B. TECH IN CIVIL ENGINEERING

PROGRAM SPECIFIC OUTCOMES (PSOS)

Program Specific Outcomes (PSOs) of the B. Tech. in Civil Engineering are as follows:

1. Students should be able to understand, design and analyze Civil Engineering problems.
2. Students should be able to understand the provisions of various Civil Engineering Codes, their uses in the analysis and Design.
3. Students should be able to use various Civil engineering tools and techniques to solve the real life problems.
4. Students should be able to analyze and interpret the data for its appropriate use.
5. Students should be able to develop self-learning, self-confidence and communicate effectively.

COURSE STRUCTURE FOR B. TECH IN CIVIL ENGINEERING

(w.e.f. 2018 batch)

Semester I

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	PH 101	Physics	3	1	0	4
2	MA 101	Mathematics I	3	1	0	4
3	ME 101	Engineering Mechanics	3	1	0	4
4	EE 101	Basic Electrical Engineering	3	1	0	4
5	HS 101	Communicative English	3	0	0	3
6	CE 101	Engineering Graphics & Design	1	0	3	3
7	PH 111	Physics Laboratory	0	0	3	2
8	EE 111	Basic Electrical Engineering Laboratory	0	0	3	2
9	HS 111	Language Laboratory	0	0	3	2
10		Extra-Curricular Activities (EAA)[1]	0	0	2	0

TOTAL CREDIT (Semester I) 28

Semester II

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	CH 101	Chemistry	3	1	0	4
2	MA 102	Mathematics II	3	1	0	4
3	CS 101	Introduction to Programming	3	1	0	4
4	EC 101	Basic Electronics	3	1	0	4
5	CE 102	Environmental Science & Engineering	3	0	0	3
6	CH 111	Chemistry Laboratory	0	0	3	2
7	CS 111	Programming Laboratory	0	0	3	2
8	EC 111	Basic Electronics Laboratory	0	0	3	2
9	ME 111	Workshop Practice	0	0	3	2
10		Extra-Curricular Activities (EAA)[1]	0	0	2	0

TOTAL CREDIT (Semester II) 27

1 EAA consists of YOGA/Physical Training/NCC/NSS/NSO, where YOGA is compulsory as a one semester course (first or second semesters), while any one from the rest is compulsory as a one semester

course. Thus, if YOGA is registered in first semester then any one from the rest four is to be opted in second semester and vice-versa.

Semester III

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	CE 201	Mechanics of Materials	3	1	0	4
2	MA 201	Mathematics III	3	1	0	4
3	CE 202	Civil Engineering Material, Testing and Evaluation	3	0	0	3
4	CE 203	Introduction to Geo Sciences	3	0	0	3
5	CE 204	Surveying & Geomatics	3	1	0	4
6	CE 205	Fluid Mechanics	3	0	0	3
7	CE 211	Surveying & Geomatics Laboratory	0	0	3	2
8	CE 212	Civil Engineering Materials, Testing and Evaluation Laboratory	0	0	3	2
9	CE 213	Civil Engineering Drawing Laboratory	0	0	3	2

TOTAL CREDIT (Semester III) 27

Semester IV

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	CE 206	Structural Analysis -I	3	1	0	4
2	CE 207	Hydraulics	3	1	0	4
3	CE 208	Design of Concrete Structures-I	3	1	0	4
4	CE 209	Transportation Engineering	3	1	0	4
5	CE 210	Geotechnical Engineering	3	1	0	4
6	CE 214	Hydraulics Laboratory	0	0	3	2
7	CE 215	Concrete Laboratory	0	0	3	2
8	CE 216	Geotechnical Engineering Laboratory	0	0	3	2
9	CE 217	Geo Science Laboratory	0	0	3	2

TOTAL CREDIT (Semester IV): 28

Semester V

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	CE 301	Design of Concrete Structures -II	3	1	0	4
2	CE 302	Foundation Engineering	3	1	0	4
3	CE 303	Structural Analysis-II	3	1	0	4
4	CE 304	Surface and Ground water Hydrology	3	1	0	4
5	CE 305	Water Supply Engineering	3	1	0	4
6	CE 311	Detailing of Civil Engineering Structures	0	0	3	2
7	CE 312	Foundation Engineering Laboratory	0	0	3	2
8	CE 313	Transportation Engineering Laboratory	0	0	3	2
9	CE 314	Water Resources Engineering Laboratory	0	0	3	2

TOTAL CREDIT (Semester V): 28

Semester VI

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	CE 306	Civil Engineering Estimation	3	0	0	3
2	CE 307	Design of Steel Structures	3	1	0	4
3	CE 308	Sewage Treatment And Disposal	3	0	0	3
	CE 309	Structural Analysis- III	3	1	0	4
4	CE 3XX	Professional Core Elective- I	3	1	0	4
5	CE 3XX	Open Elective- I	3	1	0	4
6	CE 315	Environment Engineering Laboratory	0	0	3	2
7	CE 316	Computer Aided Design Laboratory	0	0	3	2
8	CE 317	Structural Engineering Laboratory	0	0	3	2

TOTAL CREDIT (Semester VI): 28

Semester VII

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	HS XXX	Engineering Economics / Management Studies	3	0	0	3
2	CE 401	Concrete Technology	3	0	0	3
3	CE 4XX	Professional Core Elective- II	3	1	0	4
4	CE 4XX	Open Elective- II	3	0	0	3
5	CE 498	Project I	0	0	6	4
6	CE 430	Industrial Training	0	0	3	2

TOTAL CREDIT (Semester VII): 19

Semester VIII

Sl. No.	Code	Subject	Hours per week			Credit
			L	T	P	
1	HS XXX	Engineering Economics / Management	3	0	0	3
2	CE 4XX	Professional Core Elective- III	3	0	0	3
3	CE 4XX	Open Elective- III	3	0	0	3
4	CE 499	Project II	0	0	6	6

TOTAL CREDIT (Semester VIII): 15

Professional Core Elective- I (6^{th} Semester) (CE 331 - CE 380)

1. CE 331: Soil Dynamics and Machine Foundation
2. CE 332: Water Resource & Irrigation Engineering
3. CE 333: Elements of Ocean Engineering
4. CE 334: Railway and Bridge Engineering

Open Elective- I (6^{th} Semester) (CE 381 - CE 397)

1. CE 381: Modeling, Simulation and Application
2. CE 382: Remote Sensing and GIS

Professional Core Elective- II (7^{th} Semester) (CE 431 - CE 450)

1. CE 431: Coastal Engineering
2. CE 432: Advanced Structural Analysis
3. CE 433: Advanced Foundation Engineering
4. CE 434: Dynamics of Structures

5. CE 435: Open Channel Flow

Open Elective- II (7th Semester) (CE 481 - CE 490)

1. CE 481: Data Analytics in Engineering
2. CE 482: Numerical Methods in Engineering

Professional Core Elective- III (8th Semester) (CE 451 - CE 480)

1. CE 451: Earthquake Resistant Design of Structures
2. CE 452: Elementary Performance-Based Seismic Design
3. CE 453: Hydraulic Structures
4. CE 454: Application of Geosynthetics
5. CE 455: Construction Engineering & Management

Open Elective- III (8th Semester) (CE 491 - CE 497)

1. CE 491: Finite Elements Methods in Engineering
2. CE 492: Optimization Techniques
3. CE 493: Engineering Risk Analysis

DETAILED SYLLABI FOR B.TECH IN CIVIL ENGINEERING

CE 101	Engineering Graphics & Design	L	T	P	C
	B. Tech (All Branch) First & Second Semester(Core)	1	0	3	3

Unit-1 **Introduction:** Introduction to Engg. Graphics. General instruction regarding instruments, dimensions and lettering.

Unit-2 **Geometrics Constructions:** Division of lines, angles and curves. Construction of different polygons.

Unit-3 **Conic Sections:** Construction of parabola, ellipse, hyperbola, cycloid, trochoids, epicycloid and hypocycloid.

Unit-4 **Orthographic Projection:** Introduction to orthographic projection, Elements and angles of projections, projection of points, Projection of straight lines, Projection of planes, Conversion of pictorial views of objects into orthographic projections.

Unit-5 **Isometric projection:** Isometric projection and isometric views of different plans and solids, conversion of orthographic projections into isometric views.

Unit-6 **Product design and development software:** Introduction to Auto-CAD and CATIA software, design and development of 2D and 3D models for simple objects.

Text Books / Reference Books:

1. N.D. Bhatt & V. M. Panchal. ***Engineering Drawing.*** Rupalee Publication, New Delhi.
2. K. Venugopal. ***Engineering Drawing and Graphics+AutoCAD.*** New Age International, New Delhi
3. Prof. Shyam Tickoo. ***CATIA V5-6R, 2016 of Designers.*** BPB Publication, ISBN: 9789386551191, 9386551195, Edition: 14th, 2017.
4. Narayana, K.L. & P Kannaiah. ***Text book on Engineering Drawing.*** Scitech Publishers.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Produce geometric construction, multi-view, dimensioning and detail drawings of typical 3-D engineering objects.

2. Apply the skill for preparing detail drawing of engineering objects.
3. Understand and visualize the 3-D view of engineering objects.
4. Understand and apply computer software to prepare engineering drawing.

CE 102	Environmental Science & Engineering	L	T	P	C
	B. Tech (All Branch) First & Second Semester(Core)	3	0	0	3

Unit-1 **Introduction:** Environment, Definition, scope and importance, multidisciplinary nature of environmental studies.

Unit-2 **Natural Resources:** Forest Resources –use and over-exploitation of forests, deforestation, timber extraction, mining, dams and their effects on forests and tribal people Water Resources-Use and over utilization of surface and groundwater, floods, droughts, conflicts over water, dams-benefits and problems. Mineral resources-use and exploitation, environmental effects of extracting and using mineral resources. Agriculture land and food resources-Land as resources land degradation, man induce landslides, soil erosion and desertification; World food problems, changes caused agricultural and overgrazing, effects of modern agriculture practices, fertilizers and pesticides problems, water logging, salinity, case studies Energy Resources-Growing energy needs, renewable and non-renewable energy resources, Sources of alternate energy sources, Case studies Energy conservation.

Unit-3 **Ecosystem and Biodiversity:** Ecosystem-Concept of an ecosystem, structure and function of an ecosystem, Food chain, food webs and ecological pyramids, Energy flow in ecosystem producers and consumers Ecological Succession, Biodiversity and its Conservation – introduction, definition, genetic species and ecosystem diversity, value of biodiversity, Consumptive use, productive use, social, ethical aesthetic and optional values, biodiversity at global, national and local values, India as a mega-biodiversity nation, hotspots of biodiversity, threats to biodiversity- habitat loss, poaching of wildlife conflicts, endangered and endemic species in India, conservation of biodiversity – in-situ and ex-situ conservation of biodiversity.

Unit-4 **Environmental Pollution:** Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear radiation hazards, Solid waste management, sources of solid waste effects and control measures of urban industrial wastes: Pollution case studies, disaster management- floods, earthquakes, cyclones and landslides.

Unit-5 **Environment and society:** Role of an individual prevention of pollution, consumerism and waste products, unsustainable to sustainable development, water conservation, rainwater harvesting, watershed management, wasteland reclamation, observance and popularization of Environmental Protection Act. Air (Prevention and control of pollution) Act. Water (Prevention and

control of pollution) Act, Wildlife Protection Act, Forest Conservation Act, issue involved in enforcement of environmental legalizations, population growth, variation among nations, Environment and human health, epidemics, Women and child welfare, Role of information technology in environment and human health.

Text Books / Reference Books:

1. Henry J.G. and Heinke G.W. ***Environmental Science and Engineering.*** Prentice Hall of India. New Delhi.
2. Chandrasekhar M. ***Environmental Science.*** Hi-Tech Publishers.
3. Masters G.M. ***Environmental Engineering and Science.*** Prentice Hall of India, New Delhi.
4. Garg S.K. and Garg R. ***Ecological and Environmental Studies.*** Khanna Publishers, Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand environmental problems arising due to developmental activities.
2. Identify the natural resources and suitable methods for conservation and sustainable development.
3. Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
4. Identify the environmental pollutants and abatement devices.

CE 201	Mechanics of Materials	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	3	1	0	4

Unit-1 **Simple stresses and Strains:** Stress, strain, tensor, type of stresses, elastic limit, Hooke's law, stress-strain curve, factor of safety, elastic constants, initial stiffness, secant stiffness, elongation of bars of varying sections, elongation of bars of composite sections, elongation due to self-weight, bars of uniform strength, complementary shear stresses, Thermal stress.

Unit-2 **Bending moments and Shear forces:** Beam – elastic curve, type of loads, type of supports, SF and BM, sign convention, SF and BM diagrams for cantilever, simple supported and overhanging beams, relationship between rate of loading, SF and BM.

Unit-3 **Deflection of beams:** Relationship among curvature, slope and deflections, slope and deflection for cantilever and simply supported beams, Macaulay's method.

Unit-4 **Stresses in beams:** Theory of bending, neutral axis and moment of resistance, bending stresses in symmetrical sections, section modulus, composite beams, and shear stresses in beams.

Unit-5 **Compound stresses:** Stresses on inclined plane, stresses on inclined plane due to biaxial normal stresses and shear stresses, principal planes, principal stresses and strains, Mohr's circle of stresses.

Unit-6 **Torsion:** Analysis of torsional stresses in a plane circular shaft, power transmitted, combined bending and torsion, equivalent bending moment and torque.

Unit-7 **Combined Bending and Direct Stresses:** Resultant stresses for rectangular column and circular columns subjected to eccentric load, limit of eccentricity for no tension, middle third rule.

Unit-8 **Thin Shells:** Thin cylinders and spherical shells – Hoop stresses and strains and volumetric changes**.**

Unit-9 **Column and Struts:** Short and long columns, Failure of columns, slenderness ratio, Euler's theory, crippling load, Rankine's formula, Straight line and parabolic formula.

Unit-10 **Mechanical Properties:** Definitions of different properties and description of experiments for their determination.

Text Books / Reference Books:

1. G.H. Ryder. ***Strength of Materials.*** ELBS & Macmilan.
2. Pytel & Singer. ***Mechanics of Materials.*** Harper Collins Publications.

3. U.C. Jindal. ***Strength of Materials.*** Umesh Publications.
4. Beer & Johnston. ***Mechanics of Materials.*** Tata McGraw-Hill.
5. Timoshenko and Gere. ***Mechanics of Materials***. CBS Publishers, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the basic concepts and principles of mechanics of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of mechanics of materials on engineering applications and design problems.

CE 202	Civil Engineering Material, Testing and Evaluation	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	3	0	0	3

Unit-1 **Building stones:** Classification of stones- Characteristics of good building stones, important types of building stones, their properties and uses.

Unit-2 **Brick & other clay products:** Composition of brick-earth, manufacturing process of bricks, characteristics of good building bricks, classification and testing of bricks, special types of bricks and their uses. Types of tiles and their use in buildings, terracotta, Stoneware.

Unit-3 **Lime and Cement:** IS classification of lime and uses, flow diagram of manufacturing process of cements, chemicals, composition of cement, IS specification and tests on Portland cement, different types of cement and their uses.

Unit-4 **Paints, Varnishes & Distempers:** Types of paints, varnishes and distempers, White washing.

Unit-5 **Timber & wood based products:** Classification of timber trees, cross section of exogenous tree, hard wood and soft wood, seasoning of timber, important types of timber and their uses, plywood and its uses.

Unit-6 **Steel & aluminium:** Types of steel-mild steel, high carbon steel, high strength steel- properties and uses, commercial forms of steel and their uses.

Unit-7 **Introduction to some new materials:** Ferro cement, super plasticizers, FAL-G brick, fly ash, plastics, paints and geotextiles.

Unit-8 **Testing & Evaluation:** Stress-strain characteristics of Mild steel, Tor steel, Copper and Aluminium Compressive strength of wood and punching shear strength of GI sheets- Brinnell's and Vicker's hardness test-Modulus of-rigidity of Soild shafts and Hollow shafts-Modulus of elasticity of the materials- Ductility test for steel- Shear test on Mild steel rods.

Unit-9 **Advanced topics:** Repair, rehabilitation & retrofitting materials such as micro concrete, FRP, Epoxy etc.

Text Books / Reference Books:

1. S.C. Rangwala. ***Civil engineering Materials.*** Charotar Publishing House.
2. R.K. Gupta. ***Civil engineering Materials and Construction Practices.*** Jain Brothers.
3. B.C. Punmia, Ashok Kumar Jain and Arun K Jain. ***Building Construction.*** Lakshmi Publications.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify and characterize building materials.
2. Understand the manufacturing process of bricks, cement etc.
3. Identify the methods for preservation of timber and metals.
4. Understand the use of non-conventional Civil Engineering materials.
5. Understand the Characteristics of materials & able to evaluate the results.

CE 203	Introduction to Geo Sciences	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	3	0	0	3

Unit-1 **General Geology:** Branches and scope of geology, Importance of geology in Civil engineering. Earthsurface features and internal structure. Weathering of rock, erosion, transportation, deposition, geological agents.

Unit-2 **Mineralogy:** Definition of a crystal and mineral, physical properties in mineral identification, physical properties of common rock forming minerals and economic minerals.

Unit-3 **Petrology:** Formation and classification of rocks – Igneous, Sedimentary and metamorphic rocks, their texture and structures, properties of granite, pegmatite, dolerite, gabbro, charnockite, basalt, sandstone, conglomerate, breccia, limestone, shale, laterite, schist, gneiss, quartzite, marble, khondalite and slate.

Unit-4 **Structural Geology:** Geological map, outcrop, attitude of beds, types and classifications of folds, faults, joints, unconformities.

Unit-5 **Engineering Properties of Rocks:** Drilling, Core recovery, RQD, Sample preparation, tests on rock samples - compression, tensile, shear and slake durability tests.

Unit-6 **Ground Water:** Subsurface distribution of ground water, water table, aquifers, occurrence of ground water in different geological formations, springs, ground water exploration.

Unit-7 **Earthquakes and Landslides:** Causes and effects of earthquakes and landslides, Remedial measures to prevent damage for engineering structures.

Unit-8 **Subsurface Investigations:** Soil Profile, Geophysical methods – Electrical Resistivity and Seismic refraction methods. Site selection for engineering projects.

Text Books / Reference Books:

1. P.K. Mukherrjee. ***A text Book of Geology.*** World Press Pvt Ltd.
2. N. Chenna Kesavulu. ***Textbook of Engineering Geology.*** Laxmi Publications Pvt Ltd; Third edition (2018).

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand weathering process and identify geological formations.
2. Determine quality of rock based on engineering properties.

3. Address remedial measures required to counter effect of earthquakes and landslides.
4. Analyse subsurface information for appropriate selection of site.
5. Understand the Characteristics of materials & able to evaluate the results.

CE 204	Surveying & Geomatics	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	3	1	0	4

Unit-1 **Introduction:** Classification, Principles of Surveying, Types of Surveying.

Unit-2 **Chain and compass survey:** Distance measurement, Instruments, Adjustments, Angular measurements, Latitude and departure, Compass traversing.

Unit-3 **Accuracy and errors:** Errors and corrections in Chain and compass survey.

Unit-4 **Triangulation:** Triangulation systems, Intervisibility, Signals Satellite stations, computation and adjustments.

Unit-5 **Levelling**: Instruments, Adjustments, Levelling principles, Long sections, Cross sections, Reciprocal levelling, Trigonometrical levelling, Effects of curvature and refraction.

Unit-6 **Theodolite Traversing**: Details of instruments, Adjustments, Angular measurement, Horizontal and vertical traversing.

Unit-7 **Contouring:** Characteristic, Methods & uses.

Unit-8 **Plane Table surveying:** Equipments, Principles, Operation, Methods, Errors, Advantage and disadvantages.

Unit-9 **Tacheometric survey:** Principles, Stadia and Tangential methods, Error and Precision in Tacheometry

Unit-10 **Curves:** Classification, Setting out of circular curve, setting out of Transition curve.

Unit-11 Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Total Station – Parts of a Total Station – Accessories – Advantages and Applications Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements.

Unit-12 **Photogrammetry Surveying:** Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy.

Unit-13 **Remote Sensing:** Introduction, Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors.

Text Books / Reference Books:

1. B.C. Punmia. ***Surveying (Vol I & II).*** Laxmi Publication.
2. KR Arora. ***Surveying (Vol-I & Vol-II).*** Standard Book House.

3. TP Kanetkar and SV Kulkarni. ***Surveying & Leveling (Vol-I & Vol-II)***. Pune Vidyarthi Griha Prakashan.
4. W Schofield and M Breach. ***Engineering Surveying***. A Butterworth-Heinemann Title; 6 edition (14 February 2007).
5. Manoj K. Arora and Badjatia. ***Geomatics Engineering***. Nem Chand & Bros
6. Anji Reddy M. ***Textbook of Remote Sensing and Geographical information system***. B.S. Publications

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand about different theories of surveying and application of the same.
2. Understanding of the different aspects of surveying.
3. Use of the theories for measuring distances, levelling and bearings, setting out of curves, contours maps and use of total station.
4. Build self-confidence in different types of surveying, get motivated for further learning, and face competitive examinations.

CE 205	Fluid Mechanics	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	3	0	0	3

Unit-1 **Basic Concepts:** Continuum Approach, Important physical properties: Density, Specific weight, Viscosity, Surface tension, Capillarity, Compressibility, Vapour pressure, Classification of fluids – ideal and real fluid, non- Newtonian fluids.

Unit-2 **Fluid Statics:** Pressure at a point-Pascal's Law, pressure variation in a static fluid. Scales of pressure – absolute and gauge pressure, Measurement of pressure-manometers, Forces on submerged plane and curved surfaces, Buoyant Force-centre of buoyancy, metacenter, determination of metacentric height, equilibrium of floating and submerged bodies.

Unit-3 **Kinematics of Fluid:** Study of fluid motion – Lagrangian and Eulerian methods, Classification of flow-steady and unsteady flow, uniform and non-uniform flow, rotation and irrotational flow, laminar and turbulent flow, 1-,2- & 3D flow, Concepts of streamlines, pathlines and streakline, stream tube, Continuity equation, Circulation, vorticity, Stream function, Velocity potential, Flownet.

Unit-4 **Dynamics of fluid flow:** Euler's equation of motion, Bernoulli's equation and its application- venturimeter, orificemeter, Pitot tube, momentum equation and its application to simple problems.

Unit-5 **Orifice, mouthpiece, Notches and Weirs:** Classification, discharge through a free orifice, orifice coefficients- experimental determination, External and internal mouthpiece, mouthpiece running full and free. Classification, Velocity of Approach, Broad crested weir.

Unit-6 **Laminar Flow:** Navier Stokes equation, Laminar flow through pipes-Hagen Poiseuille law, Laminar flow between parallel plates, laminar flow around a sphere-Stokes law.

Text Books / Reference Books:

1. John F. Douglas, Janusz M. Gasiorek and John A. Swaffield. ***Fluid Mechanics.*** Pearson Education.
2. K.L. Kumar. ***Fluid Mechanics.*** S. Chand & Co.
3. Streeter & Wily. ***Fluid Mechanics.*** Mc Graw Hill.
4. R.K. Bansal. ***Fluid Mechanics and hydraulic Mechanics***. Laxmi Publisher.
5. S. K. Som and G. Biswas. ***Introduction to fluid mechanics and fluid machines***. Tata Mc Graw Hill.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Apply fundamental knowledge of mechanics and analysis of fluid flow problems in civil engineering.
2. To understand the basics concepts of Pascal's law, design of pressure-pipe and open-channel hydraulics in civil engineering.
3. To understand the Euler's and Lagrangian approach. Bernoullis equation and application of Bernuallis theorem in various flow measuring devices.

CE 211	Surveying & Geomatics Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	0	0	3	2

Unit-1 Chain survey by perpendiculars offsets.

Unit-2 Chain survey by oblique offsets.

Unit-3 Open and closed traverse survey with chain prismatic compass.

Unit-4 Plane table survey by methods of radiation, intersection, resection.

Unit-5 Profile leveling with dumpy level, cross sections, reciprocal leveling, contouring.

Unit-6 Surveying with Theodolite – vertical and horizontal angles.

Unit-7 Measuring distances and angles using total station.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify different problems encountered in different types of surveying like problems in chaining, compass survey, levelling, total station etc. and will learn to solve these problems considering realistic constraints by performing these experiments.
2. Gain knowledge of taking accurate measurements, data filling in field booking, plotting of maps.
3. Learn to identify different errors that may arise in different experiments and corrections to be applied to eliminate these errors.

CE 212	Civil Engineering Materials, Testing and Evaluation Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	0	0	3	2

Unit-1 **Tests on steel**

(a) Tensile and Elongation
(b) Proof Stress
(c) Bend-rebend test
(d) Nominal mass

Unit-2 **Tests on Cement**

(a) Normal Consistency
(b) Fineness
(c) Initial and Final setting time
(d) Specific Gravity
(e) Soundness
(f) Compressive Strength

Unit-3 **Tests on bricks**

(a) Dimensional Tolerance
(b) Compressive Strength
(c) Water absorption
(d) Efflorescence

Unit-4 **Tests on fine aggregates**

(a) Fineness modulus and grain size distribution
(b) Specific gravity
(c) Water absorption
(d) Bulking.
(e) Bulk density

Unit-5 **Tests on coarse aggregates**

(a) Specific gravity and water absorption of coarse aggregates
(b) Sieve analysis of coarse aggregates
(c) Aggregate Crushing Value
(d) Aggregate Impact value
(e) Specific Gravity

Text Books / Reference Books:

1. Davis, Troxell and Hawk. ***Testing of Engineering Materials.*** International Student Edition McGraw Hill Book Co. New Delhi.
2. M L Gambhir and Neha Jamwal. ***Building and construction materials Testing and quality control.*** McGraw Hill.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion.
2. Identify, formulate and solve engineering problems of structural elements subjected to flexure.
3. Evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to undesirable materials.

CE 213	Civil Engineering Drawing Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Third Semester(Core)	0	0	3	2

Drawings to be prepared using AutoCAD

Unit-1 Plan, elevation, side view of residential/office buildings

Unit-2 Drawing of 2 bed room / 3 bed room houses (Single and two story), ground and first floor plans, elevation and section for load bearing and framed structures.

Unit-3 Detailing of doors/windows

Unit-4 Drawing of several types of footing, bricks work, floor, staircase, masonry, arches and lintels.

Unit-5 Types of steel roof trusses.

Unit-6 Project on establishments like building/post office/Hostel/Library/Hospital/ Auditorium etc.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Prepare working drawings to communicate the ideas and information.
2. Read, understand and interpret engineering drawings.

CE 206	Structural Analysis -I	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	3	1	0	4

Unit-1 **Introduction to Structural Analysis**: Different types of structures, loads and forces, static and kinematic indeterminacy, stability and determinacy, methods of analysis based on equilibrium equations and compatibility requirements, principle of superposition.

Unit-2 **Beams:** Different types of statically determinate beams, theories/ principles for evaluation of slope and deflection under bending using moment area method and conjugate beam method, computing slope and deflection for different statically determinate beams having prismatic and non- prismatic sections under concentrated and distributed loads.

Unit-3 **Columns and Struts:** Euler's theory of buckling, load carrying capacity of column under different support condition, eccentrically loaded column, Rankine's formula.

Unit-4 **Other structures:** Truss, three hinged arches, cables, three hinged stiffening girder, determinate portal frames, introduction to redundant structures.

Unit-5 **Energy Principles:** Evaluation of strain energy under axial- deformation, bending, shear and torsion; Castigliano's theorems; principles of virtual work and unit load method; Maxwell- Betti reciprocal theorem; Evaluation of deformation for different structures using energy principles, principle of least work.

Text Books / Reference Books:

1. Timoshenko and Young. ***Theory of Structural Analysis.*** McGraw Hill International.
2. R.C. Hibbeler. ***Structural Analysis.*** Pearson Education.
3. C S Reddy. ***Basic Structural Analysis.*** Tata McGraw Hill.
4. Norris and Wilber. ***Structural Analysis***. McGraw Hill international.
5. D.S. Prakash Rao. ***Structural Analysis- Unified approach***. Universities Press.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the fundamental principles of structural analysis.
2. Understand the analytical procedures for determining deformation under bending e.g. moment- area method, double integration method.
3. Evaluate force and deformation for various statically determinate structures.

4. Understand fundamentals of energy principles and their applications in structural analysis problems.
3. Solve problems with different types of structures like column/strut, arch, cable, truss etc.

CE 207	Hydraulics	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	3	1	0	4

Unit-1 **Flow through Pipes:** Losses in pipes flow- major loss(Loss due to friction) Darcy Weisbach equation, Minor losses, Hydraulic gradient lines, Total energy lines, Pipes in series, Pipes in parallel, equivalent pipe, Siphon.

Unit-2 **Laminar Flow and Turbulent Flow:** Types of fluid flow, laminar flow, laminar flow in pipe, and flow of laminar fluid between parallel plates, laminar-Turbulent transition, Reynolds decomposition of turbulent flow, intermittency, derivation of governing equation of turbulent flow, apparent stress or Reynold stress, Pandtl's mixing length hypothesis, Von Karman Constant.

Unit-3 **Pipe network systems:** introduction, Components of water distribution systems, Simulation of network, hardy- cross method, linear theory method, optimization of water distribution systems.

Unit-4 **Dimensional Analysis:** Dimensional- fundamental and derived qualities, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method and Bucklingham's π Theorem.

Unit-5 **Boundary layer theory:** Boundary layer theory- its thickness, momentum, equation for boundary layer along a flat plate, Laminar and turbulent boundary layers, Boundary layer separation.

Unit-6 **Flow around submerged bodies:** Drag and lift- types of drag, dimensional analysis of drag and lift, drag on flat plate sphere and cylinder, Karman trail, circulation, lift on a cylinder with circulation- Magnus effect.

Unit-7 **Open Channel Flow:** Types of channels- classification of flows- basic equations- velocity distribution – velocity coefficients- pressure distribution- momentum and energy correction factors- uniform flow, most efficient channel sections.

Unit-8 **Hydraulic Similitude:** Review of dimensional analysis, Similarity laws and model studies.

Text Books / Reference Books:

1. P.N. Modi & S.M. Seth. ***Hydraulics and fluid Mechanic including Hydraulic Machines (in SI Units).*** Rajsons Publication Pvt. Ltd., 21st edition.
2. John F. Douglas, Janusz M. Gasiorek and John A. Swaffield. ***Fluid Mechanics.*** Pearson Education.
3. K L Kumar. ***Fluid Mechanics.*** S. Chand& Co.
4. Streeter & Wily. ***Fluid Mechanics***. McGraw Hill.
5. R K Bansal. ***Fluid Mechanics and hydraulic mechanics***. Laxmi Publisher.

6. S K Som and G. Biswas. ***Introduction to fluid mechanics and fluid machines.*** Tata Mc Graw Hill.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Apply fundamental knowledge of Types fluid flow problems in civil engineering.
2. Understand the basics concepts of laminar flow and turbulent flow in civil engineering.
3. Understand the boundary layer theory and applications.

CE 208	Design of Concrete Structures-I	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	3	1	0	4

Unit-1 **Design philosophies:** Working Stress Method (WSM) – Ultimate load method – Limit State Design (LSD).

Unit-2 **Limit State Design:** Limit state of collapse – comparison of WSM and LSD.

Unit-3 **Limit states of strength and serviceability:** Consideration of durability – fire resistance – partial safety factors.

Unit-4 **Analysis and Design of Singly Reinforced Beams:** Analysis of Singly Reinforced RC Section- Neutral axis-Balanced- Under Reinforced- Over Reinforced Sections- Moment of Resistance- Design parameters- Design examples.

Unit-5 **Analysis and Design of Doubly Reinforced Beams:** Necessity of Doubly Reinforced sections- Analysis of Doubly Reinforced RC Section- Moment of Resistance- Design parameters- Design.

Unit-6 **Design for shear and torsion:** Design for shear, vertical stirrups, inclined stirrups, design of torsional moment.

Unit-7 **Design of RC Columns:** Design principles of RC columns, Assumptions, Rectangular and Circular columns, helical reinforcement, Minimum eccentricity, Use of Interaction diagrams for Axial load and Moment.

Unit-8 **Design of Slabs:** Classification of slabs, specifications of slabs, one way slab and two way slab, cantilever slab, continuous slab.

Unit-9 **Design of Footings:** Classification of footings, design of isolated footing and combined footing.

Unit-10 **Retaining walls:** Cantilever retaining wall, counterfort retaining wall.

Unit-11 **Redistribution of moments:** Introduction to moment redistribution.

Text Books / Reference Books:

1. P.C. Varghese. ***Limit State Design of Reinforced Concrete.*** PHI, New Delhi
2. S.U. Pillai and D. Menon. ***Reinforced Concrete Design.*** Tata McGraw Hill.
3. A.K. Jain. ***Reinforced Concrete – Limit State Design.*** Nem Chand and Co.
4. IS: 456 – 2000. ***Indian Standard Code for RCC Design***.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand basic R.C. design philosophy.
2. Design RC Beam member for flexural, shear and Torsional condition.

3. Design Reinforced Concrete slabs for serviceability condition.
4. Design the Reinforced Concrete Columns and footings.

CE 209	Transportation Engineering	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	3	1	0	4

Unit-1 **Introduction:** Importance of transportation, role of transportation systems, different modes of transportation, characteristics of road transport, importance of road in India, scope of highway engineering.

Unit-2 **Highway Development and Planning:** Transportation planning, surveying and highway alignment, road networking and urban transportation planning.

Unit-3 **Highway Materials:** Soil, stone aggregate, bituminous binders, various tests and their significances.

Unit-4 **Geometric Design of Highway:** Highway cross-section elements, sight distance, curves, design of horizontal alignment, design of vertical alignment, hill roads.

Unit-5 **Traffic Engineering:** Traffic studies, traffic prediction, traffic control – signal design, intersections and transport facilities.

Unit-6 **Design of pavements:** Pavement analysis and design, types of pavements – flexible pavements and rigid pavements, design factors, design methods, reliability.

Unit-7 **Relevant IRC and IS codes**

Text Books / Reference Books:

1. SK Khanna and CEG Justo. ***Highway Engineering.*** Nemchand Bros.
2. LR Kalliyali. ***Traffic Engineering and Transportation.*** Khanna Publishers.
3. William W. Hay. ***An Introduction to Transportation Engineering.*** Toppan Co. Ltd.
4. E.J. Yoder and M.W. Nitterzal. ***Principles of Pavement Design***. John Wiley & Sons
5. Relevant IRC and IS Codes

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand basics and application of Transportation Engineering.
2. Realise the importance of the transportation planning and highway design for the development of the society.
3. Identify the suitable materials and design methods for different types of pavement. Understand the traffic system and transport facilities.
4. Analyse current systems of road network using basic scientific tools.

CE 210	Geotechnical Engineering	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	3	1	0	4

Unit-1 **Soil:** Introduction, origin and types of soil; soil-phase relationship; index properties of soil; consistency of clay soil; sensitivity, thixotropy and activity of clay soil; identification and classification of soils; soil structure and clay mineralogy.

Unit-2 **Permeability and seepage:** Darcy's law of permeability; determination of coefficient of permeability; factors affecting permeability; equivalent permeability for stratified soil; flow nets – principles, construction and application; effective stress analysis; quick sand condition; piping; capillarity in soil; filtration criteria.

Unit-3 **Compaction:** Principle of compaction; light and heavy compaction; factors affecting compaction; characteristics of compacted soil; methods of field compaction; compaction specification and field control.

Unit-4 **Compressibility and consolidation:** Compressibility; principle and types of consolidation; determination of consolidation parameters; Terzaghi's theory of one-dimensional consolidation; secondary consolidation; estimation of consolidation settlement.

Unit-5 **Shear strength of soil:** Introduction; Mohr-Coulomb failure criterion; strength envelope; determination of shear strength parameters - direct shear test, triaxial shear test, unconfined compression test, vane shear test; shearing characteristics of sand and clay; pore pressure parameters; total and effective stress; stress paths.

Unit-6 **Lateral earth pressure:** Earth pressure at rest; active and passive earth pressure; Rankine's earth pressure theory; Coulomb's wedge theory; graphical solutions.

Unit-7 **Stability of slope:** Stability of infinite slope; stability of finite slope; slope protection.

Text Books / Reference Books:

1. BM Das. ***Introduction to Soil Mechanics.*** Galgotia Publication.
2. BC Punmia. ***Soil Mechanics and Foundation Engineering.*** Dhanpat Rai & Sons.
3. Gopal Ranjan & Rao. ***Soil Mechanics.*** Dhanpat Rai & Sons.
4. Whitman & Lambe. ***Soil Mechanics***. John Willey.
5. VNS Murthy. ***Soil Mechanics & Foundation Engineering.*** Dhanpat Rai & Sons.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand fundamental principles of Geotechnical Engineering.
2. Understand different engineering properties (index and strength properties) of soil.
3. Understand properties and behavior of soil under different loading condition.
4. Understand fundamentals of lateral earth pressure and slope stability analysis etc.
5. Apply and articulate the principles of Geotechnical Engineering in analyzing, understanding and solving real life problems after completion of the course.

CE 214	Hydraulics Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	0	0	3	2

Unit-1 Study of Bernoulli's Theorem
Unit-2 Determination of co-efficient of orifice
Unit-3 Determination of metacentric height of vessels.
Unit-4 Flow measurement by venturimeter.
Unit-5 Flow measurement by orificemeter.
Unit-6 Study of force due to impact of jet.
Unit-7 Study of flow visualization apparatus.
Unit-8 Determination of viscosity.

Text Books / Reference Books:

1. K. L. Kumar. ***Engineering Fluid Mechanics Experiments.*** Eurasia Publishing House.
2. Jagdish Lal. ***Hydraulic Machines.*** Metropolitan Book Co., Delhi.
3. P.N Modi & S.M. Seth. ***Hydraulics and Fluid Mechanics including Hydraulic Machines (in SI units).*** Rajsons Publications Pvt. Ltd, 21st edition.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the basic principles and theorems of fluid flow.
2. Use different flow measuring devices working with specific hydraulics principles.
3. Understand the streamlines in a flow field.

CE 215	Concrete Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	0	0	3	2

Unit-1 **Concrete Making Materials:** Cement, Fine Aggregates, Coarse Aggregates, Water, Chemical And Mineral Admixtures.

Unit-2 **Hydration of Cement:** Bogues Compounds, Hydration, Gel Formation, Types Of Cement, Pore And Capillary Water.

Unit-3 **Quality test on cement:** Different test on cement as per Indian standards.

Unit-4 **Aggregates:** Test on aggregates as per Indian standards, bulking of Sand, sieve analysis grading.

Unit-5 **Fresh Concrete:** Properties of fresh concrete-Workability-different test on workability- Factors influencing workability compaction, finishing, curing.

Unit-6 **Hardened concrete:** Tests on hardened concrete as per IS codes-Relationship between different strengths- factors influencing strength, NDT techniques.

Unit-7 **Durability:** Factors influencing durability-Chemical effects on concrete carbonation, sulphate attack, chloride attack.

Unit-8 **Concrete Mix Design:** Different methods of mix design-factors affecting design-exercises.

Unit-9 **Special Concrete:** Heavy density concrete, underwater concrete, Self-compacting concrete, light weight concrete, Geopolymer concrete, Bacterial concrete etc.

Text Books / Reference Books:

1. Aminul Islam Laskar. ***Concrete Technology Practices.*** Narosa Publication
2. A.M. Nevelli. ***Properties of Concrete.*** Prentice Hall Publisher.
3. M.S. Shetty. ***Concrete Technology.*** S Chand Co.
4. M.L. Gambhir. ***Concrete Technology.*** Tata Mc Graw Hill.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify Quality Control tests on concrete making materials.
2. Understand the behavior of fresh and hardened concrete.
3. Design concrete mixes as per IS and ACI codes.
4. Understand the durability requirements of concrete.
5. Understand the need for Special concretes.

CE 216	Geotechnical Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	0	0	3	2

Unit-1 Determination of field density and dry density by core cutter method.

Unit-2 Determination of field density and dry density by sand replacement method.

Unit-3 Determination of specific gravity of soil solid.

Unit-4 Determination of liquid limit and plastic limit of clayey soil. Demonstration of shrinkage limit test.

Unit-5 Determination of gradation of soil by dry sieve analysis.

Unit-6 Determination of gradation of soil by hydrometer analysis.

Unit-7 Determination of density index / relative density of soil.

Unit-8 Determination of optimum moisture content and maximum dry density of soil by proctor compaction test.

Unit-9 Determination of CBR value of soil by California bearing ratio test.

Text Books / Reference Books:

1. BM Das. ***Introduction to Soil Mechanics.*** Galgotia Publication.
2. BC Punmia. ***Soil Mechanics and Foundation Engineering.*** Dhanpat Rai & Sons.
3. Gopal Ranjan & Rao. ***Soil Mechanics.*** Dhanpat Rai & Sons.
4. Whitman & Lambe. ***Soil Mechanics.*** John Wiley.
5. VNS Murthy. ***Soil Mechanics & Foundation Engineering***. Dhanpat Rai & Sons.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Perform experimental application of knowledge of Geotechnical Engineering.

CE 217	Geo Science Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fourth Semester(Core)	0	0	3	2

Unit-1 Introduction to Crystallography: Identification of Crystals.

Unit-2 Introduction of minerals and the study of physical properties: Identification of Quartz and feldspars.

Unit-3 Identification of important ore deposits.

Unit-4 Identification of igneous rocks.

Unit-5 Identification of sedimentary rocks.

Unit-6 Identification of metamorphic rocks.

Unit-7 Structural geology – strike and dip, fold, fault and unconformity.

Unit-8 Study of geological maps.

Text Books / Reference Books:

1. P. K. Mukharjee. ***A Textbook of Geology.*** World Press Pvt Ltd. Kolkata
2. N. Chenna Kesavulu. ***Textbook of Engineering Geology.*** Laxmi Publications Pvt. Ltd.
3. Vasudev Kanithi. ***Engineering Geology.*** Orient Blackswan.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Differentiate between different rocks and crystals.
2. Identify presence of fault and unconformity in earth crust.
3. Explore geological maps.

CE 301	Design of Concrete Structures -II	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	3	1	0	4

Unit-1 **Design of Columns:** Columns subjected to compression, uniaxial bending and biaxial bending - design using SP16 charts for limit state-design of slender columns.

Unit-2 **Design of Stair Cases:** Staircase – Types of Stair Case – Design of Stair Cases - Lateral load analysis - portal and cantilever method - Transfer of load from slab to beams equivalent load - continuous beams.

Unit-3 **Design of Retaining walls:** Design of cantilever retaining wall without surcharge-detailing - design principles of counter fort retaining wall and detailing.

Unit-4 **Design of Circular Slabs:** Circular slabs-simply supported, fixed and partially fixed subjected to uniformly distributed load.

Unit-5 **Design of Domes:** Design and detailing of spherical and conical domes.

Unit-6 **Water Tanks Design:** Design of water tanks-design philosophy and requirements-joints-IS code recommendations- design of rectangular and circular water tanks using IS code coefficients (IS 3370).

Text Books / Reference Books:

1. N. Krishnaraju. ***Reinforced Concrete Design: Principles and Practice.*** New Age International.
2. Pillai S.U & Menon D. ***Reinforced Concrete Design.*** Tata McGraw Hill.
3. Punmia B.C, Jain A.K and, Jain A.K. ***RCC Designs.*** Laxmi Publications Ltd.
4. Relevant IS codes (IS: 456, IS: 875, IS: 1343, IS: 3370, SP 16, SP 34).

Course Outcomes (COs):

At the end of the course, students are expected to

1. Design eccentrically loaded and slender columns using SP 16 design charts.
2. Design and detailing of stair cases.
3. Design and detail cantilever retaining wall and understand the design principles of counterfort retaining wall.
4. Design and detail circular slabs and domes.
5. Design rectangular and circular water tanks using IS code coefficients (IS 3370).

CE 302	Foundation Engineering	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	3	1	0	4

Unit-1 **Stress Distribution in Soil:** Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, Isobar.

Unit-2 **Soil Exploration and Site Investigation:** Methods of soil exploration, Geophysical exploration, Soil sampling and samplers, In-situ and laboratory tests on soil samples, Soil investigation report.

Unit-3 **Shallow Foundation:** Different types of shallow foundations, Theories of Bearing capacity, Calculation of settlement, Bearing capacity from SPT, CPT and Plate load test, Combined footing, Strap footing, Mat foundation, Methods of design.

Unit-4 **Deep Foundation:** Different types of deep foundations, Estimation of load carrying capacity of single and pile group under vertical and horizontal load, Negative skin friction, Settlement of pile foundation, Pile Load tests, Foundations on expansive soils, Design methods.

Unit-5 **Well Foundation:** Types, components, construction methods, design methods, check for stability.

Unit-6 **Ground Improvement Techniques:** Basic concept of soil improvement, various methods and applicability.

Text Books / Reference Books:

1. J. E. Bowles. ***Foundation Analysis and Design.*** McGraw Hill Education.
2. Braja Das. ***Principles of Foundation Engineering.*** Cengage Learning.
3. NN. Som and SC Das. ***Theory and Practice of Foundation Design.*** PHI.
4. D.P. Coduto. ***Foundation Design - Principles and Practices***. Pearson.
5. S. Prakash and HD Sharma. ***Pile Foundations in Engineering Practice.*** John Wiley and Sons.
6. VNS Murthy. ***Soil Mechanics and Engineering***. Dhanpat Rai & Sons.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Analyse data obtained from soil exploration.
2. Identify the applicability of different types of foundation under different conditions.
3. Analyse different types of foundation systems under different loading conditions.

4. Design the suitable foundation system for different structures.
5. Select appropriate ground improvement technique.

CE 303	Structural Analysis-II	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	3	1	0	4

Unit-1 Concept of Determinate and Indeterminate Structures; Determinacy and stability.

Unit-2 Introduction to analysis of statically indeterminate structures: Propped cantilever, fixed and continuous beams; effects of sinking of supports, temperature.

Unit-3 Continuous beam analysis by Three Moment Theorem.

Unit-4 Slope deflection method: Analysis of continuous beams for various loading including settlement/ rotation of support, analysis of portal frame with and without sway.

Moment distribution method: Analysis of continuous beams & portal frames including sway.

Kanis method: Introductory concepts, Rotation Contribution, Rotation Factor, analysis of continuous beams and portal frames including sway.

Unit-5 Application of energy methods method for analysis of trusses and rigid frames, column analogy method.

Unit-6 Analysis of two hinged arches, Parabolic arches, circular arches, Secondary stresses.

Unit-7 Analysis of masonry dams and retaining walls, condition for no tension at base, chimneys, piers and abutments.

Unit-8 Introduction to the concept of matrix method of analysis, flexibility matrix and stiffness matrix, Types of skeletal structures, Internal forces and deformations.

Text Books / Reference Books:

1. R C Hibbler. ***Structural Analysis.*** PHI.
2. C S Reddy. ***Basic Structural Analysis.*** Tata McGraw Hill.
3. C K Wang. ***Indeterminate Structural Analysis.*** Tata McGraw Hill.
4. DP Coduto. ***Foundation Design - Principles and Practices***. Pearson.
5. TS Thandavamoorthy. ***Structural Analysis.*** Oxford University Press.
6. Devdas Menon. ***Structural Analysis***. Narosa Publishing House.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand knowledge of indeterminate structures in civil engineering applications.

2. Learn various force and displacements based method for analysis of statically indeterminate structures.
3. Apply these methods to determine response of structures.

CE 304	Surface and Ground Water Hydrology	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	3	1	0	4

Unit-1 **Basic of Hydrology:** Introduction of Hydrology: definition, application. Hydrologic cycle, different terminology, Water Budget equation.

Unit-2 **Hydrometeorology:** Formation and types, forms; measurement, estimating missing precipitation data, average precipitation over area, depth-area-duration analysis; intensity/depth- duration-frequency analysis.

Unit-3 **Stream flow:** Water stage and its measurements, discharge current meter and current-meter measurements, stage-discharge relations, extension of rating curves.

Unit-4 **Runoff and hydrograph analysis:** The component of runoff, hydrograph, hydrograph separation, factors affecting runoff, unit hydrograph concept, derivation of unit hydrograph, Estimation of peak discharge by Rational Method, Isochrones synthetic unit hydrograph, Definition if IUF, Design flood. Frequency analysis and probability.

Unit-5 **Groundwater:** Aquifers, movement of ground water, discharge of groundwater, equilibrium hydraulics of wells. Groundwater management, Surface and sub-surface drainage: water logging, remedial measures.

Unit-6 **Flood Routing:** Definition, storage equation, lumped, distributed and dynamic wave routing.

Unit-7 **Sediment transport:** Origin and formation of sediments, stream erosion and deposition, definition of regime of flow, plane bed, ripple and dune regime, transition regime, anti-dune regime, introduction to bed loads, siltation, suspended load and wash load.

Unit-8 **Floor Damage Mitigation:** Reduction of peak flow, confinement of flow, reduction of peak stage, diversion of floodwater, flood proofing, reduction of flood runoff, temporary evaluation of flood prone, flood insurance.

Text Books / Reference Books:

1. H.M. Raghunath. ***Hydrology.*** New Age International, Delhi.
2. Linsley, Kohlew Paulhors. ***Hydrology for Engineers.*** Tata McGraw Hill.
3. V.T. Chow, D.R. Maidment, and L.W. Mays. ***Applied Hydrology.*** Tata McGraw Hill.
4. K. Subramanya. ***Engineering Hydrology***. McGraw Hill.
5. D.K. Todd. ***Groundwater Hydrology.*** John Wiley & Sons.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop clear concepts on basic of hydrological and hydro-meterlogical process and related problems.
2. Conceptualize surface and subsurface drainage system.
3. Formulate and solve simple surface and ground water flow problems.

CE 305	Water Supply Engineering	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	3	1	0	4

Unit-1 **Water Supply Systems:** Need for planned water supply schemes, Components of water supply system; Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards.

Unit-2 **Water Demand:** Population forecasting, design period, estimation of water demand for various uses, factors affecting consumption and fluctuation of demand.

Unit-3 **Collection, Conveyance and Distribution of water:** Intakes, Types of pipes, Methods of distribution and supply, Storage and distribution reservoirs, Method of layout, Pressure requirements, Power requirements of pumps, Design of distribution systems.

Unit-4 **Water Treatment Processes:** Screening, aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Text Books / Reference Books:

1. Davis ML & Cornwell DA. ***Introduction to Environmental Engineering (SIE).*** Tata McGraw Hill Publication.
2. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain. ***Water Supply Engineering.*** Laxmi Publications.
3. P.N. Modi. ***Water Supply Engineering.*** Standard Book House Publications.
4. H.S. Peavy, D.R. Rowe and G. Tchobanoglous. ***Environmental Engineering***. McGraw Hill Publication.
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify the source of water and water demand.
2. Apply the water treatment concept and methods.
3. Apply water distribution processes and operation and maintenance of water supply.
4. Prepare basic process designs of water treatment plants, collect, reduce, analyze, and evaluate basic water quality data.

CE 311	Detailing of Civil Engineering Structures	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	0	0	3	2

Unit-1 Detailing of beam, column, footing (isolated footing, combined footing, well foundation, pile foundation).

Unit-2 Detailing of King Post and Queen Post truss.

Unit-3 Detailing of Steel roof truss.

Unit-4 Detailing of Culvert.

Unit-5 Detailing of pipes.

Text Books / Reference Books:

1. Rangwala and KB Dalal. ***Civil Engineering Drawing.*** Charotar Publication.
2. V.B. Sikka. ***A Course in Civil Engineering Drawing.*** S. K. Kataria & Sons.
3. Malik R and Meo G. ***Civil Engineering Drawing.*** Asian Publishers.
4. SP 34: Detailing of Structures.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Draw different structural engineering details.
2. Get familiarized with structural components.
3. Conceptualize the importance of code provisions.
4. Get inspiration for higher studies and life-long learning.

CE 312	Foundation Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	0	0	3	2

Unit-1 Tests on soil:

(a) Determination of co-efficient of permeability by Constant head method.
(b) Determination of co-efficient of permeability by Falling head method.
(c) Determination of soil shear strength parameters by Direct shear Test.
(d) Determination of soil shear strength parameters by Triaxial compression test (UU test).
(e) Determination of soil shear strength parameters by Unconfined compression test.
(f) Determination of Compression index by 1-D Consolidation test.
(g) Standard Penetration Test.

Unit-2 Tests on soil:

(a) Determination of mass per unit area.
(b) Determination of thickness
(c) Determination of Specific gravity
(d) Puncture resistance test
(e) Apparent Opening Size

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the different techniques for determination of shear strength of soil.
2. Understand consolidation properties of soft clay.
3. Perform different tests for choice of geosynthetics.
4. Understand suitability of a candidate geosynthetics.

CE 313	Transportation Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	0	0	3	2

Unit-1 **Tests on Subgrade Soil:** California Bearing Ratio Test

Unit-2 **Tests on Aggregates:**

(a) Aggregate Gradation
(b) Aggregate Crushing Value Test
(c) Aggregate Impact Test
(d) Los Angeles Abrasion Test
(e) Shape Test
(f) Soundness Test
(g) Stripping Test.

Unit-3 **Tests on Bituminous Materials:**

(a) Penetration Test.
(b) Ductility Test
(c) Softening Point Test (Ring &Ball)
(d) Viscosity Test
(e) Specific Gravity Test for Bitumen
(f) Flash and Fire Point Test

Unit-4 **Traffic Study:**

(a) Traffic volume study
(b) Vehicle Occupancy Survey

Text Books / Reference Books:

1. S.K. Khanna and C.E.G. Justo. ***Highway Material Testing.*** New Chand & Bros.
2. S.K. Khanna, C.E.G. Justo and A. Veeraragavan. ***Highway Engineering.*** New Chand & Bros.
3. R. N. Hunter. ***Bituminous Mixtures in Road Construction.*** Thomas Telford Services Ltd.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the different techniques for testing highway engineering materials.
2. Understand different aspects of traffic survey.

CE 314	Water Resources Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Fifth Semester(Core)	0	0	3	2

Unit-1 Experiment on evaluation and variation of flow in a fixed bed flume.

Unit-2 Determination of losses in pipe fittings.

Unit-3 Study of hydraulic jump in a fixed bed flume.

Unit-4 Rainfall – Runoff relationships using Rainfall Simulator.

Unit-5 Determination of Manning's and Chezy's coefficients of roughness.

Unit-6 Velocity of a river flow across a given section using River Surveyor.

Unit-7 Computation of critical flow condition in a fixed bed flume.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand Rainfall-Runoff relationships and Well hydraulics using Rainfall Simulator.
2. Determine velocity of a river flow.
3. Study various flow conditions such as critical flow and rapidly varied flow.
4. Determine losses in pipe fittings.

CE 306	Civil Engineering Estimation	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester(Core)	3	0	0	3

Unit-1 **Introduction:** Study of various drawings with estimates, important terms, units of measurement, abstract, Methods of taking out quantities and cost – center line method, long and short wall method or crossing method.

Unit-2 **Estimates:** Types, complete set of estimate, working drawings, site plan, layout plan, index plan, plinth area, administrative approval and Technical Sanction.

(a) Estimate of buildings
(b) Estimate of R. C.C. works
(c) Estimate of sloped roof and steel structures
(d) Estimate of water supply and sanitary works
(e) Estimates of roads (i) Earthwork (ii) Bridges and culverts (iii) Pavement
(f) Estimate of Irrigation works.

Unit-3 **Specifications:** Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings.

Unit-4 **Rate Analysis:** Working out quantities and rates for the following standard items of works – earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.

Unit-5 **Contracts:** Types of contract – essentials of contract agreement – legal aspects, penal provisions on breach of contract. Definition of the terms –Tender, earnest money deposit, security deposit, tender forms, documents and types. Acceptance of contract documents. Termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval – Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements –preparation of bills. Valuation- Definitions of various terms, method of valuation, Freehold &Leasehold properties, Sinking fund, depreciation and method of estimating, depreciation, outgoings.

Text Books / Reference Books:

1. M. Chakraborti. ***Estimating Costing Specification & Valuation in Civil Engineering.*** ISBN-10: 818530436X, ISBN-13: 978-8185304366.
2. BN Dutta. ***Estimating and Costing in Civil Engineering.*** UBS Publishers.
3. Birdie GS. ***Estimating and Costing.*** Dhanpat Rai & Sons.
4. Kohli DD, Kohli RC. ***Estimating and Costing***. S. Chand & Company.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Prepare quantity estimates for buildings, roads and canal works.
2. Calculate the quantity of materials required for civil engineering works as per specifications.
3. Evaluate contracts and tenders in construction practices.
4. Prepare cost estimates.

CE 307	Design of Steel Structures	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester(Core)	3	1	0	4

Unit-1 **Introduction:** Types of steel, types of connections, durability, classes of sections, steel sections, types of loads, load combinations, permissible deflections, permissible slenderness ratio, methods of design.

Unit-2 **Limit state Design Philosophy:** Characteristic load and strength, partial safety factors for material and load.

Unit-3 **Connections:** Riveted and welded connections, strength of rivet, eccentric connections. Pitch, gauge, lap joint and butt joint.

Unit-4 **Tension member:** Types of failure, design strength, bolted/riveted and welded system.

Unit-5 **Compression members:** Column buckling, effective length of column, permissible stress. Built-up columns- laced and battened. Design of slab base and gusseted base.

Unit-6 **Flexural members:** Design for flexure, shear, torsional flexural buckling. Beams, purlin. Plate girder- section design, design of stiffeners, connections.

Unit-7 **Miscellaneous:** Design under combined stresses, Roof Trusses. Design for earthquake loads. Fatigue. Introduction to working stress method of design. Durability and fire resistance.

Text Books / Reference Books:

1. N. Subramanian. ***Design of Steel Structures.*** Oxford University Press.
2. J.E. Bowles. ***Structural Steel Design.*** McGraw Hill, New York.
3. A.S. Arya and J.L. Ajmani. ***Design of Steel Structures.*** Nem Chand & Sons, Roorkee.
4. Ramachandran. ***Design of Steel Structures***. Standard Book House, New Delhi.
5. S.K. Duggal. ***Design of Steel Structures.*** McGraw Hill, New York.
6. Indian Standard Code of Practices IS: 800-2007, IS: 816, SP-38, SP-6 (6).

Course Outcomes (COs):
At the end of the course, students are expected to

1. Understand types of steel and behaviouer of steel.
2. Design components of steel structures.
3. Design connections.
4. Design roof truss and allied items.

CE 308	Sewage Treatment And Disposal	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester(Core)	3	0	0	3

Unit-1 **Introduction:** Wastewater treatment systems, Terms and definitions. Pollution due to improper disposal of sewage, National River cleaning plans.

Unit-2 **Collection and Conveyance systems:** Water carriage system, Hydraulic Design of sewers, Dry and wet weather flow, Storm Water- Quantification and design of Storm water; Planning and Design procedure, Sewer materials, Crown corrosion, Operation and maintenance of sewers, Sewage pumping, Sewer appurtenances.

Unit-3 **Wastewater Characteristics:** Domestic sewage Characteristics, Physical and chemical parameters, Treatment standards, Municipal wastewater treatment systems, BOD, COD, Decomposition of sewage. Sewage disposal and self-purification of natural stream.

Unit-4 **Wastewater Treatment:** Unit operation and process, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, Preliminary treatment, Primary treatment, Secondary treatment, Trickling filters, Activated sludge process, Miscellaneous Treatment systems, Disinfection, recycling of sewage – quality requirements for various purposes. Rural sanitation, Septic tank.

Unit-5 **Sludge Treatment and Disposal:** Thickening, Digestion, Dewatering.

Text Books / Reference Books:

1. Davis ML & Cornwell DA. ***Introduction to Environmental Engineering (SIE).*** Tata McGraw Hill Publication.
2. Kumar Jain, Arun Kumar Jain. ***Wastewater Engineering.*** Laxmi Publications.
3. Santosh Kumar Garg. ***Sewage Waste Disposal and Air Pollution Engineering.*** Khanna Publishers.
4. P.N. Modi. ***Sewage Treatment Disposal & Waste Water Engineering***. Standard Book House, New Delhi.
5. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Carry out the design of Collection and Conveyance systems of sewage and storm water drainage.
2. Determine the sewage characteristics and design parameters for sewage treatment plants
3. Carry out municipal water and wastewater treatment system design and operation.
4. Apply environmental treatment technologies and design processes.

CE 309	Structural Analysis- III	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester(Core)	3	1	0	4

Unit-1 **Approximate analysis of structures:** Substitute frame method for approximate analysis of building frames subjected to gravity loads; Portal Method and Cantilever Method for approximate analysis of building frames subjected to lateral loads.

Unit-2 **Moving loads and influence lines:** Construction and uses of influence lines for bending moment, shear force for determinate structures like beams, trusses, three-hinge arches; Use of influence line for moving load problems; Qualitative evaluation of influence line using Muller Breslau's principle.

Unit-3 **Matrix method of structural analysis:** Introduction to matrix method; Flexibility Method and Stiffness Method for beams, plane truss and frames.

Unit-4 **Plastic methods of structural analysis:** Concept of plastic method of structural analysis; Shape factor; Collapse mechanism; Plastic analysis for beam and frames.

Unit-5 **Introduction to Finite Element Method:** Fundamentals of Finite Element Method and similarities with Direct Stiffness Matrix Method; Introduction to plane stress and plane strain problems.

Text Books / Reference Books:

1. W. Weaver and J.M. Gere. ***Matrix Method of Structural Analysis.*** CBS Publishers, New Delhi.
2. C S Reddy. ***Basic Structural Analysis.*** Tata McGraw Hill, New Delhi.
3. C.K. Wang. ***Indeterminate Structural Analysis.*** Tata McGraw Hill, New Delhi.
4. G.S. Pundit, S.P. Gupta and R. Gupta. ***Theory of Structures***. Tata McGraw Hill, New Delhi.
5. R.C. Hibbeler. ***Structural Analysis***. Pearson Education
6. B.G. Neal. ***Plastic method of Structural Analysis.*** Chapman and Hall.

Course Outcomes (COs):

At the end of the course, students are expected to

Understanding and perform approximate analysis of building frames under vertical and lateral loads.

1. Understanding and evaluate problems associated with moving loads.
2. Understanding and do structural analysis using matrix methods.
3. Understanding and do of plastic analysis of structures.
5. Understanding the framework of Finite Element Method.

CE 331	Soil Dynamics and Machine Foundation	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Professional Core Elective- I)	3	1	0	4

Prerequisites: Geotechnical Engineering (CE 210), Foundation Engineering (CE 302)

Unit-1 **Introduction:** Importance of soil dynamics; Different static and dynamic systems; Types of dynamic loading and their nature.

Unit-2 **Theory of Vibration:** Vibration of elementary systems; Degrees of freedom (SDOF and MDOF systems); Equation of motion for SDOF system; Types of vibrations; Transient and steady state vibration.
Undamped and damped free vibrations; Critical damping; Decay of motion; Undamped and damped forced vibration; Constant force and rotating mass oscillators; Dynamic magnification factor; Transmissibility ratio; Vibration isolation; Vibration measuring instruments.

Unit-3 **Dynamic Soil Properties:** Stresses in soil element; Determination of dynamic soil properties; Field tests; Laboratory tests; Stress-strain behavior of cyclically loaded soils; Estimation of shear modulus and damping ratio.

Unit-4 **Liquefaction:** Types and estimation of liquefaction; Effect of liquefaction, Simplified procedure for liquefaction estimation; Factor of safety; Cyclic stress ratio; Cyclic resistance ratio.

Unit-5 **Machine Foundations:** Types of machines; Basic design criteria; Methods of analysis; Mass-Spring-Dashpot model; Elastic-Half-Space theory; Types of foundations; Modes of vibrations; Vertical, sliding, torsional and rocking modes of oscillations; Design guidelines as per codes; Typical design problems of foundations: Reciprocating type, Impact type, and High Speed Machines.

Text Books / Reference Books:

1. Braja M. Das. ***Fundamentals of soil dynamics.*** Elsevier.
2. Swami Saran. ***Soil Dynamics and Machine Foundations.*** Galgotia Pub. (P) Ltd.
3. Shamsher Prakash. ***Soil Dynamics.*** McGraw-Hill Book Company.
4. J.E. Bowles. ***Foundation Analysis and Design***. Tata McGraw Hill, New Delhi.

Course Outcomes (COs):
At the end of the course, students are expected to

1. Develop basic knowledge about theory of vibration and dynamic properties of soil.
2. Identify liquefaction susceptibility of a site and estimate the factor of safety against liquefaction.
3. Analyze and design different types of foundation system and vibration isolation system for different structures subjected to different types of dynamic loading.

CE 332	Water Resource & Irrigation Engineering	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Professional Core Elective- I)	3	1	0	4

Prerequisites: Hydraulics (CE 207), Surface and Ground water Hydrology (CE 304)

Unit-1 **Introduction:** Flow measurements; Infiltration losses, Reservoir planning - Investigations, life of reservoir, definition, necessity, types, advantages and disadvantages of irrigation.

Unit-2 **Soil Water-plant Relationship:** Soil-water plant relationship, soil-fertility and crop rotation, crop-water relationship, manure and fertilizers for improving soil characteristics, principal crops in India.

Unit-3 **Water-requirements of Crops:** Factors affecting water-requirement of crops, consumptive use of water, determination of irrigation water requirement, command area, delta, duty, base period, relation between delta, duty and base period, Kor depth and Kor period.

Unit-4 **Tube Well Irrigation:** Source, objectives, types of tube-well.

Unit-5 **Flow Irrigation:** (a) Unlined canal-Lacey's theory, design of canal based on silt theory. (b) Lined canal-necessity of lining, selection of lining, types of canal lining and their brief description, design consideration for line canal, maintenance of irrigation canals, Economical considerations of lining a canal.

Unit-6 **Water-logging:** Definition, adverse effects of water-logging, causes of water-logging, anti-water logging measures, Drainage system design.

Unit-7 **Canal Head Works:** Definition of diversion works and storage weirs and barrages, general layout and the components of head-words, Application of Khosla's theory of independent variables.

Unit-8 **Canal Fall**: Necessity and location, types of fall, component of fall, design of fall with hydraulic consideration-vertical drop fall and glacis fall.

Unit-9 **Cross Drainage Works:** Necessity, types of cross drainage work, selection of suitable type of cross drainage works. Design principles only.

Unit-10 **Sprinkler Irrigation, Drip irrigation and Lift Irrigation**: Definitions, advantages of sprinkler irrigation, special uses of sprinkler, component parts of sprinkler system, component parts of drip irrigation, description and advantages of drip irrigation system, lift, lift from river, types of pumps used for lifting water, selection of pumps.

Text Books / Reference Books:

1. Punmia, Pande & Lal. ***Irrigation and Water Power Engineering.*** Laxmi Pub. (P) Ltd, New Delhi.
2. P.N. Modi. ***Irrigation Water Resources and Water Power Engineering.*** Standard Book House.
3. S.K. Garg. ***Irrigation Engineering & Hydraulic.*** Khanna Publisher, Delhi.
4. GL Asawa. ***Irrigation and Water Resources Engineering***. New Age International Publisher.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Apply fundamental knowledge of hydraulics and fluid mechanics in solving and designing practical model for irrigation systems.
2. Formulate and solve simple irrigation problems.
3. Apply numerical techniques for solving real life irrigation problems.
4. Conduct experiments (in teams) in flow measurement, hydraulic machinery and open-channel flows and interpreting data from experiments, as well as documenting them in engineering reports.

CE 333	Elements of Ocean Engineering	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Professional Core Elective- I)	3	1	0	4

Prerequisites: Hydraulics (CE 207)

Unit-1 **Physical Oceanography:** Description of World's Oceans, Physical Properties of Seawater, Ocean Currents, Ocean Floor Characteristics.

Unit-2 **Waves and Tides:** Definition, various wave parameters, classification of waves and tides, storm surges, Seiches, Tsunamis, Hurricanes.

Unit-3 **Basic Wave Hydrodynamics:** Wave Phenomena - Shoaling, refraction, diffraction and breaking, Generation of Wind Waves, Wave Spectrum, Wave Forecasting, Wave run-up and overtopping, Basics of Coastal Processes.

Unit-4 **Coastal and Offshore Structures:** Introduction, types of coastal structures and offshore structures, Loads on structures, Basics of Wave Structure Interaction.

Text Books / Reference Books:

1. M P M Reddy. ***Descriptive Physical Oceanography.*** A A Balkema Publishers.
2. Robert M. Sorenen. ***Basic Coastal Engineering.*** Springer, USA, 2006.
3. John Fenton. ***Coastal and Ocean Engineering.*** Course Materials, 2013.
4. US Army Corps of Engineers, 'Coastal Engg. Manual (CEM)", Parts 1 to 6, Coastal Engineering Res. Centre, Washington D.C. USA. 2006.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop basic knowledge about oceans and various disturbances that occur in them.
2. Understand the concept of wave generation and their phenomena.
3. Analyze and calculate the different loads on coastal structures.

CE 334	Railway and Bridge Engineering	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Professional Core Elective- I)	3	1	0	4

Prerequisites: Geotechnical Engineering (CE 210), Design of Concrete Structures-I & II (CE 208 & CE 301)

Unit-1 Introduction of Railway and High way bridges, Different types of bridges, Geotechnical Investigation, Prestressed Concrete.

Unit-2 Standard of Railway code of practice for bridge design, Specification of IRC codes.

Unit-3 Introduction to the design of Railway RCC Bridges, Prestressed Bridges and Steel Bridges, Railway tract, Railway curve design, super elevation, Ballast materials, Railway Sleepers, MG and BG Railway Track.

Unit-4 Design of Bridges for Highways (RCC T beam Bridge, RCC Box type Bridge, RCC Deck Slab bridge, Culvert Bridge, Pre-Stress Concrete Bridge, Steel Girder Bridges).

Text Books / Reference Books:

1. D.J Victor. ***Essential of Bridge Engineering.*** Oxford & IBH Publishing Co. Pvt. Ltd.
2. K.S. Rakshit. ***Design and Construction of Highway Bridges.*** New Central Book Agency.
3. N. Krinsha Raju. ***Coastal and Ocean Engineering.*** Tata McGraw-Hill Education.
4. N Rajagopalan. ***Bridge Super Structure***. Narosa Publisher.
5. T.R. Jagadeesh and M.A. ***Jayaram. Design of Bridge Structures***. PHI.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop basic knowledge about different classes of loading in bridges.
2. Develop basic knowledge about design of bridge structures.

CE 381	Modelling, Simulation and Application	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Open Elective- I)	3	1	0	4

Unit-1 **Introduction:** Systems, system design, models, simulations.

Unit-2 **Modelling:** Definition, types of model, components of model, Model equation, Scale of balance at spatial and temporal resolution, classification of model, analytical model, numerical model.

Unit-3 **Inverse modelling:** Parameter estimation, parsimonious model, standard error, F statistic, model efficiency, model calibration, model validation.

Unit-4 **Basic concept of probability:** Sample space, sample point, random variable, discrete and continuous random variable, probability distribution function, probability density function.

Unit-5 **Random Number Generation:** Congruence generators, long period generators, statistical quality measures of generators, goodness of fit, null hypothesis, uniformity and independence testing, chi-square, Kolmogorov-Smirnov test.

Unit-6 **Random Variate Generation:** Introduction, approaches of generating random variate, generating discrete and continuous random variate, Theoretical distribution functions, Fitting theoretical distribution to data

Unit-7 **Queuing Models:** Random process, discrete/continuous time processes, queue modelling, components and types of queue models, steady state analysis queue model; Kriging, Variogram.

Unit-8 **Simulation and application:** Definition, types of simulations, deterministic and stochastic systems, static and dynamic systems, discrete event simulation, continuous simulation, Monte Carlo simulation and application in Civil Engineering.

Text Books / Reference Books:

1. Law and Kelton. ***Simulation modelling and Analysis.*** Tata McGraw-Hill.
2. H.A. Taha. ***Operations Research- An introduction.*** Pearson.
3. Lennast Ljung and Torkel Glad. ***Modeling & Identification of Dynamic Systems.*** Studentlitteratur AB.
4. Daniel and Wood. ***Fitting equations to data***. Wiley-Interscience.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understanding of system design and modelling approach.
2. Understanding of basics of probability.
3. Understand of random number and random variate.
4. Understand queuing models along with its performance.
5. Understanding of Simulations and its applications to address real problem.

CE 382	Remote Sensing and GIS	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Open Elective- I)	3	1	0	4

Unit-1 **Remote sensing and basic principles:** Introduction, Components of remote sensing, energy source and its characteristics, atmospheric interaction, types of remote sensing.

Unit-2 **Platforms and sensors:** Introduction, satellite system parameters, sensor parameters, sensor systems, Radar technology.

Unit-3 **Image interpretation:** Visual techniques, Types of Pictoral Data Products, General procedure for photo interpretation, Basic elements of Image Interpretation, Key Elements of Visual Image Interpretation. Digital Techniques – Basic Characteristics of Digital Image, Preprocessing, Image Enhancement, Image classification and GIS.

Unit-4 **GIS:** Introduction to Geographic Information system, Terminology, GIS Architecture, Raster and vector-based GIS, Applications.

Text Books / Reference Books:

1. Anji Reddy M. ***Textbook of Remote Sensing and Geographical Information Systems.*** BS Publications.
2. Demers, Michael N. ***Geographic Information System.*** Wiley 2nd Edition.
3. Lillesand. TM and Kiefer RW. ***Remote Sensing and Image interpretation.*** John Wiley & Sons, 6th Edition.
4. Ghosh, SK and Chandra AM. ***Remote Sensing and GIS***. Narosa Publishing House.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop basic knowledge about remote sensing and GIS.
2. Know about various satellites launch programs and utilize them in solving societal problems.
3. Analyze and rectify various image errors using various techniques.

CE 315	Environment Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Core)	0	0	3	2

Unit-1 **Tests on Water:** Sampling and Analysis of water and sewage sample: Analysis of solids content of water: Dissolved, suspended, total volatile, inorganic etc. determination of Acidity, determination of Alkalinity, Hardness determination, Chloride determination, Iron Concentration, Sulphate determination, Jar test to determine optimum coagulant dose, pH value determination, Turbidity determination.

Unit-2 **Tests on Sewage:** Dissolved oxygen determination, Biochemical Oxygen Demand (BOD) test, Chemical Oxygen Demand (COD) of sewage sample.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Quantify the pollutant concentration in water and wastewater.
2. Understand the health and other effects of a water and wastewater parameter.
3. Recommend the degree of treatment required for the water and wastewater.

CE 316	Computer Aided Design Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Core)	0	0	3	2

Unit-1 Analysis of large three-dimensional building structures to find out shear force diagram, bending moment diagram and axial force diagram (Software: SAP2000 / STAAD.Pro).

Unit-2 Analysis and design of concrete beam/frame member (Software: SAP2000 / STAAD.Pro).

Unit-3 Moving load analysis (Software: SAP2000 / SCiBridge).

Unit-4 Time history analysis (following its theoretical background) (Software: SAP2000).

Unit-5 Settlement of foundation in clay (Software: Plaxis 3D).

Unit-6 Unconfined Compressive Strength Test (Software: Abaqus).

Unit-7 Design of pavement layers based on stress and strain analysis at different layers of pavement while providing different type of loading conditions (Software: IIT PAVE)

Unit-8 Geometric design of pavement while providing survey data of the alignment for a proposed project (Software: MX-Road).

Unit-9 Transport planning, traffic simulation and traffic engineering while considering multi modal network system (Software: PTV vision traffic suit software).

Unit-10 Head loss in pipe (Software: ANSYS CFX).

Unit-11 Study of flow past circular cylinder (Software: ASYS CFX).

Unit-12 Geo-referencing an image (following its theoretical background) (Software: ArcGIS).

Unit-13 Classification to prepare LULC map (following its theoretical background) (Software: ArcGIS).

Unit-14 Design of sewer system (following its theoretical background) (Software: Sewer GEMS).

Text Books / Reference Books:

1. A.K. Chopra. ***Dynamics of Structures.*** Pearson.
2. J.A. Richards. ***Remote Sensing Digital Image Analysis.*** Springer-Verlag NY.
3. Davis ML & Cornwell DA. ***Introduction to Environmental Engineering (SIE).*** Tata McGraw Hill Publication.
4. Software Manuals of all related softwares.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the requirement of computer aided analysis and design for large scale engineering problems.
2. Get familiar with various software for computer aided design problems across the Civil Engineering discipline.
3. Solve various important CAD problems in the domains of Structural Engineering, Geotechnical Engineering, Transportation Engineering and Water Resources Engineering.
4. Provide solution to important CAD problems in the domains of Earthquake Engineering, Remote Sensing, GIS and Environmental Engineering.
5. Get aware of multi-disciplinary applicability of various software primarily used in Civil Engineering.

CE 317	Structural Engineering Laboratory	L	T	P	C
	B. Tech (Civil Engg.) Sixth Semester (Core)	0	0	3	2

Unit-1 To conduct flexural test on RCC beam.

Unit-2 To conduct quasi-static test on beam-column joint.

Unit-3 To conduct flexural test on RC slab.

Unit-4 To demonstrate mode shapes of a multi-storied model building.

Unit-5 To conduct unidirectional shaking test on building model.

Unit-6 To determine proof stress, ultimate strength and ultimate strain for rebar.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Conduct lab test on structural models.
2. Understand the structural engineering behaviour through testing.
3. Get impetus for life-long learning.

CE 401	Concrete Technology	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Core)	3	0	0	3

Unit-1 **Cement and Admixtures:** Types of Portland cement, hydration, setting and hardening process, special hydraulic cements, Admixtures, accelerators, and retarders, air-entraining agents, plasticizer and super-plasticizers, mineral admixtures such as fly ash, ground granulated blast furnace slag, microsilica, rice husk ash.

Unit-2 **Aggregates:** Shape and texture, bond, strength, specific gravity, bulk-density and moisture content of aggregates, bulking of sand, deleterious substances in aggregates, alkali-aggregate reaction, sieve-analysis and grading curves, fineness modulus, practical grading, gap grades aggregates.

Unit-3 **Fresh Concrete:** Rheological aspects such as workability-flow ability, compatibility, mobility of concrete, factors affecting workability and laboratory determination, segregation, bleeding, laitance, compaction of concrete.

Unit-4 **Strength of Concrete:** Compressive strength and factors affecting it, behavior of concrete under various stress states, testing of hardened concrete – cube and cylinder test, Platen effect, flexure test, non-destructive testing such as rebound hammer test, USPV test, core-cutting, stress-strain relation and modulus of elasticity, shrinkage, creep of concrete and its effect.

Unit-5 **Durability of Concrete:** Corrosion of reinforcing bars, sulphate attack, frost action, deterioration by fire, concrete in seawater, acid attack, carbonation, cracks in concrete.

Unit-6 **Concrete Mix Design:** Basic consideration – cost, workability, strength and durability, grading, method of mix design, acceptance criteria for concrete.

Unit-7 **Advances in Construction Materials:** High strength concrete, fibre-reinforced concrete, concrete containing polymers, heavy weight and light weight concrete, mass concrete, reactive powder concrete, Engineered Cementitious Composites, geopolymer concrete.

Text Books / Reference Books:

1. P.K. Mehta. ***Concrete: Structure, Properties and Materials.*** Prentices-Hall, Inc., USA.
2. Aminul Islam Laskar. ***Concrete Technology Practices.*** Narosa Publishing House, New Delhi.
3. A.M. Neville. ***Properties of Concrete.*** Longman U.K.
4. J.H. Bungey. ***Testing of Concrete in Structures***. Surrey University Press, New York.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify quality control tests on concrete making materials.
2. Understanding properties of fresh and hardened concrete.
3. Design concrete mixes as per Indian Standard and ACI standard.
4. Identify durability requirements of concrete.
5. Understand the need for special concrete and their properties.

CE 431	Coastal Engineering	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Professional Core Elective- II)	3	1	0	4

Prerequisites: Fluid Mechanics (CE 205), Elements of Ocean Engineering (CE 382)

Unit-1 **Coastal Processes:** Littoral Drift, Coastal Erosion and Mitigation - Global Scenario and Indian Perspective, Coastal Features, Coastal Engineering Problems.

Unit-2 **Coastal sediment characteristics:** Initiation of sediment motion under waves- Radiation stress-wave set-up and wave set- down- mechanics of coastal sediment transport – Limits for littoral drift – Suspended and Bed Load – alongshore sediment transport rate – Distribution of alongshore currents and Sediment transport rates in Surf zone.

Unit-3 **Planning and Design of Coastal Protection Works:** Soft and Hard Options, Innovative Technologies, Performance of Coastal Protection Works in India, Coastal Zone Regulation, Integrated Coastal Zone Management, Coastal Pollution and Environmental Impact Assessment.

Text Books / Reference Books:

1. Mani J. S. ***Coastal Hydrodynamics.*** PHI Learning Pvt. Ltd.
2. Sorenson, R.M. ***Basic Coastal Engineering.*** Wiley-Interscience Publication, New York, 1978.
3. Kamphius, J. W. ***Introduction to coastal Engineering and Management.*** Advances on Ocean Engineering-Volume 16, World Scientific, 2002.
4. US Army Corps of Engineers, "Coastal Engineering. Manual (CEM)", Parts 1 to 6, Coastal Engineering Res. Centre, Washington D.C. USA, 2006.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop basic knowledge about various coastal processes and sediment transportation
2. Understand the various influencing parameters on coastal sediment movement and its analysis.
3. Understand coastal zone management and implement the various coastal protection techniques to minimize erosion.

CE 432	Advanced Structural Analysis	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Professional Core Elective- II)	3	1	0	4

Prerequisites: Structural Analysis- III (CE 309)

Unit-1 **Introduction of Matrix Method of Structural Analysis:** Static and kinematics indeterminacy of structures; Fundamentals of Flexibility and Stiffness method; Basic examples of application of Flexibility and Stiffness Method.

Unit-2 **Direct Stiffness Matrix Method:** Derivation of local stiffness matrices for prismatic and non-prismatic members, transformation matrices and global stiffness matrices, assembling, compatibility equation. Application of Matrix Displacement Method to plane truss, space truss, beams, grids, plane frames and space frames subjected to various loadings including effects of temperature change and support displacements, Applications of software in structural analysis.

Unit-3 Navier Method and Levy's method of analysis of slabs due to different loading conditions.

Unit-4 Analysis of Circular Slabs, Spherical Domes.

Text Books / Reference Books:

1. Weaver W. and Gere J. ***Matrix Analysis of Framed Structures.*** CBS Publishers & Distributors, Delhi.
2. Hibbler R.C. ***Structural Analysis.*** Pearson Education, Asia.
3. Wang, C.K. ***Intermediate Structural Analysis.*** McGraw-Hill.
4. CS Reddy. ***Basic Structural Analysis***. McGraw Hill Education.
5. Rajasekharan S. and Sankarasubramanian G. ***Computationsl Structural Mechanics***. PHI, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop the comprehensive understanding on matrix methods of structural analysis.
2. Develop the understanding on fundamental principles of Finite Element Method.
3. Extend the analysis skill for special structure.
4. Develop the understanding on non-linear analysis of structures.
5. Ability for structural analysis using computer software.

CE 433	Advanced Foundation Engineering	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Professional Core Elective- II)	3	1	0	4

Prerequisites: Geotechnical Engineering (CE 210) and Foundation Engineering (CE 302)

Unit-1 **Site investigation:** Different techniques of Soil Exploration, disturbed and undisturbed samples, field tests, geophysical investigations, report writing.

Unit-2 **Shallow foundations**: Design of combined footing, strip footing, strap footing, footings on layered soils, footings on slope, uplift load. Rafts and floating rafts, foundations on expansive soils, foundations on collapsible soils.

Unit-3 **Deep foundations:** Pile foundations, negative skin friction, Group capacity, settlement of pile group, uplift force, Laterally loaded piles.

Unit-4 **Sheet piles:** General concept, design of cantilever sheet piles and anchored bulkheads in different types of soils, methods of reducing lateral pressure.

Unit-5 **Soil dynamics:** Barkan's methods, elastic halt space theories, vibration isolation, attenuation laws.

Unit-6 **Ground improvement techniques:** Ground improvement methods in cohesive and cohesionless soils, Geo-synthetics.

Text Books / Reference Books:

1. S P Brahma. ***Foundation Engineering.*** Tata Mc Graw Hills, NewDelhi.
2. J. Bowles. ***Foundation Engineering.*** Mc Graw Hills International.
3. Robert M. Koerner. ***Designing with Geosynthetics.*** McGraw-Hill.
4. D.D. Barkan. ***Dynamics of bases and foundations***. McGraw Hill, New York.
5. P. Srinivasulu and CV Vaidyanathan. ***Handbook of Machine Foundation***. Tata McGraw Hills, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Communicate effectively the engineering knowledge on foundation problems.
2. Understand the behaviour of problematic soil.
3. Design foundations for a given type of soil.
4. Evaluate design parameters for dynamic loading.

CE 434	Dynamics of Structures	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Professional Core Elective- II)	3	1	0	4

Unit-1 **Introduction:** Sources of Structural vibrations; Meaning and types of excitations; spring action, spring in series and parallel. D'Alembert's Principle.

Unit-2 **Free Vibration:** Free vibrations of undamped and viscously damped SDOF systems; logarithmic decrement and its applications; Coulomb damping, material damping, hysteretic damping and radiation damping. Equivalent viscous damping.

Unit-3 **Response to harmonic excitations:** Duhamel's integral.

Unit-4 Vibration isolation and vibration absorption, Force transmissibility and base motion.

Unit-5 **MDOF systems:** Vibrations of undamped 2 DOF systems; MDOF systems, Free vibrations of MDOF systems, methods of solving eigenvalue problems; Characteristic equation method and other methods. Time step analysis.

Unit-6 **Modal Analysis:** Introduction to Modal analyses of MDOF systems, mode superposition method.

Unit-7 **Response Spectrum:** Concept of Response spectrum, its construction and applications.

Text Books / Reference Books:

1. Chopra, A. K. ***Dynamics of structures.*** Prentice Hall of India.
2. Clough RW, and Penzien J. ***Dynamics of structures.*** McGraw Hill.
3. Timoshenko SP, & Young DH. ***Advanced Dynamics.*** McGraw-Hill.
4. T K Datta. ***Seismic Analysis of Structures***. John Wiley & Sons (Asia).
5. M. Paz. ***Structural dynamics: Theory and Computation***. CBS Publishers, Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the effect of vibration on structures.
2. Analyze SDOF and MDOF structures under various dynamic loadings and obtain the responses.
3. Understand modal analysis and response spectrum construction.
4. Conceptualize the importance of structural dynamics in design code provisions.

CE 435	Open Channel Flow	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Professional Core Elective- II)	3	1	0	4

Unit-1 **Basic Flow Concepts:** Types of channels, Classification of flow, Velocity distribution-velocity coefficients, Vertical Pressure distribution.

Unit-2 **Energy and Momentum Principles:** Specific energy, Critical flow, Section factors, First hydraulic exponents, Computation of critical flow, Specific force, Simple channel transitions.

Unit-3 **Uniform Flow in Rigid-Boundary Channels:** Shear stress on boundary, Velocity distribution in turbulent flow, Chezy's equation, Manning's equation, Conveyance of a channel section, Section factor for uniform flow computation, Second hydraulic exponent, Computation of uniform flow.

Unit-4 **Uniform flow in mobile-Boundary Channels:** Incipient motion condition, Shield's analysis, Regimes of flow, Prediction of regimes, Flow resistance.

Unit-5 **Gradually Varied Flow:** Differential equation of GVF, Classification of flow profiles, Analysis of flow profiles, Computation of GVF, direct integration, simple numerical integration for prismatic and non-prismatic channels.

Unit-6 **Rapidly Varied Flow:** Hydraulics Jumps – Analysis, Classification, Flow over weir and spillways and weirs, Flow under sluice gate.

Unit-7 **Unsteady Flow:** Waves, celerity of small gravity wave, GVUF, St. Venant's equations, Method of characteristics, RVUF, surges in open channels.

Text Books / Reference Books:

1. S. Subramanya. ***Flow in Open Channel.*** Tata McGraw Hill, New Delhi.
2. V.T. Chow. ***Open Channel Hydraulics.*** McGraw Hill, New York.
3. R.H. French. ***Open Channel Hydraulics.*** McGraw Hill, New York.
4. M.H. Chaudhry. ***Open Channel Flow***. Prentice-Hall of India, New Delhi.
5. K.G. Ranga Raju. ***Flow through Open Channels***. Tata McGraw Hill, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Develop basic knowledge about open channel flow.
2. Understand different types of flow conditions.

CE 481	Data Analytics in Engineering	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Open Elective- II)	3	0	0	3

Unit-1 **Data Driven Engineering:** Motivation, Big-data in science and engineering, Data visualization, Practical problems in data analytics.

Unit-2 **Regression Analysis:** Simple linear regression, Multiple linear regression, Nonlinear transformations, Predictors, Potential problems.

Unit-3 **Classification:** Logistic regression, Linear discriminant analysis, Quadratic discriminant analysis, Bayes' theorem, Naive Bayes, Support vector machines, kernel functions, Applications.

Unit-4 **Nonlinear models:** Polynomial regression, Splines, Generalized additive models, Moving least square, engineering applications.

Unit-5 **Graphical models:** Decision tree models, Random forests, Boosting, Problems.

Unit-6 **Unsupervised learning:** Principal component analysis, Clustering methods, Problems.

Text Books / Reference Books:

1. S. L. Brunton, N. J. Kutz. ***Data-driven Science and Engineering.*** Cambridge University Press.
2. C. M. Bishop. ***Pattern Recognition and Machine Learning.*** Springer.
3. S. Marsland. ***Machine Learning: An Algorithmic Perspective.*** CRC Press.
4. Andrew N. G. ***Machine Learning Yearning***. deeplearning.ai (blog).

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the principles of data analysis and visualization.
2. Determine and interpret the data-driven statistical models.
3. Evaluate data analytics tools based on the type and size of data.
4. Apply data-informed decisions to practical problems.

CE 482	Numerical Methods in Engineering	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Open Elective- II)	3	0	0	3

Unit-1 Non-linear system of equations, curve fitting techniques, numerical integration and differentiation, numerical solution of ordinary and partial differential equations, introduction to finite difference methods, application of numerical methods in solving in engineering problems.

Unit-2 Basics of computer algorithm and flow chart, introduction to application of high level computer programming in solving numerical problems.

Text Books / Reference Books:

1. J.B. Scarborough. ***Numerical Mathematical Analysis.*** Oxford & IBH Pub. Co. Pvt. Ltd., Kolkata.
2. S.C. Chapra and R.P. Canale. ***Numerical Methods for Engineers.*** Tata McGraw-Hill, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Apply various numerical methods in solving engineering problems.
2. Develop computer programming in solving numerical problems.

CE 483	Traffic Engineering	L	T	P	C
	B.Tech. (Civil Engg.) Seventh Semester (Open Elective – II)	3	0	0	3

Unit-1: *Introduction to Traffic engineering-*
Introduction, objectives, scope; Driver behaviour and Mixed traffic characteristics of India; PIEV Theory; Macro and microscopic parameters; Relationships among traffic parameters; Traffic flow theory; Characteristics of uninterrupted and interrupted traffic flow facilities; Traffic flow modelling; Capacity and Level-of-service.

Unit-2: *Traffic Studies-*
Data Collection methods of traffic volume, speed, travel time and delay; Manual method, Mechanical method, Videogrpahy and Image processing method; Parking study; Origin & Destination Survey, Accident studies.

Unit-3: *Application of Probability and Statistics in Traffic Engineering*
Applications of correlation, linear and non-linear regression; Application of discrete and continuous probability distributions; Problems on vehicle arrival prediction; headway distributions; Queuing theory.

Unit-4: Traffic regulation and Smart mobility-
Road signs and markings; Types of intersection; Unsignalized, Signalized and rotary intersection; Conflicts at intersection; Signal time and phase diagram; Signal design as per Webster's and IRC method; Introduction to Intelligent Transportation System for traffic management, enforcement and education. Components of ITS.

Text Books/ Reference Books:

1. S K Khanna and CEG Justo and AVeeraragavan, Highway Engineering, Nem Chand and Bros.
2. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan PressLtd. 1996.
3. C Jotin Khisty and B Kent Lall, Transportation Engineering: An Introduction, Prentice Hall of India Pvt. Ltd, New Delhi-110001, 2002
4. P. Chakroborty and A. Das, Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd., 2003.
5. Roger P. Roess, William R. McShane & Elena S. Prassas, Traffic Engineering, Prentice-Hall, 1990.
6. Pignataro L. J., Traffic Engineering – Theory and Practice, Prentice Hall, 1973.
7. Wohl M. and Martin B. V., Traffic System Analysis, McGraw-Hill Book Company, 1967.
8. L. R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2000.
9. Highway Capacity Manual (HCM), Transportation Research Board, USA, 2000.

Course outcomes:

After studying this course, students will be able to:

- To understand the traffic stream characteristics, Driver behaviour and Vehicular Characteristics.
- To undertake various types of traffic surveys, analyse and interpret the traffic pattern.
- To suggest appropriate traffic regulation and control mechanism as per IRC for achieving safe and improved LOS of road links and intersections.
- To acquire basic knowledge of Intelligent Transportation System.

CE 498	Project I	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Core)	0	0	0	6

Unit-1 Site investigation, planning, analysis, design, detailing and estimation of multistoried building and other Civil Engineering Structures.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Do planning, analysis, design and detailing of civil engineering structures.
2. Get acquainted with relevant Indian Standard Codes of Practices.

CE 451	Earthquake Resistant Design of Structures	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Professional Core Elective- III)	3	0	0	3

Unit-1 **Introduction:** Origin of earthquakes, magnitude, intensity, ground motions, sensors, strong motion characteristics.

Unit-2 **Concepts of earthquake resistant design of R.C. buildings:** Earthquake and vibration effects on structure, identification of seismic damages in buildings, effect of structural irregularities on the performance of buildings during earthquakes and seismic resistant building architecture.

Unit-3 **Seismic analysis and modeling of R.C. buildings:** Codal procedure for design of lateral loads, infill walls, seismic analysis of R.C. building as per IS: 1893 – 2000 (Part 1).

Unit-4 **Earthquake resistant design of buildings and other structures:** Ductility considerations, E.R.D. of R.C. building, design of load bearing buildings, design of shear wall, design of liquid storage tanks, retaining wall, chimney and industrial structures.

Text Books / Reference Books:

1. Pankaj Agarwal and Manish Shrikhande. ***Earthquake Resistant Design of structures.*** Prentice Hall of India Pvt. Ltd.
2. R. Park and T. Paulay. ***Reinforced Concrete Structures***. Wiley.
3. T. Paulay and M.J.N. Priestly. ***Seismic Design of Reinforced Concrete and Masonry Building.*** John Wiley & Sons.
4. C. V. R. Murty. ***Learning earthquake design and construction.*** Springer.
5. Anand S. Arya. ***Masory and Timber structures including earthquake Resistant Design***. Nemchand & Bros.
6. IS: 1893 (Part-1) -2016. "***Criteria for Earthquake Resistant – Design of structures***." B.I.S., New Delhi.
7. IS: 4326-1993, "***Earthquake Resistant Design and Construction of Building***", Code of Practice B.I.S., New Delhi.
8. IS: 13920- 2016, "***Ductile detailing of concrete structures subjected to seismic force***" – Guidelines, B.I.S., New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Correlate information from various engineering and scientific discipline to understand complex behaviour of RC buildings and other structures subjected to seismic forces and various design principle.

2. Design RC buildings and other structures in accordance with the provisions of Indian and International building codes.
3. Use performance based design framework and nonlinear analysis techniques.

CE 452	Elementary Performance-Based Seismic Design	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Professional Core Elective- III)	3	0	0	3

Unit-1 Force-Based Design vs. Performance-Based Design, Historical Development. Limitations of Force-Based Method of Design. Limitations of IS 1893 (Part 1)-2002. Moment-curvature relationship. Strength and Stiffness relationship.

Unit-2 Definition of Maximum earthquake and Design Basis Earthquake. Spectrum Compatible Ground Motions. Review of Response Spectrum Method of Design. Displacement Spectra.

Unit-3 The concept of Capacity design. Expected strength and extreme strength of materials.
Performance levels – Immediate Occupancy Level, Life Safety Level, Collapse Prevention Level. The concept of Operational Level Buildings.

Unit-4 Drift in buildings and design for drift. Design for desired performance levels.

Unit-5 Displacement-Based design philosophy. Direct Displacement-Based Design Methods. Frame Buildings, Frame-Shear wall buildings. Effect of infill. Unified performance-based design philosophy.

Text Books / Reference Books:

1. M.J.N. Priestley, G.M. Calvi and M.J. Kowalsky. ***Displacement-Based Seismic Design of Structures.*** IUSS Press.
2. T.J. Sullivan, M.J.N. Priestley, G.M. Calvi. ***Seismic Design of Frame-Wall Buildings***. Research Report No. ROSE-2006/02.
3. T. Paulay and M.J.N. Priestly. ***Seismic Design of Reinforced Concrete and Masonry Building.*** John Wiley & Sons.
4. R. Park and T. Paulay. ***Reinforced Concrete Structures***. Wiley.
5. FEMA-273 (1997). ***NEHRP Guidelines for Seismic Rehabilitation of Buildings***, NEHRP.
6. FEMA-356 (2000). ***Pre-standard and Commentary on Seismic Rehabilitation of Buildings***, NEHRP.
7. FEMA-440 (2005). ***Improvement of Nonlinear Static Seismic Procedures***, ATC.
8. ATC-40 (1996). ***Seismic Evaluation and Retrofit of Concrete Buildings***, Applied Technology Council.
9. ASCE-SEI-4. ***Seismic Evaluation and Retrofit of Existing Buildings***, ASCE.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Learn the limitation of Force-based codal method of design.

2. Quantify seismic hazards.
3. Learn the displacement-based design philosophy and apply it in design.
4. Apply the latest performance-based design philosophy (PBD) including Unified PBD. As a result they get impetus for higher studies and life-long learning.

CE 453	Hydraulic Structures	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Professional Core Elective- III)	3	0	0	3

Unit-1 **Dams and their characteristics:** Classification of dams, features, advantages and disadvantages of each type, selection of each type of dam.

Unit-2 **Investigation of dam sites:** Various phases of investigation, geological investigation, sub-surface exploration, choice of location, foundation treatment, economic height of dam.

Unit-3 **River diversion:** Diversion schemes, phases of diversion, diversion flood, tunnels, cofferdams.

Unit-4 **Gravity dams:** Forces acting on gravity dams, load combinations for design, models of failure and stability requirements, structural competency of gravity dams, practical profile, stability analysis, design of non-overflow and overflow sections by single-step method.

Unit-5 **Arch dams:** Type of arch dams, forces acting on arch dam, method of analysis, most economical central angle, design of each dams based on cylinder theory.

Unit-6 **Embankment dams:** Type of embankment dams, earth dam-types, causes of failure and stability requirements, design criteria, preliminary design, seepage analysis- Flownet, phreatic line, stability analysis- safety of u/s slope against rapid draw down, safety of d/s slope against steady seepage.

Unit-7 **Hollow and Buttress dams:** Hollow gravity dams, buttress dams- types of buttress dams, forces acting on buttress dams, design of deck slab type buttress dams.

Unit-8 **Weirs and Barrages:** Types of weirs, causes of failure, design of weirs on permeable foundation, Bligh's creep theory, Khosla's theory- method of independent variables.

Unit-9 **Instrumentation:** Instrumentation in dams, types of instruments, deformation measurement of dam body and its foundation, surveying instruments.

Text Books / Reference Books:

1. B. C. Punmia, Pande B.B. Lal. ***Irrigation and Water Power Engineering.*** Laxmi Publications.
2. K. R. Arora. ***Irrigation Water Power and Water Resources Engineering***. Standard Publisher.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Learn about different types of dams, dam selection criteria and choice of location etc.
2. Design different types of dams.
3. Get familiar with different types of instruments used in dams.

CE 454	Application of Geosynthetics	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Professional Core Elective- III)	3	0	0	3

Unit-1 **Introduction:** Basic concepts of geosynthetics, composition of geosynthetics, polymer science, types and manufacturing methods, properties and testing of geosynthetics.

Unit-2 **Designing with geotextiles:** Introduction, functions and mechanisms, designing for separation, reinforcement, drainage, filtration; designing for improvement of bearing capacity, mechanically stabilized wall, construction procedure.

Unit-3 **Designing with geogrids:** Introduction, functions and mechanisms, designing for reinforcement, designing for stabilization.

Unit-4 **Designing with geomembrane:** Introduction, designing for lining.

Unit-5 **Designing with geonet:** Introduction, designing for drainage.

Unit-6 **Designing with geocells:** Introduction, designing for improvement of bearing capacity, construction methods.

Unit-7 **Designing with geocomposites:** Introduction, designing for separation, designing for reinforcement, designing for improvement of bearing capacity, construction procedure.

Text Books / Reference Books:

1. Robert M. Koerner. ***Designing with Geosynthetics.*** McGraw-Hill.
2. J. N. Mandal. ***Geosynthetics world***. New Age International Private Limited.
3. Sanjay Kumar Shukla. ***An introduction to Geosynthetic Engineering***. Taylor & Francis Ltd.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Identify the functions of geosynthetics.
2. Analyse and compute different properties of geosynthetics.
3. Apply the knowledge for designing the structures using Geosynthetic materials.
4. Identify testing method for a given function.

CE 455	Construction Engineering & Management	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Professional Core Elective- III)	3	0	0	3

Unit-1 **Modes of bidding system:** E-tendering, restricted tender, composite tender, manual tendering, EPC mode, notice inviting tender, Price bid and technical bid.

Unit-2 **Contract Management:** Earnest money, performance guarantee, justification of tenders, acceptance of tenders, award of work, mobilization advance, secured advance, advance payment, measurement book, test checking, quality assurance, Breach of contract and arbitration.

Unit-3 **Project Management through network:** Critical path method, early and late time calculations, Float, critical path, resource allocation, network compression. Programme evaluation & review technique (PERT), expected times and slack, critical path, probability of completion time of a project, construction safety standards.

Unit-4 **Construction equipment and methods:** Dozers, scrapers, excavators, graders, cranes, dragline and clamshell, forming system, fundamental concepts of equipment economics, machine equipment power requirement.

Text Books / Reference Books:

1. S. Seetharaman. ***Construction Engineering and Management.*** Umesh Publication.
2. R L Peurifoy, C J Schexnayder, A. Shapira. ***Construction planning, equipment and methods***. Mc Graw Hill Education (India).
3. CPWD Works Manual, 2019, Nirman Bhawan, New Delhi.
4. Standard operating procedure for CPWD Works Manual, 2019, Nirman Bhawan, New Delhi.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Evaluate contracts and tenders in construction process.
2. Prepare schedule of activities in a construction project.
3. Understand safety processes in construction industry.
4. Identify equipment used in construction.

CE 491	Finite Elements Methods in Engineering	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Open Elective- III)	3	0	0	3

Unit-1 Basic theory, advantages and disadvantages, convergence criteria, principle of virtual work, energy principles, variational formulations, weighted residual methods.

Unit-2 Displacement models, shape functions, element stresses and strains, element stiffness matrix. One dimensional problems, bar elements.

Unit-3 Two dimensional elements, triangular elements, quadrilateral elements, higher order elements, Axis-symmetric elements. Pin joined trusses, beams, frames, plates.

Unit-4 Practical problems.

Text Books / Reference Books:

1. T. K. Chandraputla and A.D. Belegundu. ***Introduction to finite elements in Engineering.*** Prentice Hall of India Pvt. Ltd.
2. C.S. Krishnamurthy. ***Finite Element analysis (Theory & Programming)***. Tata McGraw Hill Publishing Co. Ltd.
3. K.S. Bathe and E.L. Wilson. ***Finite Element methods***. Prentice Hall of India.
4. O.C. Zeinkiewicz. ***Finite Element methods in Engineering Sciences***. McGraw Hill Book Co.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the numerical methods involved in Finite Element Theory.
2. Understand direct and formal (basic energy and weighted residual) methods for deriving finite element equations.
3. Understand the formulation of one-dimensional elements (truss and beam).
4. Understand the formulation of two-dimensional elements (triangle and quadrilateral continuum and shell elements).
5. Perform and verify FEA using commercial FEA software.

CE 492	Optimization Techniques	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Open Elective- III)	3	0	0	3

Unit-1 **Introduction of optimization:** Definition, applications, classification, optimization techniques.

Unit-2 **Linear Optimization:** Formulation and geometrical ideas of linear programming, Simplex method, modified simplex method, Duality, Applications in various civil engineering systems planning/management using linear programming.

Unit-3 **Nonlinear optimization:** Single variable optimization, Multivariable optimization without constraint, Multivariable optimization with equality constraint, Multivariable optimization with inequality constraint, convex optimization.

Unit-4 **Numerical optimization:** Line search methods, gradient methods, Newton's method, conjugate direction methods, quasi-Newton methods, projected gradient methods, penalty methods.

Unit-5 **Dynamic programming:** Introduction to Dynamic programming, Application in water allocation problems and reservoir operational problems.

Unit-6 **Soft computing optimization Techniques:** Introduction, Foundations of Genetics Algorithms –reproduction, crossover and mutation, Analysis of GA operators – mathematical foundations. Application of Genetic algorithms in Engineering.

Unit-7 **Multi-objective optimization:** Weighted and constrained methods; Multi level optimization and application in engineering.

Text Books / Reference Books:

1. Singiresu S. Rao. ***Engineering Optimization: Theory and Practice.*** Wiley.
2. Kalyanmay Deb. ***Optimization for Engineering Design: Algorithms and Examples***. PHI.
3. GSG Beveridge and RS Schechter. ***Optimization: Theory and Practice***. McGraw Hill.
4. LR Foulds. ***Optimization Techniques***. Springer.
5. DE Goldberg. ***Genetic Algorithms in Search, Optimisation and Machine Learning***. Addison Wesley.

Course Outcomes (COs):
At the end of the course, students are expected to

1. Understand the basic of optimizations and several traditional optimization techniques and relevance of optimization.
2. Handle linear, nonlinear civil engineering systems planning/management by traditional optimization techniques.
3. Get knowledge on soft computing optimizations and also can be apply to address several Civil engineering system judiciously.

CE 493	Engineering Risk Analysis	L	T	P	C
	B. Tech (Civil Engg.) Eighth Semester (Open Elective- III)	3	0	0	3

Unit-1 **Introduction:** Motivation, Objectives of risk analysis, Risk terminologies, System framework, Uncertainty in risk quantification.

Unit-2 **Risk Analysis Methods:** Risk metrics, Regression analysis, Failure Mode and Effect Analysis, Fault tree analysis, Cause consequence analysis, other methods.

Unit-3 **Risk-informed decisions:** Overview of probabilistic models and graph theory, Decision tree and influence diagrams, Bayesian network, Series, parallel and hybrid systems, Practical examples.

Unit-4 **Safety Management:** Cost-benefit analysis, Risk reduction and elimination, life-cycle management, Risk control.

Unit-5 **Case studies:** Risk assessment of civil, mechanical and aerospace structures, Interdisciplinary application in economics, finance and medicine.

Text Books / Reference Books:

1. AHS Ang and WH Tang. ***Probability Concepts in Engineering.*** John Wiley.
2. RM Cooke and T Bedford. ***Probabilistic Risk Analysis***. Cambridge University Press.
3. T Aven. ***Risk Analysis***. John Wiley.
4. BM Ayyub. ***Risk Analysis in Engineering and Economics***. CRC Press.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Understand the principles of risk analysis in engineering.
2. Determine and interpret the standard risk models and metrics.
3. Evaluate risk management tools and techniques that are used in practice.
4. Apply risk-informed decisions to practical problems.

CE 499	Project II	L	T	P	C
	B. Tech (Civil Engg.) Seventh Semester (Core)	0	0	0	6

Unit-1 Reviewing literatures in the area of interest to identify a simple research problem and solving the same.

Course Outcomes (COs):

At the end of the course, students are expected to

1. Get exposure in emerging problems on civil engineering and develop interest in research activity.
2. Get familiar with the available literature on the research problem of his/her interest.
3. To identify a methodological approach to solve the problem.