

### B. Tech Sem VI CE

B.TECH CE 2018-2022												
SEMESTER VI												
S.No.	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Assignment	TA	Total	ESE		
1	Professional Core Courses	5APCCCE308	Construction Engineering & Management	2	0	0	20	10	30	70	100	2
2		5APCCCE309	Engineering Economics, Estimation & Costing	2	1	4	20	10	30	70	100	3
3	<b>PROFESSIONAL ELECTIVE I (Select any one of the following)</b>											
	Professional Elective Courses	5APECCEEL301	Structural Analysis-I	3	0	0	20	10	30	70	100	3
		5APECCEEL302	Structural Analysis-II	2	0	2	20	10	30	70	100	3
		5APECCEEL303	Advanced Structural Analysis	2	0	2	20	10	30	70	100	3
		5APECCEEL304	Structural Analysis by Matrix Methods	2	0	2	20	10	30	70	100	3
4	<b>PROFESSIONAL ELECTIVE II (Select any one of the following)</b>											
	Professional Elective Courses	5APECCEEL305	Soil Mechanics-I	3	0	0	20	10	30	70	100	3
		5APECCEEL306	Soil Mechanics-II	3	0	0	20	10	30	70	100	3
		5APECCEEL307	Foundation Engineering	3	0	0	20	10	30	70	100	3
		5APECCEEL308	Rock Mechanics	3	0	0	20	10	30	70	100	3
5	<b>PROFESSIONAL ELECTIVE III (Select any one of the following)</b>											
	Professional Elective Courses	5APECCEEL309	Railway Engineering	3	0	0	20	10	30	70	100	3
		5APECCEEL310	Pavement Design	3	0	0	20	10	30	70	100	3
		5APECCEEL311	Pavement Materials	3	0	0	20	10	30	70	100	3
		5APECCEEL312	Port and Harbour Engineering	3	0	0	20	10	30	70	100	3
6	<b>PROFESSIONAL ELECTIVE IV (Select any one of the following)</b>											
	Professional Elective Courses	5APECCEEL313	Ecological Engineering	3	0	0	20	10	30	70	100	3
		5APECCEEL314	Environmental Systems	3	0	0	20	10	30	70	100	3
		5APECCEEL315	Transport of Water and Wastewater	3	0	0	20	10	30	70	100	3
		5APECCEEL316	Environmental Laws and Policy	3	0	0	20	10	30	70	100	3
7	<b>OPEN ELECTIVE I (Select any one of the following)</b>											
	Open elective Courses	5A0EEL301	Humanities-Soft Skills and Interpersonal Communication	3	0	0	20	10	30	70	100	3
		5A0EEL302	Human Resource Development and Organizational Behavior	3	0	0	20	10	30	70	100	3
		5A0EEL303	Workshop On Managerial Skills	3	0	0	20	10	30	70	100	3
<b>PRACTICAL /SESSIONAL</b>												
	Professional Core Courses	5APCCCE309P	Engineering Economics, Estimation & Costing	0	0	4			30	20	50	1
	Professional Elective Courses	5APECCEEL301P	Structural Engineering	0	0	2			30	20	50	1
										<b>TOTAL</b>	<b>800</b>	<b>22</b>

**\*\* NOTE: Qualifying Non Credit Course**

**Program:** B.Tech

**Semester:** Six

**Course:** Construction Engineering & Management

**Course Code:** 5APCCCE 308

L	T	P	C
2	0	0	2

---

### Course Objective:

- To understand an idea of how structures are built and projects are developed on the field An understanding of modern construction practices
- To have a good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics
- To have basic ability to plan, control and monitor construction projects with respect to time and cost
- To have An idea of how to optimize construction projects based on costs
- To understand an idea how construction projects are administered with respect to contract structures and issues.
- To understand an ability to put forward ideas and understandings to others with effective communication processes

**Module 1:** *Basics of Construction*- Unique features of construction, construction projects-types and features, phases of a project, agencies involved and their methods of execution;

**Module 2:** Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

**Module 3:** Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with block work walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

**Module 4:** Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

**Module 5:** Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing,

motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

**Module 6: *Project Monitoring & Control***-Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

**Module 7: Contracts Management basics:**Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force, Suspension and Termination. Changes & variations, Dispute Resolution methods.

**Module 8: Construction Costs: *Make-up of construction costs*;**Classification of costs, time-cost trade-off in construction projects, compression and decompression.

***Suggested Readings:***

- Varghese, P.C., “Building Construction”, Prentice Hall India, 2007.
- National Building Code, Bureau of Indian Standards, New Delhi, 2017.
- Chudley, R., Construction Technology, ELBS Publishers, 2007.
- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
- Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
- Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

S.No	Module (No of Lectures in brackets)	Tutorials
1	Basics of Construction (2)	
2	Construction Planning (6)	Develop a WBD structure for the construction of one storeyed building; Develop a bar chart for the construction of this building, including finishing activities, assuming reasonable activity durations.
3	Construction Methods basics (6)	Develop a CPM chart for a 5 span bridge on open foundations. Develop a comparative table for a 10-storeyed building constructed by at least three different methods, listing their pros and cons.
4	Construction Equipment Basics (3)	Develop a Gantt Chart for the construction of a two storeyed precast framed structure, including open foundations, along with list of equipment resources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to placing of concrete at 3m height above ground level; show all equipment resources required, along with a site layout.
5	Planning and Organizing Construction Site and Resources (4)	For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw S-curves for concrete placing and blockwork done over the period.

6	Project Monitoring and Control (4)	Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq. m. plinth area.
7	Contract Management basics (3)	Assuming a 4 month delay in a construction contract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to act as the Contractor. One person to act as
		Arbitrator/ Judge.
8	Construction Costs (2)	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximate cost of a 3 storey, 400 sqm plinth
		area building.
	Total: 30 Lectures	15 Tutorials

***Text/Reference Books:***

- 1.Barrie D.S. & Paulson B C, Professional Construction Management, McGraw Hill
- 2.Chitkara K K, Construction Project Management, Tata McGraw Hill
- 3.P K Joy, Handbook of Construction Management
- 4.King & Hudson, Construction Hazard and Safety Handbook, Butterworths.

**Program:** B.Tech

**Semester:** Six

**Course:** Engineering Economics, Estimation & Costing

**Course Code:** 5APCCCE 309

L	T	P	C
2	1	4	5

### Course Objective:

- To understand have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses
- To understand to be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- To understand to be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
- To understand to be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
- To understand be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.

**Module 1:** Basic Principles and Methodology of Economics. Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

**Module 2:** Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

**Module 3:** Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

**Module 4:** Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

**Module 5:** *Estimation* /Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for

buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying .

**Module 6:** Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

**Module 7:** Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

**Module 8:** Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management .

**Module 9:** Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

**Term Work Assignments may include:**

- Deriving an approximate estimate for a multistoried building by approximate methods.
- Detailed estimate for the following with the required material survey for the same.
- Ground plus three storied RCC Framed structure building with blockwork walls
- bridge with minimum 2 spans
- factory building
- road work
- cross drainage work
- Ground plus three storied building with load-bearing walls
- Cost of finishes, MEP works for (f) above
- Preparation of valuation report in standard Government form.
- Assignments on rate analysis, specifications and simple estimates.
- Detailed estimate of minor structure.
- Preparation of Bar bending schedule.

**Text/Reference Books:**

1. Mankiw Gregory N. (2002), *Principles of Economics*, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics*, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), *Indian Economy*, Himalaya
4. Pareek Saroj (2003), *Textbook of Business Economics*, Sunrise Publishers
5. M Chakravarty, *Estimating, Costing Specifications & Valuation*
10. Joy P K, *Handbook of Construction Management*, Macmillan
11. B.S. Patil, *Building & Engineering Contracts*
13. *Relevant Indian Standard Specifications.*
14. *World Bank Approved Contract Documents.*
16. *FIDIC Contract Conditions.*
18. *Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration*
20. *Typical PWD Rate Analysis documents.*
22. *UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, 2016*
23. *Specification and Valuations, 2016*
24. Dutta, B.N., *Estimating and Costing in Civil Engineering (Theory & Practice)*, UBS Publishers, 2016.

**Program:** B.Tech

**Semester:** Six

**Course:** Structural Engineering (elective-I)

**Course Code:** 5APEC-CEEL 301

L	T	P	C
2	0	2	3

---

### Course Objective:

- To understand the students with a solid background on principles of structural engineering design.
- To analyse the Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels.
- To understand the Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project.
- To have a clear understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be held besides lectures

**Structural Analysis-II.** Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Application to simple problems of beams and frames; Flexibility matrix method; Application to simple problems of beams and frames; Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.

**Advanced Structural Analysis.** Elasticity: Introduction, Components of strain and strain, Hooke's law, Plane stress and plane strain, Equations of equilibrium and compatibility, Boundary conditions, Two dimensional problems in rectangular and polar coordinates, Bending of simple and cantilever beams; Model Analysis: Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations; Introduction to Finite element method for structural analysis; Review of principle of virtual work, Ritz method, Discretization of domain, Basic element shape,

Discretization process; Application of finite element method to one and two- dimensional plane stress strain elements.

**Structural Mechanics.** Beams under lateral load and thrust; beams on elastic foundations; virtual work and energy principles; principles of solid mechanics, stress and strain in three dimensions; static stability theory; torsion; computational methods.

**Structural Analysis by Matrix Methods.** Analysis of truss and frame structures using flexibility and stiffness methods of matrix analysis; computer applications.



***Suggested Readings:***

1. Nilson, A. H. *Design of Concrete Structures*. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J., 2003.
3. Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, Prentice Hall, 1996
4. Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWS Publishing, Boston.
5. Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, New York, 1990.
6. MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, New Jersey, 1997.
7. Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, Prentice Hall, New Jersey.
8. Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley, New York.
9. Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ, (2003).
10. *Related Codes of Practice of BIS*
11. Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers, New York.
12. W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000.
13. NBC, *National Building Code, BIS (2017)*.
14. ASCE, *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.

**Program:** B.Tech

**Semester:** Six

**Course:** Soil Mechanics I (Elective-II)

**Course Code:** 5APEC-CEEL 305

L	T	P	C
3	0	0	3

### Course objective:

- To develop an appreciation soil as a vital construction material, and of soil mechanics in the engineering of civil infrastructure;
- To develop an understanding of the relationships between physical characteristics and mechanical properties of soils;
- To understand and experience experimental measurement of the physical and mechanical soil properties commonly used in engineering practice.
- To understand and be able to apply the modeling and analysis techniques used in soil mechanics: (a) Darcy's Law and flow-nets for seepage; (b) consolidation models for load-time-deformation responses of soils; (c) Mohr-Coulomb models for shear strength behavior of soils.
- To develop good technical reporting and data presentation skills;

### Module-1

Introduction – Nature of Soil, Phase Representation and Relationships:

History, development and areas of application; Structure of soil; soil texture; Size and range of soil particles; shapes of individual sand and clay particles; field identification of soils; Introduction to particulate behaviour. Three-phase system : representation by Phase diagram – soil solids, water and air; Basic definitions and relationships : Specific gravity; Void ratio; Porosity; water content; Unit Weights : bulk, dry, saturated, submerged and natural; Degree of saturation and Density index

### Module-2

Index Properties and Soil Classification:

Particles size distribution: Sieve analysis; distribution curve characteristics; grain size analysis for fine-grained and mixed soils; use of hydrometer; Consistency limits and indices; Activity and Sensitivity of clays Classification of Soils : Descriptive, based on soil type; by origin; by structure; Textural, Unified and Indian Standard Classifications

### Module-3

Soil Moisture Relationship – Capillarity, Permeability and Seepage :

Capillarity in soils; Free and adsorbed water; Permeability of soils : Darcy's Law; Determination of coefficient of permeability by constant head & falling head tests, Permeability of stratified soil deposits. Factors affecting permeability; Seepage Analysis : Head, Gradient & Potential, Seepage pressure. Two dimensional flow - Laplace equation; Phreatic line in Earth dams; Graphical method of flow net construction : for flow below sheet piles, earth dams with or without core / filter; Seepage discharge across hydraulic structures; Piping; Flow net – electrical analogy; Pore water pressure and the concept of effective stress; Quick condition

#### **Module-4**

Compressibility, Compaction and Consolidation:

Difference between Compaction and Consolidation; Compaction tests : Standard and Modified Proctor; Harvard miniature compaction test; Factors affecting compaction; Field compaction methods and control One-dimensional consolidation – spring analogy; Terzaghi's theory of one-dimensional consolidation; Solution of consolidation equation; Consolidation of undisturbed & remoulded soils; Laboratory consolidation test – analysis and results; Definitions : Coefficient of volume change, Coefficient of consolidation, Compression index, Degree of consolidation; Secondary consolidation

#### **Module-5**

Earth Pressure Theory:

Plastic equilibrium in soil – active & passive cases. Active earth pressure – Rankine's Theory; Active earth pressure of cohesive soil; Rankine's active thrust by trial wedge; Coulomb's wedge theory – Rehmann's construction & Culmann's construction

#### **Module-6**

Shear Strength:

Measurement of shear strength – Unconfined strength test; Direct shear tests; Vane shear test; and Triaxial tests – strain-controlled and stress-controlled tests, Unconsolidated and Consolidated Specimens subjected to shear without drainage (with or without pore water pressure measurement); drained shear; Mohr strength envelopes for Total and Effective stresses; Mohr-Coulomb failure theory; Hvorslev's strength parameters, Skempton's pore- pressure parameters; Stress paths

#### **Module-7**

Stability of Slopes:

Stability analysis of finite & infinite slopes; Types of slope failures; Methods of analysis for slope stability – method of slices; Bishop's simplified method; Friction circle method; Stability Number; Stability of slopes of Earth dams; Slope protection and Drainage

#### **References :**

1. Venkataramaiah C : *Geotechnical Engineering*
2. Ranjan Gopal And Rao A. S. R. : *Basic & Applied Soil Mechanics*
3. Lambe T. W. And Whitman R. V. : *Soil Mechanics*

**Program:** B.Tech

**Semester:** Six

**Course:** Foundation Engineering (Elective-II)

**Course Code:** 5APEC-CEEL 307

L	T	P	C
3	0	0	3

---

**Course Objective:**

- Identify ground conditions and suggest method of improvement
- Design and assess the degree of improvement
- Understand the principles of soil reinforcement and confinement in engineering constructions
- Design reinforced soil structures

**Module-1**

Site Investigation and subsoil exploration:

Methods of soil exploration; Planning a subsoil exploration : Number of boreholes and depths of exploration for various types of works; Field Tests : Standard penetration test; Dynamic and Static cone penetration tests; Vane shear test; Soil samplers & collection of soil samples

Stress Distribution in Soil Media and Settlement:

Stress Distribution: Boussinesq's and Westergaard's equations, Pressure distribution diagram, Newmark's influence chart; Contact pressure below foundations –

Steinbrenner's coefficients Settlement of foundations : Elastic, Consolidation and Creep settlements; Total and Differential settlements; Rate of settlement, I. S. Code limitations for different structures Settlement calculation from consolidation characteristics and using N-values

**Module-2**

Bearing capacity:

Terminology: Ultimate and Safe Bearing Capacities; Allowable Bearing Pressure Gross and Net Bearing Capacities; Net Soil pressure for a specified settlement; Bearing capacity from equations of Terzaghi, Skempton, Brinch Hansen and Meyerhoff; I. S. Code of Practice; Bearing capacity from N-values; Effect of ground water table Plate Load test : Procedure, Limitations and determination of permissible bearing capacity for footings in sand and clay soils

Eccentrically loaded footings – useful width concept

**Module-3**

Shallow Foundations:

Type of foundations: Isolated and combined footings; Rafts foundations Proportioning of footings for even settlement.

**Module-4**

Types of piles; Pile construction; Load carrying capacity of piles: Dynamic and static Formulae; Elastic analysis of single axially loaded pile; Group action and efficiency; Under-reamed pile foundation; Introduction to Laterally loaded piles and Batter piles Negative skin friction – cause and prevention of n s f effect on piles; factor of safety of pile subjected to negative skin friction Pile load tests: ultimate, routine, vertical and horizontal; permissible settlement

**Module-5**

Soil dynamics, Mass-spring system; Mass-system with damping; Natural frequency of foundation soil systems; Machine Foundations: Types of Machines and Machine Foundations  
Vibration isolation: Types and Methods of Isolation

**Module-6**

Shapes and Types of wells or caissons, their advantages and disadvantages; components of a well foundation; Depth of well foundation and bearing capacity; Forces acting on a well foundation. Well sinking : operation and problems; Drilled caissons; Pier foundations

**Books References :**

1. Venkatramiah C. : *Geotechnical Engineering*
2. Garg S. K. : *Soil Mechanics And Foundation Engineering*
3. Brahma S. P. : *Foundation Engineering*
4. Bowles J. F. : *Foundation Analysis And Design*

**Program:** B.Tech

**Semester:** Six

**Course:** Rock Mechanics (Elective-II)

**Course Code:** 5APEC-CEEL 308

L	T	P	C
3	0	0	3

### Course Objective:

- The objectives of the course are for the students to develop an understanding of the engineering properties of rocks, geological and engineering rock classifications, rock failure theories, in-situ stresses in rock, and the fundamental concepts and principles of rock mechanics.
- This course is the pre-requisite for Rock Mechanics II which covers the applications of rock mechanics principles in the design of foundations, slopes and underground openings in rock

#### Module-1

Introduction and Basic Concepts:

Rock as material - geological considerations; rock forming minerals; fabric of rocks; mechanical nature of rock; joints & faults.

#### Module-2

Rock exploration:

Objective; Methods of rock exploration; Direct penetration, Core boring , Core recovery, Rock quality designation, Geophysical prospecting, Seismic methods - theory and limitations, Electrical methods, Gravity methods, Magnetic methods

#### Module-3

Engineering Properties of Rocks:

Elasticity & Strength of rocks, stress – strain curves, effect of confining pressure & temperature; types of fracture; Muel's extension of Griffith; effect of anisotropy Friction in rocks, Amonton's law, Phenomenon with smooth surfaces, stick-slip oscillations; sliding on plane of weakness – 2-D theory

#### Module-4

Tests on Rock and Rock Specimens:

Laboratory Testing of Rock specimens : Physical tests – Grain Specific Gravity, Unit Weight and Porosity; Strength Tests : Uniaxial compression, tension, indentation, Direct shear and Triaxial shear tests at high confining pressures In-situ tests, Plate bearing test, Pressure tunnel test, Deformability test, Borehole test, Shear tests, Strength tests, Flat jack test

#### Module-5

Rock Engineering Behavior :

Mechanical Behavior : strength of rock, influence of discontinuities upon engineering behavior of rock masses, rock-quality indices; joints, folds and faults Mass Behavior : Structure & anisotropy of rock masses; orientation of geological planes, statistical density of fissures, rock mechanics surveys Methods of improving properties of rock masses : Pressure-grouting, consolidation grouting, rock reinforcement, rock freezing

**Module-6**

Failure Theories:

Various theories of failure and yield criteria; Rankine, St. Venant, Tresca, Maxwell, and Mohr-Coulomb; Griffith's theory of fracture; strength criteria of jointed rocks; Barton's theory; Rheological models – St. Venants, Kelvin, Maxwell, Bingham and Burger models

Application of Rock Mechanics in Mining:

Structural nature of mineral deposits, forces due to weight of strata, tectonic and orogenic; residual and thermal forces; stress fields, stress concentrations and ground failures – bumps and rock bursts; concept of ring stresses; open cast mining; design of pillars, land subsidence

**References :**

1. *Jaeger And Cook : Fundamentals Of Rock Mechanics*
2. *Stagg K. G. And Zienkiewicz O. C. : Rock Mechanics In Engineering Practice*
3. *Farmer : Rock Mechanics*
4. *Fairhurst C. : Design Methods In Rock Mechanics*
5. *Hoskins E. R. Jr. : Applications Of Rock Mechanics*
6. *Hardy H. R. Jr. : New Horizons In Rock Mechanics*
7. *O'bert And Leonard : Rock Mechanics And Design Of Structures*

**Program:** B.Tech

**Semester:** Six

**Course:** Railway Engineering (Elective-III)

**Course Code:** 5APEC-CEEL 309

L	T	P	C
3	0	0	3

**Course Objective:**

- Explain Components of Railway Track, different Railway Gauges
- Design track Gradients as per given requirements
- Discuss various Types of Track Turnouts
- Describe purposes and facilities at Railway Stations
- Explain Interlocking and modern signal system
- Describe Surface Defects on Railway Track and Their Remedial Measures

**MODULE: 1**

Introduction, Alignment of Railway Lines Rails, Track Fittings and Track Stresses: History of Indian Railways, Importance of Railways for Environment Recent Developments. Role of Civil Engineers in Construction and Maintenance, Components of Railway Track Definition of Railway Gauges, Types, Uniformity of Gauge. Different Gauges n Indian Railways, Cross-section of Permanent Way as Per IRS Problems Caused By Change of Gauge. Basic Requirements and selection of An Ideal Alignment, Functions and Types of Rails, Standard Rail Sections, Causes and Effects of Creep, Measures to Reduce Creep. Fittings and Fastening and their requirements. Forces Acting On Track, Coning Of Wheels.

**MODULE: 2**

Sleeper & Geometric Design of Track Functions & Requirements of sleepers .Types and Spacing of Sleepers, Method Of Fixing Rails With Prestressed Concrete And Wooden Sleepers, Function and Specifications Of Track Ballast, Necessity and Details of geometric design of track Design of track Gradients, Grade compensation on curves. Curves and Super elevation.

**MODULE: 3**

Resistance to Traction, Points and Crossings: Resistance to-friction, wave action, speed, track irregularity, wind, Resistance to gradient, curvature, starting and accelerating. Stress in rails, sleepers, ballast and formation Necessity of Points & Crossing, Track Layouts and Sketches of Turn Out, Types of Crossing, Types of Track Turnout.

**MODULE: 4**

Railway Stations and Yards: Purposes Facilities Required at Railway Stations. Requirements Of Station Yard, Classification Of Railway Stations, Types Of Yards.

**MODULE: 5**

Signaling And Interlocking: Objectives of signaling, Classification of signals, Types and working of Interlocking, Modern signal system .

**MODULE: 6**



Maintenance of Railway Track: Introduction of Maintenance Programme. Monsoon, PreMonsoon & Post-Monsoon Maintenance, Causes for Maintenance, Routine Maintenance, Tools For Railway Track Maintenance & Their Functions. Surface Defects and Their Remedial Measures.

***Suggested Readings:***

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,

**Program:** B.Tech

**Semester:** Six

**Course:** Pavement Materials. (Elective-III)

**Course Code:** 5APEC-CEEL 311

L	T	P	C
3	0	0	3

---

### Course Objective:

- To understand the carry out surveys involved in planning and highway alignment
- To analyze the design the geometric elements of highways and expressways
- To carry out traffic studies and implement traffic regulation and control measures and intersection design
- To characterize pavement materials.
- To design flexible and rigid pavements as per IRC.

### Module-1

**Pavement Materials.** Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements.

### Module-2

Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders. Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests, Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes.

### Module-3

Bituminous mix design methods and specifications. Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications;

### Module-4

Super pave mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials.

### Suggested Readings:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,

**Program:** B.Tech

**Semester:** Six

**Course:** Pavement Design (Elective-III)

**Course Code:** 5APEC-CEEL 310

L	T	P	C
3	0	0	3

---

### Course Objective:

- To understand the carry out surveys involved in planning and highway alignment
- To analyze the design the geometric elements of highways and expressways
- To carry out traffic studies and implement traffic regulation and control measures and intersection design
- To characterize pavement materials.
- To design flexible and rigid pavements as per IRC.

### Module-1

**Pavement Design.** Introduction; Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements. Stresses and Deflections in Flexible Pavements; Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behavior under transient traffic loads. Flexible

### Module-2

Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements; Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.

### Module-3

Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacing's; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method.

### Module-4

Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC.

### Suggested Readings:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,

**Program:** B.Tech

**Semester:** Six

**Course:** Port and Harbour Engineering (Elective-III)

**Course Code:** 5APEC-CEEL 312

L	T	P	C
3	0	0	3

### Course Objective:

- Explain the significance of ports and harbours as a mode of transport.
- Demonstrate the fundamental principles of wave hydrodynamics and port cargo handling.
- Demonstrate the basic design of port layout
- Design, plan and integrate port and harbour infrastructure.
- Explain the construction, maintenance and renovation aspects of ports and inland waterways.

### Module-1

**Port and Harbour Engineering:** Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities:

### Module-2

Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates;

### Module-3

Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile;

### Module-4

Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

### Suggested Readings:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., 'Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, 'Principles Of Transportation Engineering, PHI Learning,

**Program:** B.Tech

**Semester:** Six

**Course:** Ecological Engineering. (Elective-IV)

**Course Code:** 5APEC-CEEL 313

L	T	P	C
3	0	0	3

---

Course Objective:

- To analyses the Understand the impact of humans on environment and environment on humans
- To understand and identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
- To understand and able to plan strategies to control, reduce and monitor pollution.
- To analyses and elect the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air.
- Be conversant with basic environmental legislation.

### Module-1

Characteristics of rivers and lakes which affect the management of domestic and industrial wastewaters;

### Module-2

Chemical hazards assessment, surveillance and biomonitoring, and review of regulations governing effluents.

### Module-3

**Stream Ecology.** Description of physical, chemical, and biological characteristics in stream sand rivers including an integrated treatment of the environmental factors affecting the composition and distribution of biota; emphasizes the application of ecological engineering principles in aquatic ecosystem protection.

### Suggested Readings:

- *Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey*
- *Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.*
- *Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.*

**Program:** B.Tech

**Semester:** Six

**Course:** Environmental Systems (Elective-IV)

**Course Code:** 5APEC-CEEL 314

L	T	P	C
3	0	0	3

---

The course, students will:

- To analyses the Understand the impact of humans on environment and environment on humans
- To understand and identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
- To understand and able to plan strategies to control, reduce and monitor pollution.
- To analyses and elect the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air.

#### **Module-1**

**Environmental Systems.** Introduction to the concepts and applications of environmental systems analysis.

#### **Module-2**

Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy.

#### **Module-3**

Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non-inferior sets, single and multi-objective optimization.

#### **Module-4**

Practical application to case studies to convey an Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.

#### **Module-5**

**Water Quality Engineering.** Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters.

#### ***Suggested Readings:***

- *Introduction to Environmental Engineering and Science* by Gilbert Masters, Prentice Hall, New Jersey
- *Introduction to Environmental Engineering* by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.

L	T	P	C
3	0	0	3

**Program:** B.Tech

**Semester:** Six

**Course:** Transport of water and wastewater (Elective-IV)

**Course Code:** 5APEEC-CEEL 315

---

### **Course Objective:**

The objective of the course is to make students gain insight into how the water and wastewater gets transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems

### **Module-1**

Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation.

### **Module-2**

Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.

### **Module-3**

Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance.

### **Suggested Readings:**

- *Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey*
- *Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.*
- *Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.*

**Program:** B.Tech

**Semester:** Six

**Course:** Environmental Laws and Policy (Elective-IV)

**Course Code:** 5APEC-CEEL 316

L	T	P	C
3	0	0	3

### Module-1

**Environmental Laws and Policy.** Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies,

### Module-2

Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment.

### Module-3

International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

### *Suggested Readings:*

- *Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey*
- *Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.*
- *Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.*

**Program:** B.Tech

**Semester:** Six

**Course:** Soft skills & Interpersonal communication (Open Elective I)

L	T	P	C
3	0	0	3



**Course Code: 5AOEEL301**

---

**Course Objective:**

- 1. To develop inter personal skills and be an effective goal oriented team player.*
- 2. To develop professionals with idealistic, practical and moral values.*
- 3. To develop communication and problem solving skills.*
- 4. To re-engineer attitude and understand its influence on behavior.*

**Module 1: Self Analysis**

- Introduction to Soft Skills and Hard Skills, Importance of Soft Skills, Attributes regarded as Soft Skills, Identifying and improving your Soft Skills, Art of Negotiation
- Stage Fright
- Self Discovery, Importance of knowing oneself, Process of knowing oneself, SWOT Analysis, Benefits of SWOT analysis, SWOT Analysis , Self Esteem, Ways to improve Self Esteem, Aristotle on Self-Gender and Self, Feminist Self, Escaping the Self
- Self Development
- Developing Positive Attitude and Self Confidence, Forming Values

**Module 2: Goal Setting and Career Planning**

- Wish List, SMART Goals, Blue print for Success, Short term, Long Term, Life Time Goals,
- Art of Listening, Art of Reading, Art of Speaking, Art of Writing, writing E-mail
- Motivation Skills, Personality Development, Improving Perception
- Time Management, Stress Management, Conflict Handling
- Problem Solving and Decision Making, adaptability.

**Module 3: Effective Communication**

- Communication Skills, Concept/Meaning, Definition
- Types of Communication, Process of Communication, stages of Communication
- Difference between General and Technical Communication
- Barriers to Communication
- Communication Network
- 7 C's of Communication
- Verbal & non verbal Communication

**Module 4: Interpersonal Skills**

- Interpersonal Communication, Basic Skill set
- Effective Interpersonal Communication in Organization
- Team Building, Communicating in a Team
- Intercultural Communication
- Leadership traits through Communication
- Communicating assertively
- Presentation Skills

***Suggested Readings:***

1. Covey Sean *Seven Habits of Highly Effective Teens*, New York, Fireside Publishers, 1998.
2. Carnegie Dale, *How to win Friends and Influence People*, New York: Simon & Schuster, 1998.
3. Thomas A Harris, *I am ok, You are ok*, New York-Harper and Row, 1972
4. Dr. K. Alex *Soft Skills*, S. Chand

**Semester:** Six

**Course:** Human Resource Development & Organizational Behavior

**Course Code:** 5APEC-CEEL 302

L	T	P	C
3	0	0	3

**Course objective:**

- The course aims to equip students to develop themselves into a critically reflective and capable HRD practitioner, or a manager who can facilitate the learning of others.
- The major objective of the course is to explain and demonstrate the contribution of HRD in an organization and enable student to develop an ability to decide learning and training needs; and have competence in the design and delivery of learning programmes.
- Organizations are made up of people: their knowledge, skills, attitudes and interconnections. In order to survive and thrive, organizations need to facilitate the growth of all of these as part of a HRD strategy.

**Module 1:**

**Human Resource Planning: Relationship between HRM, HRP & HRD**

Concepts, approaches, process and practices of Human Resource planning, methods and techniques of Human Resource planning, measurements in Human Resource planning, Relationship between HRM, HRP & HRD.

**Module 2:**

**Human Resource Development: Concept and origin of HRD**

Nature, history and philosophy of Human Resource Development (HRD), aims of HRD, approaches to HRD, Constraints in HRD, future of HRD

**Module 3:**

**HRD Instruments and Intervention**

HRD Instruments and interventions-Introduction: Influence of HRD on Employee Behaviour, Motivation, A Framework of HRD process.

Job analysis and design: Concepts and the process of JA. Job description and specification: potential problems of JA, Factors and techniques affecting job design Recruitment and selection-Techno application:

Recruitment Process: searching, screening, evaluation and control, philosophy of recruitment, effective selection process, Induction, and Global recruitment.

Performance management: Evaluation of performance and review, potential appraisal and promotion, the relevance of American theories of Motivation with regard to compensation and reward, counseling, job evaluation.

Training and development: Importance of training and development, training process, inputs in training and development, ongoing process in training, elements of effective training

**Suggested Readings:**

1. *Aloke K.Sen, Human Resource: Planning, Planning & Deployment (Asian Books Private Limited 1st Ed 2003)*
2. *Vivek Paranjpe, Hewlett Packhard- Strategic HR Planning (Allied Publishers Ltd )*
3. *Randy L.Desimone, Jon M.Werner, and David M.Harris- Human Resource Development (Thomson South-western, Third edition)*
4. *P.C.Tripathi – Human Resource Development (Sultan Chand & sons)*
5. *Madan Mohan Verma- Human Resource Development (Gitanjali Publishing House)*
6. *D.M.Sivera- Human Resource Development: The Indian Experience (N I P)*
7. *Suresh Vyas- HRD Priorities(Pointer Publishing ,Jaipur)*
8. *Bhawdeep singh & Prem Kumar- Current Trends in HRD: Challenges & Strategies in a changing scenario. H.C.Sainy, Sharad Kumar- Human Resource Management and Development*

**Program:** B.Tech

**Semester:** Six

**Course:** Workshop on Managerial Skills (Open Elective I)

L	T	P	C
3	0	0	3

**Course Code:** 5APEC-CEEL 303

---

**Course objective:**

- To facilitate students' understanding of their own managerial skills.
- To improve communication skills.
- To learn from the management experience of others.
- To develop and learn about goals specific to the students of this class
- Have a lot of fun while learning a lot of stuff!

**Module 1:**

Writing Skills: Notice Writing, Report Writing, Memos, Circulars, Covering Letter

**Module 2:**

Communication: Employment Communication, Minutes Taking

**Module 3:**

Resume Writing: Resume, Objectives, Contents of Good Resume, Guidelines for Writing Resume, Different Types of Resumes

**Module 4:**

Managerial Skills: Business Presentation Skills, Negotiation Skills, Structuring Effective Presentation, Assertiveness

**Note:** The entire Managerial Skills' syllabus will be based on activities which include:

Role Play, Just a Minute Session, Group Discussion, Extempore, Mock Interview, Presentation, Public Speaking, Professional Grooming.

**Suggested Reading:**

1. Monippally, Matthukutty. M. 2001. *Business Communication Strategies*. 11<sup>th</sup> Reprint. Tata McGraw-Hill. New Delhi
2. Swets, Paul. W. 1983. *The Art of Talking So That People Will Listen: Getting Through to Family, Friends and Business Associates*. Prentice Hall Press. New York
3. Lewis, Norman. 1991. *Word Power Made Easy*. Pocket Books
4. Sen, Leena. *Communication Skills; Eastern Economy Edition*
5. Ghanekar, Dr. Anjali. *Essentials of Business Communication Skills; Everest Publishing House*
6. Mohan & Banerji. *Developing Communication Skills; Laxmi publications Pvt Ltd*