, USA, 2nd Edition, 2010.

SH103                    ENGINEERING CHEMISTRY
(Common to all B.E. / B.Tech., Degree Programmes)

L  T  P  C
3  0  0  3

## COURSE OUTCOMES
The students will be able to
- select suitable water treatment techniques for industrial and domestic purpose.
- acquire knowledge of electrochemistry.
- apply the contextual knowledge of adsorption techniques for industrial applications.
- synthesize polymers for domestic and industrial applications.
- understand the knowledge of nano materials for their applications in Science and Engineering.

**UNIT I          WATER TREATMENT                                              9**
Hardness: types of hardness, estimation of hardness of water – EDTA method – problems; disadvantages of hard water: scales and sludges – disadvantages of scales and sludges – boiler corrosion – priming and foaming – caustic embrittlement; domestic water treatment: screening, sedimentation, coagulation, filteration, disinfection – chlorine – UV method; water softening: demineralization process; desalination: definition, reverse osmosis.

**UNIT II         ELECTRO ANALYTICAL TECHNIQUES                        9**
Electrode potential: definition, measurement of electrode potential, Nernst equation – problems; EMF: definition, measurement of EMF – Poggendorff's method; reference electrode: standard hydrogen electrode, calomel electrode, glass electrode – measurement of pH using glass electrode; $CO_2$ sensing electrode; conductometric titrations: acid-base titration (HCI vs NaOH); potentiometric titrations: redox titration ($Fe^{2+}$ vs $K_2Cr_2O_7$), precipitation titration ($Ag^+$ vs NaCl).

**UNIT III        CATALYSIS AND SURFACE PHENOMENA                    9**
Types of catalysis – homogeneous catalysis – heterogeneous catalysis, mechanism of catalytic action - contact theory, catalytic promoters, catalytic poison; enzyme catalysis: Michaelis-Menton equation; adsorption: definition, types – physical adsorption – chemical adsorption – differences between physical and chemical adsorption; adsorption isotherms: definition, Frendlich and Langmuir adsorption isotherms, applications of adsorption.

**UNIT IV         ENGINEERING POLYMERS                                  9**
Polymerization – types of polymerization – addition – free radical addition polymerization mechanism – copolymerization – condensation polymerization; plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, teflon, perlon – U, backelite; rubber: vulcanization of rubber, synthetic rubber – butyl rubber, SBR; composites: definition, types of composites – polymer matrix composites – FRP.

**UNIT V         NANO MATERIALS                                          9**
Nanoparticles: definition, carbon nanotubes (CNT), types of carbon nano tubes – single walled and multi walled carbon nanotubes – fullerene; synthesis of carbon nanotubes: chemical vapour deposition – laser ablation – arc-discharge method; properties of CNT: mechanical, electrical, thermal and optical properties; applications of carbon nanotubes in chemical field, medicinal field, mechanical field and current applications.

**TOTAL: 45 PERIODS**

## TEXT BOOKS
1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 15th Edition, 2005.
2. S.S.Dara, "A text book of Engineering Chemistry", S. Chand and Company Limited, New Delhi, 12th Edition, 2006.

**REFERENCES**

1.  J.Hammer Mark, "Water and Waste water Technology", Prentice Hall, New Arrivals, 2012.
2.  G.Whitmore, "Electrochemistry and its Applications", Sarup book publishers, New Delhi, 2009.
3.  G.Whitmore, "Adsorption and Catalysis", Sarup Book Publishers, New Delhi, 2008.
4.  Fred.Bilmayer, "Text book of Polymer Science", Wiley, 1st Edition, 2007.
5.  T.Pradeep, "Nano – The Essential", Tata McGraw Hill Education Private Limited, New Delhi, 2012.
6.  S.C.Bhatia, "Engineering Chemistry", CBS Publishers and Distributors, 1st Edition, 2011.

### SH104          FUNDAMENTALS OF COMPUTING AND PROGRAMMING IN C
#### (Common to all B.E. / B.Tech., Degree Programmes)

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

**COURSE OUTCOMES**
- Learn the major components of a computer system.
- Formulate the algorithms and analyze their complexity.
- Identify the correct and efficient ways of solving problems.
- Acquire knowledge about dynamic memory allocation, modular programming and data organization.
- Develop real time applications using the power of C language features.

**UNIT I          COMPUTER FUNDAMENTALS                                       10**
Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis – Algorithms – Flow charts – Computer Software – Types of Software.

**UNIT II          BASIC C PROGRAMMING                                        9**
Structure of C Program – Keywords, Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making – Branching and Looping.

**UNIT III          FUNCTIONS, ARRAYS AND POINTERS                           9**
Functions: User-defined functions – Definitions – Declarations - Call by reference – Call by value. Arrays: Declaration – Definition – Multidimensional Arrays – Functions with array as arguments. Pointers: Initialization – Pointers as Arguments – Pointers to Pointers – Dynamic Memory Management Functions.

**UNIT IV          STRUCTURES AND UNIONS                                      9**
Derived types – Structures: Declaration – Definition – Initialization of structures – Accessing structures – Nested structures – Arrays  of structures – Structures and functions – Pointers to structures – Self-referential structures – Unions.

**UNIT V          FILE HANDLING                                              8**
File structure – binary and text files – File handling functions – File I/O — File Manipulations.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", Oxford University Press, 1$^{st}$ Edition, 2009.
2. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India), 2011.

**REFERENCES**
1. Ashok.N.Kamthane, "Computer Programming", Pearson Education (India), 2008.
2. Stephen G.Kochan, "Programming in C", Pearson Education (India), 3$^{rd}$ Edition, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., 2005.

### SH105                          ENGINEERING GRAPHICS
### (Common to all B.E. / B.Tech., Degree Programmes)

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

**COURSE OUTCOMES**
- Students will be able to use the drawing instruments effectively.
- An ability to draw the basic engineering curves and problems related to projections of points, straight lines, planes and solids.
- Able to apply the knowledge acquired on practical applications of sectioning and development of solids.
- Able to draw simple solids and its sections in isometric view and projections and also to draw its perspective views.

Drawing Instruments – IS specifications on lines – drawing sheets – Printing letters and dimensioning – scales (not for examination) – First angle projection should be followed.

**UNIT I          PLANE CURVES                                                     12**
Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloids – Epi and Hypo cycloids -  construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

**UNIT II         PROJECTION OF POINTS, LINES AND PLANE SURFACES        12**
Projection of points and straight lines located in the first quadrant – Traces – Determination of true lengths and true inclinations.
Projection of regular polygonal surfaces and circular lamina inclined to any one reference plane.

**UNIT III        PROJECTION OF SOLIDS                                         12**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

**UNIT IV        SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES       12**
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – obtaining true shape of section.
Development  of  lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinder and cone – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

**UNIT V          ISOMETRIC AND PERSPECTIVE PROJECTIONS                     12**
Principles of isometric projection – isometric scale – isometric projections of simple solids – cube – prisms, pyramids, cylinder and cone in simple position only, truncated prisms, pyramids, cylinders and cones.
Perspective projection of prisms, pyramids and cylinders by visual ray method and vanishing point method.

                                                            **TOTAL: 60 PERIODS**

Note: In end semester examination from each unit one question with either or pattern may be asked. No short questions.

**TEXT BOOK**
1. N.D. Bhatt, "Engineering Drawing", Charotar Publishing House, 46th Edition, 2003.

**REFERENCES**
1. K.V.Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.

2. M.S.Kumar, "Engineering Graphics", D.D. Publications, 2007.
3. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International Private Limited, 2008.
4. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson Education, 2005.
5. K.R.Gopalakrishnan, "Engineering Drawing" (Vol. I & II), Subhas Publications, 1998.
6. Dhananjay A.Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw Hill Publishing Company Limited, 2008.
7. Basant Agarwal and Agarwal.C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

SH106                 **C PROGRAMMING LABORATORY**
**(Common to all B.E. / B.Tech., Degree Programmes)**

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

## COURSE OUTCOMES
- Acquire logical thinking and problem solving skills.
- Implement the algorithms and analyze their complexity.
- Identify the correct and efficient ways of solving problems.
- Acquire hands on practice in dynamic memory allocation, modular programming and data organization.
- Implement real time applications using the power of C language features.

## LIST OF EXPERIMENTS
1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Finding the 2's complement of a binary number.
3. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
4. Computing Sine series and Cosine series.
5. Given distance traveled by a vehicle as $d = ut + 1/2at^2$, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals.
6. Solving the roots of a quadratic equation.
7. Designing a simple arithmetic calculator. (Use switch statement)
8. Performing the following operations: (Use loop statement)
    i. Generate Pascal's triangle.
    ii. Construct a Pyramid of numbers.
9. Performing the following operations to a string:
    i. To insert a sub-string into main string at a given position.
    ii. To delete 'n' characters from a given position in a string.
    iii. To replace a character of string either from beginning or ending or at a specified location.
10. Performing the following operations: (Use arrays)
    i. Matrix addition.
    ii. Transpose of a matrix.
    iii. Matrix multiplication by checking compatibility.
11. Performing the following operations: (Use recursive functions)
    i. To find the factorial of a given integer.
    ii. To find the GCD (Greatest Common Divisor) of two given integers.
    iii. To solve Towers of Hanoi problem.
12. Performing the Student Information Processing using File Handling concepts.

**TOTAL: 45 PERIODS**

## SOFTWARE REQUIREMENTS

- Turbo C/ ANSI C Compiler
- Gcc compiler

**SH107**          **PHYSICS AND CHEMISTRY LABORATORY – I**
(Common to all B.E. / B.Tech., Degree Programmes)

L T P C
0 0 3 2

## PART A – PHYSICS LABORATORY – I

**COURSE OUTCOMES**

At the end of the Laboratory classes, the students are able to
- develop collaborative learning skills and to add some of their own ideas to the experiments and their explanations.
- understand the optical properties, mechanical properties and electrical properties.

**LIST OF EXPERIMENTS**
1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength, and angle of divergence.
   (c) Determination of Numerical aperture and acceptance angle of an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
4. Determination of Dispersive power of a prism using Spectrometer.
5. Determination of Young's modulus – Non-uniform bending method.
6. Determination of coefficient of viscosity of liquid – Poiseuille's method.
7. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
   • *A minimum of FIVE experiments shall be offered.*

## PART B - CHEMISTRY LABORATORY – I

**COURSE OUTCOMES**

The student
- can estimate the amount of hardness and acidity present in the water sample.
- gain knowledge about the estimation of nickel in an alloy.
- quantify the electrolyte by measuring the conductance and pH.

**LIST OF EXPERIMENTS**
1. Estimation of hardness of Water sample by EDTA method.
2. Estimation of acidity of Water sample.
3. Estimation of Nickel by EDTA method.
4. Conductometric titration (HCl Vs NaOH).
5. Conductometric titration ($BaCl_2$ Vs $Na_2SO_4$).
6. pH metric titration (HCl Vs NaOH).
7. Determination of molecular weight and degree of polymerization using Viscometry.

• *A minimum of FIVE experiments shall be offered.*
• *Laboratory classes on alternate weeks for Physics and Chemistry.*

**TOTAL: 45 PERIODS**

**SH108**                    **ENGINEERING PRACTICES LABORATORY**
                    **(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
- Students will be able to prepare the pipe connections and identify the various components used in plumbing.
- An ability to prepare simple wooden joints using wood working tools.
- An ability to prepare simple lap, butt and tee joints using arc welding equipments.
- An ability to prepare simple components using lathe and drilling machine.

**PART A – MECHANICAL AND CIVIL ENGINEERING PRACTICES**

**I**      **PLUMBING WORKS**:                                      **5**
           Study of components related to plumbing.
           Hands-on-exercise:
           Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

**II**     **CARPENTRY PRACTICES:**                                 **6**
           Study of the joints in roofs, doors, windows and furniture.
           Hands-on-exercise:
           Wood work, joints by sawing, planning and cutting.

**III**    **WELDING:**                                             **5**
           Study of the tools used in welding Gas welding practice.
           Preparation of butt joints, lap joints and tee joints using arc welding.

**IV**      **BASIC MACHINING:**                                    **7**
           (a) Simple Turning and Taper turning.
           (b) Drilling Practice.

**REFERENCES**
1. Ramesh Babu.V., "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai, Revised Edition, 2013 – 2014.
2. Jeyachandran.K., Natarajan.S. and Balasubramanian.S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Bawa.H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad.A. and Sarma.P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah.P. and Narayana.K.L., "Manual on Workshop Practice", Scitech Publications, 1999.

## PART B – ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES

**COURSE OUTCOMES**
- An ability to develop familiarity with rudimentary measurement equipment – signal generators, oscilloscopes, multimeters and power supplies.
- Ability to demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) based on their physical parameters and dimensions.
- Define, describe, and analyze fundamentals of Boolean algebra and digital logic gates.
- An ability to predict qualitatively and quantitatively compute the steady state AC responses of basic circuits using the phasor method.
- Gain experience in the documentation of measurements and procedures as well as the preparation of formal reports.

**I     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.

**II     ELECTRONICS ENGINEERING PRACTICE                                           12**

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR 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**

**REFERENCES**
1. K.Jeyachandran, S.Natarajan and S.Balasubramanian, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. T.Jeyapoovan, M.Saravanapandian and S.Pranitha, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
3. H.S.Bawa, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. A.Rajendra Prasad and P.M.M.S.Sarma, "Workshop Practice", Sree Sai Publication, 2002.
5. P.Kannaiah and K.L.Narayana, "Manual on Workshop Practice", Scitech Publications, 1999.

**13F20**             **TECHNICAL ENGLISH – II**
           **(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
The student will be able to
- apply correct form of language while Speaking and Writing.
- prepare his own Professional letter writings.
- interpret any passage after listening.
- interact at different situations fluently.

**UNIT I**                                                                     **10**
**Language Focus:** Homonyms, Different grammatical forms of the same word, correct usage
                    of Words / phrases.
**Writing:** Recommendation writing.
**Listening:** Interpreting Poetic lines.
**Speaking:** Telephone English.

**UNIT II**                                                                    **9**
**Language Focus:** Cause and Effect, Phrasal Verbs.
**Writing:** Quotation letter, Clarification Letter, Placing orders, Complaint Letter.
**Listening:** Conversations.
**Speaking:** Asking questions.

**UNIT III**                                                                   **9**
**Language Focus:** Idioms and Phrases with animal names.
**Writing:** Checklist, Process Description.
**Speaking**: Presentations.

**UNIT IV**                                                                    **9**
**Language Focus:** Technical Definitions, Transformation of Sentences.
**Writing:** Job Application Letter, Curriculum Vitae, Bio-data, Resume.
**Speaking:** Mock Interview.

**UNIT V**                                                                     **8**
**Language Focus:** British and American Vocabulary, Numerical Expressions.
**Writing:** E-mail Writing, Report Writing.
**Speaking:** Group Discussion.

**SUGGESTED ACTIVITIES**
1. Making sentences using different grammatical forms of the same word.
2. Exercises on combining sentences using Cause and Effect expressions.
3. Writing Formal Letters.
4. Writing exercises on Recommendations.
5. Exercises on Idioms and Phrases.
6. Exercises on preparing letter of Job Application with annexure.
7. Exercises on British and American English words with meanings.

                                                          **TOTAL: 45 PERIODS**

**BOOK SUGGESTED FOR READING**
1. A.P.J.Abdul Kalam, Arun Tiwari, "Wings of Fire", an Autobiography, University Press
   Private Limited India, 1999, 30th Impression, 2007.

**REFERENCES**
1.  T.M.Farhathullah, "Communication Skills for Technical Students", Orient Longman Private Limited, 2002.
2.  K.R.Lakshmi Narayanan, "English for Technical Communication", SciTech Publications, 1999.
3.  Jack.C.Richards, Jonathan Hull and Susan Protor, "English for International Communication", Cambridge University Press, 3$^{rd}$ Edition, 2004.

**13F21**                    **INTEGRAL CALCULUS AND TRANSFORMS**
                         **(Common to all B.E. / B.Tech., Degree Programmes)**
                                                                            **L T P C**
                                                                            **3 1 0 4**

**COURSE OUTCOMES**
- Ability to find area and volume of objects using double and triple integrals.
- Ability to analyze the concepts related to vector calculus and to apply them in engineering field.
- Ability to perform the ideas of Laplace transform and Z-transform in their respective engineering subjects.

**UNIT I MULTIPLE INTEGRALS                                                       12**
Double integration – Cartesian and polar coordinates; Change of order of integration; Change of variables between cartesian and polar coordinates; Triple integration in cartesian coordinates; Area as double integral; Volume as triple integral.

**UNIT II       VECTOR CALCULUS                                                   12**
Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields; Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

**UNIT III       LAPLACE TRANSFORM                                                12**
Definition of Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and Integrals of Transform – Transform of derivatives and integrals – Transform of unit step function and impulse function – Transform of periodic function – Initial and final value theorems.

**UNIT IV        INVERSE LAPLACE TRANSFORM                                        12**
Definition of Inverse Laplace transform – Convolution theorem – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transformation techniques and solution of simultaneous differential equations of first order with constant coefficients using Laplace transformation techniques.

**UNIT V        Z – TRANSFORM                                                     12**
Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

                                              **L: 45 T: 15 TOTAL: 60 PERIODS**
**TEXT BOOKS**
1. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publications, New Delhi, 40th Edition, 2007.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 8th Edition, 2011.

**REFERENCES**
1. Bali.N.P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, 2008.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", Narosa Publishing House Private Limited, 3rd Edition, 2007.
4. Veerarajan.T., "Engineering Mathematics for semester I & II", Tata McGraw Hill Education Private Limited, 3rd Edition, New Delhi, 2012.
5. Veerarajan.T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Private Limited, New Delhi, 2012.

**13F22**                         **MATERIALS SCIENCE**
                              **(Common to Mechanical and Civil)**

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

**COURSE OUTCOMES**
The Student will

- identify the crystal lattices, their structures and how the structure influences its major properties at different levels.
- choose the major functional and structural properties required for specific applications of conducting materials
- check the parameters that satisfy the superconducting behaviours.
- relate technology to the physics of semiconductor devices.
- understand the physics underlying the magnetic behaviour of materials.
- Explain the mechanism by which electric field interacts with materials and their applications
- suggest materials based concepts to improve the properties and performance under given circumstances.

**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 and Packing factor for SC, BCC, FCC and HCP structures; Crystal defects – point, line and surface defects; Burger vector.

**UNIT II        CONDUCTING MATERIALS AND SUPERCONDUCTORS              9**
**Conductors**
Band theory of solids - Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids; 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.

**Superconductors**
Superconductivity: Properties – Meissner effect – Isotopic effect; Types of superconductors – Type I and Type II superconductors; Applications of superconductors – Magnetic levitation.

**UNIT III        SEMICONDUCTORS                                                    9**
Intrinsic semiconductor – carrier concentration derivation – Fermi level – variation of Fermi level with temperature – electrical conductivity – bandgap determination; Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration; Hall effect – Determination of Hall coefficient – Applications.

**UNIT IV        MAGNETIC MATERIALS AND DIELECTRIC MATERIALS        9**
**Magnetic materials**
Origin of magnetic moment, Bohr magneton, Dia and Para magnetism, Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials; Anti-ferromagnetic materials.
**Dielectric materials**
Electrical susceptibility, dielectric constant, Types of Polarization – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization; Internal field – Clausius-Mosotti relation (derivation); dielectric loss, dielectric breakdown, Uses of dielectric materials in capacitor and transformer.

**UNIT V          NEW ENGINEERING MATERIALS                          9**

Metallic glasses: preparation, properties and applications; Shape memory alloys ( SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA; Nano materials:synthesis – chemical vapor deposition – sol-gels – ball milling; properties of nano particles and applications; Solar cell – PN junction solar cell – Conversion efficiency and solar concentration – Hetero junction solar cell; Classification of Biomaterials and its applications.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Charles Kittel, "Introduction to Solid State Physics", John Wiley and Sons, Singapore, 7$^{th}$ Edition, 2007.
2. Charles P.Poole and Frank J.Ownen, "Introduction to Nanotechnology", Wiley India, 2007.

**REFERENCES**
1. B.N.Sankar and S.O.Pillai, "Engineering Physics", New Age International Publishers, New Delhi, 2009.
2. M.Arumugam, "Materials Science", Anuradha publications, Kumbakonam, 2010.
3. Donald A.Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill Publication, New Delhi, 3$^{rd}$ Edition, 2007.
4. M.Ali Omar, "Elementary Solid State Physics", Pearson Education Inc., 4$^{th}$ Edition, 1999.

**13F23**                **CHEMISTRY FOR CIVIL ENGINEERING**

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

**COURSE OUTCOMES**
The students
- can identify the types of corrosion and to design a method to control the corrosion.
- gain the knowledge about ceramics, refractories and abrasives.
- can select proper building materials for desired structural application.
- understand the importance of alloys and ensuring the water quality standard for construction purpose.

**UNIT I          CORROSION AND ITS CONTROL                              9**
Chemical corrosion: oxidation corrosion – Pilling-Bedworth rule; electrochemical corrosion: mechanism – hydrogen evolution mechanism – oxygen absorption mechanism, galvanic corrosion, differential aeration corrosion: pitting corrosion, water line corrosion, stress corrosion; concrete corrosion; factors influencing corrosion; corrosion control: cathodic protection – sacrificial anodic protection – impressed current cathodic protection – corrosion inhibitors.

**UNIT II         PROTECTIVE COATINGS AND ADHESIVES                       6**
Organic coating: paints – constituents and their functions; special paints – fire retardant, water repellent, temperature indicating and luminous paints; varnishes, lacquers and enamels; adhesive: definition, adhesive action, development of adhesive strength, physical and chemical factors influencing adhesive action – bonding process by adhesives, classification of adhesive.

**UNIT III        CHEMISTRY OF BUILDING MATERIALS                       12**
Lime: classification, slaking of lime, setting and hardening; cement: chemical composition, raw material for manufacture of Portland cement – wet processes – reactions in rotary kiln; reactions during setting and hardening of cement – heat of hydration; special cement – high alumina cement, Sorel cement, white Portland cement, water proof cement; plaster of Paris: manufacture – setting and hardening – uses; water quality for construction purpose: quality parameters –  acidity, alkalinity, TDS, chlorides, sulphates.

**UNIT IV        METALS IN BUILDING INDUSTRY                             9**
Alloys: definition,  the  purpose of making alloys; alloy steels – stainless steel –  types – heat treatable – non heat treatable –  heat treatment of steel: annealing, hardening, tempering, normalizing; metallic coating: electroplating– methods of cleaning the article – electroplating of Cu and Cr on mild steel; electroless plating – advantages over electroplating – electroless plating of nickel; anodizing of aluminium – applications.

**UNIT V         CERAMICS, REFRACTORIES AND ABRASIVES                    9**
Ceramics: clay products, white wares, manufacture, uses; refractories: definition, characteristics, classification – acidic, basic and neutral refractories; properties: refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling; manufacture of alumina bricks; abrasives: definition, Moh's scale, classification – natural abrasives – diamond, corundum, emery, quartz, garnet – synthetic abrasives – carborundum, norbide.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Jain.P.C. Monika Jain, "Engineering Chemistry", Dhanpat Rai publishing Company Private Limited, New Delhi, 15th Edition, 2005.
2. Dara.S.S., "A Text book of Engineering Chemistry", S.Chand Company Private Limited, New Delhi, 12th Edition, 2003.

**REFERENCES**
1.  Duggal.S.K., "Building materials", New Age International Private Limited, 2003.
2.  Puri Sharma, Pathania, "Principles of Physical Chemistry", Vishal Publication and Company, 42nd Edition, 2007.
3.  Kuriacoarse J.C., and Rajaram.J., "Chemistry in Engineering and Technology", Vol.1 & 2, Tata McGraw Hill Publishing Company Limited, New Delhi, 1989.
4.  J.Hammer Mark, "Water and Waste water Technology", Prentice Hall, New Arrivals, 2012.

**13F24**                    **ENGINEERING MECHANICS**                    **L T P C**
                  **(Common to Mechanical and Civil)**                    **3 1 0 4**

**COURSE OUTCOMES**

- An ability to use the basic concept of force systems and solve problems.
- An ability to implement the knowledge acquired in supports, reactions, equilibrium of rigid bodies for solving problems.
- The students gain an ability to predict centre of gravity, moment and product moment of inertia of simple configurations.
- An ability to solve practical problems on Projectiles, Newton's laws, work-energy and impulse momentum.
- An ability to apply the principles of friction and rigid body dynamics to analyze and solve problems.

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

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force – Vectorial representation of forces.

**UNIT II          EQUILIBRIUM OF RIGID BODIES                    12**

Free body diagram – Types of supports and their reactions – requirements of 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 – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

**UNIT III          PROPERTIES OF SURFACES AND SOLIDS                    12**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem.

**UNIT IV     DYNAMICS OF PARTICLES                    12**

Displacements, Velocity and acceleration, their relationship – Projectile motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum.

**UNIT V     FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS                    12**

Frictional force – Laws of Coulomb friction – Simple contact friction – Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

**L: 45   T: 15   TOTAL: 60 PERIODS**

**TEXT BOOK**

1. Beer, F.P. and Johnson Jr. E.R., "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw Hill International Edition, 9th Edition, 2010.

**REFERENCES**

1. Rajasekaran.S., Sankarasubramanian.G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Private Limited, 3rd Edition, 2010.
2. Hibbeller.R.C., "Engineering Mechanics", Vol.1 Statics, Vol.2 Dynamics, Pearson Education Asia Private Limited, 12th Edition, 2010.
3. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", Pearson Education Asia Private Limited, 4th Edition, 2003.

4. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Private Limited, 2002.

5. Palanichamy.M.S., Nagam.S., "Engineering Mechanics – Statics and Dynamics", Tata McGraw Hill, 2001.

**13F25        BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**
**(Common to Mechanical and Civil)        L T P C**
**3  1 0 4**

**COURSE OUTCOMES**
- Describe the basic concepts of electric circuits and measuring instruments.
- Discuss the principle of electrical machines.
- Summarize the concepts of semiconductor devices and electronic circuits.
- Solve basic binary operations and code conversion techniques using the logic gates.
- Explain the fundamentals of communication engineering.

**UNIT I        ELECTRICAL CIRCUITS AND 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 Wattmeters and Energy meters.

**UNIT II        ELECTRICAL MACHINES        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.

**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).

**L: 45  T: 15   TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. R.S.Sedha, "Applied Electronics", S.Chand and Company, 2006.
2. V.N.Mittle, "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

**REFERENCES**
1. Gnanavadivel, C.Senthilkumar, A.Vijaykumar, S.Joseph Gladwin, "Basic Electrical and Electronics Engineering", Anuradha Publishers, 2011.
2. Muthusubramanian.R, Salivahanan.S and Muraleedharan.K.A., "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, 2nd Edition, 2006.
3. Nagsarkar.T.K. and Sukhija.M.S, "Basics of Electrical Engineering", Oxford press, 2005.
4. Premkumar.N., "Basic Electrical Engineering", Anuradha Publishers, 2003.
5. Mahmood Nahvi and Joseph A.Edminister, "Electric Circuits", Schaum Outline Series, McGraw Hill, 2002.
6. Mehta V.K., "Principles of Electronics", S.Chand and Company Limited, 1994.

**13F26          COMPUTER PROGRAMMING LABORATORY**
**(Common to all B.E. / B.Tech., Degree Programmes)**

L T P C
0 1 2 2

**COURSE OUTCOMES**
Upon successful completion of this course, the students will be able to:
- Demonstrate how to use the UNIX Shell commands.
- Use the Shell programming constructs.
- Learn tracing mechanisms (for debugging), user variables, Shell variables, read-only variables, positional parameters, reading input to a Shell script.
- Test on numeric values, test on file type, and test on character strings using shell scripts.
- Write moderately complex Shell scripts and make them executable.

Execute programs written in C under UNIX environment.

**LIST OF EXPERIMENTS**

1. Study of UNIX OS, vi Editor.

2. Use of Basic UNIX Shell Commands:
    ls, mkdir, rmdir, cd, cat, banner, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit.

3. Shell Programming:
    i. Interactive shell scripts
    ii. Positional parameters
    iii. Arithmetic Operators
    iv. if-then-fi, if-then-else-fi, nested if-else
    v. Logical operators
    vi. if - elif, case structure
    vii. while, until, for loops, use of break
    viii. Metacharacters

4. Shell scripts for the following:
    i. Showing the count of users logged in
    ii. Printing column wise list of files in your home directory
    iii. To count lines, words and characters in its input (do not use wc)

5. C Programming on UNIX:
    i. Dynamic Storage Allocation
    ii. Pointers
    iii. Functions
    iv. File Handling

**TOTAL: 45 PERIODS**

**SOFTWARE REQUIREMENTS**
- UNIX/LINUX  OS
- Gcc compiler

**13F27**         **PHYSICS AND CHEMISTRY LABORATORY – II**
                  **(Common to all B.E. / B.Tech., Degree Programmes)**

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

## PART A - PHYSICS LABORATORY – II

### COURSE OUTCOMES
At the end of the Laboratory classes, the students
- demonstrate and report the elastic behaviour of materials
- demonstrate the interference property of light waves
- demonstrate the diffraction property of light waves
- measure the thermal properties of conducting materials
- identify the substance that deforms continuously when subjected to shearing stress.

### LIST OF EXPERIMENTS
1. Determination of Young's modulus – Uniform bending method.
2. Determination of Band Gap of a semiconductor material.
3. Determination of Hall Co-efficient.
4. Determination of Radius of curvature of a Plano convex lens using Newton's rings Method.
5. Determination of wavelength of mercury spectrum using spectrometer and grating
6. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
7. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.

   • *A minimum of FIVE experiments shall be offered.*

## PART B - CHEMISTRY LABORATORY – II

### COURSE OUTCOMES
The student
- can estimate the amount of alkalinity and Dissolved Oxygen (DO) present in the water sample.
- gain knowledge in the estimation of copper in an alloy and iron in rust.
- quantify electrolyte and ion by measuring the conductance and emf.

### LIST OF EXPERIMENTS
1. Estimation of copper in brass by EDTA method.
2. Determination of Dissolved Oxygen (DO) in water (Winkler's method)
3. Estimation of alkalinity of Water sample
4. Estimation of $Fe^{2+}$ ion in rust by Dichrometry
5. Conductometric titration (Mixture of acids vs NaOH)
6. Potentiometric Titration ($Fe^{2+}$ vs $K_2Cr_2O_7$)
7. Estimation of $Fe^{2+}$ ion by spectrophotometry.

                                                          **TOTAL: 45 PERIODS**

   • *A minimum of FIVE experiments shall be offered.*
   • *Laboratory classes on alternate weeks for Physics and Chemistry.*

## 13F28  COMPUTER AIDED DRAFTING AND MODELING LABORATORY
### (Common to Mechanical and Civil)

                                                                    L  T  P  C
                                                                    0  1  2  2

**COURSE OUTCOMES**
- An ability to use software for constructing curves, solids.
- An ability to create orthographic views and sectional view of the solids.
- An ability to create plan of residential building.
- An ability to draw isometric and pictorial views.

**List of exercises using software capable of Drafting and Modeling**
1. 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.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola involutes using Bspline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. 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).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

**TOTAL: 45 PERIODS**

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

**List of Equipments for a batch of 30 students**
1. Pentium IV computer or better hardware with suitable graphics facility – 30 Nos.
2. Licensed software for Drafting and Modeling – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 Nos.

**13F29**        **ENGLISH LANGUAGE SKILL LABORATORY**
**(Common to all B.E. / B.Tech., Degree Programmes)**

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

**COURSE OUTCOMES**
The Student will
- improve their pronunciation skill.
- gather information from any speech.
- imbibe the stress and intonation of the native speakers' accent.

**1. Micro Skills**
- Spotting the Homonyms / Silent letter words / mispronounced words
- Identifying the missing words in native speech
- Finding the cluster words
- Marking correct punctuation
- Marking word chunks
- Identification of sentences

**2. Content Comprehension and making inferences**
- Listening to audio files of Speech, Poetry, Recent Issues, News clippings, etc
  - a. True / False
  - b. Multiple Choice Questions
  - c. Filling the blanks
  - d. Filling the charts

**3. Listen and Act**
- Drawing the map using audio
- Picture completing task
- Transferring data to Graph

**4. Interpreting the video clippings**

**5. Listening to Conversations**

**TOTAL: 30 PERIODS**

**13CE31        FOURIER TRANSFORMS AND COMPLEX ANALYSIS        L  T  P  C**
                                                              **3  1  0  4**

**COURSE OUTCOMES**
On successful completion of the course, the students should be able to
- Perform Fourier series analysis of the functions.
- Implement the properties of Fourier transforms and Compute the Fourier transforms of various functions.
- Calculate the Fourier series solution of Wave and Heat equations.
- Grasp analytic functions and their properties and be introduced to the host of conformal mappings with suitable examples that have direct application.
- Understand the basics of complex integration and the concept of contour integration encountered in practice.

**UNIT I        FOURIER SERIES                                                        12**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range Sine series – Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

**UNIT II        FOURIER TRANSFORMS                                                   12**
Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT III        APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS        12**
Solutions of one dimensional wave equation – One dimensional equation of heat conduction– Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

**UNIT IV        ANALYTIC FUNCTIONS                                                  12**
Functions of a complex variable – Analytic functions – Necessary and Sufficient conditions excluding proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z and bilinear transformation.

**UNIT V        COMPLEX INTEGRATION                                                  12**
Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs)  – Taylor's and Laurent's expansions – Singular points – Residues – Residue theorem (excluding proof)  – Application of residue theorem to evaluate real  integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

**L: 45 T:15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Grewal, B.S, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 40th Edition, (2007).
2. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, (Reprint 2010).

**REFERENCES**
1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House Private Limited, 3rd Edition, (2007).
3. T.Veerarajan "Transforms and Partial Differential Equations", Tata McGraw-Hill Education Private Limited, updated Edition, (2012).

13CE32          **ENVIRONMENTAL SCIENCE AND ENGINEERING**          **L T P C**
                  (Common to all B.E./B.Tech. Degree Programmes)          **3 0 0 3**

**COURSE OUTCOMES**
Upon successful completion of course the student will be able to
- Understand the various ecosystem and biodiversity
- Classify the different types of natural resources and identify the role of individual in conservation of resources
- Identify and analyse the causes, effects and control measures of environmental pollution
- Identify the different types of environmental hazards and their management
- Analyse the social issues related to the environment and how human population affect the environment

**UNIT I     ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY          9**
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers– energy flow in the ecosystem – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic (pond) ecosystems. Field study of simple ecosystems –pond and forest. Introduction to biodiversity: definition - genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –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. Field study of common plants, insects, birds.

**UNIT II        NATURAL RESOURCES          9**
Forest resources: Use and over-exploitation, deforestation, case studies- dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water – 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, case studies – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT III        ENVIRONMENTAL POLLUTION          9**
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – e-Waste: Definition-dimension of the problem - source-toxic Substances in e-waste - risks related to toxic substances–environmental problems-role of an individual in prevention of pollution.

**UNIT IV        ENVIRONMENTAL HAZARDS          9**
Environmental hazards**:** Definition – Hazard- Types-Natural and man-made hazards – Natural hazards: Causes, effect and management of Earthquake, Flood, Landslide, Cyclones and Tsunami; Man-made Hazards**:** Hazards due to dams and reservoirs, hazards due to nuclear power plant, Industrial hazards. Case study: Chernobyl disaster, Bhopal gas tragedy.

**UNIT V        SOCIAL ISSUES, HUMAN POPULATION AND THE ENVIRONMENT          9**
Water conservation: rain water harvesting-climate change: global warming, acid rain, ozone layer depletion-Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – role of information technology in environment and human health – Case studies.

                                                                    **TOTAL: 45 PERIODS**

**TEXT BOOKS**
1.  Ravikrishnan. A., "Environmental Science and Engineering, Sri Krishna Hitech Publishing Company Private Limited, 2010.
2.  Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

**REFERENCES**
1.  Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2004.
2.  Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2005.
3.  Natural Hazards – Local, National, Global: G. F. White (ed), Oxford University Press.

**13CE33**                     **MECHANICS OF SOLIDS**                     **L T P C**
                                                                          **3 1 0 4**

**COURSE OUTCOMES**

**Upon successful completion of the course, the student will be able to**
- Identify stress, strain, deformation of solids and torsion in shafts & springs.
- Analyze plane truss, thin cylinders, shells and shear stresses.
- Dramatize bending moment and shear force diagram for different types of beams.

**UNIT I       STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS    12**
Rigid bodies and deformable solids – stability, strength, stiffness – tension, compression and shear stresses – strain, elasticity, Hooke's law, limit of proportionately, modules of elasticity, stress-strain curve, lateral strain – temperature stresses – deformation of simple and compound bars – shear modulus, bulk modulus, relationship between elastic constants – biaxial state of stress – stress at a point – stress on inclined plane – principal stresses and principal planes – Mohr's circle of stresses.

**UNIT II        ANALYSIS OF PLANE TRUSS, THIN CYLINDERS / SHELLS              12**
Stability and equilibrium of plane frames – types of trusses – analysis of forces in truss member's method of joints, method of sections, method of tension coefficients – thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells.

**UNIT III       TRANSVERSE LOADING ON BEAMS                                 12**
Beams – types of supports – simple and fixed, types of load – concentrated, uniformly distributed, varying distributed load, combination of above loading – relationship between bending moment and shear force – bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Theory of simple bending – analysis of stresses – load carrying capacity of beams – proportioning of sections

**UNIT IV        DEFLECTION OF BEAMS AND SHEAR STRESSES                      12**
Deflection of beams – double integration method – Macaulay's method – slope and deflection using moment area method, Conjugate Beam method – variation of shear stress – shear stress distribution in rectangular, I sections, solid circular sections, hollow circular sections, angle and channel sections – shear flow – shear centre.

**UNIT V        TORSION AND SPRINGS                                          12**
Stresses and deformation in circular (solid and hollow shafts) – stepped shafts – shafts fixed at both ends – leaf springs – stresses in helical springs – deflection of springs.

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Rajput R.K, "Strength of Materials", S.Chand and Company Limited, New Delhi, 2006.
2. Ramamurtham S, "Strength of Materials", Dhanpat Rai Publishing Company Private Limited, 2008

**REFERENCES**
1. Subramanian R, "Strength of materials", Oxford university press, New Delhi, 2005.
2. William A.Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw-Hill Publishing Company, New Delhi, 2007.
3. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 2007.

**13CE34**                    **MECHANICS OF FLUIDS**                          **L T P C**
                                                                              **3 1 0 4**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Perform unit conversion related to basic fluid properties, fluid statics and fluid dynamics including concepts of mass and momentum conservation
- Apply and analyse hydrostatic forces and moments on submerged and partially submerged surfaces
- Manipulate Bernoulli equation and continuity principle, and their application to simple flows
- Comply frictional and major losses for laminar and turbulent flows in pipes
- Evaluate dimensional analysis to determine appropriate dimensionless parameters and use the parameter for scaling and other model/prototype problems

**UNIT I          DEFINITIONS AND FLUID PROPERTIES                          10**
Definitions – Fluid and fluid mechanics – Dimensions and units – Fluid properties – Continuum Concept of system and control volume

**UNIT II         FLUID STATICS AND KINEMATICS                              14**
Pascal's Law and Hydrostatic equation – Forces on plane and curved surfaces – Buoyancy – Meta centre – Pressure measurement – Fluid mass under relative equilibrium
Fluid Kinematics
Stream, streak and path lines – Classification of flows – Continuity equation (one, two and three dimensional forms) – Stream and potential functions – flow nets – Velocity measurement (Pilot tube, current meter, Hot wire and hot film anemometer, float technique, Laser Doppler velocimetry)

**UNIT III        FLUID DYNAMICS                                            13**
Euler and Bernoulli's equations – Application of Bernoulli's equation – Discharge measurement – Laminar flows through pipes and between plates – Hagen Poiseuille equation – Turbulent flow – Darcy – Weisbach formula – Moody diagram – Momentum Principle

**UNIT IV         BOUNDARY LAYER AND FLOW THROUGH PIPES                      13**
Definition of boundary layer – Thickness and classification – Displacement and momentum thickness – Development of laminar and turbulent flows in circular pipes – Major and minor losses of flow in pipes – Pipes in series and in parallel – Pipe network

**UNIT V          SIMILITUDE AND MODEL STUDY                                10**
Dimensional Analysis – Rayleigh's method, Buckingham's Pi-theorem – Similitude and models – Scale effect and distorted models.
                                                    **L: 45 T: 15, TOTAL: 60 PERIODS**
**TEXT BOOKS**
1. Modi, P.N. & Seth, S.M "Hydraulics and fluid Mechanics", Standard book house, New Delhi, 2005.
2. Bansal R.K, "Fluid mechanics and Hydraulic machines", Laxmi Publishing Private Limited, New Delhi, 2007

**REFERENCES**
1. Streeter, Victor, L. and Wylie, Benjamin E., "Fluid Mechanics", McGraw-Hill Limited, 1998.
2. Kumar, K.L., "Engineering Fluid Mechanics", S.Chand Ltd., New Delhi, 2008.
3. Rajput, R.K., "A text book of Fluid Mechanics", S.Chand and Company, New Delhi, 2007.

**13CE35**                    **SURVEYING – I**                    **L T P C**
                                                                   **3 1 0 4**

**COURSE OUTCOMES**

**Upon successful completion of the course, the student will be able to**
- Order the basic principle of chain surveying
- Describe  the working principle of compass and plane table surveying
- Demonstrate the application of  leveling in the field surveying
- Formulate surveys  in civil engineering related works.

**UNIT I          INTRODUCTION AND CHAIN SURVEYING                    12**
Definition - Principles - Classification - Field and office work - Scales - Conventional signs - Survey instruments, their care and adjustment - Ranging and chaining - Reciprocal ranging - Setting perpendiculars - well conditioned triangles - Traversing - Plotting - Enlarging and reducing figures.

**UNIT II          COMPASS SURVEYING AND PLANE TABLE SURVEYING          12**
Prismatic compass - Surveyor's compass - Bearing - Systems and conversions - Local attraction - Magnetic declination - Dip - Traversing - Plotting - Adjustment of errors - Plane table instruments and accessories - Merits and demerits - Methods - Radiation - Intersection - Resection - Traversing.

**UNIT III          LEVELLING AND APPLICATIONS                    14**
Level line - Horizontal line - Levels and Staves - Spirit level - Sensitiveness - Bench marks - Temporary and permanent adjustments - Fly and check levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Longitudinal and cross sections - Plotting - Calculation of areas and volumes - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs.

**UNIT IV          THEODOLITE SURVEYING                    10**
Theodolite - Vernier and micmoptic - Description and uses - Temporary and permanent adjustments of vernier transit - Horizontal angles - Vertical angles - Heights and distances - Traversing - Closing error and distribution - Gale's tables - Omitted measurements.

**UNIT V          ENGINEERING SURVEYS AND MODERN INSTRUMENTS          12**
Reconnaissance, preliminary and location surveys for engineering projects - Lay out - Setting out works - Route Surveys for highways, railways and waterways -  Mine Surveying - instruments - Tunnels - Correlation of under ground and surface surveys - Shafts - Adits. Electromagnetic distance measurement - Carrier waves - Principles – Instruments –Total Station –GPS.

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Bannister A. and Raymond S., Surveying, ELBS, Sixth Edition, 2006.
2. Punmia B.C. Surveying, Vols. I, II and III, Laxmi Publications, 2005

**REFERENCES**
1. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, Sixth Edition, 1971.
2. James M.Anderson and Edward M.Mikhail, Introduction to Surveying, McGraw-Hill Book Company, 1998.
3. Kanetkar T.P., Surveying and Levelling, Vols. I and II, United Book Corporation, Pune, 1994.

**13CE36**                          **ENGINEERING GEOLOGY**                         **L T P C**
                                                                                    **3  0  0  3**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Identify the concepts of geological formations, classification and morphology of rocks,
- Translate the importance of geology with respect to foundation of structures like dams, bridges, buildings, etc.
- Demonstrate the geological formation in causing earthquakes and land slides.

**UNIT I          GENERAL GEOLOGY                                        9**
Geology in Civil Engineering – Branches of geology – Earth Structures and composition – Elementary knowledge on continental drift and plate technologies. Earth processes – Weathering – Work of rivers, wind and sea and their engineering importance – Earthquake belts in India. Groundwater – Mode of occurrence – prospecting – importance in civil engineering

**UNIT II         MINERALOGY                                             9**
Elementary knowledge on symmetry elements of important crystallographic systems – physical properties of minerals – study of the following rock forming minerals – Quartz family. Feldpar family, Augite, Hornblende, Biotite, Muscovite, Calcite, Garnet – properties, behaviour and engineering significance of clay minerals – Fundamentals of process of formation of ore minerals – Coal and petroleum – Their origin and occurrence in India.

**UNIT III        PETROLOGY                                              9**
Classification of rocks – distinction between igneous, sedimentary and metamorphic rocks. Description occurrence, engineering properties and distribution of following rocks. Igneous rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt Sedimentary rocks sandstone, Limestone, shale conglo, Conglomerate and breccia. Metamorphic rocks. Quartizite, Marble, Slate, Phyllite, Gniess and Schist.

**UNIT IV         STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD              9**
Attitude of beds – Outcrops – Introduction to Geological maps – study of structures – Folds, faults and joints – Their bearing on engineering construction. Seismic and Electrical methods for Civil Engineering investigations

**UNIT V          GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING        9**
Remote sensing techniques – Study of air photos and satellite images – Interpretation for Civil Engineering projects – Geological conditions necessary for construction of Dams, Tunnels, Buildings, Road cuttings, Land slides – Causes and preventions. Sea erosion and coastal protection.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Parbin Singh, "Engineering and General Geology", Katson Publication House, 2008.
2. Krynine and Judd, "Engineering Geology and Geotechniques", McGraw-Hill Book Company, 1990

**REFERENCES**
1. Legeet, "Geology and Engineering", McGraw-Hill Book Company, 1998
2. Blyth, "Geology for Engineers", ELBS, 1995
3. Bangar K.M, Principles of Engineering Geology, Standard Publishers and distributors, 2009

**13CE37**          **SURVEY PRACTICAL – I**          **L T P C**
         **0 0 3 2**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Categorize the practical usage of chain and compass traversing
- Examine the concepts of leveling and tachometry survey in the field.

## LIST OF EXPERIMENTS

1. Study of chains and its accessories
2. Aligning, Ranging and Chaining
3. Chain Traversing
4. Compass Traversing
5. Plane table surveying: Radiation
6. Plane table surveying: Intersection
7. Plane table surveying: Resection – Three point problem
8. Plane table surveying: Resection – Two point problem
9. Study of levels and levelling staff
10. Fly levelling using Dumpy level & Tilting level
11. Check levelling
12. Study of theodolite
13. LS and CS
14. Measurement of horizontal angles by reiteration and repetition and vertical angles

**TOTAL: 45 PERIODS**

## SURVEY PRACTICAL I & SURVEY PRACTICAL II

## LIST OF EQUIPMENTS
(For a batch of 30 students)

| Sl. No. | Description of Equipments | Quantity |
|---------|---------------------------|----------|
| 1 | Total Station | 2 Nos |
| 2 | Theodolites | Atleast 1 for every 5 Student |
| 3 | Dumpy level | Atleast 1 for every 5 Student |
| 4 | Plain table | Atleast 1 for every 5 Student |
| 5 | Prismatic compass | 6 Nos |
| 6 | Pocket stereoscope | 1 |
| 7 | Ranging rods | |
| 8 | Levelling staff | |
| 9 | Cross staff | 1 for a set of 5 student |
| 10 | Chains | |
| 11 | Tapes | |
| 12 | Arrows | |

**13CE38**         **COMPUTER AIDED BUILDING DRAWING**         **L T P C**
                                                              **0 0 3 2**

**COURSE OUTCOMES**
- Generalize basic concepts of various elements of Residential / Institutional / Workshop buildings.
- Identify and practice AutoCAD to draw truss structures, plan, elevation and sectional view of a building.

## LIST OF EXPERIMENTS

1. Buildings with load bearing walls (Flat and pitched roof) – Including details of doors and windows
2. RCC framed structures
3. Industrial buildings – North light roof structures – Trusses
4. Perspective view of one and two storey buildings

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Varma B.P , Civil Engineering Drawing & House Planning , Khanna publishers, Delhi
2. Balagopal & T.S. Prabhu, Building drawing & detailing Spades Publishers, Calicut.

**REFERENCES**
1. Shah.M.G, Building drawing , Tata McGraw-Hill,1992
2. Kumaraswamy N., Kameswara Rao A, Building planning & Drawing , Charotar Publishing
3. Shah, Kale and Patki, Building Drawing with integrated approach to built environment, Tata McGraw-Hill.

## LIST OF EQUIPMENTS
(For a batch of 30 students)

| Sl.No | Description of Equipments | Quantity |
|-------|---------------------------|----------|
| 1. | Computer system of Pentium IV or Equivalent | 1 for each student |
| 2. | Licensed version of any reputed Analysis, Design & Drafting software | 1 copy for a set of 3 student |

**13CE39    COMMUNICATION SKILLS AND TECHNICAL SEMINAR        L T P C**
                                                              **0 0 3 2**

## COURSE OUTCOMES
The student will
- express themselves fluently and appropriately in social and professional contexts.
- develop the sub-skills required for paper presentations and group discussions.
- acquire the soft skills and interpersonal skills which will help them to excel in their workplace.

## A) LANGUAGE FUNCTIONS                                                  15
1. Compare and contrast
2. Giving reasons
3. Reporting
4. Expressing agreement and disagreement
5. Evaluating different standpoints
6. Analyzing a problem and giving solution.
7. Describing daily routines, events, and weather
8. Describing Objects
9. Defending a point of view
10. Talking about future plans and intentions

Language Functions:
The teacher should build micro activities to develop the use of language required to handle these Sub-functions of communication. In the process, the learners should get used to the linguistic. Elements needed for these functions.

## B) SPEECH PRACTICE                                                    15
1. Cloning
2. Artificial satellites
3. Renewable sources
4. Telecommunication
5. Cyber Revolution
6. Space research
7. Polythene pollution
8. Fossil fuels
9. Safety measures in Automobiles.
10. Ecological threats
11. Water resources
12. Nuclear technology
13. Scientific farming
14. Thermal power plants
15. Nano Technology
16. Robotics
17. Artificial intelligence
18. Role of Fibre Optics
19. Exploration of Mars
20. Gas turbines
21. Indian space missions
22. Converting agricultural wastes for useful purposes
23. Developments in transportation
24. Scientific Farming
25. Impact of global warming
26. Desalination of water
27. Technology for national security

28. Industrial development and ecological issues
29. Recent trends in Automobiles
30. Hazards of E-waste
31. Mobile Jammer
32. Touch Screen Technology
33. Tidal Power
34. 3G Technology
35. Tsunami Warning System
36. Blue Tooth Technology

Seminar presentation on the themes allotted:

Each student should collect materials from Books, Internet, Journals and Newspapers for his/her theme and prepare a short Seminar Paper for 4 to 5 Pages. The presentation should be for 10 minutes using power point frames. It should be followed by a Viva Voce during which others should come forward to question, clarify, supplement or evaluate.

**C) GROUP DISCUSSION / DEBATE**                                                    **10**

Grouping (each group consisting of 12 members)

Topics (12 topics – 3 topics to be selected by each group - to be practiced in cycles)

**Group Discussion / Debate Topics:**

1. Advertising is a legalized form of lying- Discuss.
2. Communicative competency in English is the golden key for success in the Global arena.
3. Is it just to force people to retire?
4. Attitude decides one's altitude in life.
5. Should an aspiring student go for a course which is in demand or for a course which he / she likes?
6. Is westernization a cultural degradation or enrichment?
7. Is Brain drain a threat to India?
8. Can Nuclear Energy be replaced by solar energy? – Discuss.
9. Do Mobile phones spoil the youth?
10. No two generations see eye to eye- Discuss.
11. Is scientific advancement a boon or a bane?
12. Does ragging develop friendship?

**D) SPEAKING ON THE GIVEN PICTURE/DIAGRAM/CHART/TABLE**                    **5**
**RECORD LAY OUT:**

Every student has to maintain a record in which he/she has to incorporate the following details.

- First page containing learner details and the topic of specialization
- Use of appropriate Language used in Language Function should be listed.
- Three news paper cuttings or journal or internet sources related to the specialized theme. (To be pasted on the pages)
- 10 Quiz questions of the specialized topic with expected answers.
- The seminar paper presented by the learner (to be pasted).
- Notes of observation - Lab. ( Details about Interview skills – GD – Soft skills )
- The record should be duly signed by the course teacher and submitted to the External Examiner for verification during the semester practical.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Rizvi.M.Ashraf, "Effective Technical Communication", The MC Graw Hill Education Private Limited, Companies, New Delhi, 2010.
2. Sangeetha Sharma and Binod Mishra, "Communication Skills for Engineers and scientists", PHI Learning Private Limited, Delhi, 2009.

**13CE41          PROBABILITY, STATISTICS AND NUMERICAL METHODS     L T P C**
**3 1 0 4**

**COURSE OUTCOMES**
At the end of the course, students should be able to
- Understand the concepts of probability, random variables and their distributions.
- Apply the concepts of estimation (confidence intervals) and hypothesis testing for population averages and percentages.
- Analyze the appropriate tabular for displaying design of experiments.
- Able to use numerical techniques for solving linear system of equations and numerical integration problems.
- Demonstrate the utility of numerical techniques of ordinary differential equations.

**UNIT I      ONE DIMENSIONAL RANDOM VARIABLES AND ITS DISTRIBUTIONS      12**
Discrete and continuous random variables –Moments, Moment generating functions and their properties- Discrete distributions: Binomial and Poisson– Continuous distribution: Normal distribution.

**UNIT II        TESTING OF HYPOTHESIS                                    12**
Sampling distributions - Tests for single mean, Proportion, Difference of means (for large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

**UNIT III        DESIGN OF EXPERIMENTS                                   12**
Completely randomized design – Randomized block design – Latin square design.

**UNIT IV        SOLUTION OF EQUATIONS AND NUMERICAL INTEGRATION        12**
Solution of Algebraic  and transcendental equations-Newton-Raphson method- Solutions of linear System of equations-Gauss Elimination method - Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Numerical integration using Trapezoidal and Simpson's  rules for single and double integration.

**UNIT V     NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS    12**
Taylor's series method - Euler's methods -Fourth order Runge-Kutta method for solving first and second order equations – Adams - Bashforth and Milne's predictor-corrector  methods for solving first order equations - Finite difference methods for solving second order equation.

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
2. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 6th Edition, 2004.

**REFERENCES**
1. R.E.Walope, R.H.Myers, S.L.Myers and KYe, "Probability and Statistics for Engineers and scientists", Pearson Education Asia, New Delhi, 6th Edition, 2007.
2. P. Kandasamy, K. Thilagavathy and K. Gunavathy, 'Numerical Methods', S.Chand & Company Limited, New Delhi, 2003.
3. T.Veerarajan "Probability Statistics and Random Process", Tata McGraw-Hill Education Private Limited, New Delhi, 3rd Edition, (2010).

**13CE42**          **STRENGTH OF MATERIALS**          **L T P C**
         **3 1 0 4**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Recognize the concept of Forces and their effects with suitable protective measures
- Analyze structures as determinate and indeterminate
- Acquire Knowledge on Energy principles, Columns and State of stress

**UNIT I      ENERGY PRINCIPLES      12**
Strain energy and strain energy density – strain energy in traction, shear in 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      INDETERMINATE BEAMS      12**
Propped cantilever and fixed beams-fixed end moments and reactions for concentrated load (central, non central), uniformly distributed load, triangular load (maximum at centre and maximum at end) – theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams for continuous beams

**UNIT III      COLUMNS      12**
Eccentrically loaded short columns – middle third rule – core section – columns of unsymmetrical sections – (angle channel sections) – Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – thick cylinders – compound cylinders.

**UNIT IV      STATE OF STRESS IN THREE DIMENSIONS      12**
Spherical and deviatory components of stress tensor - determination of principal stresses and principal planes – volumetric strain – dilatation and distortion – theories of failure – principal stress dilatation – principal strain – shear stress – strain energy and distortion energy theories – application in analysis of stress, load carrying capacity and design of members – residual stresses

**UNIT V      ADVANCED TOPICS IN BENDING OF BEAMS      12**
Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – curved beams – Winkler Bach formula – stress concentration – fatigue and fracture.

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Bansal R.K. "Strength of materials", Laxmi Publications, New Delhi, 2007.
2. Ramamrutham.S, "Strength of Materials", Dhanpat Rai Publishing Company Private Limited, Jan-2008.

**REFERENCES**
1. Srinath, L.S. Advanced mechanics and solids, Tata-McGraw Hill Publishing Company Limited, 2005.
2. Punmia B.C. Theory of Structures (SMTS) Vol 1&II, Laxmi Publishing Private Limited, New Delhi, 2004.
3. Rajput R.K. Strength of Materials, S.Chand & Company Limited, New Delhi, 2006.

**13CE43** **APPLIED HYDRAULIC ENGINEERING** **L T P C**
**3 1 0 4**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Reproduce the basics of hydraulics such as the occurrence, movement and use of water
- Express specific energy principles to assess flow depth and velocity flows in open channel systems
- Analyse rapidly varied channel-flow and dam break problems by the method of characteristics
- Derive flow calculation for weirs and various types of water measurement devices and demonstrate their application to measure flow, velocity and pressure
- Examine the pumps for various engineering applications based on pump performance curves without incurring cavitations.

**UNIT I** **OPEN CHANNEL FLOW** **12**
Open channel flow – Types and regimes of flow – Velocity distribution in open channel – Wide open channel – Specific energy – Critical flow and its computation – channel transition.

**UNIT II** **UNIFORM FLOW** **11**
Uniform flow – Velocity measurement – Manning's and Chezy's formula – Determination of roughness coefficients – Determination of normal depth and velocity – Most economical sections – Non-erodible channels

**UNIT III** **VARIED FLOW** **12**
Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Flow through transitions - Hydraulic jump – Types – Energy dissipation – Surges.

**UNIT IV** **PUMPS** **12**
Centrifugal pump - minimum speed to start the pump – multistage Pumps – Jet and submersible pumps - Positive displacement pumps - reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done - rotary pumps.

**UNIT V** **TURBINES** **13**
Turbines - draft tube and cavitations – Application of momentum principle – Impact of jets on plane and curved plates - turbines - classification - radial flow turbines - axial flow turbines – Impulse and Reaction

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Ramamrutham S, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpatrai Publishing Company, 2011.
2. Modi, P.N, and Seth S.M. Hydraulic and Fluid Mechanics Standard Book House, 2011.

**REFERENCES**
1. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", Khanna Publishers, 8th Edition, 1995.
2. Ranga Raju, K.G., "Flow through Open Channels", Tata McGraw-Hill, 1985
3. Bansal R.K, Fluid mechanics & Hydraulic machines, Laxmi Publishing Private Limited, New Delhi, 2007.

**13CE44**                          **SURVEYING – II**                          **L T P C**
                                                                                  **3  1  0  4**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Employ the concept in designing of curves.
- Compute tacheometric surveying and the application of various electronic instruments in surveying.
- Generate the probable error and its correction factor in surveying.

**UNIT I           SETTING OUT OF CURVES                                         12**
Curve ranging - Horizontal and vertical curves - Simple curves  - Setting with chain and tapes, tangential angles by theodolite, double theodolite - Compound and reverse curves - Transition curves - Functions and requirements - Setting out by offsets and angles - Vertical curves - Sight distances

**UNIT II          TACHEOMETRIC SURVEYING                                        10**
Tachometric systems - Tangential, stadia and subtense methods - Stadia systems - Horizontal and inclined sights - Vertical and normal staffing - Fixed and movable hairs - Stadia constants –
Anallactic lens - Subtense bar.

**UNIT III         CONTROL SURVEYING                                             12**
Working from whole to part - Horizontal and vertical control methods - Triangulation - Signals - Base line - Instruments and accessories -  Satellite station - Reduction to centre –Trilateration - Trigonometric leveling - Single and reciprocal observations – Bench marking

**UNIT IV          SURVEY ADJUSTMENTS                                            12**
Errors - Sources, precautions and corrections - Classification of errors - True and most probable values - weighted observations - Method of equal shifts - Principle of least squares - Normal equation - Correlates - Level nets - Adjustment of simple triangulation networks.

**UNIT V           ASTRONOMICAL AND HYDROGRAPHIC SURVEYING                       14**
Celestial sphere - Astronomical terms and definitions - Motion of sun and stars - Apparent altitude and corrections - Celestial co-ordinate systems - Nautical almanac - Star constellations - Practical astronomy - Field observations and calculations for azimuth- Hydrographic Surveying - Tides - MSL - Sounding methods - Location of soundings and methods - Three point problem - Strength of fix - Sextants and station pointer .

**L: 45 T: 15, TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Punmia B.C., Surveying, Vols. I, II and III, Laxmi Publications, 2005.
2. Kanetkar T.P., Surveying and Levelling, Vols. I and II, United Book Corporation, Pune, 1994.

**REFERENCES**
1. Clark D., Plane and Geodetic Surveying, Vols. I and II, C.B.S. Publishers and Distributors, Delhi, 6th Edition, 2006.
2. James M.Anderson and Edward M.Mikhail, Introduction to Surveying, McGraw-Hill Book Company, 2012.
3. Bannister A. and Raymond S., Surveying, ELBS, 6th Edition, 2006.

**13CE45**                    **CONSTRUCTION MATERIALS AND PRACTICE**        **L T P  C**
                                                                              **3 0 0 3**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Describe the building materials and their properties
- Illustrate new topics such as construction joints and water proof materials
- Select the ingredients of special and conventional concrete and admixtures

**UNIT I          PRIMARY CONSTRUCTION MATERIALS                          9**
Stones – Types – characteristics – uses - BIS tests - Tiles-types-selection -suitability – uses - maintenance – Bricks – composition – manufacture – types - BIS tests. Hollow concrete blocks, Burnt clay hollow Blocks, Stabilized mud blocks – Selection of Building Blocks – Cement – Manufacturing – Different types - hydration- setting and hardening – Initial & Final Setting Time-Cement mortar

**UNIT II          SECONDARY CONSTRUCTION MATERIALS                        9**
Timber- defects-causes of decay - seasoning – preservation - fire proofing -Laminated wood products - types – properties – uses of fiber boards, particle boards, hard boards and A.C boards - Paints – types – wall paints – wood paints – metal paints. Steel Properties – types- Aluminum products - UPVC – crack fillers – Asbestos –GI Sheets– Glass – water proofing compounds – Neoprene – thermocole – fiber reinforced plastic – smart concrete and smart bricks.

**UNIT III          CONSTRUCTION PRACTICES                                 9**
Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry – concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection.

**UNIT IV          SPECIAL FORMS OF CONSTRUCTION                           9**
Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation. Launching girders, bridge decks, off shore platforms. Material handling - erecting light weight components on tall structures.

**UNIT V          CONSTRUCTION EQUIPMENT                                   9**
Selection of equipment for earth work - earth moving operations - types of earthwork equipment - tractors, motor graders, scrapers, front end waders, earth movers – Equipment for foundation and pile driving. Equipment for compaction, batching and mixing and concreting - Equipment for material handling and erection of structures - Equipment for dredging, trenching, tunneling.

**TOTAL: 45 PERIODS**
**TEXT BOOKS**
1. S.C. Rangawala, "Engineering materials", Charotar Publishing House, New Delhi.2000.
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 1997.

**REFERENCES**
1. R.K.Rajput, "Engineering Materials", S.Chand & Company Limited, New Delhi, Revised Edition, 2008.
2. Shetty M.S., "Concrete Technology", S.Chand & Company, New Delhi, 2008.
3. Santhakumar. A.R, "Conrete Technology", Oxford University Press, 2007.

**13CE46**                          **HIGHWAY ENGINEERING**                       **L T P C**
                                                                                  **3  0  0  3**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Describe the components of Highways and properties of highway materials & various practices adopted for construction.
- Examine highway planning, engineering surveys for highway alignment.
- Appraise knowledge on Design of Geometric Elements of Highways ,Urban roads, Rigid and Flexible pavements
- Formulate the skills on evaluation of the pavements and to decide appropriate types of maintenance.

**UNIT I          HIGHWAY PLANNING AND ALIGNMENT                                    9**
History of Road Construction, Highway Development in India - Jayakar Committee Recommendations and Realizations, Twenty-year Road Development Plans, Concepts of Ongoing Highway Development Programmes at National Level, Institutions for Highway Development at National level - Indian Roads Congress, Highway Research Board, National Highway Authority of India, Ministry of Road Transport and Highways (MORTH) and Central Road Research Institute. Requirements of Ideal Alignment, Factors Controlling Highway Alignment Engineering Surveys for Alignment - Conventional Methods and Modern Methods (Remote Sensing, GIS and GPS techniques) Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements – Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths [IRC Standards], Cross sections of different Class of Roads - Principles of Highway Financing.

**UNIT II         GEOMETRIC DESIGN OF HIGHWAYS                                      9**
Design of Horizontal Alignment – Horizontal Curves Super elevation, Widening of Pavements on Horizontal Curves and Transition Curves Design of Vertical Alignments – Rolling, Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves-Sight Distances – Factors affecting Sight Distances, PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance [Derivations and Problems in SSD and OSD] -Geometric Design of Hill Roads [IRC Standards Only]

**UNIT III        FLEXIBLE AND RIGID PAVEMENTS                                      9**
Rigid and Flexible Pavements - Components and their Functions - Design Principles of Flexible and Rigid Pavements, Factors affecting the Design of Pavements - ESWL, Climate, Sub-grade Soil and Traffic - Design Practice for Flexible Pavements [IRC Method and Recommendations - Problems] - Design Practice for Rigid Pavements – IRC Recommendations - concepts only.

**UNIT IV        HIGHWAY MATERIALS AND CONSTRUCTION PRACTICE                        9**
Desirable Properties and Testing of Highway Materials: Soil – California Bearing Ratio Test, Field Density Test - Aggregate - Crushing, Abrasion, Impact Tests, Water absorption, Flakiness and Elongation indices and Stone polishing value test - Bitumen - Penetration, Ductility, Viscosity, Binder content and Softening point Tests. - Construction Practice - Water Bound Macadam Road, Bituminous Road and Cement Concrete Road [as per IRC and MORTH specifications] - Highway Drainage [IRC Recommendations]

**UNIT V          HIGHWAY MAINTENANCE                                               9**
Types of defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments. - Types of Pavement, Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks Spalling of Joints and Mud Pumping – and Special Repairs. - Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening - Overlay design by Benkelman Beam Method [Procedure only].

**TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2014.
2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2000.

**REFERENCES**
1. Sharma S.K, Highway Engineering,  S.Chand Publishing & Company Limited, 2012.
2. IRC Standards (IRC 37 - 2001 & IRC 58 -1998)
3. Bureau of Indian Standards (BIS) Publications on Highway Materials Specifications for Road and Bridges, NORTH (India)

**13CE47**                    **HYDRAULIC ENGINEERING LABORATORY**          **L T P C**
                                                                            **0 0 3 2**
**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Apply knowledge on flow measurements in pipes and open channels
- Calculate the performance on hydraulic machineries
- Develop pipe layouts and design pumps for residential buildings

**LIST OF EXPERIMENTS**

1. Determination of co-efficient of discharge for orifice
2. Determination of co-efficient of discharge for notches
3. Determination of co-efficient of discharge for venturimeter
4. Determination of co-efficient of discharge for orifice meter
5. Study of impact of jet on flat plate (normal / inclined)
6. Study of friction losses in pipes
7. Study of minor losses in pipes
8. Study on performance characteristics of Pelton turbine.
9. Study on performance characteristics of Francis turbine
10. Study on performance characteristics of Kaplan turbine
11. Study on performance characteristics of Centrifugal pumps (Constant speed / variable speed)
12. Study on performance characteristics of reciprocating pump.

                                                          **TOTAL: 45 PERIODS**
**LIST OF EQUIPMENTS**

| | | |
|---|---|---|
| 1. Bernoulli's theorem – Verification Apparatus | - | 1 No. |
| 2. Flow Measurement open channel flow | | |
| (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 |
| 3. Flow measurement in pipes | | |
| (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 |
| 4. Losses in Pipes | - | 1 Unit |
| Major loss – Friction loss Pipe lengths (min. 3m) of different diameters with Valves and pressure rapping & collecting tank | | |

Minor Losses                                                    -        1 Unit
Pipe line assembly with provisions for having Sudden
contractions in diameter, expansions Bends, elbow fitting, etc.

5.  Pumps

   (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

6.  Turbine

   (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

**13CE48**                           **SURVEY PRACTICAL – II**                    **L T P C**
                                                                                  **0 0 3 2**

**COURSE OUTCOMES**
**Upon successful completion of the course, the student will be able to**
- Analyse and design simple curves
- Apply knowledge to find horizontal angle, vertical angle and distance using total station.

## LIST OF EXPERIMENTS

1. Theodolite survey traverse
2. Tacheometry
   - i. Tangential system
   - ii. Stadia system
   - iii. Subtense system.
3. Setting out works
   - i. Foundation marking
   - ii. Simple curve by Rankine's method & Two Theodolite method
   - iii. Transition curve.
4. Triangulation – Single plane method – Double plane method
5. Sun / Star observation to determine azimuth
6. Surveying using Total Station

**TOTAL: 45 PERIODS**

**13CE51**                 **STRUCTURAL ANALYSIS – I**                  **L T P C**
                                                                         **3 1 0 4**

**COURSE OUTCOMES**
Upon successful completion of this course, the students will be able to
   CO 1: Apply the fundamentals of Energy principles in simple problems
   CO 2: Draw ILD for shear force, bending moment for statically determinate structure and for indeterminate structure restricted to redundancy of one
   CO 3: Analyse hinged arches
   CO 4: Analyse a structure using slope deflection method
   CO 5: Analyse a structure using moment distribution method

**UNIT I      FUNDAMENTALS - DEFLECTION OF DETERMINATE STRUCTURES          12**
Definition and Determination of Static and Kinematic Indeterminacy – Beams, Trusses and Frames – Degree of Freedom– Equilibrium and Kinematic Stability – Principle of Superposition – Basic Methods of Structural Analysis.
Work – Energy principles – Principle of Stationary Potential Energy – Principle of Virtual Displacements – Complementary Energy – Principle of virtual Forces – Castigliano's First and Second Theorem – Theorem of least work – Clark Maxwell's theorem of reciprocal deflection – Betti's theorem – Application to simple problems of Statically determinate beams, trusses and frames.

**UNIT II          MOVING LOADS AND INFLUENCE LINES                       12**
          **(Determinate & Indeterminate Structures with Redundancy Restricted To One)**
Influence lines for reactions in statically determinate structures – influence lines for members forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads.
Muller Breslau's principle – Influence lines for continuous beams and single storey rigid frames

**UNIT III        ARCHES                                                  12**
Arches as structural forms – Examples of arch structures – Types of arches – Analysis of three hinged and two hinged arches, parabolic and circular arches – Settlement and temperature effects.

**UNIT IV         SLOPE DEFLECTION METHOD                                 12**
          **(Redundancy restricted to Two)**
Continuous beams and rigid frames (Single storey, single bay with and without sway) – Symmetry and antisymmetry – Simplification for hinged end – Support displacements – Gable frames – Box Culverts

**UNIT V          MOMENT DISTRIBUTION METHOD                              12**
          **(Redundancy restricted to Two)**
Distribution and carryover of moments – Stiffness and carry over factors – Analysis of continuous beams – Plane rigid frames (Single storey, single bay with and without sway) – Support displacements – Gable frames – Box Culverts

                                            **L: 45 T: 15 TOTAL: 60 PERIODS**
**TEXT BOOKS**
   1. Punmia B.C., Theory of Structures (SMTS) Vol.II Laxmi Publishing Pvt. Ltd., New Delhi, 2004.
   2. Vaidyanathan.R and Perumal.P, "Comprehensive structural Analysis – Vol.1", Laxmi Publications, New Delhi, 2007

**REFERENCES**
   1. Analysis of Indeterminate Structures – C.K. Wang, Tata McGraw-Hill, 1992.
   2. L.S. Negi & R.S. Jangid, "Structural Analysis", Tata McGraw-Hill Publications, New Delhi, 6th Edition, 2003.
   3. Vaidyanathan.R and Perumal.P, "Comprehensive structural Analysis – Vol.2", Laxmi Publications, New Delhi, 2015
   4. Bhavi katti, S.S, "Structural Analysis–Vol.1", Vikas Publishing House Pvt. Ltd., New Delhi, 2007
   5. Bhavikatti, S.S, "Structural Analysis–Vol.2", Vikas Publishing House Pvt. Ltd., New Delhi, 2013
   6. NPTEL

**13CE52**                              **SOIL MECHANICS**                       **L T P C**
                                                                                 **3 1 0 4**

**COURSE OUTCOMES**

Upon successful completion of this course, the students will be able to

CO 1: Classify the soil based on Index and Engineering properties

CO 2: Explain the principle of soil water movement and its effect on stress distribution.

CO 3: Explain the stresses in the soil and principle of consolidation.

CO 4: Determine the shear strength parameters of soil

CO 5: Analyse the stability of slopes and slope protection measures

**UNIT I          INTRODUCTION                                                    15**

Nature of Soil - Problems with soil - phase relation - sieve analysis - sedimentation analysis – Atterberg limits - classification for engineering purposes - BIS Classification system - Soil compaction - factors affecting compaction – field compaction methods and monitoring.

**UNIT II          SOIL WATER AND WATER FLOW                                      15**

Soil water – Various forms – Influence of clay minerals – 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 - Seepage – Laplace Equation - Introduction to flow nets –properties and uses - Application to simple problems.

**UNIT III          STRESS DISTRIBUTION, COMPRESSIBILITY AND SETTLEMENT            12**

Stress distribution in soil media – Boussinesque formula – stress due to line load and Circular and rectangular loaded area - approximate methods - Use of influence charts – Westergaard equation for point load - Components of settlement - Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory – governing differential equation - laboratory consolidation test – Field consolidation curve – NC and OC clays - problems on final and time rate of consolidation

**UNIT IV          SHEAR STRENGTH                                                  9**

Shear strength of cohesive and cohesionless soils - Mohr - Coulomb failure theory – Saturated soil - Strength parameters - 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 – Stress path for conventional triaxial test.

**UNIT V          SLOPE STABILITY                                                  9**

Slope failure mechanisms - Modes - Infinite slopes - Finite slopes – Total and effective stress analysis - Stability analysis for purely cohesive and C- soils - Method of slices – Modified Bishop's method - Friction circle method - stability number – problems – Slope protection measures.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Punmia P.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 1995.
2. Gopal Ranjan and Rao A.S.R., "Basic and applied soil mechanics", New Age International Publishers, New Delhi, 2000.
3. 

**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 Geo techniques", 6th Edition, Prentice-Hall, New Jersey, 2002.
3. Das, B.M, "Principles of Geotechnical Engineering", 5th Edition, Thomas Books cole, 2002
4. Muni Budhu, "Soil Mechanics and Foundations", John Willey & Sons, Inc, New York, 2000.
4. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, 1995
5. Khan I.H., "A text book of Geotechnical Engineering", Prentice Hall of India, New Delhi, 1999.
6. NPTEL

**13CE53**        **DESIGN OF REINFORCED CONCRETE ELEMENTS**     **L T PC**
                                                                           **3 1 0 4**

**COURSE OUTCOMES**
   Upon successful completion of this course, the students will be able to
     CO 1: Design the reinforced concrete flexural members by working stress method and
           explain the different method of design.
     CO 2: Design the reinforced concrete beams, slabs by limit state method.
     CO 3: Design and identify the behavior of reinforced concrete subjected to bond,
           anchorage, shear and torsion by limit state method.
     CO 4: Design the reinforced concrete columns by limit state method.
     CO 5: Design the reinforced concrete footings by limit state method.

**UNIT I**           **METHODS OF DESIGN OF CONCRETE STRUCTURES**     **12**
Materials for Concrete – Stress-Strain curve for concrete and reinforcing steel – Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods – Design codes and specification – Limit State philosophy as detailed in IS code – Design of flexural members and slabs by working stress method – Properties of un-cracked section.

**UNIT II**      **LIMIT STATE DESIGN FOR FLEXURE**                 **12**
Analysis and design of singly and doubly reinforced rectangular and flanged beams – Analysis and design of one way and two way rectangular slab subjected to uniformly distributed load for various boundary conditions and corner effects.

**UNIT III**        **LIMIT STATE DESIGN FOR BOND, ANCHORAGE SHEAR AND**
                       **TORSION**                                           **12**
Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending shear and torsion.

**UNIT IV**      **LIMIT STATE DESIGN OF COLUMNS**                 **12**
Types of columns – Braced and unbraced columns – Design of short column for axial, uniaxial and biaxial bending – Design of long columns.

**UNIT V**      **LIMIT STATE DESIGN OF FOOTING AND DETAILING**     **12**
Design of wall footing – Design of axially and eccentrically loaded rectangular footing – Design of combined rectangular footing for two columns only – Standard method of detailing RC beams, slabs and columns – Special requirements of detailing with reference to erection process.

                                        **L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**
1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Private Limited, New Delhi, 2002.
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Limited, New Delhi
3. Krishna Raju, N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi,2003.

**REFERENCES**
1. Jain, A.K., "Limit State Design of RC Structures", Nemchand Publications, Rourkee
2. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. NPTEL

**13CE54**               **WATER SUPPLY TREATMENT AND MANAGEMENT    L T PC**
                                                                    **3  0 0 3**

**COURSE OUTCOMES**

  Upon successful completion of this course, the students will be able to
    CO 1: Summarize the various sources of water and their characteristics
    CO 2: Classify the different types of conveyance system, pipes and pumping system
    CO 3: Design the components of a water treatment plant
    CO 4: Explain the various processes of advance water treatment
    CO 5:  Outline the different types of distribution networks and water supply to
    buildings

**UNIT I                PLANNING FOR WATERSUPPLY SYSTEM               9**
Public water supply system - Planning - Objectives - Design period - Population forecasting -
Water demand - Sources of water and their characteristics - Surface and Groundwater -
Impounding Reservoir Well hydraulics - Development and selection of source - Water quality
- Characterization -Water quality standards.

**UNIT II        CONVEYANCE SYSTEM                                    9**
Water supply - intake structures - Functions and drawings - Pipes and conduits for water -
Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing
and testing of pipes - Drawings appurtenances - Types and capacity of pumps - Selection of
pumps and pipe materials.

**UNIT III       WATER TREATMENT                                     9**
Objectives - Unit operations and processes - Principles, functions design and drawing of
Flash mixers, fiocculators, sedimentation tanks and sand filters – Filter press – Disinfection -
Ozonation and UV - Residue Management – TSDF & Cement plant.

**UNIT IV        ADVANCED WATER TREATMENT                            9**
Aerator - Iron and manganese removal, Defluoridation and demineralization - Water
softening - Desalination - Membrane Systems - Construction and Operation & Maintenance
aspects of Water Treatment Plants - Recent advances - Membrane Processes – Arsenic
treatment.

**UNIT V        WATER DISTRIBUTION AND SUPPLY TO BUILDINGS           9**
Requirements of water distribution - Components - Service reservoirs - Functions and
drawings - Network design - Economics - Computer applications - Analysis of distribution
networks - Appurtenances - operation and maintenance - Leak detection, Methods. Principles
of design of water supply in buildings - House service connection - Fixtures and fittings -
Systems of plumbing and drawings of types of plumbing.

                                                    **L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
    1. Garg, S.K., Environmental Engineering, Vol.1 Khanna Publishers, New Delhi, 2014.
    2. Modi, P.N. Water Supply Engineering, Vol. I Standard Book House, New Delhi,
       2010.
    3. Punmia, B.C., Ashok K Jain and Arun K Jain, Water Supply Engineering, Laxmi
       Publications Private Limited, New Delhi, 2014

**REFERENCES**

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013
2. Syed R.Qasim and Edward M.Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Private Limited, New Delhi – 2006
3. NPTEL

| **13CE55** | **PROFESSIONAL ETHICS AND HUMAN VALUES** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | (Common to all branches) | **3** | **0** | **0** | **3** |

## COURSE OUTCOMES

Upon completion of this course, the student will be able to

    CO1: Understood the core values that shape the ethical behavior of an engineer

    CO2: Exposed awareness on professional ethics and human values.

    CO3: Known their role in technological development

**UNIT I**           **HUMAN VALUES**           **9**

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

**UNIT II**        **ENGINEERING ETHICS**           **9**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

**UNIT III**        **ENGINEERING AS SOCIAL EXPERIMENTATION**           **9**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

**UNIT IV**        **SAFETY, RESPONSIBILITIES AND RIGHTS**           **9**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

**UNIT V**        **GLOBAL ISSUES**           **9**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - Moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

**L: 45, TOTAL: 45 PERIODS**

## TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

## REFERENCES

1. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

4. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)

**13CE56**              **CONCRETE TECHNOLOGY**              **L T P C**
                                                             **3 0 0 3**

**COURSE OUTCOMES**

Upon successful completion of this course, the students will be able to

CO 1: Explain the properties of concrete making materials and their testing methods.

CO 2: Explain the testing procedures of concrete in plastic and hardened state.

CO 3: Design concrete mixes by various methods.

CO 4: Apply statistical quality control techniques to concrete quality.

CO 5: Summarize durability of concrete and concreting under special circumstances.

CO 6: Outline the properties of special concrete and its applications.

**UNIT I        INGREDIENTS OF CONCRETE                         9**

Cement – constituents – Hydration – Tests on cement – Types of cement – Aggregates – properties and uses – Classification of aggregates – Properties and test on aggregates – gradation – Quality of water – Admixtures – Accelerators – Retarders – Water proofers – workability agents – air entraining admixtures.

**UNIT II     PROPERTIES OF CONCRETE                         9**

Properties of fresh concrete – Workability – Segregation – Bleeding – Properties of hardened concrete – Strength – Stress - Strain characteristics – Modulus of Elasticity – Shrinkage – Creep – Thermal properties – Permeability – Test for Tension, Compression and Flexure – Non-Destructive Test

**UNIT III      CONCRETE MIX DESIGN AND QUALITY CONTROL OF**
                **CONCRETE                                    9**

Quality Control - Frequency of sampling – Statistical analysis of test results – standard deviation – Coefficient of variation – Characteristic strength –Acceptance and rejection Criteria – Importance of water cement ratio– Importance of cover to concrete – Nominal mixes – Design Mixes – factors influencing the design mix – Mix Design by ACI and IS method.

**UNIT IV      DURABILITY AND CONCRETE UNDER SPECIAL**
               **CIRCUMSTANCES                                9**

Durability – Strength and durability relationship – Permeability – Chemical and sulphate attack – Underground Construction – Concreting in Marine Environment – Under water Construction – Hot weather and Cold weather concreting - Concrete corrosion.

**UNIT V      SPECIAL CONCRETES                               9**

High Strength – High Performance Concrete – reactive powder concrete – Light weight, heavy weight and mass concrete – Self Compacting Concrete – Self Curing Concrete – Polymer Concrete – Fibre Reinforced Concrete – Ready Mixed Concrete – Ferro cement – Shortcrete – Vacuum concrete.

**L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Shetty M.S., "Concrete Technology", S.Chand & Company, New Delhi, 2008
2. Santhakumar. A.R, "Conrete Technology", Oxford university press, 2007
3. M.L. Gambhir, "Concrete Technology", Tata Mc-Graw Hill Company, Noida, 2011

**REFERENCES**
1. Orchard D.F., "Concrete Technology", Vol I & II ,1998
2. Neville A.M "Properties of Concrete", Pearson Education, 2008
3. NPTEL

**13CE57**          **STRENGTH OF MATERIALS LABORATORY**          **L T P C**
                                                                  **0 0 3 2**

**COURSE OUTCOMES**
    Upon successful completion of this course, the students will be able to
        CO 1: Demonstrate the fundamental modes of loading the structures
        CO 2: Perform experiments making measurements of loads, displacements and
               strains.
        CO 3: Compute experimentally the strength of the material and stiffness properties of
               structural elements.

**LIST OF EXPERIMENTS**

   1. Test involving axial compression to obtain the stress – strain curve
   2. Test involving axial tension to obtain the stress – strain curve and the strength
   3. Test involving torsion to obtain the torque vs. angle of twist and hence the stiffness
   4. Test involving flexure to obtain the load deflection curve and hence the stiffness
   5. Tests on springs
   6. Test to verify Maxwell's reciprocal theorem
   7. Test on wooden specimen (Compression, Tension and shear)
   8. Hardness tests
   9. Shear test
   10.  Test for impact resistance
   11.  Compression test on bricks

The student should learn the use of deflectometer, extensometer, compressometer and strain
gauges.

                                              **P:45 TOTAL: 45 PERIODS**

**LIST OF EQUIPMENTS** (For a batch of 30 students)

| S. NO. | DESCRIPTION OF EQUIPMENTS | 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 test | |
| | Rockwell | |
| | Vicker's | 1 Each |
| | Brinnel | |
| 5. | Beam deflection test apparatus | 1 |
| 6. | Extensometer | 1 |
| 7. | Compressometer | 1 |
| 8. | Dial gauges | Few |
| 9. | Compression Testing Machine (100 Ton) | 1 |

**13CE58**                    **SOIL MECHANICS LABORATORY**          **L T P C**
                                                                    **0  0  3 2**

**COURSE OUTCOMES**
   Upon successful completion of this course, the students will be able to
      CO 1: Determine the index properties of soil
      CO 2: Determine the engineering properties of soil

1. Grain size distribution - Sieve analysis
2. Grain size distribution - Hydrometer analysis
3. Specific gravity of soil grains
4. Relative density of sands
5. Atterberg limits test
6. Determination of moisture - Density relationship using standard Proctor test.
7. Permeability determination (constant head and falling head methods)
8. Determination of shear strength parameters.
9. Direct shear test on cohesionless soil
10. Unconfined compression test on cohesive soil
11. Triaxial compression test (demonstration only)
12. One dimensional consolidation test (Demonstration only)
13. Field density test (Core cutter and sand replacement methods)

                                             **P: 45 TOTAL: 45 PERIODS**

**LIST OF EQUIPMENTS** (For a batch of 30 students)

| S. NO. | DESCRIPTION OF EQUIPMENTS | QUANTITY |
|--------|---------------------------|----------|
| 1. | Sieves | 2 sets |
| 2. | Hydrometer | 2 sets |
| 3. | Liquid and plastic limit apparatus | 2 sets |
| 4. | Shrinkage limit apparatus | 3 sets |
| 5. | Proctor compaction apparatus | 1 set |
| 6. | CBR Apparatus | 1 |
| 7. | Direct shear apparatus | 1 |
| 8. | Thermometer | 2 |
| 9. | Field density measuring device | 2 |
| 10. | Triaxial shear apparatus | 1 |
| 11. | Three gang consolidation test device | 1 |

**13CE59**      **CONCRETE AND HIGHWAY ENGINEERING LABORATORY**

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

## COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

CO 1: Perform test on cement

CO 2: Demonstrate properties of concrete experimentally

CO 3: Predict properties of highway materials experimentally

### I. TEST ON CEMENTS
   a. Consistency
   b. Initial & Final Setting time
   c. Soundness
   d. Cube Compressive strength

### II. TESTS ON FRESH CONCRETE
   a. Slump cone test
   b. Flow table
   c. Compaction factor
   d. Vee bee test.

### III. TESTS ON HARDENED CONCRETE
   a. Compressive strength – Cube
   b. Splitting tensile – cylinders
   c. Flexure test
   d. Modulus Of Elasticity

### IV. TESTS ON BITUMEN
   a. Penetration
   b. Softening Point
   c. Ductility
   d. Viscosity
   e. Elastic Recovery

### V. TESTS ON AGGREGATES
   a. Proportioning of Aggregates
   b. Water Absorption & Specific gravity
   c. Aggregate Impact Value
   d. Aggregate Crushing value
   e. Bulking of sand

### VI. TESTS ON BITUMINOUS MIXES
   a. Determination of Binder Content
   b. Marshall Stability and Flow values

**P:45 TOTAL: 45 PERIODS**

## EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS

| S.NO | DESCRIPTION OF EQUIPMENTS | QUANTITY |
|------|---------------------------|----------|
| 1. | Concrete cube moulds | 6 |
| 2. | Concrete cylinder moulds | 3 |
| 3. | Concrete Prism moulds | 3 |
| 4. | Sieves | 1 set |
| 5. | Concrete Mixer | 1 |
| 6. | Slump cone | 3 |
| 7. | Flow table | 1 |
| 8. | Vibrator | 1 |
| 9. | Trovels and planers | 2 set |
| 10. | Vee Bee Consistometer | 1 |
| 11. | Aggregate impact testing machine | 1 |
| 12. | Blains Apparatus | 1 |
| 13. | Compression Testing Machine 200T capacity | 1 |
| 14. | Flexure Testing Machine | 1 |
| 15. | Compressometer | 1 |
| 16 | Le Chatelier's apparatus | 2 |
| 17 | Vicat's apparatus | 2 |
| 18 | Mortar Cube moulds | 10 |

**13CE61**        **DESIGN OF REINFORCED CONCRETE AND BRICK MASONRY**        **L T P C**
                                **STRUCTURES**                                        **3 1 0 4**

## COURSE OUTCOMES
Upon successful completion of this course, the students will be able to
   CO 1: Design the retaining walls.
   CO 2: Design the water tanks.
   CO 3: Design the staircase, flat slab, reinforced concrete walls and explain the basic
         concept of mat foundation, box culvert, road bridges.
   CO 4: Design the slab using yield line theory.
   CO 5: Design the brick masonry walls under axial and eccentricity loaded.

## UNIT I        RETAINING WALLS                                        12
Retaining wall – Types – Design and detailing of cantilever and counterfort retaining walls

## UNIT II        WATER TANKS                                        12
Design – Underground rectangular tanks – Domes – Overhead circular and rectangular tanks
– Design of staging and foundations

## UNIT III        SELECTED TOPICS                                        12
Staircase – Types – Design of staircases (ordinary and doglegged) – Design of flat slabs –
Design of Reinforced concrete walls – Principles of design of mat foundation, box culvert
and road bridges

## UNIT IV        YIELD LINE THEORY                                        12
Application of virtual work method and equilibrium method to square, rectangular, circular
and triangular slabs

## UNIT V        BRICK MASONRY                                        12
Introduction, Classification of walls, Lateral supports and stability, effective height of wall
and columns, effective length of walls, design loads, load dispersion, permissible stresses,
design of axially and eccentrically loaded brick walls – design of masonry footings

**L: 45 T: 15 TOTAL: 60 PERIODS**

## TEXT BOOKS
   1. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata
      McGraw-Hill Publishing Company Limited, New Delhi 2009
   2. Dayaratnam, P., "Brick and Reinforced Brick Structures", Oxford & IBH Publishing
      House, 2006
   3. Varghese, P.C., "Advanced Reinforced Concrete Structures "Prentice hall of India
      Private Limited, New Delhi, 2009.

## REFERENCES
   1. Mallick, D.K. and Gupta A.P., "Reinforced Concrete", Oxford and IBH Publishing
      Company, 2007
   2. Krishna Raju, N., "Design of RC Structures", CBS Publishers and Distributors,
      Delhi, 2009
   3. Ram Chandra.N and Virendra Gehlot, "Limit State Design", Standard Book House,
      2004.
   4. NPTEL

**13CE62**             **STRUCTURAL ANALYSIS - II**           **L T P C**
                                                              **3 1 0 4**

**COURSE OUTCOMES**

Upon successful completion of this course, the students will be able to
   CO 1: Explain the concept of flexibility method and be able to apply it for analysis of statically indeterminate Structures.
   CO 2: Explain the concept of stiffness method and be able to apply stiffness methods for analysis of statically indeterminate structures.
   CO 3: Make use of the fundamental theory of the FEA method.
   CO 4: Make use of appropriate assumptions to perform plastic hinge analysis of statically indeterminate axial problems.
   CO 5: Analyze the behavior of space trusses and suspension cables and bridges.

**UNIT I       FLEXIBILITY MATRIX METHOD                                12**

Equilibrium and compatibility – Determinate Vs Indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

**UNIT II      STIFFNESS MATRIX METHOD                                  12**

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames  (with redundancy restricted to two).

**UNIT III     FINITE ELEMENT METHOD                                    12**

Introduction – Discretisation of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain - Triangular elements.

**UNIT IV      PLASTIC ANALYSIS OF STRUCTURES                           12**

Statically indeterminate axial problems – Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.

**UNIT V       SPACE AND CABLE STRUCTURES                               12**

Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables – suspension bridges with two and three hinged stiffening girders.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**
   1. Bhavikatti, S.S, "Structural Analysis – Vol. 1", Vikas Publishing House Pvt. Ltd., New Delhi, 2007
   2. Bhavikatti, S.S, "Structural Analysis – Vol. 2", Vikas Publishing House Pvt. Ltd., New Delhi, 2013
   3. L.S. Negi & R.S. Jangid, "Structural Analysis", Tata McGraw-Hill Publications, New Delhi, 2003.

**REFERENCES**
   1. Vaidyanathan.R and Perumal.P, "Comprehensive Structural Analysis – Vol.I ", Laxmi Publications, New Delhi, 2007
   2. Vaidyanathan.R and Perumal.P, "Comprehensive Structural Analysis – Vol.II", Laxmi Publications, New Delhi, 2015
   3. Ghali.A, Nebille,A.M. and Brown,T.G. "Structural Analysis", A unified classical and Matrix approach", 5th Edition, Spon Press, London and New York, 2003.

4. Coates R.C, Coutie M.G. and Kong F.K., "Structural Analysis", ELBS and Nelson, 1990
5. G.S. Pandit & S.P. Gupta, Structural Analysis – A Matrix Approach, Tata McGraw Hill 2004.
6. NPTEL

**13CE63**                **DESIGN OF STEEL STRUCTURES**           **L T P C**
                                                                  **3 1 0 4**

**COURSE OUTCOMES**
   Upon successful completion of this course, the students will be able to
   CO 1: Design simple, eccentric connections
   CO 2: Design tension members by appropriate identification of structural steel
   CO 3: Design compression members by appropriate identification of structural steel
   CO 4: Design beams, plate girder and web splices
   CO 5: Design the basic components of a truss
   CO 6: Explain the basics of gantry girder design

**UNIT I               INTRODUCTION                                    12**
Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Metal joining methods using rivets, welding, bolting – Design of bolted, riveted and welded joints – Eccentric connections (load-parallel& perpendicular to the plane of bolts) - Efficiency of joints – High Tension bolts

**UNIT II        TENSION MEMBERS                                       10**
Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

**UNIT III       COMPRESSION MEMBERS                                   14**
Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base

**UNIT IV        BEAMS                                                 12**
Types of simple beam connections – Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Web splices

**UNIT V        ROOF TRUSSES AND INDUSTRIAL STRUCTURES                 12**
Roof trusses – Roof and side coverings – Design loads, design of purlin and elements of truss; end bearing – Basics of gantry girder design
                                          **L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**
   1. Dayaratnam, P., "Design of Steel Structures", Second edition, S. Chand & Company, 2003.
   2. Ramachandra.S. and Virendra Gehlot, "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi, 2007
   3. Bhavikatti.S.S. ,"Design of steel Structures", I.K.International Private Limited, 2009

**REFERENCES**
   1. "Teaching Resources for Structural Steel Design – Vol. I & II", INSDAG, Kolkatta.
   2. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., "Design of Steel Structures", 3rd Edition, McGraw Hill Publications, 1992
   3. Negi L.S. Design of Steel Structures, Tata McGraw Hill Publishing Private Limited, New Delhi, 2007.

4.  IS 800-2007 Indian Standard General Construction in Steel – code of practice, 3<sup>rd</sup> Revision.
5.  NPTEL

**13CE64**                    **FOUNDATION ENGINEERING**              **L T P C**
                                                                       **3 0 0 3**
**COURSE OUTCOMES**
    Upon successful completion of this course, the students will be able to
        CO 1: Plan site investigation program to select foundation
        CO 2: Design shallow foundation based on the soil conditions
        CO 3: Design raft and footings based on contact pressure distribution
        CO 4: Explain the load carrying capacity of piles
        CO 5: Illustrate the behavior of soil behind retaining structures

**UNIT I        SITE INVESTIGATION AND SELECTION OF FOUNDATION        9**
Scope and objectives – Methods of exploration-auguring and boring – Water boring and rotatory drilling – Geophysical methods- 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) – Selection of foundation based on soil condition.

**UNIT II        SHALLOW FOUNDATION        9**
Introduction – Location and depth of foundation – 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.

**UNIT III        FOOTINGS AND RAFTS        9**
Types of foundation – Contact pressure distribution below footings and raft - Isolated and combined footings – Types and proportioning - Mat foundation– Types, applications uses and proportioning-principle of floating foundation.

**UNIT IV        PILES        9**
Types of piles and their function – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil - Static formula - dynamic formulae (Engineering news and Hiley's) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – uplift capacity – Group capacity by different methods (Feld's rule, Converse Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test – Forces on pile caps – under reamed piles – Capacity under compression and uplift.

**UNIT V        RETAINING WALLS        9**
Plastic equilibrium in soils – active and passive states – Rankine's theory – cohesionless and cohesive soil - Coloumb's wedge theory – condition for critical failure plane - Earth pressure on retaining walls of simple configurations – Graphical methods (Rebhann and Culmann) - pressure on the wall due to line load – Stability of retaining walls.

**L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
    1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi publications Private Limited, New Delhi, 1995.

2. Murthy, V.N.S, "Soil Mechanics and Foundation Engineering", UBS Publishers Distribution Limited, New Delhi, 1999.

3. Gopal Ranjan and Rao, A.S.R. "Basic and Applied Soil Mechanics", Wiley Eastern Limited, New Delhi (India), 2003.

**REFERENCES**

1. Das, B.M. "Principles of Foundation Engineering", 5th Edition, Thomson Books, COLE, 2003

2. Bowles J.E, "Foundation analysis and design", McGraw-Hill, 1994

3. Venkatramaiah,C. "Geotechnical Engg.", New Age International Publishers, New Delhi, 1995

4. NPTEL

**13CE65**         **WASTE WATER TREATMENT AND MANAGEMENT**    **L T P C**
                                                               **3 0 0 3**

**COURSE OUTCOMES**

Upon successful completion of this course, the students will be able to

CO 1: Summarize the various sources of waste water and their characteristics

CO 2: Design the sewer system and classify the pumps and plumbing system

CO 3: Design the components of primary treatment of a waste water treatment plant

CO 4: Design the components of secondary treatment of a waste water treatment plant

CO 5: Explain the various methods of sludge and sewage disposal

**UNIT I       PLANNING FOR SEWERAGE SYSTEMS           9**

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

**UNIT II       SEWER DESIGN                                 9**

Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe Drainage - Plumbing System for Buildings – One pipe and two pipe system.

**UNIT III      PRIMARY TREATMENT OF SEWAGE            9**

Objective – Unit Operation and Processes – Selection of treatment processes – Onsite sanitation - Septic tank, Grey water harvesting – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects.

**UNIT IV      SECONDARY TREATMENT OF SEWAGE        9**

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB –Biomethanisation and Gobar gas plant - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants - Online monitoring system

**UNIT V        DISPOSAL OF SEWAGE AND SLUDGE         9**

Standards for Disposal – Methods – Self purification of surface water bodies – Oxygen sag curve – Land disposal – Soil dispersion system - Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Composting (Vermi)- Advances in Sludge Treatment and disposal.

                                                    **L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2014.
2. Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2014.

**REFERENCES**

1. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2014.
2. Wastewater Engineering – Treatment and Reuse, Tata McGraw Hill Company, New Delhi, 2015.
3. NPTEL

**13CE66**                    **IRRIGATION ENGINEERING**                    **L T P C**
                                                                            **3 0 0 3**

**COURSE OUTCOMES**
Upon successful completion of this course, the students will be able to
   CO 1: Compute the water requirement of crops based on soil conditions.
   CO 2: Illustrate on different types of irrigation systems and their performances.
   CO 3: Demonstrate the behaviour of various irrigation structures and their design principles.
   CO 4: Analyze the concept of seepage through appropriate theories.
   CO 5: Evaluate the purpose and function of different types of dams.

**UNIT I          INTRODUCTION                                               8**
Irrigation – Need and mode of irrigation – Merits and demerits of irrigation – Crop and crop seasons – consumptive use of water – Duty – Factors affecting duty – Irrigation efficiencies – Planning and Development of irrigation projects – Water quality standards for Irrigation

**UNIT II         IRRIGATION METHODS AND WATER MANAGEMENT                    9**
Canal irrigation – Lift irrigation – Tank irrigation – Flooding methods – Merits and demerits – Sprinkler irrigation – Drip irrigation – Optimum use of water – Need for optimisation of water use – Methods for improving canal irrigation management – Water losses – On farm development works

**UNIT III        CANAL IRRIGATION                                           8**
Alignment of canals – Classification of canals – Canal falls – Types – Design of vertical drop – Cross drainage works – Types – Canal Head works – Canal regulators – River Training works.

**UNIT IV         WEIRS AND TANKS                                            10**
Weirs and Barrage – Classification of weirs – Layout of a diversion head work – component parts – Failure of weirs founded on impervious foundation – Bligh's creep theory – Khosla's theory – Tanks – Isolated tanks and tanks in series – Tank weirs – Types of tank weirs – Tank sluices.

**UNIT V          DAMS                                                       10**
Dams – Types of dams – Problems in dam construction – Factors governing the selection of particular type of dam – Selection of dam site – Gravity dam – Typical cross section – Forces acting on gravity dam – Earth dam – Types of Earth dam – Causes of failure – Arch dam – Types – Forces acting on arch dam – Spillways – Types

                                                         **L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
   1. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000
   2. Punima B.C. & Pande B.B.Lal, "Irrigation and Water Power Engineering", Laxmi Publishing, New Delhi, 2007
   3. Santosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publications Private Limited, New Delhi, 2009

**REFERENCES**

1. Dilip Kumar Majumdar, "Irrigation Water Management (Principles & Practices)", Prentice Hall of India Private Limited, 2000
2. Basak.N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 1999
3. Sharma R.K, "Irrigation Engineering", S.Chand & Co, 2007.
4. NPTEL

**13CE67       ENVIRONMENTAL ENGINEERING LABORATORY     L T P C**
**                                                           0 0 3 2**

**COURSE OUTCOMES**

   Upon successful completion of this course, the students will be able to
      CO 1: Determine the quality parameters of water
      CO 2: Determine the quality parameters of sewage

## LIST OF EXPERIMENTS

1. Sampling and preservation methods and significance of characterisation of water and wastewater.
2. Determination of pH & Electrical conductivity
3. Determination of Turbidity & Hardness
4. Determination of iron & fluoride
5. Determination of residual chlorine
6. Determination of Chlorides
7. Determination of Ammonia Nitrogen
8. Determination of Sulphate
9. Determination of Optimum Coagulant Dosage
      i)     Alum dozing
      ii)    Lime dozing
10. Determination of available Chlorine in Bleaching powder
11. Determination of dissolved oxygen
12. Determination of solids
13. C.O.D Test
14. B.O.D Test (Demonstration only)
15. Introduction to Bacteriological Analysis (Demonstration only)

**P: 45 TOTAL: 45 PERIODS**

### LIST OF EQUIPMENTS (For a batch of 30 students)

| 1 | pH meter | - | 1 No. |
|---|---|---|---|
| 2 | Turbidity meter | - | 1 No. |
| 3 | Conductivity meter | - | 1 No. |
| 4 | Refrigerator | - | 1 No. |
| 5 | BOD incubator | - | 1 No. |
| 6 | Muffle furnace | - | 1 No. |
| 7 | Hot air oven | - | 1 No. |
| 8 | Magnetic stirrer with hot plates | - | 5 Nos. |
| 9 | Desicator | - | 1 No. |
| 10 | Jar test apparatus | - | 1 No. |
| 11 | Water bath | - | 1 No. |
| 12 | Furniture | - | 1 lot |
| 13 | Glass waves / Crucibles | - | 1 lot |

| 14 | COD apparatus | - | 1 No |
| 15 | Kjeldane apparatus | - | 1 No. |
| 16 | Calorimeter | - | 1 No. |
| 17 | Chlorine comparator | - | 1 No. |
| 18 | Beaker | - | 30 Nos. |
| 19 | Standard Flask | - | 30 Nos. |
| 20 | Burette with stand | - | 15 Nos. |
| 21 | Pipette with stand | - | 15 Nos. |
| 22 | Crucible | - | 15 Nos. |
| 23 | Filtration assembly | - | 1 No. |
| 24 | Chemicals | - | 1 lot |
| 25 | Chemical Balance | - | 1 No. |

**REFERENCES**
1. Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998
2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi
3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi

**13CE68        COMPUTER AIDED DESIGN AND DRAFTING LABORATORY**

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

## COURSE OUTCOMES
Upon successful completion of this course, the students will be able to
CO 1: Design various elements of Retaining wall / RCC Bridges / Water tanks / Plate girder bridges.
CO 2: Sketch structural drawings using simulation software of a various elements in a Retaining wall / RCC Bridges / Water tanks / Plate girder bridges.

## LIST OF EXPERIMENTS

1. Design and detailing of Reinforced Cement Concrete cantilever and counterfort type retaining walls with reinforcement details
2. Design of solid slab and Reinforced Cement Concrete Tee beam bridges for Indian Road Congress loading and reinforcement details
3. Design and detailing of Intz type water tank, circular and rectangular water tanks
4. Design of plate girder bridge – Twin Girder deck type railway bridge – Truss Girder bridges – Detailed Drawings including connections

**P: 45 TOTAL: 45 PERIODS**

### LIST OF EQUIPMENTS

|   |   |   |   |
|---|---|---|---|
| 1. Models of Structures | - | 1 each. |
| 2. Computers Pentium IV | - | 30 Nos. |
| 3. Auto CAD Software |   |   |
|   - Multi user License | - | 1 No. |

## TEXT BOOKS
1. Krishna Raju, "Structural Design & Drawing (Concrete & Steel)", CBS Publishers 2004.
2. Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Design of steel structures", Lakshmi Publications Private Limited, 2003.

## REFERENCES
1. Krishnamurthy D., "Structural Design & Drawing – Vol.II", CBS Publishers & Distributors, Delhi 1992.
2. Krishnamurthy D., "Structural Design & Drawing – Vol.III Steel Structures", CBS Publishers & Distributors, New Delhi 1992.

**13CE71**          **PRESTRESSED CONCRETE STRUCTURES**          **L T P C**

**3 1 0 4**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

  CO 1: Explain the basic concepts of prestressed concrete
  CO 2: Classify deflection and losses in prestressed concrete
  CO 3: Design prestressed concrete beams with simply supported ends
  CO 4: Illustrate the design of circular prestressing
  CO 5: Analyse for stresses in a composite construction

**UNIT I  INTRODUCTION – THEORY AND BEHAVIOUR  12**

Basic concepts – Advantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Partial prestressing – Applications.

**UNIT II  DEFLECTION AND LOSSES  12**

Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections - Losses of prestress – Losses in pretensioned and post tensioned members – Estimation of crack width

**UNIT III  DESIGN OF PRESTRESSED CONCRETE BEAMS  12**

Pre tensioned and post tensioned simply supported rectangle, I, T sections – Stress method – Design for flexure, bond and shear – IS Code provisions. End block: Introduction – Transmission length – End zone reinforcement – Anchorage zone stresses – Guyon and Magnel method – Calculation of bearing stress and bursting tensile forces – Reinforcement in Anchorage zone.

**UNIT IV  CIRCULAR PRESTRESSING  12**

Design of prestressed concrete tanks – fixed & hinged base – Pipes

**UNIT V  COMPOSITE CONSTRUCTION  12**

Analysis for stresses – Differential shrinkage – Deflections of composite members – Flexural strength of composite members

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi 2007
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt. Ltd. 1997.
3. Rajagopalan, N, "Prestressed Concrete", Narosa Publishing House Pvt. Ltd., New Delhi, 2008

**REFERENCES**

1. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990
2. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 1995.
3. NPTEL

**13CE72          BASICS OF   DYNAMICS AND ASEISMIC DESIGN          L T P C**
                                                                         **3 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
       CO 1: Summarize the theories of vibrations
       CO 2: Infer on a multiple degree of freedom system
       CO 3: Describe the elements of seismology
       CO 4: Interpret the response of structures to earthquake
       CO 5: Explain the aseismic design methodology

**UNIT I               THEORY OF VIBRATIONS                                9**
Concept of inertia and damping – Types of Damping – Difference between static forces and
dynamic excitation – Degrees of freedom – SDOF idealisation – Equations of motion of
SDOF system for mass as well as base excitation – Free vibration of SDOF system –
Response to harmonic excitation – Impulse and response to unit impulse – Duhamel
integral

**UNIT II         MULTIPLE DEGREE OF FREEDOM SYSTEM                     9**
Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode
shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of
mode superposition (No derivations).

**UNIT III           ELEMENTS OF SEISMOLOGY                                9**
Causes of Earthquake – Geological faults – Tectonic plate theory – Elastic rebound –
Epicentre – Hypocentre – Primary, shear and Raleigh waves – Seismogram – Magnitude and
intensity of earthquakes – Magnitude and Intensity scales – Spectral Acceleration -
Information on some disastrous earthquakes

**UNIT IV          RESPONSE OF STRUCTURES TO EARTHQUAKE                 9**
Response and design spectra – Design earthquake – concept of peak acceleration – Site
specific response spectrum – Effect of soil properties and damping – Liquefaction of soils –
Importance of ductility – Methods of introducing ductility into RC structures.

**UNIT V        DESIGN METHODOLOGY                                         9**
IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base
isolation techniques – Vibration control measures – Important points in mitigating effects
of earthquake on structures.
                                                        **L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
    1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake
       Engineering", Fourth Edition, Prentice Hall, 2012.
    2. Pankaj Agarwal & shrikhande, "Earth quake resistant Design of Structures", PHI
       Learning, 2009.
    **3.** Paz, M., "Structural Dynamics – Theory & Computation", CSB Publishers &
       Distributors, Shahdara, Delhi, 1985
**REFERENCES**
    1. Biggs, J.M., "Introduction to Structural Dynamics", McGraw–Hill Book Co., N.Y.,
       1964
    2. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, London, 2009
    3. NPEEE Publications.
    4. NPTEL

**13CE73**          **ESTIMATION AND QUANTITY SURVEYING**          **L T P C**
                                                                   **3 0 0 3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to
    CO 1: Estimate quantities of various components of a building
    CO 2: Estimate quantities of various components of a building
    CO 3: Describe the specification and rates of construction
    CO 4: Discuss the role of tenders and contracts in a building construction
    CO 5: Define the need of value engineering and their types in estimation
    CO 6: Prepare report on estimate of quantities for various structures

**UNIT I          ESTIMATE OF BUILDINGS                                    11**

Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof – Various types of arches – Calculation of brick work and RCC works in arches – Estimate of joineries for paneled and glazed doors, windows, ventilators, handrails etc.

**UNIT II          ESTIMATE OF OTHER STRUCTURES                            10**

Estimating of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well – estimate of bituminous and cement concrete roads – estimate of retaining walls – culverts – estimating of irrigation works – aqueduct, syphon, fall.

**UNIT III          SPECIFICATION AND TENDERS                             8**

Data – Schedule of rates – Analysis of rates – Specifications – sources – Detailed and general specifications – Tenders – Contracts – Types of contracts – Arbitration and legal requirements.

**UNIT IV          VALUATION                                             8**

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease

**UNIT V          REPORT PREPARATION                                    8**

Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.

**L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
    1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2012
    2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand
       & Company Ltd., 2012

**REFERENCE**
    1. PWD Data Book.

**13CE74        RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING     L   T   P   C**
**                                                              3   0   0   3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

    CO 1: Define various industries involved in railway planning & designing.

    CO 2: Illustrate on railway track construction, maintenance & operation.

    CO 3: Define various industries involved in Airport planning & designing.

    CO 4: Illustrate on airport layouts, visual aids & air traffic control.

    CO 5: Summarize various industries involved in Harbor Engineering.

**UNIT I        RAILWAY PLANNING AND DESIGN                                    10**

Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS - Engineering Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments) - Permanent Way, its Components and their Functions: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks -Sleepers – Functions, Materials, Density – Functions, Materials, Ballastless Tracks - Geometric Design of Railway Tracks – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

**UNIT II       RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND          8**
**               OPERATION**

Points and Crossings - Design of Turnouts, Working Principle - Signalling, Interlocking and Track Circuiting - Construction & Maintenance – Conventional, Modern methods and Materials, Track Drainage - Track Modernisation– Automated maintenance and upgrading, Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

**UNIT III     AIRPORT PLANNING AND DESIGN                                   10**

Role of Air Transport, Components of Airports - Airport Planning – Air traffic potential, Site Selection, Design of Components, Cost Estimates, Evaluation and Institutional arrangements Runway Design- Orientation, Cross wind Component, Wind rose Diagram (Problems), Geometric Design and Corrections for Gradients (Problems), Drainage - Taxiway Design – Geometric Design Elements, Minimum Separation Distances, Design Speed, Airport Drainage - Airport Zoning - Clear Zone, Approach Zone, Buffer Zone, Turning Zone, Clearance over Highways and Railways

**UNIT IV      AIRPORT LAYOUTS, VISUAL AIDS, AND AIR TRAFFIC CONTROL      7**

Airport Layouts – Apron, Terminal Building, Hangars, Motor Vehicle Parking Area and Circulation Pattern, Case studies of Airport Layouts - Airport Buildings – Primary functions, Planning Concept, Principles of Passenger Flow, Passenger Facilities - Visual Aids – Runway and Taxiway Markings, Wind Direction Indicators, Runway and Taxiway Lightings - Air Traffic Control – Basic Actions, Air Traffic Control Network - Helipads, Hangars, Service Equipments.

**UNIT V       HARBOUR ENGINEERING                                           10**

Definition of Terms - Harbours, Ports, Docks, Tides and Waves, Littoral Drift, Sounding, Area, Depth, Satellite Ports - Requirements and Classification of Harbours - Site Selection and Selection Investigation – Speed of water, Dredging, Range of Tides, Waves and Tidal Currents, Littoral Transport with Erosion and Deposition, Soundings, Anchoring Grounds, Geological Characteristics, Winds & Storms, Position and Size of Shoals - Shore Considerations-Proximity to Towns/Cities, Utilities, Construction Materials, Coast Lines - Dry and Wet Docks, Planning and

Layouts - Entrance, Position of Light Houses, Navigating - Terminal Facilities – Port Buildings, Warehouse, Transit Sheds, Inter-modal Transfer Facilities, Mooring Accessories, Navigational Aids - Coastal Structures- Piers, Breakwaters, Wharves, Jetties, Quays, Spring Fenders - Coastal Shipping, Inland Water Transport and Container Transportation.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. Saxena Subhash C and Satyapal Arora, A Course in Railway Engineering, Dhanpat Rai and Sons, Delhi, 1998.
2. Khanna S K, Arora M G and Jain S S, Airport Planning and Design, Nemchand and Brothers, Roorkee, 2012.
3. S P Bindra, A Course in Docks and Harbour Engineering, Dhanpat Rai and Sons, New Delhi, 2013.

**REFERENCES**
1. Rangwala, Railway Engineering, Charotar Publishing House, 2013.
2. Rangwala, Airport Engineering, Charotar Publishing House, 2013.
3. Oza.H.P. and Oza.G.H., "A course in Docks & Harbour Engineering", Charotar Publishing Co. 2013.
4. J.S. Mundrey, "A course in Railway Track Engineering". Tata McGraw Hill, 2007.

**13CE77        CIVIL SOFTWARE APPLICATION LABORATORY        L   T   P   C**
**0   0   4   2**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: Analyze 2D and 3D frames.
CO 2: Design and detailing of 2D and 3D truss and steel cable frames
CO 3: Analyze and design two storey buildings

## DEVELOPMENT AND IMPLEMENTATION OF PROGRAM USING SOFTWARE

1. Analysis & Design of 2D & 3D Truss
2. Analysis & Design of 2D & 3D Frames
3. Design and detailing of trusses & frames ( 2D & 3D)
4. Structural design of Steel Gable Frames
5. Analysis and Design of simple two storey buildings

**P: 60 TOTAL: 60 PERIODS**

## REFERENCES / MANUALS / SOFTWARE

1. STRAP / STAAD Pro / SAP 2000.
2. Krishnaraju, N., "Structural Design & Drawing", (Concrete & Steel – Volume II and III) CBS Publishers, 2004.
3. Punmia B.C., Jain, Ashok Kumar and Jain, Arun Kumar., "Comprehensive Design of Steel Structures", Laxmi Publications Pvt. Ltd., 2003.
4. Krishnamurthy, D., "Structural Design and Drawing", Vol. II & III, CBS Publishers & Distributors, Delhi, 1992.

| **13CE78** | **DESIGN PROJECT** | **L T P C** |
| | | **0 0 4 2** |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Apply the design skills in solving engineering problems

CO 2: Prepare design reports in a standard format.

**P: 60 TOTAL: 60 PERIODS**

**EVALUATION PROCEDURE**

1.  Internal Marks : 40 marks
    (decided by the staff in-charge appointed by the Institution)

2.  Evaluation of Project Report : 20 marks
    (Evaluated by the external examiner appointed by the COE with the approval of HOI)

3.  Viva voce examination : 40 marks
    (evaluated by the internal examiner appointed by the HOD with the approval of HOI and external examiner appointed by
    the COE with the approval of HOI – with equal Weightage)

**TOTAL: 100 MARKS**

**13CE79**                          **COMPREHENSION**                    **L T P C**
                                                                          **0  0 3 1**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

> CO 1: Review the comprehensive knowledge acquired through the various Civil Engineering domains.
>
> CO 2: Develop technical skills in Civil Engineering to engage them in lifelong learning.

**EVALUATION PROCEDURE**

| S.No | Module | Guidance | Assessment methods | Internal (50Marks) | | External (50 Marks) |
|---|---|---|---|---|---|---|
| | | | | Weight | Attendance | |
| 1 | Structural Engineering | MC - 1 CC - 2 | Objective Test | 5 | | A Panel of members, one external and one expert from each module shall be evaluating the students based on Viva Voce |
| | | | Assignments | 2 | | |
| | | | Seminars | 2 | | |
| 2 | Geo Technical Engineering | MC - 1 CC - 1 | Objective Test | 5 | | |
| | | | Assignments | 2 | | |
| | | | Seminars | 2 | | |
| 3 | Survey and Transportation Engineering | MC - 1 | Objective Test | 5 | 5 | |
| | | | Assignments | 2 | | |
| | | | Seminars | 2 | | |
| 4 | Environmental Engineering | MC - 1 CC - 1 | Objective Test | 5 | | |
| | | | Assignments | 2 | | |
| | | | Seminars | 2 | | |
| 5 | Irrigation and Water Resource Engineering | MC - 1 | Objective Test | 3 | | |
| | | | Seminars | 2 | | |
| 6 | Civil Engineering Management | MC - 1 | Objective Test | 2 | | |
| | | | Seminars | 2 | | |

MC – Module Coordinator: CC – Course Coordinator

**P:45 TOTAL: 45 PERIODS**

**13CE81**                    **PRINCIPLES OF MANAGEMENT**          **L T P C**
                            (Common to all branches)                    **3 0 0 3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO1: discuss the development of management thoughts and different types of Business organization.

CO2: practice the process of planning and decision making in an industrial situations.

CO3: design the suitable selection process for a particular job description.

CO4: apply different motivational techniques and leadership skills in the organization.

CO5: justify the various controlling techniques and tools in the organization.

**UNIT I        INTRODUCTION                                          9**

Historical developments – approaches to management – Management and Administration – Development of Management Thoughts – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organization, Meaning, features merits and demerits - Social responsibility.

**UNIT II       PLANNING                                             9**

Nature and Purpose– Steps in Planning Process – Objectives – Setting Objectives – Process of Managing through Objectives – Strategies – Policies and Planning Premises – Forecasting – Importance, Methods of Forecasting - Decision-making, Decision making Process and Types of Decisions.

**UNIT III      FUNCTIONAL AREA OF ORGANISATION                      9**

Formal and Informal organization – Organization Chart – Structure and Process – Departmentation by different strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness.

**UNIT IV       DIRECTION                                            9**

Objectives– Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Types of Communication – Barriers and Breakdown -  Effective Communication - Electronic Media in Communication.

**UNIT V        CONTROLLING STRATEGIES                               9**

System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology– Computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Harold Koontz and Heinz Weihrich, "Essentials of Management – An International Perspective", Tata Mcgraw Hill, 8th Edition, 2009.

2. Hellriegel, Slocum and Jackson, "Management – A Competency Based Approach", ThomsonSouth Western, 11th Edition, 2008.

**REFERENCES**

1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall of India", 8thEdition, 2012.

2. Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw Hill Education, Special Indian Edition, 2007.
3. Vijayaraghavan G.K and Sivakumar M. "Principles of Management", Lakshmi Publications, 1st Edition, 2012.
4. Ramachandran. S. "Principles of Management", Air Walk Publications, 1st Edition, 2012.
5. Andrew J. Dubrin, "Essentials of Management", Thomson South western, 9th Edition, 2011.

**13CE87**                    **PROJECT WORK**                    **L T P C**

**0  0 12 6**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Apply their analyzing and designing skills for engineering problems.

CO 2: Practice self learning through proper application of their previously acquired knowledge.

- Synchronise themselves to work with a team
- Prepare a complete set of report in a standard format

**TOTAL: 180 PERIODS**

**13CEAA**  **BRIDGE STRUCTURES**  **L  T  P  C**
                                                                 **3  0  0  3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
- CO 1: Choose an appropriate bridge structures
- CO 2: Design a pratt type truss highway bridge
- CO 3: Design a plate girder railway bridge
- CO 4: Design a reinforced concrete slab bridges
- CO 5: Design a reinforced concrete girder bridges
- CO 6: Design a prestressed concrete bridge

**UNIT I**  **INTRODUCTION**  **9**

Design of through type steel highway bridges for IRC loading - Design of stringers, cross girders and main girders - Design of deck type steel highway bridges for IRC loading - Design of main girders

**UNIT II**  **STEEL BRIDGES**  **9**

Design of pratt type truss girder highway bridges - Design of top chord, bottom chord, web members - Effect of repeated loading - Design of plate girder railway bridges for railway loading - Wind effects - Design of web and flange plates - Vertical and horizontal stiffeners.

**UNIT III**  **REINFORCED CONCRETE SLAB BRIDGES**  **9**

Design of solid slab bridges for IRC loading - Design of kerb - Design of tee beam bridges - Design of panel and cantilever for IRC loading

**UNIT IV**  **REINFORCED CONCRETE GIRDER BRIDGES**  **9**

Design of tee beam - Courbon's theory - Pigeaud's curves - Design of balanced cantilever bridges - Deck slab - Main girder - Design of cantilever - Design of articulation

**UNIT V**  **PRESTRESSED CONCRETE BRIDGES**  **9**

Design of prestressed concrete bridges - Preliminary dimensions - Flexural and torsional parameters - Courbon's theory - Distribution coefficient by exact analysis - Design of girder section - Maximum and minimum prestressing forces - Eccentricity - Live load and dead load shear forces - cable zone in girder –Check for stresses at various sections - Check for diagonal tension - Diaphragms - End block - Short term and long term deflections.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Co., New Delhi, 2008.
2. Rajagopalan,N "Bridge Superstructure", Alpha Science International, 2006

## REFERENCES
1. Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 2012.
2. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi, 2014.

**13CEAB**                **STORAGE STRUCTURES**          **L  T  P  C**
                                                          **3  0  0  3**

## COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO 1: Design a rectangular riveted steel water tank
CO 2: Design a circular concrete water tank
CO 3: Design a rectangular concrete water tank
CO 4: Genelaralise the design of steel bunkers and silos
CO 5: Genelaralise the design of concrete bunkers and silos
CO 6: Apply principles of circular prestressing in prestressed concrete water tanks

**UNIT I          STEEL WATER TANKS                                          12**
Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –Longitudinal and transverse beams – Design of staging – Base plates – Foundation and anchor bolts – Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation.

**UNIT II         CONCRETE WATER TANKS                                        12**
Design of Circular tanks – Hinged and fixed at the base – IS method of calculating shear forces and moments – Hoop tension – Design of intze tank – Dome – Ring girders – Conical dome – Staging – Bracings – Raft foundation – Design of rectangular tanks – Approximate methods and IS methods – Design of underground tanks – Design of base slab and side wall – Check for uplift.

**UNIT III        STEEL BUNKERS AND SILOS                                      7**
Design of square bunker – Jansen's and Airy's theories – IS Codal provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams – Design of cylindrical silo – Side plates – Ring girder – stiffeners.

**UNIT IV         CONCRETE BUNKERS AND SILOS                                   7**
Design of square bunker – Side Walls – Hopper bottom – Top and bottom edge beams – Design of cylindrical silo – Wall portion – Design of conical hopper – Ring beam at junction

**UNIT V          PRESTRESSED CONCRETE WATER TANKS                             7**
Principles of circular prestressing – Design of prestressed concrete circular water tanks

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
1.    Rajagopalan K., Storage Structures, Tata McGraw-Hill, New Delhi, 2004.
2.    Krishna Raju N., Advanced Reinforced Concrete Design, CBS Publishers and Distributors, New Delhi, 2012.

## REFERENCES
1.    Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990
2.    Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 1995.
3.    David A.Sheppard, William R. and Philips, Plant Cast precast and prestressed concrete - A design guide, McGraw Hill, New Delhi 1992

| 13CEAC | DESIGN OF PLATE AND SHELL STRUCTURES | L | T | P | C |
|--------|---------------------------------------|---|---|---|---|
|        |                                       | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Analyse thin plates having small deflection
CO 2: Analyse a rectangular plate
CO 3: Classify thin shells
CO 4: Analyse a shell
CO 5: Design a shell.

**UNIT I        THIN PLATES WITH SMALL DEFLECTION                9**

Laterally loaded thin plates – governing differential equations – Simply supported and fixed boundary conditions

**UNIT II        RECTANGULAR PLATES                9**

Simply supported rectangular plates – Navier's solution and Levy's method.

**UNIT III        THIN SHELLS                9**

Classification of shells-structural actions – membrane theory

**UNIT IV        ANALYSIS OF SHELLS                9**

Analysis of spherical dome – cylindrical shells – folded plates

**UNIT V        DESIGN OF SHELLS                9**

Design of spherical dome – cylindrical shells – folded plates

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.    Bairagi N K, A text book of Plate Analysis, Khanna Publishers, New Delhi, 2008.
2.    G.S. Ramaswamy, Design and Construction of Shell Structures, CBS Plublishers, New Delhi, 1996
3.    S. Timoshenko & S. Woinowsky – Krieger, "Theory of Plates and Shells", McGraw Hill Book Company

**REFERENCES**

1.    Szilard R, Theory and analysis of plates, Prentice Hall Inc, 1995
2.    Chatterjee B. K., Theory and Design of Concrete Shells, Oxford & IBH, New Delhi, 1998
3.    Billington D. P., Thin Shell Concrete Structures, McGraw-Hill, 1995.

| 13CEAD | TALL BUILDINGS | L | T | P | C |
|--------|----------------|---|---|---|---|
|        |                | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Define the various loads acting on a tall building
CO 2: Describe the forces and frames of tall building
CO 3: Outline the common high rise structures
CO 4: Analyse a tall structure approximately
CO 5: Design a tall structure approximately

**UNIT I          INTRODUCTION                                                          9**

The Tall Building in the Urban Context - The Tall Building and its Support Structure - Development of High Rise Building Structures - General Planning Considerations. Dead Loads - Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading – Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

**UNIT II          THE VERTICAL STRUCTURE PLANE                              10**

Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement - Behaviour of Shear Walls under Lateral Loading. The Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems The High - Rise Building as related to assemblage Kits Skeleton Frame Systems - Load Bearing Wall Panel Systems - Panel – Frame Systems - Multistory Box Systems.

**UNIT III          COMMON HIGH RISE STRUCTURES                           10**

The Bearing Wall Structure- The Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - The Counteracting Force or Dynamic Response.

**UNIT IV          APPROXIMATE STRUCTURAL ANALYSIS & DESIGN OF          9
                    BUILDINGS**

Approximate Analysis of Bearing Wall Buildings The Cross Wall Structure - The Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings The Rigid Frame - Shear Wall Structure - The Vierendeel Structure - The Hollow Tube Structure.

**UNIT V          OTHER HIGH-RISE BUILDING STRUCTURE                      7**

Deep - Beam Systems -High-Rise Suspension Systems - Pneumatic High -Rise Buildings - Space Frame Applied to High - Rise Buildings - Capsule Architecture.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Wolfgang Schueller "High - rise building Structures", John Wiley and Sons, New York 1976.
2. Bryan Stafford Smith and Alex Coull, "Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc., 1991.

**REFERENCES**
1. Coull, A. and Smith, Stafford, B, "Tall Buildings", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers", John Wiley, 1994.
3. Taranath.B.S., Structural Analysis and Design of Tall Buildings, Mc Graw Hill,1998

| **13CEAE** | **PREFABRICATED STRUCTURES** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

        CO 1: Identify the need for prefabrication of structures.
        CO 2: Describe the various components of prefabricated structures
        CO 3: Explain various design principles of joints
        CO 4: Summarize the various joints in structural members.
        CO 5: Interpret the abnormal loads to design structure.

## UNIT I       INTRODUCTION       9

Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection.

## UNIT II      PREFABRICATED COMPONENTS      9

Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls.

## UNIT III      DESIGN PRINCIPLES      9

Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

## UNIT IV      JOINT IN STRUCTURAL MEMBERS      9

Joints for different structural connections – Dimensions and detailing – Design of expansion joints.

## UNIT V      DESIGN FOR ABNORMAL LOADS      9

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

1. CBRI, Building materials and components, India, 1990
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994

## REFERENCES

1. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
2. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978

**13CEAF**          **COMPUTER AIDED DESIGN OF STRUCTURES**     **L  T  P  C**
                                                                **3  0  0  3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to
>    CO 1: Identify need of hardware and software in design process.
>    CO 2: Explain various drafting packages for modeling
>    CO 3: Describe various analysis packages and application
>    CO 4: Illustrate the principle of design and optimization of structures
>    CO 5: Define the artificial intelligence and simple applications.

**UNIT I          INTRODUCTION                                            9**

Fundamentals of CAD - Hardware and software requirements -Design process - Applications and benefits.

**UNIT II          COMPUTER GRAPHICS                                      9**

Graphic primitives - Transformations -Wire frame modeling and solid modeling -Graphic standards –Drafting packages.

**UNIT III          STRUCTURAL ANALYSIS                                   9**

Fundamentals of finite element analysis - Principles of structural analysis - Analysis packages and applications.

**UNIT IV          DESIGN AND OPTIMISATION                               9**

Principles of design of steel and RC Structures -Applications to simple design problems – Optimisation techniques - Algorithms - Linear Programming – Simplex method.

**UNIT V          EXPERT SYSTEMS                                          9**

Introduction to artificial intelligence - Knowledge based expert systems -Rules and decision tables – Inference mechanisms - Simple applications.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
1.     Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 1993.
2.     Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 1993.

**REFERENCES**
1.     Harrison H.B., "Structural Analysis and Design", Part I and II Pergamon Press, Oxford, 1990.
2.     Rao S.S., "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi, 2009.
3.     Richard Forsyth (Ed), "Expert System Principles and Case Studies", Chapman and Hall, London, 1989.

| 13CEAG | INDUSTRIAL STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Demonstrate the planning and requirements of Industrial structures.

CO 2: Interrelate the various functional requirements of Industrial building.

CO 3: Generalize the design of steel structures.

CO 4: Generalize the design of reinforced concrete structures

CO 5: Summarize the concept of prefabrication

**UNIT I          PLANNING                                                    9**

Classification of Industries and Industrial structures – General requirements for industries like cement, chemical and steel plants – Planning and layout of buildings and components.

**UNIT II          FUNCTIONAL REQUIREMENTS                              9**

Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act.

**UNIT III          DESIGN OF STEEL STRUCTURES                         9**

Industrial roofs – Crane girders – Mill buildings – Design of Bunkers and Silos.

**UNIT IV          DESIGN OF R.C. STRUCTURES                           9**

Silos and bunkers – Chimneys – Principles of folded plates and shell roofs.

**UNIT V          PREFABRICATION                                        9**

Principles of prefabrication – Prestressed precast roof trusses- Functional requirements for Precast concrete units.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Purushothaman .P, "Reinforced Concrete Structural Elements" McGraw-Hill Inc., US (1st Sep 1984)
2. Dayaratnam, P., "Design of Steel Structures", Second edition, S. Chand & Company, 2003.
3. Ramachandra, S. and Virendra Gehlot, "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi, 2007.

**REFERENCES**

1. Henn W. Buildings for Industry, vols.I and II, London Hill Books, 1995.
2. Handbook on Functional Requirements of Industrial buildings, SP32 – 1986, Bureau of Indian Standards, New Delhi 1990.
3. Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Structural Engineering Research Centre, Madras, 1982.

**13CEAH      SMART STRUCTURES AND SMART MATERIALS      L   T   P   C**
**3   0   0   3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Describe the smart materials and smart systems
CO 2: Select apt technique for measuring distress in the structures
CO 3: List various sensors for structural assessment (Physical, Chemical, Biochemical and distributed)
CO 4: Describe various actuator materials

**UNIT I          INTRODUCTION                                             9**

Introduction to Smart Materials and Structures – Instrumented structures functions and response – Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

**UNIT II         MEASURING TECHNIQUES                                     9**

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

**UNIT III        SENSORS                                                  9**

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

**UNIT IV         ACTUATORS                                                9**

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials.

**UNIT V          SIGNAL PROCESSING AND CONTROL SYSTEMS                     9**

Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non-Linear.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOK**

1.      Brain Culshaw, "Smart Structure and Materials" Artech House Borton, London-1996.

**REFERENCES**

1.      L. S. Srinath, "Experimental Stress Analysis" Tata McGraw-Hill, 1998.
2.      J. W. Dally & W. F. Riley, "Experimental Stress Analysis"  Tata McGraw-Hill, 1998.

**13CEAJ      REPAIR AND REHABILITATION OF STRUCTURES    L   T   P   C**
                                                                              **3   0   0   3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Recognize the degradation and assessment procedure for evaluating the concrete structures

CO 2: Illustrate the quality assurance for various concrete properties

CO 3: Infer on the effects of durability of concrete

CO 4: Select appropriate materials for repair of concrete structures

CO 5: select suitable techniques for repair of concrete structures

CO 6: Indicate the suitable retrofit to overcome the repairs

**UNIT I          MAINTENANCE AND REPAIR STRATEGIES          9**

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

**UNIT II         SERVICEABILITY AND DURABILITY OF CONCRETE       11**

Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking.

**UNIT III        MATERIALS FOR REPAIR            9**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

**UNIT IV        TECHNIQUES FOR REPAIR AND DEMOLITION       8**

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Engineered demolition techniques for dilapidated structures - case studies.

**UNIT V        REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES      8**

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Denison Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, Repair of Concrete Structures, Blakie and Sons, UK, 1987

**REFERENCES**

1. M.S.Shetty, Concrete Technology - Theory and Practice, S.Chand and Company, New Delhi, 1992.
2. Santhakumar, A.R., Training Course notes on Damage Assessment and repair in Low Cost Housing , "RHDC-NBO" Anna University, July 1992.

3.    Raikar, R.N., Learning from failures - Deficiencies in Design, Construction and Service - R&D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

4.    N.Palaniappan, Estate Management, Anna Institute of Management, Chennai, 1992.

5.    Lakshmipathy, M. etal. Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 - 30th October 1999.

**13CEAK**                 **FINITE ELEMENT TECHNIQUES**          **L  T  P  C**
                                                                   **3  0  0  3**

## COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
>    CO 1: Outline the fundamental theory of Finite element analysis method
>    CO 2: Explain finite element analysis of one dimensional problem
>    CO 3: Explain finite element analysis of two dimensional problems
>    CO 4: Describe isoparametric elements formulation in one and two dimensions
>    CO 5: Apply finite element analysis to field problems in two dimensions

**UNIT I          INTRODUCTION – VARIATIONAL FORMULATION          9**
General field problems in Engineering – Modelling – Discrete and Continuous models – Characteristics – Difficulties involved in solution – The relevance and place of the finite element method – Historical comments – Basic concept of FEM, Boundary and initial value problems – Gradient and divergence theorems – Functionals – Variational calculus Variational formulation of VBPS. The method of weighted residuals – The Ritz method.

**UNIT II          FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL          10**
**                  PROBLEMS**
One dimensional second order equations – discretisation of domain into elements – Generalised coordinates approach – derivation of elements equations – assembly of elements equations – imposition of boundary conditions – solution of equations – Cholesky method – Post processing – Extension of the method to fourth order equations and their solutions – time dependant problems and their solutions – example from heat transfer, fluid flow and solid mechanics.

**UNIT III          FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL          10**
**                   PROBLEMS**
Second order equation involving a scalar-valued function – model equation – Variational formulation – Finite element formulation through generalised coordinates approach – Triangular elements and quadrilateral elements – convergence criteria for chosen models – Interpolation functions – Elements matrices and vectors – Assembly of element matrices – boundary conditions – solution techniques.

**UNIT IV          ISOPARAMETRIC ELEMENTS AND FORMULATION          8**
Natural coordinates in 1, 2 and 3 dimensions – use of area coordinates for triangular elements in - 2 dimensional problems – Isoparametric elements in 1,2 and 3 dimensional Largrangean and serendipity elements – Formulations of elements equations in one and two dimensions - Numerical integration.

**UNIT V          APPLICATIONS TO FIELD PROBLEMS IN TWO          8**
**                 DIMENSIONALS**
Equations of elasticity – plane elasticity problems – axisymmetric problems in elasticity – Bending of elastic plates – Time dependent problems in elasticity – Heat – transfer in two dimensions – incompressible fluid flow.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOK
1.     Chandrupatla, T.R., and Belegundu, A.D., "Introduction to Finite Element in Engineering", Third Edition, Prentice Hall, India, 2003.

**REFERENCES**

1. J.N.Reddy, "An Introduction to Finite Element Method", McGraw-Hill, Intl. Student Edition, 1985.
2. Zienkiewics, "The finite element method, Basic formulation and linear problems", Vol.1, 4/e, McGraw-Hill, Book Co 1998.
3. S.S.Rao, "The Finite Element Method in Engineering", Pergaman Press, 2003.
4. NPTEL

| 13CEBA | ROCK ENGINEERING | L | T | P | C |
|--------|------------------|---|---|---|---|
|        |                  | 3 | 0 | 0 | 3 |

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: Classify the rock based on Index properties.
CO 2: Explain the stress strain behavior in rocks
CO 3: Explain the insitu stresses and their measurements in rocks.
CO 4: Apply the mechanism of rocks in construction
CO 5: Explain the  in rock masses

**UNIT I          CLASSIFICATION AND INDEX PROPERTIES OF ROCKS          7**

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose.

**UNIT II          ROCK STRENGTH AND FAILURE CRITERIA          11**

Modes of rock failure – Strength of rock – Laboratory and field measurement of shear, tensile and compressive strength – Stress strain behaviour in compression – Mohr-coulomb failure criteria and empirical criteria for failure – Deformability of rock.

**UNIT III          INITIAL STRESSES AND THEIR MEASUREMENTS          10**

Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – technique for measurements of insitu stresses.

**UNIT IV          APPLICATION OF ROCK MECHANICS IN ENGINEERING          9**

Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence.

**UNIT V          ROCK BOLTING          8**

Introduction – Rock bolt systems – rock bolt installation techniques – Testing of rock bolts – Choice of rock bolt based on rock mass condition.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

1. Goodman P.E., "Introduction to Rock Mechanics", John Wiley and Sons, 1999.
2. Stillborg B., "Professional User Handbook for rock Bolting", Tran Tech Publications, 1996.

## REFERENCES

1. Brown E.T., "Rock Characterisation Testing and Monitoring", Pergaman Press, 1991.
2. Arogyaswamy R.N.P., "Geotechnical Application in Civil Engineering", Oxford and IBH, 1993.
3. Hock E. and Bray J., "Rock Slope Engineering, Institute of Mining and Metallurgy", 1991.
4. NPTEL

**13CEBB**        **GROUND IMPROVEMENT TECHNIQUES**        L  T  P  C
                                                          3  0  0  3

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

  CO 1: Identify suitable ground improvement techniques based on soil conditions
  CO 2: Demonstrate the various dewatering and drainage systems
  CO 3: Summarise various insitu treatment of cohesionless and cohesive soils
  CO 4: Explain the concept of reinforcement in ground improvement
  CO 5: Explain soil stablisation with grouting techniques

**UNIT I**        **INTRODUCTION**        **9**

Role of ground improvement in foundation engineering - methods of ground improvement – Geotechnical problems in alluvial, laterite and black cotton soils -Selection of suitable ground improvement techniques based on soil condition.

**UNIT II**        **DRAINAGE AND DEWATERING**        **9**

Drainage techniques - Well points - Vacuum and electro osmotic methods - Seepage analysis for two dimensional flow-fully and partially penetrating slots in homogenous deposits (Simple cases only).

**UNIT III**        **INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS**        **9**

Insitu densification of cohesionless and consolidation of cohesive soils -Dynamic compaction and consolidation - Vibrofloatation - Sand pile compaction - Preloading with sand drains and fabric drains – Stone columns – Lime piles - Installation techniques only - relative merits of various methods and their limitations.

**UNIT IV**        **EARTH REINFORCEMENT**        **9**

Concept of reinforcement - Types of reinforcement material - Applications of reinforced earth – use of Geotextiles for filtration, drainage and separation in road and other works.

**UNIT V**        **GROUT TECHNIQUES**        **9**

Types of grouts - Grouting equipment and machinery - Injection methods - Grout monitoring – Stabilisation with cement, lime and chemicals - Stabilisation of expansive soils.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.  Koerner R.M., "Construction and Geotechnical Methods in Foundation Engineering", McGraw-Hill, 1994.
2.  Purushothama Raj, P. "Ground Improvement Techniques", Tata McGraw-Hill Publishing Company, New Delhi, 2005

**REFERENCES**

1.  Moseley M.P., Ground Improvement Blockie Academic and Professional, Chapman and Hall, Glassgow, 1998.
2.  Jones J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1995.
3.  Koerner, R.M., "Design with Geosynthetics", (3$^{rd}$ Edition) Prentice Hall, New Jersey, 2002.
4.  Jewell, R.A., "Soil Reinforcement with Geotextiles", CIRIA special publication, London, 1996
5.  Das, B.M., "Principles of Foundation Engineering", Thomson Books / Cole, 2010
6.  NPTEL

**13CEBC          INTRODUCTION TO SOIL DYNAMICS AND          L  T  P  C
                          MACHINE FOUNDATIONS**

                                                                          **3  0  0  3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: Describe the vibratory motion of elementary systems
CO 2: Illustrate the propagation of waves in different mediums
CO 3: Explain the dynamic properties of soil
CO 4: Design foundations under dynamic loading
CO 5: Interpret vibration isolation with engineering considerations

**UNIT I          INTRODUCTION                                                    9**

Vibration of elementary systems-vibratory motion-single degree freedom system-free and forced vibration with and without damping.

**UNIT II          WAVES AND WAVE PROPAGATION                              9**

Wave propagation in an elastic homogeneous isotropic medium- Raleigh, shear and compression waves-waves in elastic half space.

**UNIT III          DYNAMIC PROPERTIES OF SOILS                              9**

Elastic properties of soils - coefficient of elastic, uniform and non-uniform compression – shear - effect of vibration dissipative properties of soils - determination of dynamic properties of soil - codal provisions.

**UNIT IV          DESIGN PROCEDURES                                            9**

Design criteria - dynamic loads - simple design procedures for foundations under reciprocating machines - machines producing impact loads - rotary type machines.

**UNIT V          VIBRATION ISOLATION                                            9**

Vibration isolation technique – mechanical isolation – foundation isolation – isolation by location - isolation by barriers- active passive isolation tests.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

1.     S.Prakesh & V.K Puri, Foundation for machines, McGraw-Hill 1993
2.     Srinivasulu, P & Vaidyanathan, Hand book of Machine Foundations, McGraw-Hill, 1996

## REFERENCES

1.     Swamisaran, "Soil Dynamics and  Machine  Foundations", Galgotia Publications Pvt. Ltd., 1999
2.     Kramar S.L, "Geotechnical Earthquake Engineering", Prentice Hall International series, Pearson Education (Singapore) Pvt. Ltd 1996.
3.     Kameswara Rao, "Dynamics Soil Tests and Applications", Wheeler Publishing, New Delhi, 2003
4.     Kameswara Rao, "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998
5.     IS code of Practice for Design and Construction of Machine Foundations, McGraw-Hill, 1996
6.     Moore P.J., "Analysis and Design of Foundation for Vibration", Oxford and IBH, 1995.
7.     NPTEL

**13CEBD      EARTHQUAKE GEOTECHNICAL ENGINEERING     L   T   P   C**
                                                                             3   0   0   3

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Identify the causes and mechanism of earthquakes

CO 2: Discuss basic facts of soil behaviour under dynamic loading

CO 3: Define the role of soil deposits in modifying the seismic ground motion

CO 4: Select design methodology using seismic codes while designing foundations, slopes and retaining walls

CO 5: Explain the principles of earthquake hazard mitigation measures

**UNIT I           ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS      9**

Mechanism of Earthquakes – Causes of earthquake – Earthquake Fault sources – Elastic Rebound theory – Seismic wave in Earthquake shaking – Definition of earthquake terms – Locating an earthquake – Quantification of earthquakes.

**UNIT II         GROUND MOTION CHARACTERISTICS                     9**

Strong Motion Records – Characteristics of ground motion – Factors influencing ground motion – Estimation of frequency content parameters – Seismic site investigations – Evaluation of Dynamic soil properties.

**UNIT III        GROUND RESPONSE ANALYSIS AND GROUND MOTION      9**

Wave propagation Analysis – Site Amplification – Need for Ground Response Analysis – Shear Beam analysis – Methods of analyses – One Dimensional Analysis – Equivalent linear Analysis - Site effects – Design Ground Motion – Developing Design Ground Motion – Codal provisions.

**UNIT IV        SEISMIC STABILITY ANALYSIS                          9**

Earthquake – Resistant Design of foundation of buildings – Design considerations – Geotechnical – Architectural – Structures – Capacity Design – Seismic analysis. Dynamic Analysis – Earth pressure due to ground shaking – Liquefaction – Susceptibility – evaluation – Cyclic stress approach – Liquefaction Resistance – Laboratory and Field Tests – Interpretation– Lateral Deformation – Codal recommendation.

**UNIT V          EARTHQUAKE HAZARD MITIGATION                        9**

Seismic risk vulnerability and hazard – Percept of risk – Risk mapping – Hazard assessment – Maintenance and modifications to improve hazard resistance – Different type of foundation and its impact on safety – Ground Improvement Techniques.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing – New Delhi, 2006.
2. Krammer S.L., "Geotechnical Earthquake Engineering", Prentice hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.
3. Kameswara Rao, "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998.

**REFERENCES**
1.    McGuire, R.K., "Seismic Hazard and Risk Analysis", Earthquake Engineering Research Institute. MNo – 10, ISBN 0-943198-01-1, 2004.
2.    Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., "Disaster Management", Narosa Publishing House, New Delhi, India ISBN: 81-7319-727X-2006.
3.    NPTEL

| 13CECA | REMOTE SENSING TECHNIQUES AND GEOGRAPHIC   INFORMATION SYSTEM | L T P C |
|--------|--------------------------------------------------------------|---------|
|        |                                                              | 3 0 0 3 |

## COURSE OUTCOMES
 Upon Successful completion of this course, the students will be able to
   CO 1: Summarize the principles of EMR and its interaction with atmosphere and object
   CO 2: Classify various types of platforms and sensors
   CO 3: Interpret the elements of visual image & DIP
   CO 4: Describe the basic concepts of map projections, GIS and DBMS
   CO 5: Apply GIS software in civil engineering field

**UNIT I          EMR AND ITS INTERACTION WITH ATMOSPHERE          9**
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

**UNIT II          PLATFORMS AND SENSORS          9**
Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and space borne TIR and microwave sensors.

**UNIT III          IMAGE INTERPRETATION AND ANALYSIS          9**
Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.

**UNIT IV          GEOGRAPHIC INFORMATION SYSTEM          9**
Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).

**UNIT V          DATA ENTRY, STORAGE AND ANALYSIS          9**
Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
   1.   Lillesand, T.M., Kiefer, R.W. and J.W.Chipman. (2008). Remote Sensing and Image Interpretation. V Edn. John Willey and Sons (Asia) Pvt. Ltd., New York.
   2.   Anji Reddy, M. (2013). Textbook of Remote Sensing and Geographical Information System.Fourth edn. BS Publications, Hyderabad.

## REFERENCES
   1.   Lo. C.P.and A.K.W.Yeung (2002). Concepts and Techniques of Geographic Information Systems. Prentice-Hall of India Pvt. Ltd., New Delhi. Pp: 492.
   2.   Peter A.Burrough, Rachael A.McDonnell (2015). Principles of GIS. Oxford University Press, Third edition
   3.   NPTEL

| 13CECB | PAVEMENT ENGINEERING | L | T | P | C |
|--------|----------------------|---|---|---|---|
|        |                      | 3 | 0 | 0 | 3 |

## COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to

CO 1: Outline the distribution of stresses in pavements
CO 2: Design flexible pavements based on empirical, semi empirical and theoretical methods
CO 3: Design rigid pavements and the joints
CO 4: Explain the performance evaluation and maintenance of pavements
CO 5: Describe the stabilization of pavement with suitable stabilizers

**UNIT I          TYPE OF PAVEMENT AND STRESS DISTRIBUTION          9**
Introduction - Pavement as layered structure - Pavement types - flexible and rigid - Stress and deflections in pavements under repeated loading.

**UNIT II          DESIGN OF FLEXIBLE PAVEMENTS          9**
Flexible pavement design – Empirical – Semi empirical and theoretical Methods – Design procedure as per latest IRC guidelines - Design and specification of rural road.

**UNIT III          DESIGN OF RIGID PAVEMENTS          9**
Cement concrete pavements - Modified Westergard approach - Design procedure as per latest IRC guidelines - Joints in rigid pavements - Concrete roads and their scope in India.

**UNIT IV          PERFORMANCE EVALUATION AND MAINTENANCE          9**
Pavement Evaluation [Condition and evaluation surveys (Surface Appearance, Cracks, Patches And Pot Holes, Undulations, Ravelling, Roughness, Skid Resistance), Structural Evaluation By Deflection Measurements, Present Serviceability Index] Pavement maintenance. [IRC Recommendations Only]

**UNIT V          STABILISATION OF PAVEMENTS          9**
Stabilisation with special reference to highway pavements - Choice of stabilisers -Testing and field control –Stabilisation for rural roads in India -use of Geosynthetics (geotextiles & geogrids) in roads.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
1.  Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna tech. Publications, New Delhi, 2000.
2.  Wright, P.H., "Highway Engineers", John Wiley & Sons, Inc., New York, 2009
3.  Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001

## REFERENCES
1.  Yoder R.J and Witczak M.W., "Principles of Pavement Design", John Wiley, 2000.
2.  Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
3.  Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
4.  NPTEL

**13CECC          TRAFFIC ENGINEERING AND MANAGEMENT          L   T   P   C**
**3   0   0   3**

## COURSE OUTCOMES
 Upon Successful completion of this course, the students will be able to
> CO 1: Describe the fundamental characteristics of road, traffic and land use
> CO 2: Analyze a variety of traffic facilities and evaluate capacity and level of service
> CO 3: Explain the methods of traffic control
> CO 4: Design elements of traffic intersections
> CO 5: Summarise various methods of traffic management

**UNIT I          INTRODUCTION          9**
Significance and scope, Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency (Problems), Components of Traffic Engineering- Road, Traffic and Land Use Characteristics.

**UNIT II          TRAFFIC SURVEYS AND ANALYSIS          9**
Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Basic principles of Traffic Flow.

**UNIT III          TRAFFIC CONTROL          9**
Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design.

**UNIT IV          GEOMETRIC DESIGN OF INTERSECTIONS          9**
Conflicts at Intersections, Classification of 'At Grade Intersections, - Channallised Intersections - Principles of Intersection Design, Elements of Intersection Design, Rotary design, Grade Separation and interchanges - Design principles.

**UNIT V          TRAFFIC  MANAGEMENT          9**
Traffic Management- Transportation System Management (TSM) - Travel Demand Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes, Introduction to Intelligent Transportation System (ITS).

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
1. Kadiyali L R, Traffic Engineering and Transport Planning, Khanna Technical Publications, Delhi, 2008.
2. Khanna K and Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2001.

## REFERENCES
1. Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management
2. Guidelines of Ministry of Road Transport and Highways, Government of India.
3. Subhash C.Saxena, A Course in Traffic Planning and Design, Dhanpat Rai Publications, New Delhi, 1989.
4. Transportation Engineering – An Introduction, C.Jotin Khisty, B.Kent Lall, Prentice Hall of India Pvt Ltd, 2006.
5. NPTEL

**13CEDA**            **ENVIRONMENTAL IMPACT ASSESSMENT**        **L  T  P  C**
                                                                 **3  0  0  3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
    CO 1: Outline the basic concepts of EIA
    CO 2: Discuss the methodologies adopted in EIA
    CO 3: Summarize the assessment of impacts on environment
    CO 4: Develop an environmental management plan for mitigating the impacts on environment
    CO 5: Analyze the case studies of EIA for various infrastructure projects

**UNIT I          INTRODUCTION                                        8**
Impact of development projects under Civil Engineering on environment - Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on 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 and air, noise, social, cultural flora and fauna; Mathematical models; public participation – Rapid EIA.

**UNIT IV         ENVIRONMENTAL MANAGEMENT PLAN                        9**

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – ISO 14000

**UNIT V          CASE STUDIES                                       10**
EIA for infrastructure projects – Stadium – Highways – Dams – Township – Gas/Oil pipe line – Petrochemical industries.

**L: 45 TOTAL: 45 PERIODS**

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

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

**13CEDB**             **INDUSTRIAL WASTE MANAGEMENT**     **L  T  P  C**
                                                          **3  0  0  3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: Summarize  the types, characteristics and effects of industrial waste
CO 2: Outline the concepts of cleaner production
CO 3: Describe the sources, characteristics and treatment of waste from major industries
CO 4: Discuss various treatment technologies & residue management
CO 5: Identify various treatments and management of hazardous waste

**UNIT I          INTRODUCTION                                           8**

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

**UNIT II          CLEANER PRODUCTION                                    8**

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

**UNIT III          POLLUTION FROM MAJOR INDUSTRIES                      9**

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Pulp & Paper, distilleries, Steel plants, Refineries, fertilizer, power plants of Thermal and nuclear, Cement Industries – Wastewater reclamation concepts.

**UNIT IV          TREATMENT TECHNOLOGIES                               10**

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

**UNIT V          HAZARDOUS SOLID WASTE MANAGEMENT                      10**

Hazardous wastes - Physico chemical treatment – solidification – incineration – Secure land fills - Common TSDF (Steel and Cement plant).

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

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

## REFERENCES

1.   T.T.Shen, "Industrial Pollution Prevention", Springer, 1999.
2.   R.L.Stephenson and J.B.Blackburn, Jr., "Industrial Wastewater Systems Hand book", Lewis Publisher, New Yark, 1998
3.   H.M.Freeman, "Industrial Pollution Prevention Hand Book", McGraw-Hill Inc., New Delhi, 1995.
4.   Bishop, P.L., "Pollution Prevention: Fundamental & Practice", McGraw-Hill, 2000.

**13CEDC**          **AIR POLLUTION MANAGEMENT**      **L  T  P  C**
                                                                                 **3  0  0  3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

      CO 1: Summarize the sources and effects of air pollutants

      CO 2: Describe the factors and models contributing the dispersion of air pollutants

      CO 3: Identify the concepts and principles of air pollution control and air quality management

      CO 4: Outline the sources, effects and control measures of noise pollution

**UNIT I**         **SOURCES AND EFFECTS OF AIR POLLUTANTS**        **9**

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Ambient Air Quality Standards – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.

**UNIT II**         **DISPERSION OF POLLUTANTS**        **9**

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

**UNIT III**         **AIR POLLUTION CONTROL**        **12**

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries (Cement, Smelter, Pulp & Paper and Thermal Power Plant).

**UNIT IV**         **AIR QUALITY MANAGEMENT**        **8**

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality.

**UNIT V**         **NOISE POLLUTION**        **7**

Sources of noise pollution – Effects – Assessment - Standards – Control methods – Prevention.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Anjaneyulu, D., "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 2001.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata-McGraw-Hill, New Delhi, 2007.

**REFERENCES**

1. W.L.Heumann, Industrial Air Pollution Control Systems, McGraw-Hill, New Yark, 1997.
2. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw-Hill Publishing Company, New Delhi, 2008.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi, 1985.

4.      Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2015.
5.      NPTEL

**13CEDD          MUNICIPAL SOLID WASTE MANAGEMENT          L   T   P   C**
**                                                          3   0   0   3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
>    CO 1: Outline the sources and types of municipal solid wastes
>    CO 2: Identify the methods to collect and covey the municipal solid wastes
>    CO 3: Discuss the onsite / offsite storage and processing of solid wastes
>    CO 4: Summarize the disposal & management of solid wastes

**UNIT I          SOURCES AND TYPES OF MUNICIPAL SOLID WASTES          9**
Sources and types of solid wastes – Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes – Public health effects. Principle of solid waste management – social & economic aspects Public awareness; Role of NGOs; Legislation.

**UNIT II          ON-SITE STORAGE AND PROCESSING          9**
Source segregation - On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

**UNIT III          COLLECTION AND TRANSFER          9**
Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

**UNIT IV          OFF-SITE PROCESSING          9**
Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.

**UNIT V          DISPOSAL AND MANAGEMENT          9**
Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment –Plastic management – public health.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
1. George Tchobanoglous et.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1996.

**REFERENCES**
1. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
2. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 1997.
3. Bhide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 1993.

**13CEDE**             **ECOLOGICAL ENGINEERING**         **L  T  P  C**
                                                          **3  0  0  3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to
> CO 1: Summarize the principles & concepts of ecological engineering
> CO 2: Outline the basic functions of an eco system
> CO 3: Describe the methods of rehabilitation of ecosystem
> CO 4: Discuss the ecological effects of industrialization
> CO 5: Analyze the case studies of integrated ecological engineering system

**UNIT I         PRINCIPLES AND CONCEPTS                               9**

Scope and applications of Ecological Engineering – Development and evolution of ecosystems – principles and concepts pertaining to species, populations and community.

**UNIT II        ECOSYSTEM FUNCTIONS                                  10**

Energy flow and nutrient cycling – Food chain and food webs – biological magnification, diversity and stability, immature and mature systems. Primary productivity – Biochemical cycling of nitrogen, phosphorous, sulphur and carbon dioxide – Habitat ecology - Terrestrial, fresh water, estuarine and marine habitats.

**UNIT III       ECOLOGICAL ENGINEERING METHODS                       9**

Bio monitoring and its role in evaluation of aquatic ecosystem; Rehabilitation of ecosystems through ecological principles – step cropping, bio-wind screens, Wetlands, ponds, Root Zone Treatment for wastewater, Reuse of treated wastewater through ecological systems.

**UNIT IV        ECOLOGICAL EFFECTS OF INDUSTRIALISATION              9**

Ecological effects of exploration, production, extraction, processing, manufacture & transport.

**UNIT V         CASE STUDIES                                         8**

Case studies of integrated ecological engineering systems.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

1.    Odum, E.P., "Fundamental of Ecology", W.B.Sauders, 1990.
2.    Kormondy, E.J., "Concepts of Ecology", Prentice Hall, New Delhi, 1996

## REFERENCES

1.    Mitch, J.W. and Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley and Sons, 1996.
2.    Colinvaux, P., Ecology, John Wiley and Sons, 1996.
3.    Etnier, C & Guterstam, B., "Ecological Engineering for Wastewater Treatment", 2nd Edition, Lewis Publications, London, 1996.

**13CEEA**                 **HYDROLOGY**          **L   T   P   C**
                                                     **3   0   0   3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

         CO 1: Predict the quantity of precipitation

         CO 2: Predict the quantity of losses of precipitation.

         CO 3: Manipulate the quantity of effective rainfall using hydrograph.

         CO 4: Apply various flood routing techniques.

         CO 5: Summarize on ground water hydrology.

**UNIT I         PRECIPITATION                                      9**

Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, duration, frequency relationship – Probable maximum precipitation.

**UNIT II         ABSTRACTION FROM PRECIPITATION             9**

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall.

**UNIT III        HYDROGRAPHS                                           9**

Factors affecting Hydrograph – Base flow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different deviations - Synthetic Unit Hydrograph.

**UNIT IV        FLOODS AND FLOOD ROUTING                       9**

Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control.

**UNIT V         GROUND WATER HYDROLOGY                         9**

Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – Pumping test – Steady flow analysis only.

                                          **L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Publishing Co., Ltd., 2006
2. Raghunath, H.M., "Hydrology", Wiley Eastern Ltd., 2000
3. Jayaramy Reddy. P.,"Hydrology", Tata McGraw-Hill Publications Pvt. Ltd, New Delhi, 2005.
4. Santosh Kumar Garg, "Hydrology and Water Resources Engineering", Khanna Publications Pvt. Ltd. New Delhi, 2009.

**REFERENCES**

1. Chow, V.T. and Maidment, "Hydrology for Engineers", McGraw-Hill Inc., Ltd., 2000
2. Singh,V.P.,"Hydrology",McGraw-HillInc., Ltd., 2000.
3. NPTEL

| **13CEEB** | **GROUND WATER ENGINEERING** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: List the various modes of ground water distribution.
CO 2: Interpret hydraulics of flow in ground water
CO 3: Generalize estimation of ground water parameter
CO 4: Summarize the various ground water development techniques
CO 5: Describe various water quality parameters.

**UNIT I          FUNDAMENTALS OF GROUND WATER                           9**

Introduction – Characteristic of Ground water – Distribution of water - ground water column – Permeability - Darcy's Law - Types of aquifers - Hydro geological Cycle – water level fluctuations.

**UNIT II          HYDRAULICS OF FLOW                                      9**

Storage coefficient - Specific field - Heterogeneity and Anisotropy -Transmissivity - Governing equations of ground water flow - Steady state flow - DupuitForchheimer assumptions - Velocity potential - Flow nets.

**UNIT III          ESTIMATION OF PARAMETERS                              9**

Transmissivity and Storativity – Pumping test - Unsteady state flow - Thiess method - Jacob method - Image well theory – Effect of partial penetrations of wells - Collectors wells.

**UNIT IV          GROUND WATER DEVELOPMENT                             9**

Infiltration gallery - Conjunctive use - Artificial recharge Rainwater harvesting - Safe yield - Yield test – Geophysical methods – Selection of pumps.

**UNIT V          WATER QUALITY                                           9**

Ground water chemistry - Origin, movement and quality - Water quality standards - Saltwater intrusion –Environmental concern.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.     Raghunath H.M., "Ground Water Hydrology", Wiley Eastern Ltd., 2000.
2.     Todd D.K., "Ground Water Hydrology", John Wiley and Sons, 2000.

**REFERENCE**

1.     C Walton, "Ground Water Resource Evaluation", McGraw-Hill Publications 1998.

| 13CEEC | COASTAL ZONE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Demonstrate on the various coastal processes.

CO 2: Paraphrase various terms involved in wave dynamics.

CO 3: Classify methods of wave forecasting

CO 4: Summarize effect of tides on structure

**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.

**UNIT III        WAVE FORECASTING AND TIDES                         9**

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.

**UNIT IV        COASTAL PROCESSES                                     8**

Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.

**UNIT V        HARBOURS                                                 9**

Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore forest.

**L: 45 TOTAL: 45 PERIODS**

**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".

**13CEED**              **WATER RESOURCES ENGINEERING**          **L   T   P   C**
                                                                **3   0   0   3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Outline the water resource planning and water policy

CO 2: Generalize the station network design.

CO 3: Infer on water resource needs.

CO 4: Discuss on reservoir planning and management

CO 5: Explain on economic analysis

**UNIT I          GENERAL                                                      9**

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Economics of water resources planning, physical and socio economic data – National Water Policy – Collection of meteorological and hydrological data for water resources development.

**UNIT II         NETWORK DESIGN                                               9**

Hydrologic measurements – Analysis of hydrologic data – Hydrologic station network – Station network design – Statistical techniques in network design.

**UNIT III        WATER RESOURCE NEEDS                                         9**

Consumptive and non-consumptive water use - Estimation of water requirements for irrigation, for drinking and navigation - Water characteristics and quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget and development plan.

**UNIT IV         RESERVOIR PLANNING AND MANAGEMENT                            9**

Reservoir - Single and multipurpose – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation - Sedimentation of reservoirs - Design flood-levees and flood walls - Channel improvement.

**UNIT V          ECONOMIC ANALYSIS                                            9**

Estimation of cost and Evaluation of Benefits - Discount rate - Discounting factors - Discounting techniques – Computer Applications.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.   Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000.
2.   Douglas J.L. and Lee R.R., "Economics of Water Resources Planning", Tata McGraw-Hill Inc. 2000.
3.   Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers 2008

**REFERENCES**

1.   Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.
2.   Goodman Alvin S., "Principles of Water Resources Planning", Prentice-Hall, 1984.
3.   NPTEL

| 13CEFB | HOUSING PLANNING AND MANAGEMENT | L | T | P | C |
|--------|--------------------------------|---|---|---|---|
|        |                                | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Outline the basics involved in housing planning
CO 2: Explain the various programs involved in housing
CO 3: Design a housing project
CO 4: Summarize the construction techniques
CO 5: Summarize the cost effective materials
CO 6: Discuss on housing finance and project appraisal

**UNIT I          INTRODUCTION TO HOUSING          9**

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels.

**UNIT II          HOUSING PROGRAMMES          9**

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

**UNIT III          PLANNING AND DESIGN OF HOUSING PROJECTS          9**

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems).

**UNIT IV          CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS          9**

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation.

**UNIT V          HOUSING FINANCE AND PROJECT APPRAISAL          9**

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 1999.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 1997.

**REFERENCES**

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 1994.
3. National Housing Policy, 1994, Government of India

**13CEFC          CONSTRUCTION PLANNING AND SCHEDULING     L   T   P   C**
                                                                          **3   0   0   3**

**COURSE OUTCOMES**
 Upon Successful completion of this course, the students will be able to
        CO 1: Describe the basic concepts in construction planning
        CO 2: Identify the critical paths in scheduling the activities using network diagrams
        CO 3: Predict the cost control monitoring and accounting
        CO 4: Describe quality control and safety during construction
        CO 5: Predict the use of project information in organizing database systems

**UNIT I          CONSTRUCTION PLANNING                                    8**
Basic concepts in the development of construction plans - choice of Technology and Construction method -Defining Work Tasks – Definition - Precedence relationships among activities - Estimating Activity Durations - Estimating Resource Requirements for work activities - coding systems.

**UNIT II         SCHEDULING PROCEDURES AND TECHNIQUES                     12**
Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling - Activity float and schedules - Presenting project schedules - Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads, lags and windows - Resource oriented scheduling-Scheduling with resource constraints and precedences - Use of Advanced Scheduling Techniques - Scheduling with uncertain durations-Crashing and time/cost trade offs -Improving the Scheduling process – Introduction to application software.

**UNIT III        COST CONTROL MONITORING AND ACCOUNTING                   9**
The cost control problem-The project Budget-Forecasting for Activity cost control - financial accounting systems and cost accounts - Control of project cash flows - Schedule control-Schedule and Budget updates -Relating cost and schedule information.

**UNIT IV         QUALITY CONTROL AND SAFETY DURING CONSTRUCTION           8**
Quality and safety Concerns in Construction-Organizing for Quality and Safety - Work and Material Specifications - Total Quality control-Quality control by statistical methods - Statistical Quality control with Sampling by Attributes - Statistical Quality control by Sampling and Variables - Safety.

**UNIT V          ORGANIZATION AND USE OF PROJECT INFORMATION              8**
Types of project information - Accuracy and Use of Information - Computerized organization and use of Information - Organizing information in databases - relational model of Data bases - Other conceptual Models of Databases - Centralized database Management systems - Databases and application programs -Information transfer and Flow.

                                                          **L: 45 TOTAL: 45 PERIODS**
**TEXT BOOKS**
    1.     Chitkara, K.K. "Construction Project Management Planning", Scheduling and Control, Tata McGraw-Hill Publishing Co., New Delhi, 1998.
    2.     Srinath,L.S., "Pert and CPM Principles and Applications", Affiliated East West Press, 2001

**REFERENCES**

1.  Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamentals Concepts for Owners", Engineers, Architects and Builders, Prentice Hall, Pitsburgh, 2000

2.  Moder.J., C.Phillips and Davis, "Project Management with CPM", PERT and Precedence Diagramming, Van Nostrand Reinhold Co., Third Edition, 1983.

| 13CEFD | CONSTRUCTION MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: To plan construction projects, schedule the activities using network diagrams.

CO 2: To determine the cost of the project, control the cost of the project by creating cash flows and budgeting.

CO 3: To use the project information as information and decision making tool.

**UNIT I        CONSTRUCTION PLANNING                                    9**

Basic concepts in the development of construction plans - choice of Technology and Construction method -Defining Work Tasks – Definition - Precedence relationships among activities - Estimating Activity Durations - Estimating Resource Requirements for work activities - coding systems.

**UNIT II        SCHEDULING PROCEDURES AND TECHNIQUES              9**

Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling - Activity float and schedules - Presenting project schedules - Critical path scheduling for Activity -on-node and with leads, Lags and Windows - Calculations for scheduling with leads, lags and windows -Resource oriented scheduling - Scheduling with resource constraints and precedences - Use of Advanced Scheduling Techniques - Scheduling with uncertain durations - Crashing and time/cost tradeoffs - Improving the Scheduling process – Introduction to application software.

**UNIT III        COST CONTROL MONITORING AND ACCOUNTING          9**

The cost control problem-The project Budget-Forecasting for Activity cost control - financial accounting systems and cost accounts - Control of project cash flows - Schedule control - Schedule and Budget updates -Relating cost and schedule information

**UNIT IV        QUALITY ASSURANCE CONTROL AND MONITORING        9**

Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

**UNIT V        ORGANIZATION AND USE OF PROJECT INFORMATION        9**

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information -Organizing information in databases-relational model of Data bases-Other conceptual Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow- Introduction to softwares.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.    Chitkara, K.K. "Construction Project Management Planning", Scheduling and Control, Tata McGraw-Hill Publishing Co., New Delhi, 2004.

2.    Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamentals Concepts for Owners", Engineers, Architects and Builders, Prentice Hall, Pitsburgh, 2000.

**REFERENCES**

1. Moder.J., C.Phillips and Davis, "Project Management with CPM, PERT and Precedence Diagramming", Van Nostrand Reinhold Co., 1995.
2. Halpin,D.W., "Financial and cost concepts for construction Management", John Wiley and Sons, New York, 2005.
3. Srinath L S, "PERT/CPM Principles and Applications", Affiliated East West Press (P) Ltd, 2002.

**13CEFE**             **ARCHITECTURE AND TOWN PLANNING**      **L  T  P  C**
                                                              **3  0  0  3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Define the basic elements and principles of architectural design
CO 2: Illustrate site planning with layout regulations and design concepts
CO 3: Classify the different types of buildings
CO 4: Interpret the interaction of climate and environment with building design
CO 5: Explain the concepts and processes of town planning

**UNIT I          ARCHITECTURAL DESIGN                                8**

Architectural Design – an analysis – integration of function and aesthetics – Introduction to basic elements and principles of design.

**UNIT II          SITE PLANNING                                      9**

Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

**UNIT III         BUILDING TYPES                                     12**

Residential, institutional, commercial and Industrial – Application of anthropometry and space standards-Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design.

**UNIT IV         CLIMATE AND ENVIRONMENTAL RESPONSIVE DESIGN      8**

Man and environment interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

**UNIT V          TOWN PLANNING                                      8**

Planning – Definition, concepts and processes- Urban planning standards and zoning regulations- Urban renewal – Conservation – Principles of Landscape design.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.      Francis D.K. Ching, "Architecture: Form, Space and Order", VNR, N.Y., 1999.
2.      Givoni B., "Man Climate and Architecture", Applied Science, Barking ESSEX, 1982
3.      Edward D.Mills, "Planning and Architects Handbook", Butterworth London, 1995.

**REFERENCES**

1.      GallianB. Arthur and Simon Eisner, "The Urban Pattern – City Planning and Design", Affiliated Press Pvt. Ltd., New Delhi, 1995.
2.      Margaret Robert, "An Introduction to Town Planning Techniques", Hutchinso London, 1990.

## 13CEFF      ENGINEERING ECONOMICS AND COST ANALYSIS   L  T  P  C
                                                         3  0  0  3

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

       CO 1: Describe the concept of economics

       CO 2: Identify the various costs involved in product design and process planning

       CO 3: Describe the role of value engineering in decision making

       CO 4: Determine the cash flows in various project which assist in decision making

       CO 5: Identify the types of maintenance and replacement problem for determining the life of an asset

       CO 6: Describe the methods of depreciation

## UNIT I       INTRODUCTION TO ECONOMICS       8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

## UNIT II       VALUE ENGINEERING       10

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

## UNIT III       CASH FLOW       9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

## UNIT IV       REPLACEMENT AND MAINTENANCE ANALYSIS       9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

## UNIT V       DEPRECIATION       9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation / Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1.    Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

2.    Suma Damodaran, "Managerial economics", Oxford University press 2006.

**REFERENCES**

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984

| 13CEFG | INTELLECTUAL PROPERTY RIGHTS | L | T | P | C |
|--------|------------------------------|---|---|---|---|
|        | (Common to IT & Civil)       | 3 | 0 | 0 | 3 |

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: understand the principles, functions and basic legal rules of IP law

CO 2: Recognize the relevant criteria for generating and protecting intellectual work.

## UNIT I          TYPES OF PROPERTY                                        9

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (i). Movable Property (ii). Immovable Property and (iii). Intellectual Property.

## UNIT II          PATENTS AND APPLICATION PROCEDURES                      9

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark Registration – Definitions – Industrial Designs and Integrated circuits – Protection ofGeographical Indications at national and International levels – Application Procedures.

## UNIT III          INTERNATIONAL PARTICES                                 9

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT).

## UNIT IV          LEGISLATIONS AND POLICY                                 9

Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

## UNIT V          CASE STUDIES                                            9

Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications –Protection against unfair competition.

### L: 45 TOTAL: 45 PERIODS

## TEXT BOOK

1. Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S.Viswanathan Printers and Publishers Private Limited, 1998.

## REFERENCES

1. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1974.
2. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. www.ipmatters.net/features/000707_gibbs.html.

| 13CEFH | MANAGEMENT OF IRRIGATION SYSTEMS | L | T | P | C |
|--------|----------------------------------|---|---|---|---|
|        |                                  | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

        CO 1: Generalise on suitable irrigation system requirements
        CO 2: Explain on irrigation scheduling
        CO 3: Summarise on irrigation management system
        CO 4: Review the operation of irrigation management
        CO 5:  Infer the involvement of stake holders in irrigation management systems

**UNIT I          IRRIGATION SYSTEM REQUIREMENTS                    9**

Irrigation systems – Supply and demand of water – Cropping pattern – Crop rotation – Crop diversification – Estimation of total and peak crop water requirements – Effective and dependable rainfall – Irrigation efficiencies.

**UNIT II          IRRIGATION SCHEDULING                              8**

Time of irrigation – Critical stages of water need of crops – Criteria for scheduling irrigation – Frequency and interval of irrigation.

**UNIT III          MANAGEMENT                                        9**

Structural and non-structural strategies in water use and management – Conjunctive use of surface and ground waters – Quality of irrigation water.

**UNIT IV          OPERATION                                          9**

Operational plans – Main canals, laterals and field channels – Water control and regulating structures – Performance indicators – Case study.

**UNIT V          INVOLVEMENT OF STAKE HOLDERS                        10**

Farmer's participation in System operation – Water users associations – Farmer councils – Changing paradigms on irrigation management – Participatory irrigation management.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**
    1.    Dilip Kumar Majumdar, "Irrigation Water Management – Principles and Practice", Prentice Hall of India Pvt. Ltd., New Delhi, 2000
    2.    Hand book on Irrigation Water Requirement, R.T. Gandhi, et. al., Water Management Division, Department of Agriculture, Ministry of Agriculture, New Delhi

**REFERENCES**
    1.    Hand Book on Irrigation System Operation Practices, Water Resources Management and Training Project, Technical report No. 33, CWC, New Delhi, 1990
    2.    Maloney, C. and Raju, K.V., "Managing Irrigation Together", Practice and Policy in India, Stage Publication, New Delhi, India, 1994.

| 13CEHA | ENERGY CONSCIOUS IN BUILDINGS | L | T | P | C |
|--------|-------------------------------|---|---|---|---|
|        |                               | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Describe the basic concepts of building and its environment
CO 2: Discuss the principle of energy conscious in buildings
CO 3: Explain the level of human comfort in Green buildings
CO 4: Acquire the knowledge about the different climatic zones
CO 5: Summarize the concept of Energy managements in building

**UNIT I          GENERAL ASPECTS                                        9**

Introduction - Building Envelope - Building Materials - Embodied Energy of Building Materials - Alternative Building Materials - Indoor Environment. Components of Indoor Environment. Quality of Indoor Environment.

**UNIT II         ENERGY EFFICIENCY                                      9**

Passive Heating - Direct Gain-Indirect Gain- Isolated Gain-Solarium Passive Cooling - Ventilation Cooling- Evaporative Cooling - Nocturnal Radiation Cooling - Desiccant Cooling - Earth Coupling – Daylighting - Basic Principles of Daylighting - Daylighting Systems

**UNIT III        HUMAN COMFORT                                         9**

Human Comfort - Thermal, Visual, Acoustical and Olfactory comfort. Concept of Sol-air temperature and its significance. Ventilation and is significance.

**UNIT IV         CLIMATE AND BUILDINGS                                  9**

Introduction - Climatic zones and their characteristics - Factors affecting climate - Implications of climate on building design - Urban climate - Microclimate.

**UNIT V          ENERGY MANAGEMENT                                      9**

Energy Management of Buildings - Energy Audit of Buildings – Energy- Management matrix monitoring and targeting.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Hand book on Energy Conscious Buildings (http://mnre.gov.in/centers/about-sec-2/hand-book-on-energy-conscious-buildings/)
2. J.K. Nayak and J.A. Prajapati Handbook on Energy Conscious Buildings, Solar Energy Control MNES, 2006.

**REFERENCES**

1. Energy Conservation Building Codes 2006; Bureau of Energy Efficiency.
2. M.S. Sodha, N.K., Bansal, P.K. Bansal, A.Kumar and M.A.S. Malik. Solar Passive Building, Science and Design, Pergamon Press, 2003.
3. J.Duffie and W. Beckman Solar Engineering of Thermal Processes, Fourth Edition, Wiley, 2013

| 13CEHB | HEATING VENTILATION AND AIR CONDITIONING OF BUILDINGS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: Describe the need of heating and cooling in the buildings

CO 2: Explain basic concept of the heat gain and heat loss in the buildings

CO 3: Discuss the conventional and natural cooling process in the buildings

CO 4: Explain the Ventilation system in the building

CO 5: Analyze the heating and cooling load require for the buildings

**UNIT I          INTRODUCTION                                            9**

Fundamentals of good indoor air quality - Need for cooling and heating in buildings and methods of ventilation - Moist air systems and processes, applications of psychometrics to the HVAC process - comfort conditions.

**UNIT II          ENERGY TRANSFER IN BUILDINGS                          9**

Human body and thermal comfort - heat transfer from the human body - design conditions for heating and cooling loads of the building Heat Gain from People - Lights and Appliances - Transfer through Walls and Roofs Heat Loss from Basement Walls and Floors Heat Transfer through Windows - Solar Heat Gain through Windows - Infiltration Heat Load and Weatherizing - Annual Energy Consumption.

**UNIT III          COOLING CONCEPTS IN BUILDINGS                        9**

Summer and Winter AC - Simple summer AC process, Room sensible heat factor, Coil sensible heat factor, ADP - Precision AC- Winter AC-Natural Cooling - Ventilation Cooling - Evaporative Cooling - Nocturnal Radiation Cooling- Solar Absorption cooling.

**UNIT IV          VENTILATION                                            9**

Ventilation – Need-Air Diffusion- Methods of Ventilation - Natural-wind effect, stack effect, combined effect Mechanical, forced, exhaust, combined Displacement ventilation - Industrial Ventilation - Steel  plants, car parks, plant rooms, mines, etc.

**UNIT V          BUILDING ENERGY CALCULATION                          9**

Cooling Load Estimation – Design conditions, outdoor, indoor - External load - wall-roof-glass – Internal load - occupancy - lighting – equipment – Ventilation - air quantity. Heating load estimation - Vapour transferring wall, vapour barrier.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. M.S. Sodha, N.K., Bansal, P.K. Bansal, A.Kumar and M.A.S. Malik. Solar Passive Building, Science and Design, Pergamon Press, 1986.
2. J.Duffie and W. Beckman Solar Engineering of Thermal Processes, Fourth Edition, Wiley, 2013

**REFERENCES**

1. ASHRAE Handbook – HVAC Systems and Equipment, American Society of eating Refrigerating and Air-Conditioning Engineers  Inc. Atlanta, USA, 2008.
2. F.C. McQuiston, J.D. Parker and Spitler, J.D.Heating, Ventilating and Air Conditioning, John Wiley & Sons Inc., 2001.

**13CEHC          NON DESTRUCTIVE TESTING TECHNIQUES          L T P C**
**                       AND APPLICATIONS                              3 0 0 3**
                       *(Common to EIE and Civil)*

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
    CO 1:  differentiate the Non destructive testing from destructive testing techniques.
    CO 2:   explain the fundamentals and principles involved in the various Non destructive testing.
    CO 3:  describe the procedures used to perform basic NDT techniques.
    CO 4:  analyze the advantages and limitations of one method over other methods.
    CO 5:  critically appraise the NDT techniques available and select the most appropriate one for a given situation/application.

**UNIT I      VISUAL INSPECTION AND LIQUID PENETRANT TESTING          9**
**Introduction**: Comparison of Destructive and Non-Destructive Tests-Conditions for Effective Non-Destructive Testing
**Visual Inspection**:-Optical aids used for visual Inspection-Applications
**Liquid Penetrant Testing**: Physical Principles-Procedure for Penetrant Testing-Penetrant Testing Materials –Penetrant Testing Methods-Water washable and Post-Emulsifiable Method.

**UNIT II    ULTRASONIC AND ACOUSTIC EMISSION TESTING          9**
**Ultrasonic Testing**: Principle- Ultrasonic Transducers-Flaw detection equipment-Modes of display- Variables affecting Ultrasonic Test-Pulse echo, through transmission and Angle Beam Testing- Applications, Advantages and Limitations.
**Acoustic Emission Testing**: Principle – Instrumentation –Advantages, Limitations and applications- Acoustic Emission testing of metal pressure vessels-Fatigue crack detection in Aerospace structures.

**UNIT III  MAGNETIC PARTICLE, EDDY CURRENT AND MAGNETIC FLUX**
**             LEAKAGE TESTING          9**
**Magnetic Particle Testing:** Principle- magnetizing techniques- Procedure used for testing a component – Advantages, Limitations and applications
**Eddy current Testing:** Principles –Instrumentation for Eddy current testing – Inspection of ferromagnetic materials-Pulsed eddy current testing- Applications.
**Magnetic Flux Leakage (MFL) Testing:** Principle- Magnetizing and Demagnetizing methods – MFL sensors – Flaw detection and analysis in ferromagnetic specimen – advantages, Limitations and applications.

**UNIT IV  THERMOGRAPHY AND RADIOGRAPHY TESTING**
**          9**
**Thermography:** Principle- Detectors and Equipments for active thrermography –heating sources – applications-Thermal imaging for condition monitoring of Industrial Components
**Radiography:** Principle- Electromagnetic radiation sources – Radiographic imaging equipments various inspection techniques-Reading and interpretation of radiographs – safety in industrial radiography.

**UNIT V    INDUSTRIAL APPLICATIONS OF NON DESTRUCTIVE TESTING    9**
**Industrial Applications of Non Destructive Testing:** Railways- Nuclear industry –
Concrete structures -aircraft and aerospace industries –automotive industries-Selection of
NDT methods –Codes, standards, specifications and Procedures.

**L : 45 TOTAL : 45 PERIODS**

**TEXT BOOK**
1. Baldev Raj, Jeyakumar, T., Thavasimuthu, M., "Practical Non Destructive Testing", NarosaPublishing House, New Delhi, 2014.

**REFERENCES**
1. Charles J. Hellier, "Hand Book of Non-Destructive Evaluation", The McGraw-Hill Companies, New York, 2012.
2. Christiane Maierhofer, Hans-Wolf Reinhardt and Gerd Dobmann, "Non-destructive evaluation of reinforced concrete structures", Volume 2, CRC Press, New York, 2010.
3. Prasad J and C.G.K. Nair, "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
4. V.M. Malhotra and N.J. Carino, "Handbook On Nondestructive Testing on Concrete", Second Edition, CRC Press, New York, 2004.
5. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application", Marcel Dekker, Inc., New York, 2002.

**13CEHD       ENVIRONMENTAL INSTRUMENTATION           L T P C**
               *(Common to EIE and CIVIL)*                          **3 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
CO 1:  discuss the fundamental blocks of Measurement system.
CO 2:  explain the working and list the types of sensor and transducer.
CO 3:  explain the causes and effects of water, air and noise pollution on environment.
CO 4:  describe the working principle of instruments for quality of water, air and sound monitoring and measurement.
CO 5:  select the appropriate instrument for specific application.
CO 6:  list the manufacturers of instruments for environmental monitoring and measurement and control.

**UNIT I       INTRODUCTION                                          9**
Definition: Measurement and Instrumentation, Block diagram of Measurement system – Types of Sensor and Transducer. Necessity of instrumentation and control for environment, sensor requirement for environment.

**UNIT II      WATER                                                 9**
Definitions - causes and effects of water pollution - Standards of raw and treated water - sources of water and their natural quality - effects of water quality - Water quality measurement: Thermal conductivity detectors - Opacity monitors - pH analyzers and their application - conductivity analyzers and their application.

**UNIT III     GROUND AND WASTE WATER                                9**
Level measurement in wells - laboratory analysis of ground water samples - instrumentation in ground water monitoring - instrumentation in assessment of soil and ground water pollution - Automatic waste water sampling - optimum waste water sampling locations - Instrumentation set up for waste water treatment plant - Latest methods of waste water treatment plants - Quality assurance of storage water.

**UNIT IV      AIR                                                   9**
Definitions - causes and effects of air pollution - air pollution from thermal power plant - Air sampling methods and equipments - analytical methods for air pollution studies - Measurement of ambient air quality - Flow monitoring: Air flow measurement - gas flow – non-open channel flow measurement.

**UNIT V       SOUND                                                 9**
Definitions - causes and effects of Noise Pollution and Its Monitoring - Ambient noise - Noise intrusions - impulsive noise - transient noise - airport noise - Sound level meters - Tape recorders - noise dosimeters - sound level monitors and acoustical calibrators - Field equipments for noise measurement.

                                          **L: 45 TOTAL : 45 PERIODS**
**TEXT BOOKS**
   1. E.O.Doebelin, Dhanesh N Manik, "Measurement Systems", 6th Edition, TMcGH, 2011.
   2. Randy.D.Down, Jay.H.Lehr, "Environmental Instrumentation and Analysis", John Wiley and Sons, Hand book, 2005.

3. Narendra.S.Goel, John.M.Norman, Taylor and Francis, "Instrumentation for Studying Vegetation Canopies for Remote Sensing in Optical and Thermal Infrared Regions", 1990.

**REFERENCES**
1. A course manual: Instrumentation in Environmental Engg. NEERI Publications. Nagpur.
2. Handbook of Analytical Instruments, 2$^{nd}$ Edition, R.S. Khandpur, TMcGH, 2007.

**WEB REFERENCES**
1. http://cafefoundation.org/v2/pdf_tech/Noise.Technologies/PAV.Environ.Noise.Band K.pdf
2. http://www.aweimagazine.com/article.php?article_id=148
3. ftp://ftp.energia.bme.hu/pub/hullgazd/Environmental%20Engineers'%20Handbook/Ch06.pdf

**13CEHE**            **EXPERIMENTAL STRESS ANALYSIS**            **L   T   P   C**
                                                                   **3   0   0   3**

## COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
   CO 1: Discuss on various strains measurement methods.
   CO 2: Classify the various measuring instruments in experimentation
   CO 3: Relate the concept of photo elasticity in calibration of photoelastic materials.
   CO 4: Analyze models based on various methods
   CO 5: Describe the advanced techniques in measurements.

**UNIT I            STRAIN MEASUREMENT METHODS                              9**
Strain gauges – basic characteristics – mechanical, optical, acoustic, electrical inductance and capacitance, pneumatic types – description and working principles – factors producing strain sensitivity – Gauge construction – temperature compensation – Gauge sensitivities and gauge factors – Strain rosettes –Calculation of principal strains and principal stresses.

**UNIT II           MEASURING INSTRUMENTS                                   9**
Linear Variable Differential Transducer – Cathode Ray Oscilloscope – XY Plotter – Digital Data Acquisition System – Hydraulic Jacks – Pressure Jacks – load cells – Proving Rings – Vibration meter – Wind Tunnel – Calibration of Testing Instruments.

**UNIT III          PHOTO ELASTICITY                                        9**
Two dimensional photo elasticity – Stress optic law – Polariscope – isoclinic and isochromatic fringes – compensators – Separation techniques – Model materials – Calibration of photo elastic materials.

**UNIT IV           MODEL ANALYSIS                                          9**
Model analysis – Direct and Indirect models – laws of structural similitude – choice of scales – Model materials – Limitations of model studies –Buckingham pi theorem –Design of direct and indirect models – Begg's Deformeter and its applications.

**UNIT V            ADVANCED TECHNIQUES                                     9**
Fundamentals of photo elastic coatings – Morie fringe and Brittle coating technique – crack detection techniques – Introduction to stress freezing technique – Introduction to nondestructive testings – Holography.

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS
   1.    Dally and Railey, "Experimental stress analysis", 2003.
   2.    Richard G Budynas, "Advanced Strength and Applied Stress Analysis", Tata McGraw Hill Publishing company Ltd., New Delhi, 2011

## REFERENCES
   1.    Sadhu Singh, "Experimental stress analysis", Khanna Publishers, New Delhi, 2005
   2.    Dove and Adam, "Experimental stress analysis and Motion measurements",1989

| **13CEHF** | **ELECTRONIC SURVEYING** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: Summarise the fundamentals of electronic surveying
CO 2: Explain the basics of electronics
CO 3: Explain the propagation of of electromagnetic waves
CO 4: Describe the electromagnetic distance measuring system
CO 5: Practice with the EDM system in field studies

### UNIT I         FUNDAMENTALS                                                 7

Methods of measuring distance, historical development, basic principles of EDM, classifications, applications and comparison with conventional surveying.

### UNIT II        BASIC ELETRONICS                                             8

Fundamentals of electronics, resonant circuits, semiconductors, Lasers, Cathode ray tube, photo multiplier tube, transducers, oscillators, frequency mixing, modulation and demodulation, Kerrcell modulator, measurement of phase difference, reflectors and power sources.

### UNIT III       PROPAGATION OF ELECTROMAGNETIC WAVES                          11

Definition, classification, applications, propagation properties, wave propagation at lower and higher frequencies. Refractive index, factors affecting, computation of group refractive index for light and near infrared waves at standard conditions and ambient conditions, reference refractive index, first velocity correction, computation of refractive index for microwaves, measurement of atmospheric parameters, mean refractive index, real time application of first velocity correction, second velocity correction and total atmospheric correction.

### UNIT IV        ELECTROMAGNETIC DISTANCE MEASURING SYSTEM                     11

Electro-optical system, measuring principle, working principle, sources of error, infrared EDM instruments, Laser EDM instruments and total station.Microwave system, measuring principle, working principle, sources of error, microwave EDM instruments, comparison with Electro-optical system, care and maintenance of EDM instruments, Modern Positioning Systems.EDM traversing, trilateration and base line measurement using EDM.

### UNIT V         FIELD STUDIES                                                8

Study of different EDM instruments and Total Station.EDM traversing, trilateration and base line measurement using EDM.

**L: 45 TOTAL: 45 PERIODS**

## REFERENCES

1.    Burnside, C.D. Electromagnetic distance measurement Crosby Lock wood staples, U.K. 1971.
2.    Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1990.
3.    Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983.
4.    Soastamoinen, J.J. Surveyor's guide to electro-magnetic Distance Measurement, Adam Hilger Ltd., 1967

**13TD01**                    **INDIAN BUSINESS LAWS**                    **L T P C**
                                                                          **0 0 0 3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

CO 1: explain the elements of a valid contract.

CO 2: discuss main provisions relating to Sale of Goods Act and Negotiable Instruments Act.

CO 3: explain provisions relating to incorporation and functioning of company and partnership firm.

CO 4: understand the fundamentals of Consumer Protection Act and Foreign Exchange Management Act.

CO 5: understand the basic knowledge of Information Technology Act and RTI Act.

**UNIT I          THE INDIAN CONTRACT ACT, 1872**

Definition of a Contract and its essentials - Formation of a valid Contract - Offer and Acceptance, Consideration -  Capacity to Contract - Free consent - Legality of object - Discharge of a Contract by performance - Impossibility and Frustration - Breach, Damages for breach of a contract - Quasi contracts - Special Contracts - Contract of Indemnity and Guarantee - Contract of Bailment and Pledge - Contract of Agency.

**UNIT II          THE SALE OF GOODS ACT, 1930**

Definition of a Contract of Sale - Conditions and Warranties - Passing of Property - Right of Unpaid Seller against the Goods - Remedies for Breach - The Negotiable Instrument Act, 1881 Definition and characteristics - Kinds of negotiable instruments - Promissory Note - Bill of Exchange and Cheques - Holder and Holder in due course - Negotiation, Presentment, Discharge from Liability - Noting and Protest – Presumption - Crossing of Cheques - Bouncing of Cheques.

**UNIT III          THE COMPANIES ACT, 1956**

Nature and Definition of a Company - Registration and Incorporation - Memorandum of Association - Articles of Association – Prospectus - Kinds of Companies - Directors: Their powers and duties – Meetings - Winding up - The Indian Partnership Act, 1932 - Definition of Partnership and its essentials - Rights and Duties of Partners: Types of Partners - Minor as a partner - Doctrine of Implied Authority - Registration of Firms - Dissolution of firms - Limited Liability Partnership Act, 2000.

**UNIT IV          THE CONSUMER PROTECTION ACT, 1986**

Aims and Objects of the Act - Redressal Machinery and Procedure for complaints under the Act – Remedies – Appeals - Enforcement of orders and Penalties - Foreign Exchange Management Act 2000 - Definition and  Main Provisions.

**UNIT V          THE INFORMATION TECHNOLOGY ACT**

Definition, Digital Signature - Electronic Governance – Attribution - Acknowledgment and Dispatch of Electronic Records - Sense Electronic Records and Sense Digital Signatures - Regulation of Certifying Authorities  Digital Signature Certificates - Duties of Subscribers - Penalties and Offences - The Right to Information Act, 2005 - Right to know - Salient Features of the Act - Obligation of Public Authority - Designation of Public Information Officer - Request for obtaining information - Duties of a PIO - Exemption from Disclosure of Information - Partial Disclosure of Information - Information Commissions - Powers of Information Commissions - Appellate Authorities – Penalties - Jurisdiction of Courts.


**TEXT BOOKS**

 1. Kuchhal M.C, "Business and Industrial Laws", 3rd Edition, JBA Publishers, New Delhi, 2013.
 2. Gulshan S.S, "Merchantile Law", 3rd Edition, JBA Publishers, New Delhi, 2007.

**REFERENCES**

1. Mulla D.F, "The Sale of Goods Act and the Indian Partnership Act", 10$^{th}$ Edition, LexisNexis Ltd., India, 2012.
2. Dabas J, "Negotiable Instruments Act", 2$^{nd}$ Edition, JBA Publishers, New Delhi, 2013.
3. Avtar S, "The Principles of Mercantile Law", 9$^{th}$ Edition, Eastern Book Company, India, 2011.

**13TD02          LEADERSHIP AND PERSONALITY DEVELOPMENT          L T P C**
**0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
        CO 1: identify the various leadership skills.
        CO 2: understand group dynamics and factors influencing the team performance.
        CO 3: describe the personality dimensions based on personality theories.
        CO 4: explain personality determinants and personality types.
        CO 5: apply effective training program for personality development.

**UNIT I          INTRODUCTION**
Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership-Leader, Followers and Situations - Leadership Skills – Basic Leadership Skills - Building Technical Competency - Advanced Leadership Skills - Team Building for Work Teams - Building High Performance Teams.

**UNIT II          TEAMS AND LEADERSHIP**
 Assessing Leadership & Measuring Its Effects - Group- Nature, Size, Roles, Norms, Cohesion, and Stages of Group Development - Teams and their Leadership – Effective Team Characteristics and Team Building - Ginnetts Team Effectiveness Leadership Model.

**UNIT III          PERSONALITY**
 Personality - Meaning, Concept, Personality Patterns, Symbols of Self, Moulding the Personality Pattern, Persistence & Change - Personality & Personal Effectiveness - Psychometric Theories – Cattele and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysi - Johari – Window - Personal Effectiveness.

**UNIT IV          PERSONALITY DETERMINANTS**
Personality Determinants – Heredity and Environment – Types of personality.

**UNIT V          PERSONALITY TRAINING**
Concept, Role, Need, Importance and types of personality Training - Understanding Process of Learning - Developing an Integrated Approach of Learning in Training Programme - Training Needs Assessment.

**TEXT BOOKS**
    1. Yukl G, "Leadership in Organisations", 8th Edition, Pearson Education Ltd., England, 2013.
    2. Lall M, Sharma S, "Personal Growth Training & Development", Kindle Edition, USA, 2009.

**REFERENCES**
    1. Janakiraman B, "Training and Development", Wiley Dream tech, Biztantra, 2005.
    2. Pareek U, "Understanding Organizational Behaviour", 2nd Edition, Oxford University Press, USA, 2007.

**13TD03**          **INTERNATIONAL BUSINESS MANAGEMENT**          **L T P C**
                                                                    **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
>    CO 1: understand the global business environment.
>    CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.
>    CO 3: discuss the issues and problems of Multinational Enterprises.
>    CO 4: discuss the role of various international financial institutions.
>    CO 5: discuss about important aspects of WTO and GATT agreement.

**UNIT I          INTERNATIONAL BUSINESS ENVIRONMENT**
International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

**UNIT II          RISK ANALYSIS AND PRACTICES**
Country Risk Analysis - Political, Social and Economic - Cultural and Ethical practices - Responsibilities of International Business - Economic crisis in foreign countries.

**UNIT III          MULTINATIONAL ENTERPRISES**
Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

**UNIT IV          INTERNATIONAL FINANCIAL MANAGEMENT**
Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

**UNIT V          INTERNATAIONAL AGREEMENT**
General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

**TEXT BOOKS**
1.  Bhalla V.K, Shivaramu S, "International Business Environment", 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2.  Apte P.G, "International Financial Management", 5th Edition, Tata McGraw Hill, India, 2008.
3.  Cherulinam F, "International Business", 5th Edition, Prentice Hall of India, New Delhi, 2010.

**REFERENCES**

1. Rao, Rangachari, "International Business", Himalaya Publishing House, New Delhi, 2010.
2. Hill C, "International Business", 10$^{th}$ Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, "International Business Environment", 15$^{th}$ Edition, Prentice Hall of India, New Delhi, 2014.

**13TD04**                **BASICS OF MARKETING**            **L T P C**
                                                            **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
      CO 1: describe the basic concepts of marketing.
      CO 2: discuss the significance of consumer behavior and market segmentation.
      CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.
      CO 4: formulate strategies for pricing and channels of distribution.
      CO 5: analyze and selection of best promotional technique.

**UNIT I**         **INTRODUCTION**
Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

**UNIT II**         **CONSUMER BEHAVIOR AND MARKET SEGMENTATION**
Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

**UNIT III**        **PRODUCT PLANNING**
Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions -  Brand Name and Trade Mark - After- Sales Service - Product Life Cycle Concept.

**UNIT IV**        **PRICING AND PHYSICAL DISTRIBUTION**
Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

**UNIT V**        **PROMOTION**
Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

**TEXT BOOKS**
1.   Etzel M.J, Walker B.J, Stanton W.J, "Fundamentals of Marketing", 13th Edition, McGraw Hill, New York, 2004.
2.   Tanner J, Raymond M, "Principles of Marketing", University of Minnesota Libraries Publishing, New York, 2015.

**REFERENCES**
1.  Rajan Nair N, Varma M.M, "Marketing Management", 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2.  Ramaswamy V.S, Namakumari S, "Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

**13TD05**         **RETAILING AND DISTRIBUTION MANAGEMENT**         **L T P C**
                                                                      **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
>    CO 1: explain the concepts of retailing and distribution management.
>    CO 2: analyze and solve retailers' problems to make decisions in retail organizations.
>    CO 3: plan and formulate strategy for retail management process.
>    CO 4: discuss about various distribution technology and stores management.
>    CO 5: analyze the issues and challenges in Logistic Management

**UNIT I          INTRODUCTION**
Meaning and Nature of Distribution and Retail Industry - Future of Retailing and Distribution in India - Distribution Channels – Concept, Role and Types - Factors Affecting Choice of Distribution Channel.

**UNIT II          TYPES OF RETAILING**
Stores Classified by Owners - Stores Classified by Merchandising Categories - Wheel Of Retailing - Traditional Retail Formats Vs. Modern Retail Formats in India - Store and Non-Store Based Formats - Cash and Carry Business - Retailing Models – Franchiser Franchisee, Directly Owned - Wheel of Retailing and Retailing Life Cycle – Issues in Retailing.

**UNIT III          MANAGEMENT OF RETAILING OPERATIONS**
Meaning - Functions of Retail Management - Strategic Retail Management Process - Retail Planning - Importance and Process - Developing Retailing Strategies.

**UNIT IV          TECHNOLOGY IN DISTRIBUTION**
Bar-Coding – RFID – Electronic Payment Systems - Store Administration - Floor Space Management – Managing Store Inventories and Display Action Plans - Pricing Strategies and Location Strategies.

**UNIT V          LOGISTICS OF RETAIL MANAGEMENT**
Components and Functions; Distribution Related Issues and Challenges - Gaining Competitive Advantage through Logistics Management.

**TEXT BOOKS**
1. Agrawal D. K., "Distribution & Logistics Management: A Strategic Marketing Approach", Macmillan Publishers India Limited, New Delhi, 2007.
2. Berman B, Evans J.R, "Retail Management – A Strategic approach", 12th Edition, Pearson Education Ltd., England, 2013.
3. Cox R, Brittan P, "Retailing an introduction, Financial Times Management", 5th Edition, Pearson Education Limited, England, 2004.

**REFERENCES**
1. Rushton A, Croucher P, Baker P, "The Handbook of Logistics & Distribution Management", Kogan Page Limited, London, 2006.
2. Coughlan A.T, Anderson E, Stern L.W, El-Ansary A.I, "Marketing Channels", 7th Edition, Prentice Hall, New Jersey, 2006.
3. Sinha P. K, Uniyal D.P, "Managing Retailing", Oxford University Press, India, 2007.

**13TD06**          **INTERNATIONAL ECONOMICS**          **L T P C**
                                                          **0 0 0 3**

## COURSE OUTCOMES

Upon Successful completion of this course, the students will be able to

       CO 1: discuss the impact of globalization.

       CO 2: identify and analyze different theoretical models of international economics in light of 'real world' situations.

       CO 3: examine the consequences of trade policies.

       CO 4: explain the importance of international financial markets.

       CO 5: discuss the important aspects of international banking.

## UNIT I          INTRODUCTION

Background of International Business Economics - Globalization and International Business – The Emergence of Global Institutions – Drivers of Globalizations - The Globalization Debate.

## UNIT II          THE INTERNATIONAL TRADE THEORY

The Law of Comparative Advantage – The Demand and Supply, Offer Curves - The Terms of Trade – Factor Endowments and the Heckscher – Ohlin Theory – Implications of Trade Theories - Economics of Scale - Imperfect Competition.

## UNIT III          INTERNATIONAL TRADE POLICY

Trade Restrictions - Tariffs, Non –Tariff Trade Barriers - Tariff Vs. Quota - The New Protectionism – Economic Integration - Custom Unions and Free Trade Areas - Major Regional Trade Agreements - Foreign Exchange Market – Types of Foreign Exchange Transactions – Reading Foreign Exchange Quotations – Forward and Futures Market – Foreign - Currency Options – Exchange Rate Determination – Arbitrage – Speculation and Exchange - Market Stability.

## UNIT IV          WORLD FINANCIAL ENVIRONMENT

Global Foreign Exchange Markets – Economic Theories of Exchange - Rate Determination - International Regime for FDI and MNC - Consequences of Economic Globalization.

## UNIT V          INTERNATIONAL BANKING

Reserves, Debt and Risk - Nature of International Reserves – Demand for International Reserves – Supply of International Reserves – Gold Exchange Standard – Special Drawing Rights – International Lending Risk – The Problem of International Debt – Financial Crisis and The International Monetary Fund – Eurocurrency Market.

## TEXT BOOKS

1. Krugman P.R, Obstfeld M, "International Economics Theory and Policy", 8th Edition, Prentice Hall, Boston, 2008.
2. Carbaugh R.J, "International Economics", 15th Edition, South Western College publication, USA, 2014.

## REFERENCES

1. Daniels J, Radebaugh L, Sullivan D, Salwan P, "International Business", 12th Edition, Pearson Education, New Delhi, 2010.
2. Suranovic S, "International Economics: Theory and Policy", Flat World Knowledge, USA, 2010.

**13TD07**                    **INDIAN ECONOMY**                    **L T P C**
                                                                   **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
      CO 1: discuss the current economic development in India
      CO 2: describe the key indicators of estimation of national income
      CO 3: explain elementary concepts of economic planning and development in India
      CO 4: discuss the concept of public finance and preparation of budget
      CO 5: discuss the influence of infrastructure growth on economic development

**UNIT I**          **ECONOMIC DEVELOPMENT**
Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

**UNIT II**          **NATIONAL INCOME**
The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

**UNIT III**          **ECONOMIC PLANNING**
Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

**UNIT IV**          **INDIAN PUBLIC FINANCE**
Budgetary policies of the central government - Composition and trends in public revenue and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

**UNIT V**          **INFRASTRUCTURE AND ECONOMIC DEVELOPMENT**
Power and energy - Transport system in India's economic development  - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

**TEXT BOOKS**
1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

**REFERENCES**
1. Arvind P, "India: The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

**13TD08**                        **RURAL ECONOMICS**                    **L T P C**
                                                                          **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
      CO 1: discuss the role and importance of agriculture in economic development of India.
      CO 2: describe the impact of agricultural forming in rural employment, wage policy, technological change and green revolution.
      CO 3: analyze the relationship between rural and urban society.
      CO 4: recognize the formation and system of rural social institutions.
      CO 5: compare the social changes in the rural society after modernization and globalization.

**UNIT I          INTRODUCTION**
Nature and Scope of Rural Economy - Importance of Agriculture in Economic Development of India - Nature of Land Problems - Evolution of Policy – Land Tenure System - Land Reform Measures.

**UNIT II          AGRICULTURE AND FARMING**
Agricultural Holdings - Fragmentation and Sub-Division of Holdings, Cooperative Farming-Rural Labour Problems - Nature of Rural Unemployment - Employment and Wage Policy - Sources of Technological Change and Green Revolution.

**UNIT III          RURAL SOCIETY**
Rural Society Structure and Change - Village and its Social Organization - Indian Village and its Types - Rural-Urban Continuum and Rural-Urban Relationships.

**UNIT IV          RURAL SOCIAL INSTITUTIONS**
Rural Social Institutions - Family, Property, Caste, Class, Agrarian Structure - Indebtedness and Poverty - Jajmani System - Religion, Village, Panchayat Raj and Community Development Programmes – Problems.

**UNIT V          SOCIAL CHANGES**
Social Change in Rural India-Impact of Westernization - Secularization, Urbanisation, Industrialisation, Migration, Transportation, Modernization of Indian Rural Society - Post Modernization and Globalization and Indian Villages.

**TEXT BOOKS**
    1. Carver T.N, "The Principles of Rural Economics", Ginn and company, USA, 1911.
    2. Desai A.R, "Rural Sociology in India", 5th Edition, Popular Prakashan Ltd., Mumbai, 2011.

**REFERENCES**
    1. Dube S.C., "India's changing villages", Psychology Press, UK, 2003.
    2. Datt R, Sundharam K.P.M, Datt G, Mahajan A,"Indian Economy", 72nd Edition, S.Chand & Co., New Delhi, 2016.
    3. Chaudhari, C.M., "Rural Economics", Sublime Publication, Jaipur, 2009.

**13TD09**                          **INTERNATIONAL TRADE**                          **L T P C**
                                                                                     **0  0  0  3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

CO 1: discuss the importance of international trade in developing countries.

CO 2: describe the impact of Trade agreements in international Business environment.

CO 3: explain the role of foreign exchange and their impact on trade and investment flows.

CO 4: discuss the benefits of Multinational Corporation in Internal Trade

CO 5: analyze the key role of globalisation in Indian economy.

**UNIT I          INTRODUCTION**

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

**UNIT II          INTERNATIONAL BUSINESS ENVIRONMENT**

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

**UNIT III          INTERNATIONAL FINANCIAL ENVIRONMENT**

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

**UNIT IV          MULTINATIONAL CORPORATIONS**

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances.

**UNIT V          INDIA IN THE GLOBAL SETTING**

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

**TEXT BOOKS**

1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

**REFERENCES**

1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

**13TD10**              **GLOBAL CHALLENGES AND ISSUES**              **L T P C**
                                                                      **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
    CO 1: understand the various global issues.
    CO 2: demonstrate a reasonable understanding of environmental debates and issues.
    CO 3: explain the developmental issues relating to food, health and energy.
    CO 4: demonstrate the economical issues in international trade.
    CO 5: describe the civilization issues relating to human rights and social justice.

**UNIT I          SECURITY ISSUES**
Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal
Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends
- Cyber Terrorism – Counter Terrorism.

**UNIT II          ENVIRONMENTAL ISSUES**
Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-
Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green
Cover and Wild Life.

**UNIT III          DEVELOPMENTAL ISSUES**
Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and
Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs.
Environment - Sustainable Development.

**UNIT IV          ECONOMIC ISSUES ON INTERNATIONAL TRADE**
International Trade - GATT, WTO - Regional Associations - ECM,          ASEAN,          OPEC,
BRICS - Financial Crisis - ASEAN, Mexico and Greece -   Global Issues in Trade and
Commerce.

**UNIT V          CIVILIZATION ISSUES**
Human Rights - Issues Relating to Freedom of Speech  and Expression - Right to Self
Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and
Children - Dividends of Globalization and Social Justice – Good Governance.

**TEXT BOOKS**
1. Payne R, "Global Issues", 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, "The Globalization of World Politics", 3rd Edition, Oxford
   University Press, USA, 2013.

**REFERENCE**
1. Chirco J.A, "Globalization: Prospects and Problems", Sage Publications, New Delhi,

   2013.

**13TD11**                 **INDIAN CULTURE AND HERITAGE**                 **L T P C**
                                                                          **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
    CO1: describe Indian culture, civilization and its features.
    CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.
    CO3: explain historical development of Indian culture.
    CO4: explain the significance, conditions and development of Vedic culture.
    CO5: analyze the advent of Islam and European culture.

**UNIT I**              **INTRODUCTION**
Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

**UNIT II**             **PRE-HISTORIC CULTURE**
Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

**UNIT III**            **HISTORICAL DEVELOPMENT OF INDIAN CULTURE**
Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture - Importance of Indus Valley and Vedic Cultures.

**UNIT IV**             **CULTURE IN SANGAM AGE AND POST SANGAM AGE**
Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

**UNIT V**              **ADVENT OF ISLAM AND EUROPEAN CULTURE**
Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

**TEXT BOOKS**
1. Luniya B.N, "Evolution of Indian Culture", Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, "History of Indian culture", Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, "Indian Culture and Heritage", Neha Publishers & Distributors, New Delhi, 2012.

**REFERENCES**
1. John G.A, "Dictionary of Indian Philosophy (Sanskrit-English)", University of Madras, Madras, 1998.
2. Misra R.S, "Studies in philosophy and Religion", Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, "Culture and Rationality", Sage publications India pvt. Ltd., New Delhi, 1988.
4. Suda J.P, "Religious in India", Sterling Publishers Pvt. Ltd., New Delhi, 1978.

**13TD12**               **INDIAN HISTORY**               **L T P C**
                                                          **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
   CO1: illustrate the basics of Indian cultural heritage.
   CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.
   CO3: demonstrate Innovation by rulers of medieval period in the area of Administration, and their contact with the Europeans.
   CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.
   CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

**UNIT I          ANCIENTY INDIAN CULTURE**
Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

**UNIT II          LAW RELATING TO CULTURE**
Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

**UNIT III          ADMINISTRATION IN ANCIENT INDIA**
Innovation by Rulers of Medieval Period in the Area of General and Revenue Administration - District Administration - Court Systems - Indian Contact with the Europeans.

**UNIT IV          SOCIO-ECONOMIC HISTORY**
Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

**UNIT V          EUROPEAN CULTURE IMPACT**

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

**TEXT BOOKS**
   1. Sreenivasa M.H.V, "History of India Part I and II", JBA Publishers, New Delhi, 2015.
   2. Agarwal R.C, Bhatnagar M, "Constitutional Development and National Movement of India", S. Chand Publishers, New Delhi, 2005.

**REFERENCES**
   1. Altekar S, "State and Government in Ancient India", Motilal Banarsidass Publishers, New Delhi, 2002.
   2. Majumdur R.C, "History and Culture of the Indian People", Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

**13TD13**          **SUSTAINABLE DEVELOPMENT AND PRACTICES**          **L T P C**
                                                                      **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
      CO 1:  recognize the sustainable development and the way to achieve the sustainable
              development.
      CO 2:  outline the concept, factors governing the sustainability and their linkages.
      CO 3:  explain the environmental impact assessment and environmental audit.
      CO 4:  describe the environmental planning and managing the resources.
      CO 5:  acquire the knowledge about the environmental problems and their solutions.

**UNIT I          SUSTAINABLE DEVELOPMENT**
Need for Sustainability - Nine Ways to Achieve Sustainability - Economics as the Dismal
Science - Population, Resources and Environment.

**UNIT II          CHALLENGES OF SUSTAINABLE DEVELOPMENT**
Concept of Sustainability - Factors Governing Sustainable Development - Linkages among
Sustainable Development, Determinants of Sustainable Development - Case Studies on
Sustainable Development.

**UNIT III          ENVIRONMENT IMPACT ASSESSMENT AND AUDIT**
Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit
programme - typical audit process - carrying out the audit-benefits of environmental auditing-
environmental audit programmes in India.

**UNIT IV          ENVIRONMENTAL PLANNING**
Introduction - Perspective of Environmental Planning - land resource development planning -
Planning and managing the natural resources - landscape ecological planning - information and
decision of environmental planning - Land use policy in India.

**UNIT V          ENVIRONMENTAL EDUCATION**
Knowledge about the environment - Knowledge about the environment and population growth -
Knowledge about the solution and environmental problems - Environmental education (EE) –
Strategies for EE – Models for future Environmental Education Systems.

**TEXT BOOKS**
    1. Rogers P, Jalal K.F, Boyd J.A, "An introduction to sustainable development", Earthscan
       Publications Ltd., UK, 2006.
    2. Santra S.C," Environmental Science", 3rd Edition, New Central Book Agency (P) Ltd.,
       London, 2013.

**REFERENCES**
    1. Stavins R.N. "Economics of the Environment: Selected Readings", 5th Edition, W.W.
       Norton and Company, New York, 2005.
    2. Sachs J.D, "The Age of Sustainable Development", Columbia University Press, New
       York, 2015.

**13TD14**                    **WOMEN IN INDIAN SOCIETY**                    **L T P C**
                                                                              **0 0 0 3**

**COURSE OUTCOMES**

Upon Successful completion of this course, the students will be able to

     CO1: Demonstrate historical perspective about women in Indian society.

     CO2: Explain social problems of women.

     CO3: Understand the legislation for women protection in India.

     CO4: Demonstrate the involvement of women literacy, career and politics.

     CO5: Analyse the role of NGO's in women empowerment.

**UNIT I**          **INTRODUCTION**

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

**UNIT II**          **SOCIAL ISSUES**

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

**UNIT III**          **PROTECTIVE LEGISLATION FOR WOMEN**

Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence(Prevention) Act.

**UNIT IV**          **WOMEN AND EDUCATION**

Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

**UNIT V**          **ROLE OF NGO'S IN WOMEN EMPOWERMENT**

Gender Economy - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

**TEXT BOOKS**

    1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.

    2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

**REFERENCES**

    1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.

    2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

    .

**13TD15**                    **INDIAN CONSTITUTION**                    **L T P C**
                                                                        **0 0 0 3**

**COURSE OUTCOMES**
Upon Successful completion of this course, the students will be able to
    CO1: describe the basic understanding of the Indian Constitution.
    CO2: understand the structure and functions of parliament.
    CO3: demonstrate the organization and working of the Judiciary.
    CO4: understand the structure and functions of state legislature.
    CO5: understand the 73$^{rd}$ and 74$^{th}$ Constitutional Amendments.

**UNIT I**          **INDIAN CONSTITUTION**
Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

**UNIT II**          **PARLIAMENTARY SYSTEM**
Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

**UNIT III**          **THE JUDICIARY**
Organisation and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

**UNIT IV**          **STATE GOVERNMENTS**
Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

**UNIT V**          **LOCAL GOVERNMENTS**
73rd and 74th Constitutional Amendments – Federalism - Center – State Relations.

**TEXT BOOKS**
1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

**REFERENCES**
1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.

**13TD16**                           **BIO MECHANICS IN SPORTS**                   **L T P C**
                                                                                  **0 0 0 3**

## COURSE OUTCOMES
Upon Successful completion of this course, the students will be able to
      CO1**:** discuss the basics of biomechanics in sports & movement technique accurately.
      CO2**:** discuss the basics of linear kinematics and its applications in the field of sports.
      CO3: demonstrate the linear kinematics in the field of sports.
      CO4**:** discuss the basics of angular kinematics and its applications in the field of sports.
      CO5: demonstrate the angular kinematics in the field of sports.

## UNIT I            INTRODUCTION
Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

## UNIT II           LINEAR KINEMATICS
Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

## UNIT III          ANGULAR KINEMATICS
Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

## UNIT IV           LINEAR KINETICS
Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

## UNIT V            ANGULAR KINETICS
Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

### TEXT BOOKS
    1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
    2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

### REFERENCES
    1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
    2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.