

# BACHELORS' DEGREE PROGRAMME

## B.Tech

Detailed Syllabi for students admitted to KIIT University in  
School of Civil Engineering



**KIIT UNIVERSITY**

Declared U/S 3 of U G C A c t, 1956  
B h u b a n e s w a r, O r i s s a, I n d i a



## COURSE STRUCTURE FOR B.TECH IN CIVIL ENGINEERING

### SEMESTER-III

<b>Theory</b>							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	MA2001	Mathematics-III	3	1	-	4	4
2	CE2001	Fluid Mechanics-I	3	1	-	4	4
3	CE2003	Solid Mechanics	3	1	-	4	4
4	CE2005	Surveying	3	-	-	3	3
5	CE2007	Civil Engineering Materials & Construction	3	-	-	3	3
6	CE2009	Environmental Engineering-I	3	-	-	3	3
<b>Total of Theory</b>						<b>21</b>	<b>21</b>
<b>Practical</b>							
1	CE2091	Environmental Engg. Lab	-	-	3	3	2
2	CE2093	Material Testing Lab	-	-	3	3	2
3	CE2095	Surveying Field Work-I	-	-	3	3	2
<b>Sessional</b>							
1	CE2081	Building Drawings	-	-	3	3	2
<b>Total Practical &amp; Sessional</b>						<b>12</b>	<b>8</b>
<b>Semester Total</b>						<b>33</b>	<b>29</b>

### SEMESTER-IV

<b>Theory</b>							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	MA2004	Numerical Methods	3	1	-	4	4
2	CE2002	Fluid Mechanics-II	3	1	-	4	4
3	CE2004	Structural Analysis-I	3	1	-	4	4
4	CE2006	Transportation Engineering-I	3	-	-	3	3
5	CE2008	Advanced Surveying	3	-	-	3	3
6	CE2012	Design of Concrete Structure-I	3	1	-	4	4
<b>Total of Theory</b>						<b>22</b>	<b>22</b>
<b>Practical</b>							
1	CE2092	Fluid Mechanics Lab	-	-	3	3	2
2	CE2094	Transportation Engg. Lab.	-	-	3	3	2
3	CE2096	Surveying Field Work-II	-	-	3	3	2
<b>Sessional</b>							
1	HS 2081	Language Lab	-	-	2	2	1
<b>Total Practical &amp; Sessional</b>						<b>11</b>	<b>7</b>
<b>Semester Total</b>						<b>33</b>	<b>29</b>

## SEMESTER-V

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE3001	Structural Analysis-II	3	1	-	4	4
2	CE3003	Water Resources Engineering-I	3	1	-	4	4
3	CE3005	Geotechnical Engineering-I	3	1	-	4	4
4	CE3007	Design of Steel Structure	3	1	-	4	4
5	HS2002	Engineering Economics	3	-	-	3	3
<b>Total of Theory</b>						<b>19</b>	<b>19</b>
Practical							
1	CE3091	Geotechnical Engineering Lab.	-	-	3	3	2
Sessional							
1	CE3081	Hydrology & Irrigation Design	-	-	3	3	2
2	CE3083	Structural Design (Steel)	-	-	3	3	2
3	TP3081	CAT-I	-	-	2	2	1
<b>Total Practical &amp; Sessional</b>						<b>11</b>	<b>7</b>
<b>Semester Total</b>						<b>30</b>	<b>26</b>

## SEMESTER-VI

Theory							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE3002	Water Resources Engineering-II	3	1	-	4	4
2	CE3004	Geotechnical Engineering-II	3	1	-	4	4
3	CE3006	Design of Concrete Structures-II	3	1	-	4	4
4	CE3008	Environmental Engineering-II	3	-	-	3	3
5	CE3012	Construction Planning & Management	3	-	-	3	3
<b>Total of Theory</b>						<b>18</b>	<b>18</b>
Practical							
Sessional							
1	CE3082	Water Resources Design	-	-	3	3	2
2	CE3084	Structural Design (RCC)	-	-	3	3	2
3	CE3086	Geotechnical Engineering Design	-	-	3	3	2
4	CE3088	Estimating & Costing	-	-	2	2	1
5	TP3082	CAT-II	-		2	2	1
<b>Total Practical/ Sessional</b>						<b>13</b>	<b>8</b>
<b>Semester Total</b>						<b>31</b>	<b>26</b>

## SEMESTER-VII

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE4001	Transportation Engineering-II	3	-	-	3	3
2		Department Elective-I	3	-	-	3	3
3		Department Elective-II/Open Elective	3	-	-	3	3
4		Department Elective-III/Open Elective	3	-	-	3	3
5		Institute Elective	3	-	-	3	3
<b>Total of Theory</b>						<b>15</b>	<b>15</b>
<b>Practical</b>							
1	CE4091	Concrete & Structure Lab.	-	-	3	3	2
<b>Sessional</b>							
1	CE4081	Transportation Design	-	-	3	3	2
2	CE4083	Environmental Design	-	-	3	3	2
3	CE4085	Project Preparation	-	-	6	6	3
4	CE4087	Practical Training	-	-	-	-	2
<b>Total Sessional</b>						<b>15</b>	<b>11</b>
<b>Semester Total</b>						<b>30</b>	<b>26</b>

## SEMESTER-VIII

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1		Department Elective-IV	3	-	-	3	3
2		Department Elective-V/ Open Elective	3	-	-	3	3
3		Department Elective-VI/ Open Elective	3	-	-	3	3
<b>Total of Theory</b>						<b>9</b>	<b>9</b>
<b>Sessional</b>							
1	CE4082	Project	-	-	9	9	5
2	CE4084	Comprehensive Viva-Voce	-	-	-	-	2
3	CE4086	Seminar	-	-	3	3	2
<b>Total of Sessional</b>						<b>12</b>	<b>9</b>
<b>Semester Total</b>						<b>21</b>	<b>18</b>

### List of Electives

#### Department Electives I, II, III

CE4031	Concrete Technology
CE6231	Finite Element Methods
CE6239	Composite Structures
CE4033	Structural Dynamics
CE4035	Advanced Solid Mechanics

CE4037	Reinforced Concrete Repairs and Maintenance
CE4039	Pavement Materials
CE4041	Engineering Geology
CE4043	Machine Foundation Engineering
CE6235	Advanced Foundation Engineering
CE4045	Open Channel Hydraulics
CE4047	Groundwater Hydrology and Management
CE4049	Remote Sensing & GIS
CE4051	Flood and Drought Estimation and Management
CE4053	Solid and Hazardous Waste Management
CE4055	Construction Finance Management

#### **Department Electives IV, V, VI**

CE4032	Structural Analysis-III
CE6232	Design of bridges
CE4034	Earthquake Engineering
CE4036	Advanced Steel Design
CE6234	Pre-stressed Concrete
CE6242	Soil-Structure Interaction
CE6138	Advanced Repairs and Rehabilitation of Structures
CE4038	Tunnel Engineering
CE4042	Earth and Earth Retaining Structures
CE4044	Ground Improvement Engineering
CE4046	Traffic Engineering & Transportation Planning
CE4048	Pavement Design
CE4052	Disaster Management
CE6136	Building Services Planning
CE4054	Construction Methods & Equipments
CE6106	Construction Engineering Practices
CE4056	Cost Effective Housing
CE6134	Project quality and Safety Management
CE4058	Water Power Engineering
CE4062	Water Resources Systems
CE4064	Environmental Impact Assessment & Auditing
CE6244	Optimization Techniques

#### **Institute Elective**

HS3008	Management Concept and Practices
HS3006	Entrepreneurship
HS3004	Human Resource Management

## LIST OF OPEN ELECTIVES

(Offered by School of Civil Engineering)

Sl. No.	Course code	Subjects	Credit	Pre-requisite
1	CE2003	Solid Mechanics	4	Engineering Mechanics
2	CE2001	Fluid Mechanics-I	4	Nil
3	CE2007	Civil Engineering Materials & Construction	3	Nil
4	CE2002	Fluid Mechanics-II	4	Fluid Mechanics-I
5	CE2006	Transportation Engg.-I	3	Nil
6	CE3005	Geotechnical Engineering-I	4	Nil
7	CE3003	Water Resources Engineering-I	4	Nil
8	CE3004	Geotechnical Engineering-II	4	Geotechnical Engg-I
9	CE3002	Water Resources Engineering-II	4	Water Resources Engg.-I
10	CE4001	Transportation Engg.-II	3	Transportation Engg.-I
11	CE4064	Environmental Impact Assessment & Auditing	3	Nil
12	CE4052	Disaster Management	3	Nil

**CE2001****FLUID MECHANICS-I****Cr-4**

**Introduction:** Properties of Fluids, Concept of Shear Stress in Fluids, Newtonian, Non Newtonian & Ideal Fluids. **(04 Hrs)**

**Fluid-Statics:** Pressure at a Point, Pascal's Law, Pressure Head and Piezometric Head, Measurement or Pressure (Manometers), Pressure on Plane & Curved Surfaces, Buoyancy & Floating Bodies, Stability of Floating Bodies, Metacentre. **(12 Hrs)**

**Fluid Kinematics:** Fluid Motion, Fluid Acceleration, Types of Flows, Stream Lines, Path Lines, Streak Lines and Stream Tubes, Concept of Control Volume, Continuity Equation, Rotational & Irrotational Motion, Stream Function & Velocity Potential Function, Potential Flow & Laplace Equation, Flow Net Analysis and its Utility. **(08 Hrs)**

**Fluid Dynamics:** Euler's Equation, Bernoulli's Energy Equation, Application Of Bernoulli's Energy Equation, Pitot Tube, Venturimeter, Orifice Meter, Flow Through Orifices And Mouth Pieces, Momentum Principles, Application Of Momentum Equation, Force On Pipe Bend. **(14 Hrs)**

**Laminar Flow:** Navier Stoke's Equation, Laminar Flow Through Circular Pipes, Flow Between Parallel Plates, Stoke's Law, Measurement Of Viscosity. **(04 Hrs)**

**Dimensional Analysis & Model Analysis:** Dimensions, Physical Quantities In Fluid Flow, Dimensionally Homogeneous Equations, Buckingham's II Theorem And Model Studies. **(06 Hrs)**

**Text Book:**

1. *A text book of Fluid Mechanics by R.K.Rajput, S.Chand and company Ltd. 2012,*
2. *"Engineering Fluid Mechanics", by Prof K. L. Kumar, 8<sup>th</sup> Revised Edition, S. Chand & Co Ltd.*

**Reference Books:**

1. *"Engineering Fluid Mechanics" by R.J. Garde & A. G. Mirajgaonker, Scitech Publications (India) Private Limited.*
2. *"Fluid Mechanics & Hydraulic Machines" by R.K. Bansal, 9<sup>th</sup> Edition, Laxmi Publications.*
3. *"Fluid Mechanics" by V.L. Streeter, E.B. Wylie & K.M. Bedford, 9<sup>th</sup> Edition, Tata McGraw-hill Publication.*
4. *"Fluid mechanics" by Frank M. White, 7<sup>th</sup> Edition, Tata McGraw-hill Publication*
5. *"Hydraulics & Fluid Mechanics" by P.N Modi & S.M.Seth, 19<sup>th</sup> Edition, Rajsons Publication Private Limited.*

**CE2002****FLUID MECHANICS-II****Cr-4**

**Pumps & Turbines:** Jet striking in a plane & curved surfaces, Classification of turbines, Pelton turbine components, work done and efficiencies, Kaplan turbine, Francis Turbine, Classification of pumps. Classification of pumps, Reciprocating pumps, Centrifugal pump - Components, classification and velocity diagram. **(08 Hrs)**

**Boundary Layer Theory:** Laminar & Turbulent boundary layer, momentum equation for Boundary layer, hydrodynamically smooth & rough surfaces. **(06 Hrs)**

**Pipe flow:** Darcy-Weisbach formula, Laminar flow in pipes, velocity distribution & resistance to flow, resistance to flow in turbulent flow, Moody's diagram. **(08 Hrs)**

**Pipe flow problem:** energy losses in transition, pipe fittings & valves, problems on siphons, pipes in series and parallel, branching of pipes, pipe networks. **(10 Hrs)**

**Drag & Lift:** Drag due to ideal & real fluids, types, drag in a flat plate, sphere, circular disc, cylinders and aerofoil. Lift due to ideal & real fluids, lift on a sphere, cylinder and aerofoil, induced drag. **(04 Hrs)**

**Flow in open channels:** Uniform flow- Chezy's & Manning's formulae, Uniform flow problems, hydraulically efficient section, Energy & momentum equations, specific energy, flow in transitions. Gradually varied flow - Differential equation of GVF, Flow profiles, GVF computation. Rapidly varied flow, Hydraulic jump, Water Hammer, Surge tank. **(12 Hrs)**

**Text Book:**

1. *"Fluid Mechanics through problems" by R.J.Garde, 3rd Edition, Newage International Publishers, New Delhi*
2. *"Flow in Open Channels" by K. Subramanya, 3rd Edition, TMH Education Pvt. Ltd, New Delhi*

**Reference Books:**

1. "Hydraulics & Fluid Mechanics" by P. N. Modi & S. M. Seth, 19<sup>th</sup> Edition, Rajsons Publication Private Limited.
2. "Fluid Mechanics & Hydraulic Machines" by R.K. Bansal, 9<sup>th</sup> Edition, Laxmi Publications, New Delhi.
3. "Fluid Mechanics" by V.L. Streeter, E.B. Wylie & K.M. Bedford, 9<sup>th</sup> Edition, Tata McGraw-hill Publication, New Delhi.
4. "Fluid mechanics" by Frank M. White, 7<sup>th</sup> Edition, Tata McGraw-hill Publication, New Delhi.

**CE2003**

**SOLID MECHANICS**

**Cr-4**

**Simple Stresses and Strains:** Concept of Stress, Stress and Strain in Materials Under Tension, Compression and Shear, Elastic Constants, Relation Between Elastic Constants, Thermal Stress and Strain, Stress & Strain of Composite Bars. **(10Hrs)**

**Compound Stresses and Strains:** Two Dimensional Stress System, Principal Planes, Principal Stresses, Mohr's Stress Circle, Principal Strains, Mohr's Strain Circle, Principal Stresses Computed From Principal Strains. **(10Hrs)**

**Bending Stresses & Shear Stresses in Beams:** Bending Moment and Shear Force Diagram of Determinate Beams, Theory of Simple Bending of Initially Straight Beams, Distribution of Normal & Shear Stresses, Unsymmetrical Bending, Shear Center, Position of Shear Centre, Shear Flow, Shear Center for Symmetrical & Unsymmetrical Section. **(10 Hrs)**

**Torsion:** Torsion in Solid & Hollow Circular Shafts, Torque and Power Transmitted by Solid and Hollow Shafts, Strength of Shafts, Combined Bending & Torque, Closed Coiled Helical Springs. **(06 Hrs)**

**Columns & Struts:** Elastic Instability, Euler Theory-Column with One end Free & Other end Fixed, Column with Both ends Hinged, Column with both ends fixed, Column with one end fixed and the other end Hinged, Eccentrically Loaded Column, Column with Initial Curvature. **(06 Hrs)**

**Cylinders & Shells:** Stresses & Strains in Thin Cylinders and Thin Spherical Shell Under Internal Pressure, Thick Cylinders Subjected to Internal & External Pressures Compound Cylinders. **(04 Hrs)**

**Theories Of Failure:** Stress Concentration, Principal Stress Theory, Maximum Shear Stress Theory, Principal Strain Theory, Total Strain Energy Theory, Distortion Energy Theory. **(02 Hrs)**

**Text Book:**

1. "Strength of Material" by S. S. Ratan, Second Edition, TMH Education Pvt Ltd, New Delhi
2. "Strength of Material", by R.K.Rajput, Fifth Edition, S.Chand and Co. Ltd.

**Reference Books:**

1. "Strength of Materials" by G. H. Ryder, Third Edition, Macmillan Publisher India Ltd
2. "Elements of strength of Materials" by S. Temoshenko & D. H. Yong, Fifth Edition, EWP an east-west edition
3. "Engineering Mechanics of Solids" by E. P. Popov, Second Edition, PHI Publisher Ltd

**CE2004**

**STRUCTURAL ANALYSIS-I**

**Cr-4**

**S.F.D. & B.M.D.:** Definition, type of supports, shears force and bending moment diagram of all determinate beams, frames etc. S.F.D and B.M.D for the structures with internal hinge, Inter-relation between S.F.D and B.M.D. Obtain B.M diagram from S.F diagram. **(09 Hrs)**

**Slope And Deflection of Beams:** Double Integration method, Maculay's method, Moment Area method, Conjugate beam method, virtual work (Unit load) method, strain energy method. Castiglione's theorems of strain energy. Maxwell's reciprocal theorem, Betti's theorem, Rayleigh-Ritz method. **(15 Hrs)**

**Plane Trusses and Space Trusses:** Analysis of forces in members of a simple truss, Deflection of truss joints- Analytical and graphical methods, Williot-Mohr diagram. Forces in members of simple space truss. **(05 Hrs)**

**Arches & Cables:** Analysis of three hinged parabolic and circular arches for bending moment, normal thrust and radial shear, Analysis of cables and three hinged suspension bridges. **(07 Hrs)**

**Influence lines and Rolling loads:** Rolling loads and influence lines for simple supported beams. Influence lines for forces in members of Pratt and Warren trusses with parallel top and bottom cords, Influence lines for three hinged arch i.e. for horizontal thrust, bending moment, normal thrust and radial shear. **(12 Hrs)**

**Text Book:**



1. "Structural Analysis Vol I", by S.S. Bhavikatti, 4th Edition, Vikas Publishing House Pvt Ltd, New Delhi.
2. "Structural Analysis", R C Hibbeler, 8th Edition, Pearson Education India.

**Reference Books:**

1. "Fundamentals of structural analysis", S K Roy and S Chakrabarthy, 2<sup>nd</sup> edition, S Chand.
2. "Theory of Structures", S Ramammrutham and R Narayan, Dhanpat Rai, 1993.

**CE2005**

**SURVEYING**

**Cr-3**

**Introduction to Surveying:** Objectives of Surveying, Primary divisions of Surveying, Classification of Surveying, Principles of Surveying, Units of measurements, Plans and Maps, Introduction to types of scales used in Surveying maps, Introduction to Vernier and Types of Vernier, Error due to Wrong Scales, Types of Mistakes and Errors in Surveying (in brief). **(04 Hrs)**

**Chaining:** Introduction to chaining, Principle of chain surveying, Methods of measuring distance, Types of Chains and Tapes used in Surveying, Other accessories used in chain surveying, Ranging of a Survey line (Direct & Indirect), Process of measuring distances with chains and tapes, Errors caused by wrong chain length (In length, Area and Volume), Types of errors in chaining and taping, Correction of errors in chaining and taping (Problems), Chain Surveying (Process in Field, Important line terminologies used in chain surveying, Offsets and Types of Offsets, Instruments for measuring right angles, Obstacles in Chaining and Problems on Obstacles, Precautions during Chain surveying). **(05 Hrs)**

**Compass Surveying:** Introduction to Compass Surveying, Principle of Compass Surveying, Designation of Bearings used in Compass Surveying, Types of Bearing Systems, Declination of the Magnetic Bearing w.r.t. True Bearing, Types of Compasses used in Compass Surveying, Fore Bearing and Back Bearing with examples, Calculation of included angles from Bearings, Computation of Bearing from Internal Angles, Local attraction, Correction of Bearing for Local attraction, Traversing with Chain and Compass, Types of errors in Compass surveying, Plotting the compass traversing survey, Adjustments for closing error in closed traverse surveys, Precautions in Compass surveying. **(05 Hrs)**

**Plane Table Surveying:** Introduction to Plane Table Surveying, Principle of Plane Table Surveying, Plane table accessories, Setting up of plane table in field, Orientation in plane table, Plane table methods (Radiation, Intersection, Traversing and Resection), Comparison of the methods, Two-Point Problem, Three-Point Problem (Tracing Paper method, Graphical method, Trial and error method, Lehmann's rule, Adjustments of the Plane table, Errors in Plane tabling, Advantages and Disadvantages in Plane tabling). **(04 Hrs)**

**Measurement of Elevations-Levelling:** Introduction to Levelling, Terminology of terms used in Levelling, Methods of finding elevation, Direct methods for finding levels, Types of Levelling instruments, Levelling staff, Temporary adjustments in levelling instruments, Basic levelling operation in field and terminology, Reduction of levels (Height of Collimation Method, Rise and Fall Method), Problems on reduction of levels, Other methods in levelling (Fly levelling, Check levelling, Profile levelling, Cross section levelling, Reciprocal levelling), Curvature and Refraction (Correction for Curvature, Correction for Refraction, Distance to the Visible horizon, Dip of the Horizon, Balancing back sight and fore sight, Reciprocal levelling, Errors in levelling, Advantages of leveling). **(05 Hrs)**

**Contours:** Introduction to Contours, Terminology used in Contour Operations, Characteristics of Contours, Use of Contour maps (Elaborate practical applications in Drawing of Sections, Determination of Intervisibility between two points, Tracing contour gradient and location of route, Measurement of drainage areas, Calculation of Reservoir Capacity using Trapezoidal formula and Prismoidal formula, Intersection of Surfaces and Measurement of Earth work). **(04 Hrs)**

**Measurement of Angles in Vertical Plane-Theodolite Survey:** Introduction to Theodolite Surveying, Principle of Theodolite Surveying, Essentials of Transit Theodolite, Definitions and Terms used in Theodolite Surveying, Temporary adjustments in Theodolite, Measurement of Horizontal angles (Method of Repetition, Method of Reiteration), Field procedure for Theodolite Surveying, Sources of errors in Theodolite Work, Advantages and Disadvantages of Theodolite Survey, Problems in Theodolite Surveying, Problems on Omitted Measurements. **(05 Hrs)**

**Curves:** Types of Horizontal and Vertical Curves, Simple Circular Curve, Elements of a Simple Circular Curve, Designation of Curve, Fundamentals of Geometry of Circular Curve, Introduction to layout of Simple Circular Curve, Tape and Theodolite Method, Laying out a curve by Deflection angle (Rankine's Method), Laying out a curve by Two Theodolite Method, Transition Curve, Combined Curve, Requirements of Vertical Curve, Length of Vertical Curve, Vertical Curves by equation of parabola, Different applications of Curve setting. **(04 Hrs)**

**Text Book:**

1. "Surveying and Levelling" by R. Subramanian; 2<sup>nd</sup> Edition, Oxford publications, New Delhi.
2. "Surveying Vol. I" by S. K. Duggal; McGraw Hill Education (India) Private Limited.

**Reference Books:**

1. "Surveying Vol. I" by Dr. B. C. Punmia, Ashok K. Jain & Arun K. Jain; Laxmi Publications (P) Ltd.
2. "A Text book of Surveying and Levelling" by R. Agor; Khanna Publishers.
3. "Surveying and Levelling (Part 1)" by T. P. Kanetkar & S. V. Kulkarni; Pune Vidyarthi Griha Prakashan.
4. "Surveying and Levelling" by N. N. Basak; Tata McGraw-Hill Private Limited.
5. "Surveying and Levelling" by S. C. Rangwal, K. S. Rangwala & P. S. Rangwala; Charotar Publishing House Pvt. Ltd.

**CE2006**

**TRANSPORTATION ENGINEERING-I**

**Cr-3**

**Introduction:** Definition of Transportation Engineering, Role of transportation, different modes of transportation and their merits and demerits, scope of highway engineering. **(01 Hrs)**

**Highway development and planning:** Historical development of road construction, roman road, Tresaguet construction, Metcalf construction, Telford construction and Macadam construction. **(01 Hrs)**

**Highway development in India:** Jayakar Committee, Central Road Fund, Indian Roads Congress, Central Road Research Institute, Motor vehicle act, First twenty year road plan, Second twenty year road plan, Highway Research board, Third twenty year road plan. **(01 Hrs)**

**Classification of roads:** Classification of roads by Nagpur road plan, classification of urban roads. **Road pattern.** **(01 Hrs)**

**Highway alignment and survey:** Requirements, factors controlling the highway alignment. **(01 Hrs)**

**Engineering survey and highway location:** Map study, reconnaissance survey, preliminary survey, final location and detail surveys. Drawing & reports, new highway projects. **(01 Hrs)**

**Highway Geometric Design:** Importance of geometric design, design control and criteria, Highway cross section element, Typical cross section of road, Sight distance, SSD, OSD, ISD, Design of horizontal alignment, Superelevation, Attainment of super elevation, Widening of pavement on horizontal curve, Horizontal transition curve, Set-back distance on horizontal curves, Curve resistance, Design of vertical alignment, Grade compensation, Summit curve and Valley curve. **(08 Hrs)**

**Highway Materials:** Significance of subgrade soil, CBR test, desirable properties of road aggregate, Test for road aggregate, Bituminous materials, Bitumen, Tar, Emulsion, types of bitumen, Test on bitumen, Marshall Method of Bituminous Mix Design, Bankelman Beam, Bump Integrator, Stabilization of soil, Specification for construction of Earth, Moorum, Water bound macadam(WBM), Wet mix macadam(WMM), Bituminous and Concrete roads. **(04 Hrs)**

**Traffic Engineering:** Scope of traffic engineering, Traffic characteristics, Traffic studies, Traffic volume study, Speed studies, Origin and Destination(O&D) study, Traffic flow characteristics, Traffic capacity study, Parking study, Accident studies, Level of Service, Passenger Car Unit(PCU), Relationship between Speed, Travel Time, Volume, Density and Capacity, Regulatory sign, Informatory signs, Traffic Signals, Rotary intersection, Mini Roundabout. **(06 Hrs)**

**Pavement Design:** Difference between Flexible and Rigid pavement, Design of Flexible pavement as per IRC: 37-2001 and Design of Rigid pavement as per IRC: 58-2002. **(05 Hrs)**

**Road making machinery and equipments:** Bull dozer and Scraper, Power shovel, Dragline, Clamshell, Hoe, Compacting Equipment. **(01 Hrs)**

**Road Drainage:** Significance of highway drainage, Requirements of highway drainage, Surface drainage, Cross drainage, Sub-Surface drainage, Road construction in water-logged area. **(01 Hrs)**

**Highway maintenance:** Introduction, causes of pavement failures, failure in flexible pavement and rigid pavement, maintenance of flexible and rigid pavement. **(01 Hrs)**

**Tunnel Engineering:** Necessity of tunnel, tunneling versus open cut, different cross section of tunnel, transfer of surface alignment, heading and enlargement, drilling and blasting and shuttering, shield tunneling, tunneling under water drainage, ventilation of tunnels, tunnel lining. **(02 Hrs)**

**Bridge engineering:** Introduction, site selection, types of bridges, terminology related to bridge engineering, superstructure, bridge foundation, types of foundations. **(02 Hrs)**

**Text Book:**

1. "Highway Engineering" by S. K. Khanna & C. E. G. Justo, 9<sup>th</sup> Edition, Khanna Publishers, New Delhi.

**Reference Books:**

1. "Bridge Engineering" by Rangwala, Charotar Publishing House Pvt. Ltd.
2. "Roads, Railways, Bridges, Tunnels and Harbour dock Engineering" by B. L. Gupta & Amit Gupta, Standard Publication

**CE2007                      CIVIL ENGINEERING MATERIALS & CONSTRUCTION                      Cr-3**

**Stones:** Classification, composition, characteristics, uses, method of quarrying and dressing.                      **(04 Hrs)**

**Bricks:** Brick earth, method of Brick manufacture, testing of bricks, classification.                      **(04 Hrs)**

**Cement:** Portland cement:-Classification, Chemical composition, hydration, tests for cement fineness test, normal consistency, setting time, soundness, tensile and compressive strength.                      **(04 Hrs)**

**Concrete:** Composition of concrete, W/C ratio, Workability, Compressive and tensile strength, Nominal Mix design, pozzolanic concrete, Light weight and high density concrete, Elasticity, Shrinkage and creep of concrete.                      **(06 Hrs)**

**Timber:** Characteristics and suitability for different purposes, Defects and decay seasoning preservation of timber.                      **(04 Hrs)**

**Foundation:** Shallow foundation, Deep foundation, Description and types of spread foundation, Description and types of pile foundations, Methods of pile driving, Pile driving formulae (isolated and group of piles),Excavation and timbering of trenches, Well foundations, Caissons, Cofferdams.                      **(05 Hrs)**

**Masonry:** Definition of terms; classification of masonry; stone masonry; classification, dressing, joints, maintenance; Brick masonry; Types of bonds, brick laying, structures in brickwork; Partition walls.                      **(03 Hrs)**

**Door & Windows:** Criterion of size; types of doors and windows ventilators and fanlights sash and casement windows, skylights and lanterns; fixture and fastenings for doors and windows.                      **(03 Hrs)**

**Floors:** Ground flooring, upper flooring, types, preparation, advantages and disadvantages.                      **(03 Hrs)**

**Text Book:**

1. "A Text Book of Building Construction" by Dr. S.K.Sharma, Revised Edition, S.Chand Publication, 1987.
2. "Engineering Materials" by S.C.Rangwala, Charotar Publishing House, 2011.

**Reference Books:**

1. "Building Material" by M. L. Gambhir, 1st Edition, TMH Education, New Delhi.
2. "Building Construction" by B. C. Punmia, Jain & Jain, 10th Edition, Laxmi Publication, New Delhi.
3. "Building Material" by P. C. Verghese, PHI Learning (P) Ltd., New Delhi, 2005
4. "Building Material" by S.S.Bhavikatti, 1st Edition, Vikas Publication.
5. Materials for civil and construction engineers by Michael S. Mamlouk and John P. Zaniewski, 3<sup>rd</sup> edition, Pearson Education Inc., 2011

**CE2008    ADVANCED SURVEYING    Cr-3**

**Total Station and Electronic Distance Measurement:** Introduction to Total Station, Advantages and Disadvantages of Total Station, Measuring Angles, Types of Total Station, Advancement in Total Station Technology, Automatic Target Recognition (ATR), Introduction to EDM, Measurement Principle of EDM instrument, EDM instrument characteristics, Classification of EDM, Errors in Electronic Distance Measurement, Error correction in EDM, Zero Correction, Prisms used in EDM, Accuracy in EDM, Field procedure in EDM, Geometry of EDM, EDM without reflecting prisms, Focusing and sighting.                      **(04 Hrs)**

**Tacheometry:** Introduction to Tacheometry, Principle of Tacheometric Surveying, Methods in the Tacheometric Surveying, Uses of Tacheometry, Types of instruments used in Tacheometric Surveying, Systems of Tacheometric Measurements (Stadia Method and Non-Stadia Method), Stadia Method or Fixed-hair Method, Principle of Stadia Method, Determination of Tacheometric Constants, Anallactic Lens, Inclined Stadia Measurements, Uses of Stadia Method, Errors in Stadia Measurement, Tangential Method. Both Angles are above horizontal line of sight, Both Angles are below horizontal line of sight, One of the Vertical Angles is above and the other below the horizontal line of sight, Subtense Bar Method, Subtense bar Instrument, Effect of Angular Error.                      **(06 Hrs)**

**Triangulation :** Introduction, Triangulation, Principle of Triangulation, Purpose of Triangulation Surveys, Classification Triangulation, Layout of Triangulation, Ideal figures for triangulation, Size of triangulation, Well

conditioned triangle of a triangulation system, Strength of triangulation figures, Accuracy of triangulation, Routine of triangulation survey, Field work of triangulation, Signals and towers, Classification of signals, Base line measurement, Equipments for base line measurement, Normal tension, Extension of base, Number of Zeros, Types of triangulation stations, Triangulation computations, Height adjustment of triangulation net, Base net.

(06 Hrs)

**Theory of Errors and Adjustments:** Introduction, Definitions, Weight of the observations, Laws of weights, Assignment of weightage to the field observations, Adjustment of accidental errors, Method of least squares, Probable values of directly observed quantities, Probable values of indirectly observed quantities, Conditioned quantities, Calculation of constants of line equations by method of least squares, Probable error, Triangulation adjustment, Adjustment of a chain of triangles, Adjustment of a quadrilateral, Methods of adjustment of braced quadrilaterals, Adjustment of a centered polygon, Adjustment of level work.

(05 Hrs)

**Remote Sensing: Introductions** to remote sensing; Applications and importance of remote sensing, Introduction to GPS: Available GPS net works, Limitations and applications of GPS; GPS receivers. Basic concepts and fundamentals of remote sensing- elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology and units, over view of Indian Remote sensing satellites and sensors, Energy resources, energy interactions with earth surface features and atmosphere, resolution, visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of water bodies, introduction to digital data analysis.

(06 Hrs)

**Map Projections:** Introduction; Scale Factor; Geometry of the sphere and cone; Areas; Surface areas of solids; Types of Map Projections; Map projection to a plane; Gnomonic Projection; Stereographic Projection; Orthographic Projection; Conical Projection; Albers Equal-area Projection; Polyconic Projection; Conformal Projection; Lambert Projection; Mercator Projection; Transverse Mercator Projection; Universal Transverse Mercator Projection; The choice of projection.

(03 Hrs)

**Geographic Information System (GIS):** Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS, Data collection and input overview, data input and output. Keyboard entry and coordinate geometry procedure, manual digitizing and scanning, Raster GIS, Vector GIS - Advantages and disadvantages. File management, Spatial data – Layer based GIS, Feature based GIS mapping, Computational Analysis Methods (CAM), Visual Analysis Methods (VAM), Data storage-vector data storage, attribute data storage, overview of the data manipulation and analysis. Integrated analysis of the spatial and attribute data.

(06 Hrs)

#### **Text Books:**

1. "Global Positioning System" by Satheesh Gopi, Revised Edition, TMH Education Pvt. Ltd, New Delhi.
2. "Surveying" Vol-2 by S.K.Duggal, 4th Edition, TMH Education Pvt. Ltd, New Delhi
3. "Advanced Surveying, Total station, GIS & Remote sensing" by Satheesh Gopi, R.Sathi Kumar and N.Madhu, Pearson Education, New Delhi

#### **Reference Books**

1. "A Text Book of Advanced Surveying" by R. Agor; Khanna Publishers.
2. "Remote Sensing and GIS" by Basudeb Bhatta, Oxford University Press.
3. "Surveying" Vol. I, II and III by Dr. B. C. Punmia, Ashok K. Jain and Arun K. Jain; Laxmi Publications (P) Limited.
4. "Remote Sensing and Geographical Information System" by A. M. Chandra and S. K. Ghosh; Narosa Publishing House.
5. "Textbook of Remote Sensing and Geographical Information System" by M. Anji Reddy, BS Publications.
6. "Textbook of Remote Sensing and Geographical Information System" by Kali Charan Sahu, Atlantic Publications

**CE2009**

**ENVIRONMENTAL ENGINEERING-I**

**Cr-3**

**Water Supply Engineering:** General requirement for water supply, sources of water supply, Estimation of water demand. Intake structures, pumping and transportation of water. Physical, chemical and biological characteristics of water and their significance, Water quality criteria, Water borne diseases.

(13 Hrs)

**Engineered systems for water treatment:** Aeration, sedimentation, softening, coagulation, filtration, ion exchange, and disinfection. General description of water distribution system.

(15 Hrs)

**Plumbing systems:** House-connections, overhead tanks, design of internal distribution system, ventilation and lighting of buildings.

(02 Hrs)



1. "Structural Analysis Vol II" by S.S. Bhavikatti, 4<sup>th</sup> Edition, Vikas Publication
2. "Indeterminate structural analysis" by C. K. Wang, 1<sup>st</sup> Edition, TMH Edu. Pvt Ltd., New Delhi.

**Reference Books:**

1. "Theory of Structures" by S. Ramamrutham, Dhanpat Rai Publication, New Delhi.
2. "Theory of Structures (I & II)" by Pandit & Gupta, McGraw-Hill Education Pvt. Ltd, New Delhi.
3. "Indeterminate Structural Analysis" by J.S.Kinney, Narosa Publication, 1987

**CE3002**

**WATER RESOURCES ENGINEERING II**

**Cr-4**

**Flood:** Methods of estimation-UH method-Flood frequency studies (Gumbel's method, Log Pearson type III method), Design flood. **(06 Hrs)**

**Flood Routing:** Basic equation-Hydrologic flood routing, Modified Pulse Method, Muskingham method of channel routing, hydraulic flood routing. **(06 Hrs)**

**Flood Control works:** Flood flows, types of flood control works, river training works. **(03 Hrs)**

**Drainage: Drainage Command Area** Drainage Issues ;( Water logging and salinity, sources of excess water), Drainage criteria, Design discharges, steady and non steady flow to drains, Planning and Design surface subsurface Drainage systems, Drainage system Operation and Maintenance. **(06 Hrs)**

**Reservoirs:** Preliminary concept of reservoir planning, types of reservoirs, selection of site, reservoir capacity from mass curves silting of reservoirs, Principle of Reservoir Operation. **(06 Hrs)**

**Dams:** Classification, Investigation, Site selection, economical height of dam. **(04 Hrs)**

**Gravity dams:** Forces acting on gravity dam, structural stability of gravity dam, Elementary profile of a Gravity dam High & low gravity dam, concept of design of gravity dam, construction of Galleries, joints, foundation treatment of gravity dam. **(03 Hrs)**

**Earth Dams:** Types of earth dams, causes of failure of earth dams, criteria for safe design of earth dams, determination of phreatic line and flow net, measures to control seepage through earth dams and their foundations, slope protection, concept of stability of slopes of earth dams by slip circle method. **(05 Hrs)**

**Spillways:**Description & Design Aspects of different type of spillways. **(04 Hrs)**

**Overview on Water Power:** Different power sources, classification of hydropower plants, important terms and definitions connected with hydropower, principal component of hydropower plant. **(05 Hrs)**

**Text Books:**

1. "Irrigation Engineering & Hydraulic Structures" by S.K. Garg, Khanna Publishers
2. "Engineering Hydrology" by K. Subhrmanya, TMH Education Pvt. Ltd, New Delhi

**CE3003**

**WATER RESOURCES ENGINEERING-I**

**Cr-4**

**Hydrology:-**

**Introduction:** Hydrologic cycle, catchment area. **(02 Hrs)**

**Precipitation:** Meteorological aspects of precipitation-measurement-preparation & presentation of data-mean precipitation, DAD Curves. **(05 Hrs)**

**Abstraction:** Evaporation-measurement-empirical equation, Evapo-transpiration measurement-equation PET, Infiltration-process-measurement-infiltration capacity & indices. **(04 Hrs)**

**Runoff:** Process of stream flow measurement-Hydrograph, yield, flow duration curve, flow mass curve. **(07 Hrs)**

**Hydrograph:** Base flow, effective rainfall, Unit hydrograph-Derivation, synthetic UH, Instantaneous UH **(05Hrs)**

**Irrigation Engineering:-**

**Irrigation:** Definition, necessity, Benefits & ill effects of irrigation, types of irrigation & methods of irrigation **(02 Hrs)**

**Water Requirements of Crops:** Agro meteorological Variables, Soil water plant relationship, base period, crop period, duty and delta relationships, factors affecting Duty, G.C.A., C.C.A., intensity of irrigation, kor-watering, kor period, kor depth, cash crop, crop rotation, determination of Irrigation requirement of crops, irrigation scheduling, Assessment of irrigation water, irrigation efficiencies, consumptive use. **(05 Hrs)**

**Canal Irrigation systems:** Classification of canals, Alignment, Different types of canals, Distribution system, Design of stable channels in India, Regime Channel, Kennedy's Theory, Use of Garret's diagram, Lacey's theory, Design procedure of irrigation channels, different types of lining and its construction. **(05 Hrs)**

**Diversion Head works:** Concept of weir & barrage, Layout of diversion heads works & its components (description). canal head regulator, head sluices, Theory of seepage, concept of Blight's creep theory, Lanes Weighted creep theory, Khosla's theory on permeable foundation ( elementary concept). **(05 Hrs)**

**Canal Falls:** (Description) Necessity. Location, Elementary concept of different types of canal falls. **(02 Hrs)**

**Cross drainage works:** (Description) Type of cross drainage works, elementary idea about different types of cross drainage works. **(03 Hrs)**

**Overview on Groundwater:** Forms of sub-surface water, water table, saturated formation, specific yield, Darcy's law, Wells (steady flow in confined and un-confined aquifers), Open wells. **(03 Hrs)**

#### **Text Books**

1. "Irrigation Engineering & Hydraulic Structures" by S. K.Garg; 23<sup>rd</sup> Edition, Khanna Publisher
2. "Engineering Hydrology" by K. Subramanya; 4<sup>th</sup> Edition, Mc. Graw Hill, New Delhi

#### **Reference Book:**

1. "Applied Hydrology" by V.T.Chow, D.R.Maidment & L.W.Mays, McGraw Hill Book Co, Singapore, 1988

## **CE3004**

## **GEOTECHNICAL ENGINEERING II**

## **Cr-4**

**Stresses Distribution:** Introduction , Boussinesq's formula for determining vertical stress under point load, Pressure bulb, Vertical stress distribution on horizontal and vertical plane, Vertical stress due to uniformly loaded line, strip, circular, square and rectangular footings, New marks's influence chart and its use, Approximate methods of finding vertical stress below loaded footings, contact pressure. **(08 Hrs)**

**Bearing Capacity of Shallow Foundations:** Introduction, Rankine's analysis for cohesion less soils, Terzaghis bearing capacity equation, Factors influencing bearing capacity of soil including effect of water table , size of footings and eccentricity of loading, plate load test, standard penetration test and static cone penetration test Selection of type of foundations, Depth of foundation, Floating Foundation, Bottom heaving, Dewatering of foundation trenches. **(10 Hrs)**

**Pile Foundations:** Classification of piles, Load carrying capacity of single piles by static and dynamic formulae (Hilley's and Engineering News formula) Group action of piles, Settlement of pile groups, Negative skin friction, under reamed piles. **(08 Hrs)**

**Earth Pressure and Retaining Structures:** Active & passive earth pressure, Rankine's theory for active and passive earth pressure, Coulomb's theory and Rebha - Poncelet construction (for cohesion less soil), Culmann's construction for active and passive earth pressure (for cohesion less soils), Pressure against solid retaining walls without and with uniformly distributed load surcharge, Effect of submergence, Types of sheet pile walls, pressure against cantilever and Anchored bulkheads (free earth support method only), pressure against walling in deep trenches. **(10 Hrs)**

**Stability of Slopes:** Stability of infinite slopes, Culmann's approach for finite slope, Swedish, slice method and friction circle method of analysis, stability of homogeneous finite earth slopes without surcharge with steady seepage and under sudden drawdown condition. **(08 Hrs)**

**Site Investigations:** Methods of exploration, Preservation, shipment and storage of sampling. **(02 Hrs)**

**Introduction to Rock mechanics:** Classification of rocks, Index properties of rocks, Laboratory test for determination of strength of rocks, Modes of failure of rock, Mohr-coloums failure criterion for rocks, shear strength of rocks, hardness of rock, In-situ stresses in rocks. **(02 Hrs)**

#### **Text Book:-**

1. "Principles of Foundation Engineering" by B.M.Das, 7th Edition, Cengage Learning India Pvt. Ltd, New Delhi.
2. "Geotechnical engineering handbook" by B.M.Das, J.Ross Publishing, Cengage learning.

#### **Reference Books:**

1. "Basic and applied soil mechanics" by Gopal Ranjan & A. S. R. Rao, New age international publication, 2007.
2. "Soil Mechanics & Foundation Engineering" by B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications, New Delhi.
3. "Foundation Analysis and Design" by J. E. Bowls, TMH Education, New Delhi.
4. "Geotechnical Engineering Principles and Practices" by Donald P. Coduto, Man Chu Ronald Yeung & William A. Kitch, Prentice Hall, 2011.

**CE3005**

**GEOTECHNICAL ENGINEERING-I**

**Cr-4**

**Introduction and Classification:** Definition of soil, origin & formation of soil, General types of soil and soil deposits, Cohesive and cohesion less soils. Basic definitions, Relationship & inter-relationships. Index properties of soils & their determination. Classification base on grain size and plasticity characteristics.

**(07 Hrs)**

**Permeability of soils:** Darcy's law and its range of validity, Discharge velocity, Seepage velocity Laboratory determination of Co-efficient of permeability (K):-constant head permeability, Falling head permeability. Indirect determination of K, Factors affecting permeability, Permeability of stratified soils, Co-efficient in an inclined direction.

**(05 Hrs)**

**Effective stress principle:** Nature of effective stress, Effect of water table fluctuation on effective stress. Effective stress in a soil mass under different hydraulic conditions, Increase in effective stress due surcharge.

**Capillarity of soil and capillary zones.** Effective stress in soils saturated by capillary action, Seepage pressure, Effective stress under steady seepage conditions, Quick Sand Condition.

**(07 Hrs)**

**Seepage analysis:** Laplace's equation, Stream and Potential Functions, flow net, characteristics of flow net, graphical method, flow net for anisotropic soils, flow net in non-homogeneous soil mass, uses of flow net.

**(05 Hrs)**

**Shear strength:** Basic concept, Mohr-coulomb-failure criteria. Methods of determination of shear strength parameters: Shear tests- Direct shear test, Triaxial compression test, Unconfined compression test, Vane shear test; advantage and disadvantage of direct shear and triaxial compression test, advantages of unconfined compression test and vane shear test.

**(09 Hrs)**

**Compaction of Soils:** Objects, Measurement of compaction: Determination of OMC & MDD by standard & modified proctor compaction test. Factors affecting compaction, Zero air voids line, field compaction control using of proctor - Needle.

**(06 Hrs)**

**Consolidations of Soils:** Introduction, Principles of consolidation, soil spring analogy, consolidation characteristics of laterally confined soil, pressure void ratio diagram, Normally consolidated and over consolidated soils, Estimation of reconsolidation pressure, Terzaghi's theory of one dimensional consolidation, Laboratory consolidation test, Determination of coefficient of consolidation, Consolidation settlement.

**(09 Hrs)**

**Text Book:**

1. "Soil Mechanics & Foundation Engineering" by B.C.Punmia, Ashok K.Jain & Arun Kumar Jain, 4th Edition, Laxmi Publication, New Delhi.
2. "Geotechnical Engineering" by C. Venkatramaiah, Newage International Publishers, New Delhi

**Reference Books:**

1. "Basic and applied soil mechanics" by Gopal Ranjan & A. S. R. Rao, New age international publication, 2007
2. "Principle of Geotechnical Engineering" by B. M. Das & Khaled, 8th Edition, Global Engineering USA.
3. "Soil Mechanics and Foundation Engineering" by K. R. Arora, Standard Publisher, 2005
4. "Soil Mechanics and Foundation Engineering" by V.N.S. Murthy, CBS Publisher, 2009

**CE3006**

**DESIGN OF CONCRETE STRUCTURES - II**

**Cr-4**

Design of combined footings.

**(12 Hrs)**

Design of piles and pile caps.

**(08 Hrs)**





1. "Environmental Engineering Vol-I & Vol-II" by S.K.Garg, Revised Edition, Khanna Publisher, New Delhi.

**Reference Books:**

1. "Environmental Engineering", Peavy H.S., Rowe, D.R. and Tchobanoglous, G.. Seventh Edition, Tata McGraw Hill, 1985
2. "Wastewater Engineering: Treatment and Resource Recovery", Metcalf & Eddy, Inc., Arthur, J., Tchobanoglous, G., Burton, F., Tsuchihashi, R. and Stensel, D.H. Fifth Edition, McGraw Hill Companies Inc., 2013
3. "Water Supply and Sewerage", Terence J. McGhee. Sixth Edition, Tata McGraw Hill, 2014.
4. "Water and Wastewater Technology", M.J. Hammer. Seventh Edition, Prentice Hall, 2011.
5. "Handbook of Solid Waste Management", Tchobanoglous G. and Kreith, F., Second Edition; McGraw Hill, 2002.
6. "Water and Wastewater Engineering", Davis, Mackenzie. First Edition, McGraw Hill, 2010.

**CE3012 CONSTRUCTION PLANNING & MANAGEMENT Cr-3**

**Contracts:** General conditions and principles, various types of contracts methods of tendering. Earnest Money, Security money. **(10 Hrs)**

**Construction Management:** Construction planning, scheduling & monitoring, Bar charts, elements of critical path method (CPM) , Program Evaluation & Review Techniques (PERT), Advantages & disadvantages, Elements of Network, Network rules, critical path analysis of CPM network, Activity times & Floats, Optimization through CPM technique PERT & Three time estimates. **(12 Hrs)**

**Construction equipments:** Selection of construction equipment, excavating & transporting equipments, Housing & conveying equipments. **(10 Hrs)**

**Material Management:** Objectives & Functions. **(04 Hrs)**

**Text Book:**

1. "Construction Project Management" by Kumar Neeraj Jha, Pearson Education

**Reference Books:**

1. "Construction Planning & Management", by Dr.U.K. Shrivastava, Galgotia Publications Pvt Ltd, May 2000
2. "Construction Planning & Management", by Dr. A. K. Jha, Pearson Publication.
3. "Estimating and costing", by Dr. B. N. Dutta, UBSPD, 2013
4. "Construction Management & Planning", by B.Sengupta & H.Guha, TMH Education (P) Ltd, New Delhi
5. "Construction Planning Equipment and methods", by R.L.Peurity, McGraw-Hill Publishing Company, 2011
6. "Construction Planning and Plant", by A.J.Ackerman & C.H.Locher, McGraw Hill Company, 1940
7. "Construction Equipment and its Planning and application", by M.Verma, Metropolitan Book Co. 1975.
8. "Civil Engineering Contracts and Estimating", by B.S.Patil & Orient Logman Ltd New Delhi
9. "Construction Planning & Management", by B.C. Punmia, laxmi Publications

**CE4001 TRANSPORTATION ENGINEERING II Cr-3**

**Railway Engineering:-**

**Introduction and Location survey:** Role of railway in transportation, historical development of railway in India, advantages of railways, classification of Indian Railways. Requirements and factors of good railway track alignment. Principles of location survey, traffic survey, reconnaissance survey, preliminary survey, detailed survey or final location survey. **(01Hrs)**

**Permanent way:** Requirement of an ideal permanent way, gauge in a railway track, different gauge in India and abroad, selection of gauge, railway track cross-section, coning of wheels. **Stress in a railway track:** Track modulus, stresses in: rails, sleepers and ballast, tractive resistances, hauling capacity of locomotive. **(02 Hrs)**

**Rails:** Function of rails, composition of rails, requirements of rails, types of rail sections, comparison of different types of rail, selection of rail, length of rail, corrugated or roaring rails, hogged rails, kinks in rails, buckling of rails, rail failures, wear on rail. (01 Hrs)

**Rail joints and welding of rails:** Requirement of an ideal joint, types of rail joints, welding of rails, advantage of welding of rails, methods of welding of rails, length of welded rails. **Creep of rails:** Indication of creep, theories of creep, effect of creep, measurement of creep, prevention of creep. (02 Hrs)

**Sleepers:** Function of sleeper, requirements of sleeper, classification of sleeper, advantages and disadvantages of different type of sleepers, adzing of sleepers, spacing of sleepers and sleeper density. **Track fittings and fastenings:** Fish plate, spikes, bolts, chairs, blocks, keys, bearing plates. **Ballast:** function of ballast, requirements of ballast, types of ballast, size and section of ballast, renewal of ballast. (02 Hrs)

**Geometric Design of the track:** Necessity of geometric design, types of gradient, grade compensation, speed of the train, radius or degree of the curve, cant or super elevation, cant deficiency, negative super elevation, curves, length of transition curve, widening of gauge on curves. (03 Hrs)

**Points and crossings:** Necessity of point and crossings, turnout, left hand turnouts and right hand turnouts, point of switches and its component parts, crossings and its component parts, number of crossing and angle of crossing. (02 Hrs)

**Signaling and inter locking:** Objects of signaling, classification and types of signals, centralized traffic control system (CTC), automatic train control system (ATC), track circuiting. Necessity and functions of interlocking, methods of interlocking, mechanical device for interlocking. (03 Hrs)

**Stations and yards:** Definition, site selection for railway stations, requirements of railway station, classification of railway stations, platforms, loops, sidings, types of yards. **Level crossing:** Classification of level crossings.

**Equipment in station yards:** Weigh bridge, engine sheds or loco sheds, as-pits, ash-pans, drop-pits, turn table, fouling mark, buffer stops. **Construction and renewal of track, Drainage and maintenance of track.**

(02 Hrs)

#### **Airport Planning & Design:-**

**Introduction,** Classification of airports, General consideration for location and layout, direction of breeze use of wind-Rose diagram. Airport obstruction, Principle of design and construction of Runways, traffic, Aprons, Landing strips and hangers, Airport marking and lighting, Classification of airports, airport site selection, wind-rose diagram, airport obstruction, principle of design and construction of runways, Airport capacity, Taxiway, Aprons, Landing strips, hangers, Location of Administrative Building and control tower, Airport marking and lightening, Air traffic control. (12 Hrs)

#### **Docks & Harbors:**

**Introduction,** Natural and artificial harbours, selection of site, layout of harbor, principles of constructions of breakwater, quays, jetties, study wind tides, wave action accretion and denudation, dry docks, wet docks and floating docks. (06 Hrs)

#### **Text Book:**

1. "A Text Book of Railway Engineering", by S. C. Sexena & S. P. Arora, 7<sup>th</sup> edition, 2006, Dhanpat Rai Publications.
2. "Airport Planning and Design", by S. K. Khanna, M. G. Arora, S. S. Jain, 6<sup>th</sup> edition, 2009, Nem Chand & Bros. Publications.
3. "Harbour, Dock and Tunnel Engineering", by R. Srinivasan, 26<sup>th</sup> edition, 2013, Charotar Publishing House.

#### **Reference Books:**

1. "Railway Engineering", by Satish Chandra & M. M. Agarwal, 2<sup>nd</sup> edition, 2013, Oxford University Press.
2. "Airport Engineering", by N. Ashport & P. H. Wright, 3<sup>rd</sup> edition, 1992, Willey-Interscience.
3. "Tunnel Engineering", by S. C. Sexena, latest edition, Dhanpt Rai & Sons.



Introduction to vibration problem; Un-damped and damped free vibrations with viscous damping; forced vibrations, vibration isolation.	(12 Hrs)
Response spectra; study of shake tables.	(02 Hrs)
Multi degree freedom systems; Rayleigh's method.	(06 Hrs)
Free vibrations of un-damped systems determination of frequencies and mode shape by Holzer method and Stodola method.	(06 Hrs)
Continuous systems; Introduction of IS Codes (IS: 1893-2001).	(08 Hrs)

**Text Book:**

1. "Earthquake resistance design of structures", by Pankaj Agarwal & Manish Shikhande, Prentice hall (PHI).

**Reference Books:**

1. "Dynamics of structures (Theory and applications to Earthquake Engineering)", by Anil K. Chopra PH(I) New Delhi.

**CE4035**

**ADVANCED SOLID MECHANICS**

**Cr-3**

<b>Introduction:</b> Reviews of elementary solid mechanics.	(01 Hrs)
<b>Analysis of stress:</b> surface forces and traction /stress vector, body forces and moments; components of stress matrix and its relation to stress vector; Normal and shearing stresses on a plane stress transformations and stress tensor, introduction to tensors. Principal stresses and axes; Maximum shearing stress; Equilibrium equations; Boundary conditions.	(05 Hrs)
<b>Analysis of Deformation and strain:</b> Deformation map, displacement gradient, straining of line element and strain components as measure of deformation. Strain-displacement relations, infinitesimal strain and linearization, physical interpretation of normal and shear strain components; infinitesimal rotation vector and relative displacement; straining of arbitrary line element, strain transformation and strain tensor, principal strains and axes; analogies with stress tensor; volumetric strain and cubical dilation; strain compatibility equations.	(05 Hrs)
<b>Constitutive relations, Boundary value problems:</b> Generalized Hooke's law, 3-D stress strain relation for linear elastic isotropic solid; Compatibility equations in terms of stress; types of boundary value problems (BVPs)-displacement and stress formulations, Saint Venant's principle.	(05 Hrs)
<b>Two Dimensional Elasticity in Cartesian and Polar Coordinates:</b> Plane stress, plane strain; formulation of BVP using Airy stress function, inverse and semi-inverse methods of solution; Problems in rectangular coordinates polynomial solutions, determination of displacements, Fourier series solutions; Problems in polar coordinates-transformation of field equations in polar coordinate, axisymmetric problems, non-axisymmetric problems, stress concentrations; Use of symmetry in solving 2-D problems.	(05 Hrs)
<b>End Torsion of Bars (Prismatic, general cross section):</b> Review of torsion of circular sections; formulation of BVP using Prandtl stress function and Saint Venant's semi-inverse method (Warping function method), Membrane analogy; Solutions for solid cross section bars torsion of thin walled open section and closed section (Multicelled) members. Formulation for torsion of multi celled thick walled cross-sections; finite difference method.	(05 Hrs)
<b>Bending of Beams (Prismatic, general cross section):</b> Preliminaries-sign conventions, area moments of inertia, their transformation, principal inertias; pure bending of beam with terminal couples; bending of beam with end shear -BVP formulation, examples, shear center and its determination. One-dimensional shear flow in open thin walled beams and shear center problem solving.	(05 Hrs)
<b>Bending of curved beams:</b> (Prismatic, symmetric sectioned)-Assumption, derivation of basic results (kinematics, stresses) obtaining maximum stresses, determining deflections using energy methods.	(02 Hrs)
<b>Beams on Elastic Foundation:</b> Basic problem of infinite beam with point load, various modifications of basic problem and application of superposition for solving them.	(03 Hrs)

**Text Books:**

1. "Advanced Mechanics of Solids", by L.S.Srinath, 2nd Edition, Tata Mc Graw Hill, 2003.

2. "Theory of elasticity", by S.P.Timoshenko & J.N.Goodier, 3rd Edition, Mc Graw Hill 1970.

#### Reference Books

1. "Advanced Mechanics of Material", by A.P.Boresi & R.J.Schmidt, 6th ed., Wiley, 2003.

### CE4036 ADVANCED STEEL DESIGN Cr-3

Design of Gantry girder.	(06 Hrs)
Design of cold formed light gauge steel beams and columns.	(04 Hrs)
Design of roof truss.	(10 Hrs)
Design of power transmission tower.	(04 Hrs)
Design of water tank with staging.	(08 Hrs)
Design of self supported steel chimney.	(04 Hrs)

#### Text Books:

1. "Design of steel Structures (LSM)", by S.K Duggal Mc Graw Hill Education pvt Ltd.
2. "Design of Steel Structure", by N.Subramanian, 2<sup>nd</sup> edition, Oxford publication.
3. "Design of Steel Structure" by K.S.Sai Ram, Pearson Education Pvt. Ltd, New Delhi.

#### Reference Books:

1. "Design of Steel Structures V-II", by S. Ramchandra, Standard pub.
2. "Design of steel structure", by S.S Bhavikatti, I.K I Publishers.
3. "Design of steel structure", by Gaylord & Gaylord., TMH publication, 3 edition, 2010.

### CE4037 REINFORCED CONCRETE REPAIRS AND MAINTENANCE Cr-3

**Introduction:** Causes of deterioration of concrete structures. Effects of climate, moisture, temperature, chemicals, wear, erosion and loading on serviceability and durability. Design and construction errors. Causes of seepage and leakage in concrete structures. Formation of cracks including those due to corrosion. (03 Hrs)

**Condition Survey, Evaluation and Assessment of Damage:** Diagnostic methods and analysis. Destructive, Semi destructive and Non-Destructive methods including Core test, Carbonation test, Chloride test, Petrography, Corrosion Analysis, Cover meter test, Rebound Hammer test, Ultrasonic Pulse Velocity test, Crack measurement techniques, Concrete Endoscopy and Thermal imaging, Pull-off test and Pull-out test etc. (16 Hrs)

**Materials and Methodology of Repairs:** Repair analysis and design. Repair materials and their properties. Methodologies of crack and patch repair used of Polymer modified mortar, Polymer modified concrete, Polymer concrete. Injection grouting. Shotcreting. Joints and sealants. Rebar corrosion crack repair. (06 Hrs)

**Protection of Concrete Structures:** Protective materials and their properties for moisture barrier systems, Above-grade and below grade waterproofing of concrete structures. Systems like integral, crystalline, coatings, membranes etc., Thermal protection coatings. (04 Hrs)

**Rebar Corrosion Protection:** Methods of Corrosion protection. Corrosion inhibitors, Corrosion resistant steels, Cathodic Protection, Pre-packaged zinc sacrificial anode, Snap-on zinc mesh anode CP system. (04 Hrs)

**Maintenance of concrete structures:** Facets of maintenance. Planned preventive maintenance. Maintenance cycles. Statutory legislation and obligation. (03 Hrs)

#### Reference Books:-

1. "Concrete Repair and Maintenance", by Peter H .Emmons & Gajanan M. Sabnis, Galgotia Publication.
2. "Repairs and Rehabilitation", by Compilation from Indian Concrete Journal-ACC Publication.
3. "Guide to Concrete Repair and Protection", HB84-2006, A joint publication of Australia
4. "Concrete Repair Association", by CSIRO and Standards Australia.
5. "CPWD hand book on Repairs and Rehabilitation of RCC buildings" by DG(Works), CPWD, Government of India (Nirman Bhawan), <http://www.cpwd.gov.in/handbook.pdf>

6. "Guide to Concrete Repair", by Glenn Smoak, US Department of the Interior Bureau of Reclamation, Technical Service Center, <http://books.google.co.in>
7. "Management of Deteriorating Concrete Structures", by George Somerville, Taylor and Francis Publication
8. "Concrete Building Pathology", by Susan Macdonald, Blackwell Publishing.
9. "Testing of Concrete in Structures", by John H. Bungey, Stephen G. Millard & Michael G. Grantham, Taylor & Francis Publication.
10. "Durability of concrete and cement composites", by C.L. Page & M.M. Page, Woodhead Publishing

**CE4038 TUNNEL ENGINEERING Cr-3**

Site investigations, Geotechnical Considerations of tunneling.	<b>(03 Hrs)</b>
Design of Tunnels	<b>(15 Hrs)</b>
Construction & Excavation methods, soft ground tunnels, Rock tunnels.	<b>(08 Hrs)</b>
Micro tunneling techniques, Tunnel support design.	<b>(05 Hrs)</b>
Ventilation of tunnels, tunnel utilities, safety aspects	<b>(05 Hrs)</b>

**Text Books:**

1. "Tunnel Engineering Handbook" by J O Bickel & T R Kuesel, Chapman & Hall, New York, 2<sup>nd</sup> edition, 1996
2. "Rock Mechanics Design in Mining & Tunneling" by Z T Bieniawski, Balkema Publication, Sept 1989

**CE4039 PAVEMENT MATERIALS Cr-3**

<b>Conventional aggregates:</b> Source, preparation, grading, testing and their evaluation	<b>(05 Hrs)</b>
<b>Bituminous binders:</b> Properties, testing and applications.	<b>(05 Hrs)</b>
<b>Bituminous mixes:</b> Design, testing and evaluation; Modeling of bituminous binders and mixes.	<b>(06 Hrs)</b>
Materials for cement concrete and semi-rigid pavements, Design of mixes for stabilized roads.	<b>(08 Hrs)</b>
<b>Non-conventional and new pavement materials:</b> their application and limitations.	<b>(06 Hrs)</b>
Modern methods of testing and evaluation of paving materials.	<b>(06 Hrs)</b>

**Text Books:**

1. "Principles of Transportation and Highway Engineering", by G. V. Rao, Tata Mc. Graw Hill, 1st Ed. 1995.
2. "Principles of Traffic and Highway Engineering" by N.J. Garber, L.A. Hoel and R. Sarkar, Cengage Learning India Pvt. Ltd., First Indian Reprint 2009.

**Reference books:**

1. "Manual for Construction and Supervision of Bituminous works", by Indian Roads Congress, New Delhi, 2005.
2. Relevant IRC, ASTM and AASHTO codes and specifications.
3. "Principles of Transportation Engg", by P. Chakraborty and A. Das, PHI Publication, 1st Ed. 2nd reprint 2005.

**CE4041 ENGINEERING GEOLOGY Cr-3**

<b>General Geology:</b> Branches and scope of geology, Earth, its position in the solar systems, surface features and internal structure, work of natural agencies like lakes, oceans, atmosphere, wind, streams, sea, glacier, earth movements. Types of weathering, mountains and mountain building.	<b>(04 Hrs)</b>
<b>Mineralogy:</b> Definition of crystal and a mineral, the study of the physical properties and occurrence of quartz, Feldspar, Mica, Kyanite, calcite, talc, corundum, gypsum, fluorite, biotite, muscovite, graphite, realgar, magnetite, limonite, pyrite, galena, barite, dolomite, garnet, tourmaline, chalcopyrite, opal, topaz, aurtite, hornblende, epidote, kaolinite, diamond.	<b>(04 Hrs)</b>

**Petrology:** Formation and classification of rocks into three types, igneous, sedimentary and metamorphic rocks, description of physical properties for constructional purposes of granite, pegmatite, dolerite, gabbro, basalt, sandstone, conglomerate, breccias, limestone, shale, schist, marble, quartzite, khondalite, slate, gneiss, and esite, stratigraphy of India(a general idea),principles of correlation, fossils, their preservation and significance.

(04 Hrs)

**Structural geology:** strike and dip, out crops, volcanoes, overlaps, inliers and outliers, types classification of folds, faults, joints, unconformities, surface mapping, identification of potential zones of weakness or failure, analysis using stereonetes.

(04 Hrs)

**Engineering Geology:** Ground water, zones of ground water, water table and perched water table, water bearing properties of rocks, occurrence of ground water, springs, selection of a site for well sinking and ground water investigations.

(04 Hrs)

**Earthquakes and landslides:** Classification, causes and effects of earthquakes and landslides, seismic curve, seismographs, seismograms, accelograms, seismic problems of India, seismic zones of India, remedial measures to prevent damage for engineering structures, case histories.

(03 Hrs)

**Geological investigation:** Interpretation of geological maps, use of aerial maps in geological surveying, geophysical methods as applied to civil engineering for subsurface analysis (Electrical and seismic methods).

(03 Hrs)

**Geology of dams and reservoirs:** Types of dams, requirements of dam site, preliminary and detailed geological investigations for a dam site, important international and Indian examples of failures of dams and their causes, factors affecting the seepage and leakage of the reservoirs and the remedial measures , silting of reservoirs.

(05 Hrs)

**Rock mechanics and tunneling:** Purposes of tunneling and geological problems connected with tunneling, geological considerations in road alignment, roads in complicated regions problems after road construction, geology of bridge sites.

(05 Hrs)

**Text Books:**

1. "Engineering Geology", by Parbin Singh, S.K.Kataria and Sons, 2009

**Reference Books**

1. "Structural Geology", by H.P.Billings, Prentice hall publishers, third edition

**CE4042                      EARTH AND EARTH RETAINING STRUCTURES                      Cr-3**

Earth and Rock Fill Dam, Choice of types, material, foundation, requirement of safety of earth dams, seepage analysis

(05 Hrs)

**Mechanically Stabilized Earth retaining walls:** General considerations, backfill and reinforced materials, construction details, design method, stability.

(10 Hrs)

**Soil nailing:** applications, advantages, limitations, methods of soil nailing, case histories, analysis and design.

(08 Hrs)

**Reinforced Soil:** Introduction, basic components, strength characteristics, soil-reinforcement interface friction.

(04 Hrs)

**Reinforced Earth wall:** Stability analysis, construction procedure, drainage, design Procedure

(02 Hrs)

**Foundation on Reinforced Soil Bed:** Pressure ratio, analysis of strip, isolated, square and rectangular footing on reinforced soil bed, ultimate bearing capacity of footing on reinforced earth slab. Fiber reinforced soil.

(07 Hrs)

**Text Books:**

1. "Reinforced soil and its engineering application",by Swami Saran, Second Edition, I. K. International Publishing House Pvt. Ltd, 2011
2. "Soil Mechanics and Foundation Engineering", by V N S Murthy, CBS Publisher, 2009
3. "Analysis and Design of Foundation", by J. E. Bowles, TMH Education, New Delhi.

**CE4043                      MACHINE FOUNDATION ENGINEERING                      Cr-3**



**Vibration of elementary Systems:** Vibration motion, vector representation of harmonic motion, Single degree of freedom system: Free Vibrations- damped and undamped, Forced Vibrations – damped and undamped.

(08 Hrs)

**Dynamics of soil-foundation System:** types of machine foundation, design criteria, dynamic loads, physical modeling and response analysis, Barken's approach, Ford & Haddow's analysis, Hammer foundation, I. S. Codes.

(08 Hrs)

**Dynamic soil testing techniques:** cyclic plate load test, block vibration test, shear modulus test, geophysical methods, Resonance-column test, Two & three borehole techniques, Model tests using centrifuge and shake table, recent developments.

(06 Hrs)

**Vibration isolation and control:** vibration transmitted through soil media, active and passive isolation, vibration isolation – rigid foundation and flexible foundation, method of isolation, properties of material and media used for isolation, vibration control of existing machine, foundation isolation by barriers.

(07 Hrs)

**Guidelines for design and construction of machine foundation:** data required for design of reciprocating, impact and rotary type machines, guidelines for the design of different type machines, construction guidelines, guidelines for providing vibration absorbers.

(07 Hrs)

**Text Books:**

1. "Foundation for Machine", by S. Prakash, Wiley, 1988
2. "Soil Dynamics and Machine Foundations", by Swami Saran, Galgotia Publication Pvt Ltd, New Delhi
3. "Vibrations of Soil and Foundations", by Richard, Hall & Wood, Prentice Hall, June 1970
4. "Dynamics of Structures", by Anil K. Chopra Prentice Hall, 4th edition 2012
5. "Vibration Analysis and Foundation Dynamics", by N. S. V. Kameswara Rao, S. Chand New Delhi

**CE4044**

**GROUND IMPROVEMENT ENGINEERING**

**Cr-3**

**Introduction:** Need – methods – suitability – Mechanical modification: principle - Surface compaction: Field compaction and equipments, compaction specification and controls. Vibration methods: dynamic consolidation, vibratory rollers, Vibro floatation.

(06 Hrs)

**Drainage methods:** Well point systems, deep well drainage, vacuum dewatering system, design of dewatering system – field permeability tests, dewatering by electro osmosis. Preloading, sand drains, wick drains- Thermal methods case studies.

(06 Hrs)

**Chemical stabilization:** cement stabilization- factors affecting soil cement mixing-admixtures- lime stabilization-effect of lime on soil properties construction of lime stabilized bases-bituminous stabilization-thermal stabilization- electrical stabilization.

(04 Hrs)

**Grouting:** Classification – Methods – Types – grouts – equipments, grouting design and layout, grout monitoring – applications – Case studies.

(05 Hrs)

**Earth Reinforcement:** mechanism and concept- stress strain relationship of reinforced soil-design theories and stability analysis of retaining wall-tie back analysis-coherent gravity analysis- application areas of earth reinforcement.

(08 Hrs)

**Geotextiles:** Soil reinforcement with geotextiles- classification- concepts geotextiles as separators, filters, and drainage media-damage and durability of geotextiles.

(07 Hrs)

**Text Books:**

1. "Geotechnical Engineering", by Shashi K Gulhati and Manoj Datta, 9<sup>th</sup> Reprint edition, TMH Education Pvt. Ltd.
2. "Ground Improvement techniques", by P. Purushothama Raj, Laxmi publications Pvt. L, 2005
3. "Reinforced soil and its engineering application", by Swami Saran, Second Edition, I. K. International Publishing House Pvt. Ltd, 2011
4. "Principle and Practice of Ground Improvement", by Jie Han, 1st Edition, Wiley Publication

**Reference Books:**

1. "Foundation Analysis and Design", by J.E.Bowles, MCGRAW-HILL Higher Education, 5 Edition 1997.
2. "Soil Improvement techniques and their evolution", by Van Impe, CRC Press, Jan 1989
1. "Foundation Engineering", by P.C.Verghese, PHI Learning Pvt. L. 2005

**CE4045**

**OPEN CHANNEL HYDRAULICS**

**Cr-3**

Uniform flow, determination of roughness coefficients and the factors affecting the roughness, computation of uniform flow, flood discharge, determination of normal depth and velocity, flow in composite roughness; Design of channels for uniform flow in non-erodible and erodible with grassed channels. **(08 Hrs)**

Dynamics of Gradually varied flow and classification of flow profile, methods of computation, Dynamics of spatially varied flow - analysis of flow profile and computation by method of numerical integration. **(10 Hrs)**

Rapidly varied flow, classification, flow over spillway, Hydraulic Jump, types with characteristics of jump, the surface profile and location of the jump, jumps as energy decapitator, rapidly varied flow through non-prismatic channels. **(10 Hrs)**

Unsteady flow, dynamics of gradually varied unsteady flow, solution of unsteady flow equations, rapidly varied unsteady flow, positive and negative surges, flood routing, principle and methods of flood routing. **(08 Hrs)**

**Text Books:**

1. "Open Channel Flow", by F. M. Henderson, MacMillan Publishing Company, 1996.

**Reference Books:**

1. "Flow through Open Channel", K. G. Rangaraju, Tata McGraw Hill, New Delhi.
2. "Open Channel Hydraulics", by V.T Chow, McGraw-Hill Publishing Company, New Delhi, 1993.
3. "The Hydraulics of Open Channel Flow An Introduction", by H. Chanson, Elsevier.
4. "Flow in Open Channel", by K. Subramanya, Tata McGraw Hill, New Delhi.
5. "River Hydraulics, (Technical Engineering and Design Guides as adapted from the U.S. Army Corps of Engineers, No. 18) New York", ASCE Press.
6. "Engineering Hydraulics", by H. Rouse, John Wiley & Sons.

**CE4046 TRAFFIC ENGINEERING & TRANSPORTATION PLANNING**

**Cr-3**

**Traffic Engineering:** Importance of Traffic engineering; Road User Characteristics, Human factors governing road user behavior, vehicle characteristics, slow moving traffic characteristics in Indian conditions. **(06 Hrs)**

**Traffic Engg. Studies:** Traffic Volume, Origin and Destination, Speed and delay: Measurements; Speed-density-volume relationships; Shock waves in Traffic flow, Headway Distribution. **(08 Hrs)**

**Highway capacity analysis:** cases of different types of highways; Intersection; Parking types; Off street parking; Facilities. **(05 Hrs)**

**Traffic control devices:** Channelization, rotary and Traffic signals, Traffic Signs and making. **(05 Hrs)**

**Transportation Planning:** Brief ideas about urban and regional transportation systems; Components of transportation system planning; Land use planning, Trip generation and distribution. **(08 Hrs)**

Traffic assignment and modal split, Optimal scheduling; Economic evaluation of transportation plans. **(04 Hrs)**

**Text books**

1. "Traffic Engg & Transportation Planning", by L. R. Kadyali, 4th Ed, Khanna Publishers, 2003
2. "Transportation Planning and Planning", by C. S. Papacostas and P. D. Prevedouros, 3rd Ed, PHI, 2002

**Reference books:**

1. "Transportation Engg: An introduction", by C. J. Khisty & B. K. Lall, 3rd Edition, PHI, 2006.
2. "Principles of Transportation Engg", by P. Chakraborty and A. Das, 1st Edition, 2nd reprint 2005. PHI,
3. "Highway Traffic Analysis and Design", by R. J. Salter, ELBS Macmilan, 2nd Edition, 1990.
4. Relevant I.R. C. Codes.

**CE4047**

**Ground Water Hydrology and Management**

**Cr-3**

Hydrologic cycle, Water balance, Occurrence of ground water: Origin, geological formations as aquifers, type of aquifers, groundwater basins, springs. **(04 Hrs)**

Darcy's Law, validity of Darcy's Law permeability, laboratory and field measurement of permeability, groundwater Flow lines. **(06 Hrs)**

Well Hydraulics, steady flow to a well, steady radial flow to a well in confined aquifer and unconfined aquifer, unsteady radial flow into a confined aquifer, Non equilibrium Theis equation, Theis method of solution, multiple well system. **(06 Hrs)**

**Methods of constructions of deep and shallow wells:** The percussion (or cable tool) method of drilling, Direct circulation hydraulic rotary method, Down the hole hammer method, well logs-receptivity logging, testing of wells for yield. **(05 Hrs)**

Surface and Subsurface investigations of groundwater, Geophysical exploration, Electrical resistivity method, aerial photo interpretation, remote sensing applications to ground water exploration, test drilling. **(05 Hrs)**

Artificial recharge by water spreading, through pits and shaft, recharge through other methods. **(05 Hrs)**

**Groundwater management:** Concepts of Basin management, Equation of hydrologic equilibrium, groundwater basin investigations, conjunctive use of surface and groundwater. **(05 Hrs)**

**Text Book:**

1. "Groundwater Hydrology", by D. K. Todd, John Wiley and Sons.

**Reference Books:**

1. "Groundwater and Tube Wells", by S. P. Garg, Oxford and IBH Publishing Co., New Delhi.
2. "Hand book of Applied Hydrology", by V. T. Chow, McGraw-Hill Publishing Company, New York.
3. "Ground Water", by H. M. Raghunath, New Age International Publishers; 3rd edition, Dec 2007

**CE4048**

**PAVEMENT DESIGN**

**Cr-3**

**Introduction:** Classification of pavements, Difference between highway and runway pavements, Factors affecting structural design, Characteristics of traffic loading, Concept of VDF and Computation of design traffic. **(04 Hrs)**

**Principles of pavement design:** Concepts of structural and functional failures, Performance criteria; Analysis of pavements: ESWL. **(05 Hrs)**

Analysis of flexible and concrete pavements. **(08 Hrs)**

**Design of pavements:** IRC, AASHTO and other important methods of design of bituminous and concrete pavements. **(12 Hrs)**

**Pavement evaluation techniques:** Benkleman beam, Falling weight deflectometer and other equipments. Concepts of pavement maintenance management. **(07 Hrs)**

**Text books**

1. "Pavement Design", by R. Srinivasa Kumar, 1<sup>st</sup> Edition, University Press, 2013.
2. "Principles of Transportation Engineering", by P. Chakroborty & A. Das, PHI Publication, 1st Ed., 2nd reprint 2005.

**Reference books**

1. "Design and Performance of Road Pavements", by D. Croney & P. Croney, 3<sup>rd</sup> Edition, McGraw-Hill Professional; 1997.
2. "Principles of Transportation Engineering", by P. Chakroborty & A. Das, 1<sup>ST</sup> Edition, 1SPHI Publication, 2nd reprint 2005.
3. "Highway Engineering", by S. K. Khanna & C. E. G. Justo, Nemchand Bros, Roorkee, 8th edition 2001, Reprinted 2003.
4. "Pavement Analysis and Design", by Y. H. Huang, 2<sup>nd</sup> Edition, Prentice Hall, 2003.
5. Relevant I. R. C. and AASHTO Codes.

**CE4049**

**REMOTE SENSING & GIS**

**Cr-3**

**Introduction to Remote Sensing system:** data acquisition and processing, Applications, Multi concept in remote sensing. **(05 Hrs)**

**Physical Basis of Remote Sensing:** EMR nature, definition, nomenclature and radiation laws. Interaction in atmosphere-nature, its effects in various Wave-length regions, atmospheric windows; Interaction at ground surface soils Geometric basis of interaction. **(05 Hrs)**

**Platform and Sensors:** Terrestrial, aerial and space platforms, Orbital characteristics of space platforms, sun- and geo-synchronous; Sensor systems-radiometers, opto-mechanical and push broom sensor. **(04 Hrs)**

**Resolution :** spectral, spatial, radiometric and temporal; IFOV, FOV, GRE; geometric characteristics of scanners, V/H and S/N ratio; Data products from various air and space borne sensors-aerial photographs, LiDAR, Landsat, SPOT, IRS, ERS, IKONOS etc. **(05 Hrs)**

**Image Interpretation:** elements of interpretation; digital image processing and interpretation, Field verification. **(05 Hrs)**

**Geographical Information systems:** components of GIS-data acquisition, spatial and attribute data, pre-processing, storage and management; data structures raster and vector data. **(06 Hrs)**

**GIS analysis functions:** Errors and corrections; data presentation and generation of thematic maps. **(06 Hrs)**

**Text books:**

1. "Remote Sensing and GIS", by M. Chandra and S. K. Ghosh, Narosa Pub, 2007.
2. "Remote Sensing and Image Interpretation", by T. M. Lillisand, R. W. Kaifer & J. W. Chipman, 6th Edition , John Wiley and sons Inc, Nov 2007.

**Reference Books:**

1. "An Introduction to GIS", by I. Heywood, S. Cornelius and S. Carver, 2nd Ed, Pearson Education, 2002.

**CE4051 FLOOD AND DROUGHT ESTIMATION AND MANAGEMENT Cr-4**

**Flood Estimation:** Estimation of design flood- empirical methods, envelope curve method, unit hydrograph method, flood estimation in small watersheds, urban catchment and influence of urban drainage. **(09 Hrs)**

**Flood Control and Management:** Detailed study of various methods of flood control- flood plain identification, flood disaster monitoring and mitigation procedures, various methods of forecasting data, communication and warning, flood fighting. **(09 Hrs)**

**Drought Classification:** Importance, definition-NCA classification, direct and indirect losses. **(06 Hrs)**

**Drought Estimation:** Drought severity assessment, methods in meteorological, hydrological and agricultural aspects. **(06 Hrs)**

**Drought Monitoring:** Supply and demand oriented measures, drought prone areas programme (DPAP), short term and long-term strategies, drought management. **(06 Hrs)**

**Text Books:**

1. "Irrigation Engineering & Hydraulic Structures" by S.K. Garg, Khanna Publishers
2. "Engineering Hydrology" by K. Subhrmanya, TMH Education Pvt. Ltd, New Delhi

**Reference Books:**

1. "Applied Hydrology", by Ven Te Chow, David, R. Maidment, Lary, W. Mays., McGraw Hill Publications, 1995.
2. "Elementary Hydrology", by Vijay P. Singh, Prentice Hall of India, 1994.
3. "Hydrology", H.M. Raganath , by Wiley Eastern Ltd. 1996.
4. "Handbook of Applied Hydrology", by Ven Te Chow, etal , McGraw Hill Publications, 1995.

**CE4052 DISASTER MANAGEMEN Cr-3**

**Cyclones:** Formation, Cyclonic precipitation, anti-cyclones. **(04 Hrs)**

**Flood:** Flood and its estimation, Flood warning, Flood protection measures. **(04 Hrs)**

**Earthquake:** Causes of earthquake, plate tectonics, seismic zoning map, Characteristics of strong ground motions & attenuation, damage assessment. **(06 Hrs)**

Rehabilitation and retrofitting of structures. **(06 Hrs)**

**Environmental disaster:** Impact assessment studies, computation and preparedness. **(06 Hrs)**

**Disaster management:** Developing appropriate technology for disaster mitigation, Role of management teams, importance of awareness, alertness and preparedness camp. **(10 Hrs)**

**Text Book:**

1. "Earthquake resistant building construction", N. Sharma, S. K. Kataria & Sons, New Delhi.

**Reference books:**

1. "Engineering Hydrology", K. Subramanian, Tata McGraw Hill, New Delhi.
2. "Elementary Hydrology", V. P. Singh, Prentice Hall of India.
3. "Disaster Mitigation, Preparedness, Recovery and Response", V. P. Singh, SBS Publishers & Distributors Pvt. Ltd. Heinemann.
4. "Practical Guide to Environmental Management", F. B. Friedman, McGraw Hill.

**CE4053 SOLID AND HAZARDOUS WASTE MANAGEMENT Cr-3**

**Introduction to Solid and Hazardous waste management:** Classification of solid waste – source-based and type-based. Functional elements of solid waste management. **(03 Hrs)**

**Waste Generation aspects:** Waste generation and composition, Waste characteristics, Effects on public health and environment. **(04 Hrs)**

**Waste collection, storage, transport and disposal:** Collection components, storage devices, collection operation, Transfer station, Waste collection system design, disposal options – sanitary landfill, landfill gas emission, leachate formation. **(04 Hrs)**

**Waste Processing techniques:** Mechanical volume and size reduction, component separation, drying and dewatering. **(04 Hrs)**

**Source reduction, product recycling and recovery of biological conversion products:** Basics of source reduction, Elements of recycling – source separation, drop-off, curbside programme, storage and collection of recyclables etc., Composting, Biogasification. **(09 Hrs)**

**Incineration and energy recovery:** Incineration technologies, Energy recovery, Air emission and its control. **(03 Hrs)**

**Hazardous waste (HW):** management and treatment. Identification and classification of HW, Management strategies of HW, HW treatment – physical, chemical and biological. **(04 Hrs)**

**Integrated Waste Management (IWM):** Characteristics of IWM, Planning for IWM, Implementation of IWM, Benefits of IWM. Introduction to life cycle assessment tool and its application in IWM. **(05 Hrs)**

**Text Books:**

1. "Management of Municipal Solid Waste", by T.V. Ramachandra, Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore, TERI Press, The Energy and Resources Institute, New Delhi, 2006.
2. "Integrated Solid Waste Management", by Tchobanoglous, Thisen & Vigil, McGraw Hill International.

**Reference Books:-**

1. "Solid Waste Management in Developing Countries", by A.D. Bhide, Nagpur publications
2. "Environmental Pollution Control Engineering", C.S. Rao, Wiley Eastern, Manual of solid waste of management, CPHEEO
3. "Hazardous Waste Management" by Lagrega, Buckingham & Evans, McGraw Hill International

**CE4054 CONSTRUCTION METHODS & EQUIPMENTS Cr-3**

**Construction Equipments:** Factors affecting selection of equipment, Owning and Operating Cost. **(06 Hrs)**

**Construction Equipment fundamentals:** Classification of Construction Equipment, Earth moving Equipments, Hauling, Hoisting, Conveying Equipments, Aggregate and concrete production Equipments, Pile Driven Equipments, Cranes. **(12 Hrs)**

Analysis of production output and costs of Excavating Equipments, Characteristics and performances of equipment for Earth moving. **(10 Hrs)**

**Deep excavation support systems:** Diaphragm wall, sheet piling, secant pile, contiguous pile, strutting, ground anchors. **(08 Hrs)**

**Text Book:**

1. "Construction Planning, Equipment and Methods", R. L. Peurifoy, P. E. Clifford, J. Sehexnayder, P.E., Tata Mc Graw Hill Publishing, N.D

**Reference Books:**

1. "Construction Equipment and Management" by S.C.Sharma, Khanna Publishers, New Delhi.
2. "Construction Equipment and its Planning and Application", by Dr.Mahesh Verma, Metro Politan Book Company, New Delhi.
3. "Construction Planning and Equipment", by Satyanarayana & Saxena, Standard Publishers Distributors, Edition 3, 1985.
4. "Heavy Construction", by Vazirani & Chandolu, Khanna Publisher Delhi.

**CE4055 CONSTRUCTION FINANCE MANAGEMENT Cr-3**

Construction accounting, Profit & Loss, Balance sheet, Income statement, Ratio analysis, Depreciation and amortization, Engineering economics, time value of money, discounted cash flow, NPV, ROR, PI, comparison, incremental rate of return, benefit-cost analysis, replacement analysis, break even analysis, risks and uncertainties. **(12 Hrs)**

Management decision in capital budgeting, taxation and inflation. **(06 Hrs)**

Work pricing, cost elements of contract bidding and award, revision due to unforeseen causes, escalation, **(04 Hrs)**

Turnkey activities, project appraisal and project yield, working capital management finance. International finance. **(02 Hrs)**

Budgeting and budgetary control, Performance budgeting appraisal through financial statements, **(04 Hrs)**

Practical problems and case studies, project cash flow **(04 Hrs)**

**Text Books:**

1. "Engineering Economics" by R.Pannerselvam P.H.I, N.D. 2012
2. "Engineering Economics" by J.L.Riggs., Mc Graw Hill, 1976

**Reference Books:**

- 1 "Construction Planning & Management" by U.K.Shrivastava, Galgotia N.D, 2012
3. "Project Planning, Analysis, Selection, Implementation & Review" by Prasanna Chandra (Tata McGraw Hill Publishing Co Ltd,ND),2010
4. "Essentials of Management" by Harold Koontz and Heinz Weihrich (Mc Graw Hill)
5. "Principles of Management" by Dr. M. .M. Verma and Agarwal, Himalaya Publisher, 2008
6. "Essentials of Management" by B.P. Singh and J.N Chhabra, South Western College Publishing-1991
7. "Industrial Engg and Management" by Dr.O.P.Khanna, Khanna Publisher - 2008
8. "Construction Management and Planning" by B.Sengupta and H.Guha Tata Mc Graw Hill, ND 1995
9. "Principle of Construction Management" by Pilcher, Mc Graw Hill, 1981

**CE4056 COST EFFECTIVE HOUSING Cr-3**

Income based classification of population. High, Middle, Low Income group and economically weaker section. **(03 Hrs)**

Basic shelter issues in India. Mindset of low income group and economically weaker section people. Problems associated with this group with relation to land, living condition and dwelling standards; Recommendation of housing and urban development corporation. **(09 Hrs)**

Traditional materials and techniques (rammed earth, sun dried bricks, wood, bamboo, jute); Alternate and developed methods / materials of construction: pressed soil blocks, use of stabilized soil, soil cement blocks, fly ash brick, by-product gypsum, foundation, arch foundation, walling- rat trap bond, roofing- filler slabs. Precast blocks and their use. **(09 Hrs)**

Laurie Baker's experiments in low cost housing. ; Modular constructions. Experimental observations/findings of CBRI. **(06 Hrs)**

Use of cost effective technologies (CECT) in building constructions, stub foundation, Rat trap bond (walls), brick arches (alternates to lintels) filler slab (roof). Use of Ferro cement. (06 Hrs)  
Cost effective housing for natural disaster mitigation. (03 Hrs)

**Text books:**

1. "Low cost Housing Technology", L. J. Goodman, R. P. Lama, R. Rajani, F. J. Burian, Pergamon Press, 1979.
2. International Association for Earthquake Engg. Guidelines for Earthquake Resistant Non-Engineered Construction.

**Reference books:**

1. "Are slums inevitable", L. Baker, Centre of science & technology for Rural Development, (COSTFORD) Ayanthple, Thrissur, Kerala.
2. "Houses - How to reduce the building cost", L. Baker, Centre of science & technology for Rural Development, COSTFORD Ayanthple, Thrissur-68003, Kerala.

**CE4058 WATER POWER ENGINEERING Cr-3**

Concept of water power Engineering , Different heads such as Gross head, Effective head, Design head, rated head, critical head, classifications of water power plants based on hydraulic characteristics, topography, head , capacity of plant, load etc. Major hydroelectric schemes in India. (06 Hrs)

Planning a site selection of hydropower projects according to availability of Quantity and head of water , estimating of power potential using Mass curve and flow duration curves Economics of water power plants load factor, capacity factor, load curve, effect of pondage on flow duration curve. Estimation of unit cost of hydro power and comparison with unit cost of stream power station, General planning of hydropower projects. (06 Hrs)

Various types of intake structures. Penstocks of steel pipes economic diameter, number of penstocks wall thickness of steel penstocks, shell theory of design, welded and riveted steel pipes, Accessories of penstocks. Expansion joints anchor blocks and pipe supports. Tunnels. Dimensions and shape economic size of tunnel Tunnel lining. (08 Hrs)

Theory of water hammer, Arithmetic integration and graphical method of analysis, surge tanks and types of surge tanks theory of simple surge tank and design, Mathematical treatment f water surface oscillations including friction. Pressure relief valves stability of surge tank. Thoma formula, Balancing reservoir and fore bays Pressure. (08 Hrs)

Selection of type of turbines according to head & specific speed, various types casing of turbines. Determination of their shapes, main relative dimension of runner. Draft tube, its functions, draft tube theory. In take conduits, Preliminary power house dimensioning, general arrangement of power house. (08 Hrs)

**Text Book**

1. "Water Power Engineering", by M.M.Dandikar & K.N.Sharma, Vikas Publication, 1979.

**Reference Book**

- 1 "Water Power Engineering", by H.K. Barrows 2<sup>nd</sup> Edition, McGraw-Hill, London, 1934
- 2 "Irrigation Water Resource & Water Power Engineering", by P.N.Modi, Standard Book House Dec 2008

**CE4062 WATER RESOURCES SYSTEMS Cr-3**

Objective of water resources development, economic analysis and discounting techniques. (05 Hrs)

Conditions of project optimality, graphic optimization techniques for multipurpose projects. (04 Hrs)

Analytical optimization techniques for water resources projected by linear programming, non-linear programming and dynamic programming, optimization by simulation, mathematical models for large scale multipurpose projects, different case studies. (09 Hrs)

Stochastic optimization techniques, water quality subsystems. (09 Hrs)

Optimum operation model for reservoir systems by incremental dynamic programming, sequencing of multipurpose project. **(09 Hrs)**

**Text Book:**

1. "Design of Water", by Arthur Mass et.al., Harvard Univ. Press., Cambridge.

**Reference Books:**

1. "Water Resources Systems " by MacMillan & Co, Prentice Hall, 1962.
2. "Economics of Water Resources Planning", by L.D. James and R. R. Leo, McGraw Hill, New York, 1971.
3. "Water Resources Systems Engineering", by W.A. Hall and J.A. Dracup, McGraw Hill, New York, 1970.

**CE4064 ENVIRONMENTAL IMPACT ASSESSMENT & AUDITING Cr-3**

Evolution of EIA; EIA at project; Regional and policy levels; Strategic EIA; EIA process; Screening and scoping criteria; Rapid and comprehensive EIA. **(06 Hrs)**

Specialized areas like environmental health impact assessment; Environmental risk analysis; Economic valuation methods; Cost-benefit analysis; Expert system and GIS applications; Uncertainties; Practical applications of EIA; EIA methodologies; Baseline data collection; Prediction and assessment of impacts on physical, biological and socio-economic environment. **(12 Hrs)**

Environmental management plan; Post project monitoring, EIA report and EIS; Review process. **(06 Hrs)**

Case studies on project, regional and sectoral EIA; Legislative and environmental clearance procedures in India and other countries, Sating criteria; CRZ; Public participation. **(08 Hrs)**

Resettlement and rehabilitation. Environmental auditing. **(04 Hrs)**

**Text Books:**

1. "Introduction to Environmental Impact Assessment: A Guide to Principles and Practice" ,by B. M. Noble, Oxford University Press, USA, 2005.
2. "Introduction to Environmental Impact Assessment: Principles, and Procedures, Process, Practice and Prospects (The Natural and Built Environment Series)", by J. Glasson, Routledge; 3rd edition, 2005.

**Reference books:**

1. "Methods of Environmental Impact Assessment (The Natural and Built Environment Series)" , by P. Morris, 2nd edition, Spon Press, USA, 2001.
2. "Environmental Assessment", by R. K. Jain, L. V. Urban, G. S., Stacey, Harold, E. Balbach, 2 edition, McGraw-Hill Professional; 2001.

**CE6106 CONSTRUCTION ENGINEERING PRACTICES Cr-3**

Concrete construction methods; form work design and scaffolding, slip form and other moving forms, pumping of concrete and grouting, mass concreting (roller compacted concrete), ready mixed concrete. **(10 Hrs)**

Various methods of placing and handling concrete, Accelerated curing, hot and cold weather concreting, under water concreting, pre-stressing. **(06 Hrs)**

Steel and composites construction methods; Fabrication and erection of structures including heavy structures, Prefab construction, industrialized construction, Modular coordination. **(06 Hrs)**

Special construction methods, Construction in Marine environments, high rise construction, Bridge construction including segmental construction. **(08 Hrs)**

Incremental construction and push launching techniques, River valley projects. **(06 Hrs)**

**Text Books:**

1. "Formwork for Concrete Structures", by Robert L Peurifoy & Garold D.Oberiender, McGraw-Hill, 1996.



**Reference Books:**

1. "Formwork for Concrete", by M.K Hurd, Fifth Edition, Special Publication No-4, (American Concrete Institute, Detroit,1980).
2. "Guide for Concrete Formwork",American Concrete Institute. Box No 19150, Detroit, Michigan-48219.

**CE6134 PROJECT QUALITY AND SAFETY MANAGEMENT Cr-3**

Introduction to quality planning and control of quality during design of structures, Quantitative techniques in quality control, Quality assurance during construction. **(06 Hrs)**

Inspection of materials and machinery in process inspection and test, Preparation of quality manuals, check list and inspection report, Establishing quality assurance system. **(04 Hrs)**

Quality standards/ codes in design and construction, Concept and philosophy of total quality management (TQM), Training in quality and quality management systems (ISO-9000). **(04 Hrs)**

Concept of safety, Factors affecting safety, Physiological, Psychological and Technological, Planning for safety provisions, Structural safety, Safety consideration during construction, demolition and during use of equipment. **(06 Hrs)**

Management of accidents/ injuries and provision of first aid, Provisional aspect of safety, Site management with regard to safety recommendations. **(06 Hrs)**

Training for safety awareness and implementation, Formulation of safety manuals, safety legislation, standards/ codes with regard to construction, Quality vs. Safety. Case studies. **(10 Hrs)**

**Text book:**

1. "Construction Safety" ,by Jimmy W. Hinze, Prentice Hall Inc 1997.

**References Books:**

1. "Construction Safety and Health Management",by Richard j.coffe, jimmie Hinze and Theo C.Haud, Prentice Hall Inc 2001.
2. Tamilnadu Factory Act.
3. "Construction Planning and Management", by UK Shrivastava, Golgotia Publication.

**CE6136 Building Services Planning Cr-3**

Components of urban forms and their planning. **(06 Hrs)**

Concepts of neighborhood unit, Street system and layout in a neighborhood, Functional planning of buildings. **(04 Hrs)**

Optimization of space; Spatial Synthesis graphical techniques, heuristic procedures, formulation of linear and non-linear optimization problem. **(10 Hrs)**

Space requirements and relationships for typical buildings, like residential offices, hospitals, etc. Standard fire, fire resistance. **(08 Hrs)**

Classification of buildings, means of escape, alarms, Engineering services in a building as a systems, Lifts, escalators, cold and hot water systems, waster water systems, and electrical systems. **(10 Hrs)**

**Text Book:**

1. "Environmental Control Systems", by Mooref ,McGraw Hill,Inc 1994

**Reference Books:**

1. "Building Services", by Peter R.Smith & Warren G.Jullian, Applied Science Publisher ltd, London.
2. "Hand book of Buildings and Enclosure" ,by A.J.Elder & Martix Vinder Bary, McGraw Hill Book Co, 1982.
3. "The fire Precautions Act in Practices 1987", by Jane Taylor & Gordon Cooke, Architectural Press, June 1978

## CE6138    ADVANCED REPAIRS AND REHABILITATION STRUCTURES    Cr-4

**Introduction:** Need for strengthening due to various reasons such as ageing, natural calamities, increase of load, change of function and design, construction errors. **(03 Hrs)**

**Structural Strengthening:** Strengthening and retrofitting of columns, beams, walls, footings and slabs, piers of concrete structures by jacketing, external post-tensioning, replacing or adding reinforcement, plate bonding, textile reinforced concrete. **(13 Hrs)**

**Specialized Repairs:** Electro chemical repair using re-alkalization and chloride extraction techniques, Specialized repairs for chemical disruption, fire, marine exposure etc, Repair of damaged structures of water retaining structures, hydraulic structures, Pavements and Runways, Tunnels, Bridges, Piers and Flyovers, Parking Garages, Underwater repair, Masonary Repair, Repair and Restoration of Heritage Structures. **(08 Hrs)**

**Retrofitting by composite materials:** Fiber reinforced concrete, Ultra-high performance fibre reinforced concrete (UHPFRC), Fiber reinforced composites, Carbon fibre reinforced polymer (CFRP), Fibre wrapping (Carbon, Aramide, Glass). **(06 Hrs)**

**Seismic Retrofitting:** Seismic strengthening of existing RC structures, Use of FRP for retrofitting of damaged structures. **(02 Hrs)**

**Post-Repair Maintenance of Structures:** Protection & Maintenance schedule against environmental distress to all those structures. **(02 Hrs)**

Special cares in repair and rehabilitation of heritage structures. **(02 Hrs)**

### **Text Book:**

1. "Concrete Repair and Maintenance", Peter H. Emmons & Gajanan M. Sabnis, Galgotia Publication.
2. "Management of Deteriorating Concrete Structures", George Somerville, Taylor & Francis Publication.

### **Reference books:**

3. "Repairs and Rehabilitation", Compilation from Indian Concrete Journal-ACC Publication.
4. "Guide to Concrete Repair and Protection", HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
5. "CPWD hand book on Repairs and Rehabilitation of RCC buildings", published by DG(Works), CPWD, Government of India (Nirman Bhawan), <http://www.cpwd.gov.in/handbook.pdf>
6. "Guide to Concrete Repair", by Glenn Smoak, US Department of the Interior Bureau of Reclamation, Technical Service Center, <http://books.google.co.in>
7. "Concrete Building Pathology", Susan Macdonald, Blackwell Publishing.
8. "Testing of Concrete in Structures", John H. Bungey, Stephen G. Millard & Michael G. Grantham, Taylor & Francis Publication.
9. "Durability of concrete and cement composites", C.L. Page & M.M. Page, Woodhead Publishing.
10. "Concrete Repair, Rehabilitation and Retrofitting", M. Alexander, H. D. Beushausen, F. Dehn & P. Moyo, Taylor & Francis Publication.
11. "Concrete Repair Manual", Volume I & II, Published jointly by ACI, BRE, Concrete Society, ICRI.

## CE6231    FINITE ELEMENT METHOD

Cr-3

**Introduction:** The Continuum, Equations of Equilibrium, Boundary Conditions, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Different methods of structural analysis including numerical methods. Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct method, Energy approach, Weighted residual Method. **(12 Hrs)**

**One and Two Dimensional Problems:** Detail formulation including shape functions. stress strain relations, strain displacement relations and derivation of stiffness matrices using energy approach, Assembling of element matrices, application of displacement boundary conditions, Numerical solution of one dimensional problems using bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria. Finite Element modeling of two dimensional problems using Constant

strain Triangle(CST ) elements, Stress strain relations for isotropic and orthotropic materials, Four noded rectangular elements, axisymmetric solids subjected to axisymmetric loading. (12 Hrs)

**Isoparametric Elements:** Natural coordinates, isoparametric elements, four node, eight node elements. Numerical integration, order of integration. (06 Hrs)

**Plate Bending:** Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Concept of 3D modeling. (06 Hrs)

**Text Books:-**

1. "Finite Element Analysis", by C.S.Krishnamoorthy 2nd Edition, TMH Education, New Delhi
2. "Concepts and Applications of Finite Element Analysis", by R.D.Cook, 4th Edition, John Wiley & Sons, 2003.

**Reference books:**

1. "An Introduction to the Finite Element Method", by N.Reddy, 3rd Edition, McGraw Hill Education, 2005.
2. "The Finite Element Method", by O.C.Zienkiewicz, Butterworth-Heinemann Ltd; 5th Revised edition, August 2000
3. "Finite Element Analysis", by M.Mukhopadhaya, ANE Books, Dec 2009
4. "Finite Element Procedures in Engineering Analysis", by K.J.Bathe, Klaus-Jurgen Bathe, 1ST edition, Feb 2007

**CE6232**

**Design of Bridges**

**Cr-3**

Introduction, historical review, engineering and aesthetic requirements in bridge design. Introduction to bridge codes. Economic evaluation of a bridge project, Loading standard, IRC specification, Impact factor. (04 Hrs)

Site investigation and planning: Scour - factors affecting and evaluation. (03 Hrs)

**Bridge foundations:** Open, pile, well and caisson. Piers, abutments and approach structures-reinforced earth structure; Superstructure - analysis and design of right, skew and curved slabs. (14 Hrs)

**Girder bridges:** Types, load distribution, design. Orthotropic plate analysis of bridge decks. Introduction to long span bridges - cantilever, arch, cable stayed and suspension bridges. Methods of construction of R.C Bridges, (08Hrs)

Prestressed concrete bridges and steel bridges Fabrication, Launching & creation. Design and construction of construction joints (use of relevant codes of practice are permitted in the examination). (07 Hrs)

**Text Books**

1. "Design of Bridge Structures", by T. R. Jagadeesh & M. A. Jayaram, 2<sup>nd</sup> Edition, PHI Learning Pvt. Ltd.
2. "Design of Concrete Bridges", by M.G.Aswani, V.N.Vazirani & M.M.Ratwani, 2<sup>nd</sup> Edition, Khanna Publishers, New Delhi, 2004.

**Reference Books**

1. "Essentials of Bridge Engineering", D. J. Victor, Oxford and IBH.
2. "Design of Bridges", N. Krishna Raju, Oxford and IBH.
3. "Concrete bridge Practice: Analysis, Design and Economics", V. K. Raina, Tata McGraw Hill.
4. "Dynamics of Railway Bridges", L. Fryba, Thomas Telford Ltd ,April 1996

**CE6234**

**PRE-STRESSED CONCRETE**

**Cr-3**

Different systems of prestressing, Characteristics of concrete and steel, Other suitable materials, Losses in prestress. (08 Hrs)

Analysis and design of section for flexure, shear and torsion. Design of compressive member. Limit state design as per IS code. Introduction to Partial prestressing. (10 Hrs)

Stress distribution in end-block of post tensioned section: Magnel's method, Guyen's method, Rowe's method and IS code method. (04 Hrs)

Deflection of prestressed structures- short term as well as long term deflections of uncracked and cracked members.	(03 Hrs)
Indeterminate structures- Principles of design of prismatic continuous beams of two and three equal, unequal spans with variable moments of inertia.	(04 Hrs)
Composite construction of prestressed and in-situ concrete.	(02 Hrs)
Design of special structures- Circular tanks, Pipes, Mast, and Railway sleepers.	(05 Hrs)

**Text Book:**

1. *"Prestressed Concrete"*, by N. Krishna Raju, TMH, New Delhi.

**Reference Books:**

1. *"Design of Prestressed Concrete Structure"*, by T.Y. Lin, Asia Publishing House.
2. *"Limit State Design of Prestressed Concrete"*, by Y. Guyan, Applied Science Publishers.

**CE6235**

**ADVANCED FOUNDATION ENGINEERING**

**Cr-3**

**Machine Foundations:** Types of Machine Foundations, Basic Definitions, Degree of Freedom of a Block Foundation, General criteria for design of Machine Foundations, Free Vibration, Forced Vibration, Vibration analysis of a Machine Foundation, Determination of Natural Frequency, Design Criteria for Foundations of Reciprocating machines, Reinforcement and construction Details, Mass of Foundation, Vibration Isolation and Control. (14 Hrs)

**Liquefaction of foundation soils under earthquakes:** Introduction, Liquefaction Phenomenon, Effect of Liquefaction on Build environment, Factors Affecting Liquefaction, Assessment of Susceptibility of a Soil to Liquefaction, Prevention of Liquefaction. (06 Hrs)

**Foundations on Expansive soils:** Expansive soils, Identification of Expansive soils, Classification of Expansive soils, Causes of moisture changes in soils, Effects of swelling on buildings, Preventive measures for expansive soils Modification of Expansive soils, Design of foundation in swelling soils, Drilled piers, Belled drilled pier, Under reamed piles, construction of under reamed piles. (10 Hrs)

**Foundation Soil Improvement:** Stabilization of soil with granular skeleton, chemical, cement, lime, ash, slag & bitumen, Thermal stabilization, Electrical stabilization, Vibration methods of ground improvement, Drainage methods of ground improvement, Pre-compression and vertical drains, Grouting and injection, Reinforced earth, Use of geotextile & modern materials Ground anchors & soil nails. (06 Hrs)

**Text book:**

1. *"Advanced Foundation Engineering"*, by V. N. S. Murthy, First Edition, CBS Publishers & Distributors.
2. *"Foundation Analysis and Design"*, by J.E. Bowles, 5th Edition, McGraw Hill Higher Education, 1997.

**Reference Book**

1. *"Soil mechanics and foundation Engineering"*, by K.R. Arora. Standard Publisher, 2005
2. *"Geotechnical engineering handbook"* by B.M. Das, J. Ross Publishing, Cengage learning.
3. *"Principles Of Foundation Engineering"* by B.M. Das, 7th Edition, Cengage Learning India Pvt. Ltd, New Delhi.
4. *"Geotechnical Engineering Principles and Practices"* by Donald P. Coduto, Man Chu Ronald Yeung & William A. Kitch, Prentice Hall, 2011.
5. *"Reinforced soil and its engineering application"*, by Swami Saran, Second Edition, I. K. International Publishing House Pvt. Ltd, 2011
6. *"Geotechnical Engineering"*, by Shashi K. Gulhati & Manoj Datta, Tata Mcgraw Hill Publishing Co Ltd, 2014
7. *"Foundation Engineering"*, by P.C. Verghese, PHI Learning Private Limited, July 2013
8. *Ground Improvement techniques"*, by P. Purushothama Raj, Laxmi publications Pvt. L, 2005

**CE6239**

**COMPOSITE STRUCTURES**

**Cr-3**

**Introduction:** definition, Classification and characteristics of Composite materials, advantages and limitations, Current Status and Future Prospects. **(04 Hrs)**

**Basic Concepts and characteristics:** Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy; Characteristics and configurations of lamina, laminate, micromechanics and macro-mechanics. Constituent materials and properties. **(06 Hrs)**

**Elastic behavior of unidirectional lamina:** Anisotropic, separately orthotropic and transversely isotropic materials, stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters. **(08 Hrs)**

**Strength of unidirectional lamina:** Macromechanical failure theories: Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu). **(07 Hrs)**

**Elastic Behavior of multidirectional laminates:** Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties. Bending and vibration of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, specially orthotropic, anti-symmetric cross-ply laminates. **(07 Hrs)**

**Composite characterization:** Destructive and Non-destructive testing **(04 Hrs)**

**Text Books:**

1. "Engineering Mechanics of Composite Materials", by I M Daniel and O. Ishai, Oxford University press, 2005.
2. "Mechanics of Composite Materials", by Robert M. Jones, McGraw-Hill Book Company-1975.

**Reference Books:**

1. "Fiber-reinforced Composites", by P.K. Mallick, Marcel Dekker inc, 1993.
2. "An introduction to composite materials", by D. Hull and T W Clyne, Cambridge university press, 1996.

**CE6242**

**SOIL-STRUCTURE INTERACTION**

**Cr-3**

**Soil-Foundation Interaction:** Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour. **(12 Hrs)**

**Beam on Elastic Foundation-** Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions. **(14 Hrs)**

**Elastic Analysis of Pile:** Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap. Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis **(10 Hrs)**

**Text Book:**

1. "Foundation Analysis and Design" by J E Bowles- Tata-McGraw Hill
2. "Elastic Analysis of Soil-Foundation Interaction" by Selvadurai, A. P. S Elsevier

**Reference Books:**

1. "Pile Foundation Analysis and Design" by Poulos H. G. and Davis E. H.- John Wiley, 1980.
2. "Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation" by E.S. Melersk.
3. "Beams of Elastic Foundation" by M. Hetenyi, University Michigan Press 1946

**CE6244**

**OPTIMIZATION TECHNIQUES**

**Cr-3**

**Introduction:** Importance of optimization techniques Linear programming: Formulation, graphical solution, simplex method, Big M Method, Duality, Sensitivity analysis. **(09 Hrs)**

**Transportation problems:** Assignment problems. **(05 Hrs)**

Decision theory, decision tree, Game theory.	<b>(06 Hrs)</b>
Inventory models-deterministic models probabilistic model. Queuing theory, simulation applications.	
Introduction to non linear programming.	<b>(07 Hrs)</b>
Dynamic programming and integer programming, forecasting techniques.	<b>(09 Hrs)</b>

**Text Books:**

1. *"Optimization", by S. S. Rao, Wiley Eastern Ltd.*
2. *"Operation Research", by H. A. Taha, Mac-Millan*

**Reference Books:**

1. *"Graph Theory", by Narsingh Rao, Prentice Hall*
2. *"Operation Research", by Wagner, Wiley Eastern Ltd.*
3. *"Project Management", by Lick D., Gower Publication England*