Scheme & Syllabus of

B. Tech Civil Engineering

Batch 2018 onwards

By

Board of Study CIVIL AND ENVIRONMENTAL SCIENCE

(Affiliated Colleges)

Study scheme

Third Semester										
S. No.	**Category**	**Subject Code**	**Course Title**	**Hours per week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-301-18	Surveying & Geomatics	3	1	0	40	60	100	4
2	Professional Core courses#	BTCE-302-18	Solid Mechanics#	3	0	0	40	60	100	3
3	Professional Core courses #	BTCE-303-18	Fluid Mechanics#	3	0	0	40	60	100	3
4	Basic Science Course #	BTAM-301-18	Mathematics III # (Transform & Discrete Mathematics)	4	0	0	40	60	100	4
5	Engineering Science Course	BTEC-305-18	Basic Electronics & applications in Civil Engineering	3	0	0	40	60	100	3
6	Humanities and Social Sciences including Management	HSMC-132-18	Civil Engineering-Introduction, Societal & Global Impact	3	0	0	40	60	100	3
7	Professional Core courses	BTCE-306-18	Surveying & Geomatics Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-307-18	Fluid Mechanics Lab	0	0	2	30	20	50	1
9	Professional Core courses	BTCE-308-18	Solid Mechanics Lab	0	0	2	30	20	50	1
10		BMPD-301-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			-
11	Pofessional Skill Enhancement	BTCE-332-18	Training – I*	-	-	-	60	40	100	Satisfactory/Unsatisfactory
			Total 28	**19**	**1**	**8**	**390**	**460**	**850**	**23**
*** Students have already completed 3 weeks institutional training and field and market survey in Summer vacation which is to be evaluated by viva-voce conducted along End semester exam of Third semester.**										

Note : # These are the minimum contact hrs. allocated.

The contact hrs. may be increased by institute as per the need based on the content of subject.

Fourth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-401-18	Concrete Technology	3	0	0	40	60	100	3
2	Professional Core courses	BTCE-402-18	Material, Testing & Evaluation	4	0	0	40	60	100	4
3	Professional Core courses	BTCE-403-18	Hydrology & Water Resources	3	1	0	40	60	100	4
4	Professional Core courses	BTCE-404-18	Transportation Engineering	3	1	0	40	60	100	4
5	Professional Core courses	BTCE-405-18	Disaster Preparedness & Planning	3	0	0	40	60	100	3
6	Basic Sciences (Mandatory Courses)	EVS-101-18	Environment Science (Non- credit)	2	0	0	50	-	50	0
7	Professional Core courses	BTCE-406-18	Concrete Testing Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-407-18	Transportation Lab	0	0	2	30	20	50	1
9	Professional Skill Enhancement		Training –II*	0	0	0	-	-	-	-
10		BMPD-401-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			-
			Total 26	**18**	**2**	**6**	**310**	**340**	**650**	**20**

* 2 weeks survey camp and 4 weeks industrial/institutional training for which viva will be conducted along End semester examination of Fifth semester.

Fifth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core courses	BTCE-501-18	Engineering Geology	3	0	0	40	60	100	3
2	Professional Core courses	BTCE-502-18	Elements of Earthquake Engineering	3	0	0	40	60	100	3
3	Professional Core courses	BTCE-503-18	Construction Engineering & Management	3	0	0	40	60	100	3
4	Professional Core courses	BTCE-504-18	Environmental Engineering	4	0	0	40	60	100	4
5	Professional Core courses	BTCE-505-18	Structural Engineering	3	1	0	40	60	100	4
6	Professional Core courses #	BTCE-506-18	Geotechnical Engineering#	3	0	0	40	60	100	3
7	Professional Core courses	BTCE-507-18	Geotechnical Lab	0	0	2	30	20	50	1
8	Professional Core courses	BTCE-508-18	Environmental Engineering Lab	0	0	2	30	20	50	1
9	Professional Core courses	BTCE-509-18	Structural Lab	0	0	2	30	20	50	1
10		BMPD-501-18	Mentoring and Professional	0	0	2	Satisfactory/ Unsatisfactory			-
11	Professional Skill Enhancement	BTCE-532-18	Training – II*	-	-	-	60	40	100	Satisfactory/Unsatisfactory
			Total 28	**19**	**1**	**8**	**390**	**460**	**850**	**23**
* Students have already completed 2 weeks survey camp and 4 weeks summer internship in Summer vacation which is to be evaluated by viva-voce conducted along End semester exam of Fifth semester.										

Note : # These are the minimum contact hrs. allocated.

The contact hrs. may be increased by institute as per the need based on the content of subject.

Sixth Semester										
S No	**Category**	Subject Code	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Core course	BTCE- 601 -18	Engineering Economics, Estimation & Costing	3	1	0	40	60	100	4
2	Professional Elective courses	PECE-602 X-18	Elective –I	3	1	0	40	60	100	4
3	Professional Elective courses	PECE- 603 Y-18	Elective –II	3	1	0	40	60	100	4
4	Professional Elective courses	PECE- 604 Z-18	Elective – III	3	1	0	40	60	100	4
5	Open Elective Courses	OEZZ-XXX1	Open Elective-I	3	0	0	40	60	100	3
6	Open Elective courses	OEZZ-XXX2	Open Elective – II	3	0	0	40	60	100	3
7	Mandatory Courses (Non-credit)	BTMC-101-18	Constitution of India	3	0	0	50	-	50	0
8		BMPD-601-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory	S/US		S/US
			Total 27	**21**	**4**	**2**	**290**	**360**	**650**	**22**

Institute/Department to decide regarding sending students for One Semester Training in 7th or 8th Semester.

Seventh Semester/Eighth Semester										
S No	**Category**	**Subject Code**	**Course Title**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
1	Professional Elective courses	PECE-701X-18	Elective – IV	3	1	0	40	60	100	4
2	Professional Elective courses	PECE-702Y-18	Elective – V	3	1	0	40	60	100	4
3	Open Elective courses	OEZZ-XXX	Open Elective – II(Metro system and Engg)	3	0	0	40	60	100	3
4	Professional Elective courses	PECE-703Z-18	Elective – VI	3	1	0	40	60	100	4
5	Open Elective courses	OEZZ-XXX	Open Elective – III	3	0	0	40	60	100	3
6	Humanities and Social Sciences including Management courses HSMC255	HSMC-XXXX	Professional Practice, Law & Ethics	2	0	0	40	60	100	2
7	Mandatory Courses (Non-credit)	BTMC-XXXX	Management- I (Organizational Behavior and Entrepreneurship)	2	0	0	50	-	50	0
			Total 22	**19**	**3**	**0**	**290**	**360**	**650**	**20**

Institute/Department/Student may decide for Industry oriented courses in lieu of One Semester Training in 7th or 8th Semester (Subject to approval from Competent Authority).

Seventh/ Eighth Semester

S No	Category	Subject Code	Course Title	Evaluation Internal		External		Credits
				Institute	Industry	Ext	Total	
1	Training (one semester)	BTCE-801-18	Software Training And Project	100	50	100	250	16
			Industrial training and Project	100	50	100	250	
			Total	**200**	**100**	**200**	**500**	**16**

Or
Students may obtain relevant credits from MOOC/SWAYAM
Or

Seventh/ Eighth semester

S No	Category	Subject Code	Course Title	Hours Per Week			Marks			Credits
				L	T	P	Int	Ext	Total	
1	Professional Core courses	BTCE-802-18	Artificial Intelligence Techniques	3	1	0	40	60	100	4
2	Project		Project	0	0	24	60	40	100	12
3	Mandatory course	BMPD -803-18	Mentoring and Professional Development	0	0	2	Satisfactory/ Unsatisfactory			S/US
			Total 30	**3**	**1**	**26**				**16**

PROFESSIONAL (or PROGRAM) ELECTIVE (PE) COURSES [CIVIL ENGINEERING]

The Professional Electives are categorized into six different tracks viz. : Geotechnical engineering (PE1), Structural Engineering (PE2) and construction Engg and Management (PE3) to offer in 6th semester and the remaining three tracks i.e Transportation Engineering (PE4), Environmental Engg (PE5) & water Resources (PE6) to offer in 7th semester

The Program Elective Groups/courses have been categorized/developed keeping in mind the employment prospects of the students. The Program design in B.Tech. CE aims at providing domain specific knowledge to a student at UG level in progression. The Program/course design has been carried out jointly by the Academia in close coordination with Industry to provide a leading edge to the students and to prepare them as per the Industry needs

Professional Elective Course Tracks –Civil Engineering [PEC-CE]

Track	Code Number	Professional Core Course	Semester	Credits
Track-I	PECE-602X-18	Geotechnical engineering	6	4
Track-II	PECE-603Y-18	Structural Engineering	6	4
Track-III	PECE-604Z-18	Construction Engg and Management	6	4
Track-IV	PECE-701X-18	Transportation Engineering	7	4
Track-V	PECE-702Y-18	Environmental Engg	7	4
Track-VI	PECE-703Z-18	Water Resources	7	4
Total Credits				24

Basket of Professional Elective for different Tracks

Tracks	Basket of Professional Electives					
Track- I	Foundation Engg PECE-602A-18	Ground Improvement Techniques PECE-602B-18	Advanced Soil Mechanics PECE -602C-18	Geosynthetic Engineering PECE -602D -18	Geo-Environ Ment Engineering PECE -602E-18	Rock Mechanics PECE-602F -18
Track -II	Design of concrete structures PECE -603A-18	Design of steel Structures PECE -603B-18	Advanced Structural Analysis PECE -603C-18	Structure Analysis And Design PECE -603D -18	Prestressed structures PECE -603E-18	Bridge Engg PECE -603F -18
Track -III	Construction Equipment and Automation PECE -604A-18	Sustainable Construction methods PECE -604B-18	Repair and rehabilitation of structures PECE -604C-18	Construction Cost Analysis PECE -604D -18	Contracts Management PECE-604E -18	Construction Engineering Materials PECE -604F -18
Track -IV	Pavement and geometric design of Highways PECE -701A-18	Airport planning and Design PECE -701B-18	Intelligent Transportation On systems PECE -701C-18	Highway Construction and Management PECE -701D-18	High Speed Rail Engg PECE -701E-18	Traffic Engg And Management PECE -701F -18
Track -V	Environment Law and Policy PECE-702A-18	Rural water Supply And onsite Sanitation Systems PECE-702B-18	Water and air Quality Modelling PECE-702C-18	Solid and Hazardous Waste Management PECE-702D-18	EIA and LCA PECE-702E-18	Sustainable Engg and Technology PECE-702F -18
Track –VI	Design of Hydraulic structures PECE-703A-18	River Engg. PECE-703B-18	Ground Water PECE-703C-18	Hydraulic Modelling PECE-703D-18	Transients in Closed conduits PECE-703E-18	Urban Hydrology and hydraulics PECE-703F -18

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS
Offered by Civil Engg Department for Even Semester

S.No.	Course Title	Subject Code	Semester	Hours Per Week			Credits
				L	T	P	
1	Civil Engineering- Introduction, Societal & Global Impact	HSMC- 132-18	Even	3	0	0	3
2	Disaster Preparedness & Planning	BTCE- 405-18	Even	3	0	0	3
3	Remote Sensing & GIS	OECE-609-18	Even	3	0	0	3
4	Construction Engineering & Management	BTCE- 503-18	Even	3	0	0	3
5	Concrete Technology	BTCE-401-18	Even	3	0	0	3

- **Odd semester List will be updated soon**

3rd Sem Syllabus

Third Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	BTCE-301-18	**Surveying & Geomatics**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

1. Understand the concept, various methods and techniques of surveying
2. Compute angles, distances and levels for given area
3. Apply the concept of tachometry survey in difficult and hilly terrain.
4. Select appropriate instruments for data collection and survey purpose
5. Analyze and retrieve the information from remotely sensed data and interpret the data for survey.
6. Understand the concepts related to GIS and GPS and analyze the geographical data.

Content

Unit-I: ***Introduction to Surveying*****:** Principles, Survey stations, Survey lines- ranging, direct &indirect ranging, Bearing and its measurement with prismatic compass, calculation of angles from bearings, Local Attraction Levelling:, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes. Setting up the plane table and methods of plane tabling(Radiation and three point problem only).

Unit-II: ***Triangulation and Trilateration*****:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Balancing of Traverse, Omitted Measurements, Tachometry: Definition, determination of tachometer constants and reduced level from tachometric observations. Triangulation - network- Signals. Baseline - choices - extension of base lines - corrections - Trigonometric leveling .

Unit-III: ***Curves****:* Elements of simple and compound curves – Method of setting out Transition curve – length of curve – Elements of transition curve.

Photogrammetry Surveying: Introduction, Basic concepts, flight planning; Stereoscopy, photographic mapping-mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Unit-IV: ***Modern Field Survey Systems***: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, 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, errors and biases, Surveying with GPS, LADAR (drone and vehicle based)

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

Refernces & Books

1. Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill
2. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I, II & III, Laxmi Publications
3. Agor, R., Surveying, Khanna Publishers
4. Bhavikatti, S.S. Surveying & Levelling Volume I & II

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
2	Professional Core courses#	BTCE-302-18	**Solid Mechanics**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand the concept of static equilibrium, deformations, and material constitutive behaviour.
2. Describe the concepts of stress, strain and elastic behaviour of materials including Hooke's law relationships to analyze structural members subjected to tension, compression and torsion.
3. Apply the concept of Mohr's circle in the stress/strain calculations.
4. Develop SFD and BMD for different type of beams subjected to different types of loads
5. Plot elastic curves for beams undergoing displacements under different loadings
6. Understand the behaviour of columns and struts under axial loading.

Content

Unit-I: ***Concept of Equilibrium****:* Loads, supports, reactions, displacements; General equilibrium equations; Equilibrium of a point and a member; Concept of free body diagram; Statical determinacy of a problem.

Stresses and Strains*:* Concept of stress and strain; Type of stresses and strains; Stress-strain diagrams for ductile, brittle materials; Generalized Hooke's law; Concept of working stress and factor of safety; Lateral strain, Poisson's ratio and Volumetric strain; Elastic moduli and relationship between them; Bars of varying section, composite bars, thermal stresses.

Unit-II: ***Principal Stresses and Strains:*** Concept of principal stresses, principal strains and principal planes; use of Mohr circle in computation of stresses and strains; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress also with shear stress.

Shear Force and Bending Moment Diagrams*:* Introduction to the concept of shear force, bending moment and the sign convention; Shear force and bending moment diagrams for cantilever, simply supported and overhang beams subjected to point loads, uniformly distributed loads, uniformly varying loads, moments or their combination, point of contra flexure.

Unit-III: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams..

Bending and Shear Stresses: Assumptions - theory of simple bending; Derivation of bending equation; Centroid and section modulus of various cross sectional shapes including rectangular, circular, I, channel, angle etc.; Determination of bending stresses, bending stress distribution across various beam sections; Determination of shear stress, shear stress distribution across various beam sections.

Unit-IV: ***Columns and Struts****:* Stability of Columns; buckling load of axially loaded columns with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.

Torsion of Circular Shafts*:* Derivation of torsion equation and its assumptions, application of equation to circular shafts; combined torsion and bending of circular shafts, principal stress and maximum shear stress under combined loading of torsion and bending.

Stresses and strains in thin cylinders: spherical shells subjected to internal pressures; Normal stress, tangential stress.

Text/Reference Books

1. 'Elements of Strength of Materials', Timoshenko, S. and Young, D. H., DVNC, New York, USA.
2. 'Solid Mechanics', Kazmi, S. M. A., TMH, New Delhi.
3. 'Mechanics of Materials', Hibbeler, R. C., Pearson Prentice Hall.
4. 'An Introduction to the Mechanics of Solids', Crandall, S. H., N. C. Dahl, and T. J. Lardner, McGraw Hill.
5. 'Mechanics of Materials', Ferdinand P. Beer, E. Russel Jhonston Jr. and John T. D. Ewolf, TMH.
6. 'Strength of Materials', James M. Gere and Barry J. Goodno, Cengage Learning India Pvt. Ltd., New Delhi.
7. 'Strength of Materials', R. Subramanian, Oxford University Press, New Delhi.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
3	Professional Core courses #	BTCE-303-18	**Fluid Mechanics**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completion of the course, student is able to

1. Understand the basic terms used in fluid mechanics and its broad principles
2. Estimate the forces induced on a plane/ submerged bodies
3. Formulate expressions using dimensionless approach and able to determine design parameters by creating replica of prototype at appropriate scale.
4. Apply the continuity, momentum and energy principles and design the pipelines used for water supply or sewage under different situation.
5. Calculate drag force exerted by fluid on the body of varying shapes and able to minimize them.
6. Design and addressing problems in open channel (lined/ unlined) of different shapes and size optimally as per site condition.

Content

Unit-I: ***Basic Concepts and Definitions*** – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, Piezometer, U-Tube Manometer, U-Tube Differential Manometer, Micromanometers, pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Unit-II: ***Fluid Kinematics*** - Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Fluid Dynamics - Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

Unit-III: ***Laminar Flow & Turbulent Flow*** - Laminar flow through: circular pipes, parallel plates. Stoke's law, Reynolds experiment, Transition from laminar to turbulent flow. Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. Flow through Pipes: Loss of head through pipes, Darcy-Wiesbach equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel

Boundary Layer Analysis- Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Unit-IV: ***Open Channel Flow*** - Introduction, Comparison between open channel flow and pipe flow, geometrical parameters of a channel, Uniform Characteristics of uniform flow, Chezy's formula, Manning's formula. Most economical section of channel. Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses.

References:

1. Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
2. Hydraulic and Fluid Mechanic by P.N. Modi & S.M. Seth
3. Engineering Fluid Mechanics by R.J. Garde & A.G. Mirajgaoker
4. Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman
5. Fluid Mechanics: Streetes VL & Wylie EB;
6. Fluid Mechanics by Potter, Cengage Learning

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
4	Basic Science Course	BTAM-301-18	**Mathematics-III (Transform & Discrete Mathematics)**	4	0	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes:

1. Understand the basic results on vector function, their properties and fields so as to apply them for solving problems of engineering.

2. Find length, area and volume using integral calculus that is an important application in engineering.

3. Solve some real problems in engineering using Gauss Divergence and Stokes' theorem

4. To formulate Laplace transform of functions and its applications to solve differential equations that form real life problems in engineering.

5. To formulate Fourier Series, its properties and its applications to solve problems in engineering.

Detailed Content

Section A **(20 lectures)**

Unit I: ***Vector Calculus-I:*** Scalar and Vector point function, Gradient, Directional derivatives, Divergence, Curl and their identities, line, surface, volume integrals and their applications, Solenoidal and Irrotational fields.

Unit II: ***Vector Calculus-II*****:** Applications of Green, Gauss and Stokes Theorems, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Section B **(20 lectures)**

Unit III: ***Transforms Calculus-I*****:**Laplace Transform, Properties of Laplace Transform, Laplace Transform of Unit step function, Impulse function, Dirac-delta function, Periodic functions. Inverse Laplace Transform, convolution theorem, Evaluation of integrals by Laplace Transform, Applications to ODEs and PDEs.

Unit IV :***Transforms Calculus-II*****:** Fourier Series, half range Fourier Sine and Cosine series, Fourier integrals, Gibbs Phenomenon, Fourier transforms, Relation between Laplace and Fourier transform, Properties of Fourier Transforms, Convolution Theorem and applications

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
3. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
4. Thomas and Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, 2017.
5. R. K. Jain and S.R.K Iyengar Advanced Engineering Mathematics, 5th Edition, 2017.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
5	Engineering Science Course	BTEC- 305-18	**Basic Electronics & applications in Civil Engineering**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Objectives:

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the Devices, Instruments and Sensors used in Civil Engineering applications in subsequent courses.

Course Outcomes:

After undergoing this course students will be able to

1. Understand construction of diodes and their rectifier applications.
2. Appreciate the construction and working bipolar junction transistors and MOSFETs.
3. Design Op-Amp IC based fundamental applications.
4. Comprehend working of basic elements of digital electronics and circuits.

Unit I: **Semiconductor Diodes and Applications** - Semiconductor Diode - Ideal versus Practical, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications;

Unit II: **Transistors & Amplifiers** - Bipolar Junction Transistor (BJT) – Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, Distortion, Operating Point, Voltage Divider Bias Configuration; Introduction to nMOS and pMOS.

Unit III: Operational Amplifiers and Applications - Introduction to Op-Amp, Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Differentiator and Integrator, Square Wave and Triangular Wave Generation.

Unit IV: Digital Electronics -Boolean Algebra - Binary, Octal, Hexadecimal Number Systems, Addition, Subtraction using 1's and 2's compliment method, Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); K- Map simplification Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop.

Text/Reference Books:

1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.
2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India.
3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education.
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH
5. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
6	Humanities and Social Sciences including Management	HSMC-132-18	**Civil Engineering- Introduction, Societal & Global Impact**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Introduction to what constitutes Civil Engineering
2. Understanding the vast interfaces this field has with the society at large
3. Providing inspiration for doing creative and innovative work for the benefit of the society
4. Need to think innovatively to ensure Sustainability
5. Highlighting the depth of engagement possible within civil engineering and exploration of various possibilities of a career in this field

Content

Unit I: ***Civil Engineering and its historical developments;*** Understanding the importance of Civil Engineering in shaping and impacting the world; the ancient and modern Marvels and Wonders in the field of Civil Engineering; Scope of work involved in various branches of Civil Engineering and future vision; Recent Civil Engineering breakthroughs and innovations; Avenues for entrepreneurial working.

Unit II: ***Understanding the past to look into the future***; Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution and how these eras helped the civil engineering to grow; Concept of sustainability and the steady erosion of the environment due to haphazard developments; Global warming, its impact and possible causes; Atmospheric pollution; Pollution Mitigation measures; Health & Safety aspects for stakeholders; Environmental Impact Analysis: Concept and procedures; Innovations and methodologies for ensuring Sustainability.

Unit III: ***Infrastructure development and growth of the Nation***; its effects on the GDP, employment, living standards of the people, etc.; Introduction and overview to Futuristic systems: Megacities, Smart Cities, Stadia; Roads, Railways, Metros, Hyper Loop, Airports, Seaports, River ways, Sea canals, Tunnels, bridges.

Unit IV: ***Energy Generation***: Hydro, Solar, Wind, Wave, Tidal, Geothermal, Thermal energy; Telecommunication needs: towers, above-ground and underground cabling; Flood control: Dams, Canals, River interlinking; Energy efficient built-environments and LEED ratings; Awareness of various Codes & Standards governing Infrastructure development.

Suggested Readings

1 Salvadori, M and Heller, M, Strctures in Architectures, PHI.
2. Fintel, C, Handbook of Civil Engineering, CBS Publications.
3. *Žiga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
4.Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
5.NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
7	Professional Core courses	BTCE-306-18	**Surveying & Geomatics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcomes

After completing the course the students must demonstrate the knowledge and ability to:

1. Assess horizontal & vertical angles by Theodolite.
2. Survey the area using different methods of plane tabling and compass survey and to adjust the compass traverse graphically.
3. Compute the reduce levels using various methods of leveling.
4. Predict the location of any point horizontally and vertically using Tachometry.
5. Setting out curves in the field.
6. Use electronic survey instruments.

Course Content

1. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
2. Different methods of leveling, height of instrument, rise & fall methods.
3. Measurement of horizontal and vertical angle by theodolite.
4. Determination of tachometric constants and determination of reduced levels by tachometric observations.
5. Plane table survey, different methods of plotting, three point problem.
6. Determination of height of an inaccessible object.
7. Setting out of circular curves in the field using different methods.
8. Plotting of traverse using the Total Station and GPS.

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
8	Professional Core courses	BTCE-307-18	**Fluid Mechanics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcome

1 Select appropriate pressure measuring device under different condition of flow.
2 Determine the stability of a floating body.
3 Understand and apply Bernoulli's theorem practically.
4 Find discharge of fluid through pipe, orifices and in open channel.
5 Estimate the major and minor losses in pipe.
6 Estimate the various elements and energy losses in hydraulic jump.

Lab Experiments

1. To study of pressure measuring devices as peizometer, U-tube manometer, and pressure gauges.
2. To verify Bernoulli's Theorem
3. To determine the Meta centric height of a Floating Body under different condition.
4. To determine the coefficient of discharge of a Venturimeter.
5. To determine the coefficient of discharge of a Orifice Meter
6. To determine the coefficient of friction of different diameter pipes.
7. To estimate the minor losses as energy loss in pipe bend, sudden contraction or enlargement in pipe.
8. To determine the coefficient of discharge on rectangular and V-notches.
9. To determine the various element of a hydraulic jump.

Text/Reference Books

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	Professional Core courses	BTCE-308-18	**Solid Mechanics Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

Course Outcomes

1. Understand the importance of physical properties of steel.
2. Identify and comprehend code provisions for testing different properties of steel.
3. Develop stress-strain curve for axial compression, axial tension and shear.
4. Assess hardness and impact strength of steel.
5. Assess flexural strength of a given material.
6. Evaluate fatigue and impact strength of steel.

Content

1. Determination of physical properties of steel including strength and ductility.
2. Study of tensile and compressive stress-strain behaviour of steel.
3. Compression test on brick.
4. Development of shear stress-strain curve for steel in torsion.
5. Determination of hardness of a material by Rockwell and Brinell hardness testing machine.
6. Determination of impact strength of a material by Izod and Charpy tests.
7. Determination of bending strength of a wooden beam specimen.
8. Determination of fatigue strength of a material.
9. Study of behavior of columns and struts with different end conditions.
10. To verify the moment area theorem for slope and deflection of a given beam.

Text/Reference Books

1.Laboratory Manual of Testing Materials, William Kendrick Hall

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-301-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty in charges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
10	Skill Enhancement	BTCE-332-18	**Training -I**	-	-	4	S/US

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes:

After completing this course the student must demonstrate the ability to:

1. Visualize things/ concepts and express the thoughts in the form of sketches, models, etc
2. Create a well organized document using computers
3. Work in teams
4. Acknowledge the work of other in a consistent manner
5. Understanding of ethical and professional issues
6. Demonstrate effective oral communication and presentation skills

Content

Module I – Institutional Training (3 weeks)

1. Hands-on-training on MS Office/ Office suite (Word processor, Spreadsheet, Math tools, presentation/ ppt, etc.)
2. Introduction to Civil Engineering software's and basic overview of drafting tools such as AutoCad, etc.

Module II – Field and Market Study

1. Student shall visit construction site of significantly scale and make an inventory construction and finishing materials being used.
2. Student shall do Market Survey for availability and rates of materials in the already prepared inventory.

Note:

1. The students need to submit a summary report of the institutional training in Module I, and A detailed report/ scrapbook of inventory and market survey done in Module II.
2. The viva exam for the subject will be conducted along with the practical exams of the End-Semester Examination of Third Semester.

4th Sem Syllabus

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	BTCE-401-18	**Concrete Technology**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand the relevance of different properties of constituent materials on properties of concrete.
2. Understand the behavior and durability aspects of concrete under different loading and exposure conditions.
3. Understand the issues involved in production and use of concrete.
4. Design of concrete mixes as per BIS specifications.
5. Understand various testing methods for concrete and their applicability.
6. Knowledge of special type of non-conventional concretes.

Content:

Unit I: ***Concrete and its ingredients****:* Properties of cement, aggregate, admixture, water and other additives; Related Indian Standard codes & guidelines.

Concrete behaviour in fresh and hardened states*:* Workability, Elasticity, Shrinkage, Creep, Fatigue, Strength in compression, tension, shear and bond; Influence of various factors on test results; Concrete cracking and type of cracks; Permeability and durability characteristics of concrete including resistance to sulphate & acid attack, alkali-aggregate reaction, freezing and thawing; Fire resistance.

Unit II: ***Production of concrete****:* Mixing, handling, placing, compaction of concrete and related issues; Quality control; Behaviour in extreme environmental conditions like hot weather, cold weather and under water conditions.

Concrete mix design: Basic considerations, proportioning of material, effect of various parameters, trial mixes, Design by IS code.

Unit III: ***Inspection and testing of concrete****:* Defects in concrete; Deterioration of concrete; Strength tests including compressive, split tensile, flexural, pullout etc.; Durability tests including permeability, carbonation, rapid chlorine ion penetration etc.; Destructive and Non-destructive testing of concrete; Acceptance and compliance requirements of concrete as per IS codes.

Unit IV: ***Special concretes:*** Types and specifications; Fibre reinforced and steel reinforced concrete; Polymer concrete; Light weight concrete, High strength concrete, Prestressed concrete, Self Compacting Concrete, Pervious Concrete, Self Healing Concrete.

Text/Reference Books

1. 'Properties of Concrete', A. M. Neville, Prentice Hall
2. 'Concrete Technology', M. S. Shetty, S.Chand & Co.
3. 'Concrete Technology', M. L. Gambhir, Tata McGraw Hill Publishers, New Delhi
4. 'Concrete Technology', A. R. Santha Kumar, Oxford University Press, New Delhi

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
2	Professional Core courses	BTCE-402-18	**Materials, Testing & Evaluation**	4	0	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Appraisal about the role of materials in civil engineering
2. Introduce common measurement instruments, equipments and devices to capture the material response under loading
3. Exposure to a variety of established material testing procedures/techniques and the relevant codes of practice
4. Ability to write a technical laboratory report.

Unit-I: Introduction to Engineering Materials: Types, properties, advantages and uses of: Cement; Concrete; Admixtures; Glass and Plastics; Paints and Varnishes,; Acoustical material; Geo-synthetics, Bitumen and Asphalt; Ceramics and Refractory's ;Bricks; Concrete hollow blocks & Interlocking tiles.

Sand: Composition, types, Physical Properties, uses. Fly ash: Source, types, properties and uses Timbers: Properties, Seasoning, defects, preservation methods, laminates and adhesives,

Unit-II: Ferrous and nonferrous metals, Importance of Structural steel; Their characteristics and mechanical behaviour (elastic, plastic and elasto plastic, strength and durability w.r.t Climatic variation); Creep – fundaments and characteristics, concept of fatigue of materials; Impact test, toughness – different materials.

Unit-III: Testing Procedures for bricks, reinforcing steel, fine aggregates, coarse aggregates, Physical identification of tests for soils. Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results.

Unit-IV: Quality control- Use of test data/ testing reports in the material selection for various civil engineering projects /construction, Sampling, Acceptance criterion, Code of practice and guidelines in this regards for Cements; Aggregates; Concrete (plain and reinforced); Soils; Bitumen and asphaltic materials; Timbers; Glass and Plastics; Structural Steel.

Text/Reference Books:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann

2.Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand & Bros, Fifth Edition

3.Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications

4.Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella

5.E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition

6.American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards

(post 2000)

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
3	Professional Core courses	BTCE-403-18	**Hydrology & Water Resources Engineering**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Outcomes

At the end of the course, students must be in a position to:

1 Understand the interaction among various processes in the hydrologic cycle.

2 Calculate the average annual rainfall of any area using the rain gauge data and inter-relations of various parameters as infiltration, evapotranspiration etc

3 Understand the various component of hydro graphs and able to estimate the run off.

4 Find the water requirement for different crops and able to proposed appropriate method of applying water.

5 Understand the distribution system of canal and various components of irrigation system.

6 Classify dams and spillways, their problems and able to determine forces exerted by fluid on dams.

Content

Unit I: ***Introduction*** **-** Hydrologic Cycle, History of Hydrology, Water-Budget Equation, , World Water Balance, Applications in Engineering, Sources of Data.

Precipitation **-** Forms of Precipitation, Characteristics of Precipitation in India, Measurement of Precipitation, Rain Gauge Network, Mean Precipitation over an Area, Depth Area-Duration Relationships, Maximum Intensity/Depth-Duration-Frequency Relationship, Probable Maximum Precipitation (PMP), Rainfall Data in India.

Unit II: ***Abstractions from precipitation*** - Evaporation Process, Evaporimeters, Analytical Methods of Evaporation Estimation, Reservoir Evaporation and Methods for its Reduction, Evapotranspiration, Interception, Depression Storage, Infiltration, Infiltration Capacity, Measurement of Infiltration, Modelling Infiltration Capacity, Classification of Infiltration Capacities, Infiltration Indices.

Runoff **-** Runoff Volume, SCS-CN Method of estimating runoff volume, Flow Duration Curve, Flow-Mass Curve, Hydrograph, Factors Affecting Runoff Hydrograph, Components of Hydrograph, Base Flow Separation, Effective Rainfall, Unit Hydrograph Surface Water Resources of India, Environmental Flows.

Unit III: ***Water withdrawals and uses*** **–** Water for Energy Production, Water for Agriculture, Water for Hydroelectric Generation; Flood Control. Analysis of Surface Water Supply, Water Requirement of Crops- Crops and Crop Seasons in India, Cropping Pattern, Duty And Delta; Quality of Irrigation Water; Soil-Water Relationships, Root Zone Soil Water, Infiltration, Consumptive use, Irrigation Requirement, Frequency of Irrigation; Methods of Applying Water to The Fields: Surface, Sub-Surface, Sprinkler and Trickle / Drip Irrigation.

Distribution systems - Canal Systems, Alignment of Canals, Canal Losses, Estimation of Design Discharge. Design of Channels- Rigid Boundary Channels, Alluvial Channels, Kennedy's and Lacey's Theory of Regime Channels. Canal Outlets: Non-Modular, Semi-Modular And Modular Outlets.

Unit IV: ***Water Logging****:* Causes, Effects And Remedial Measures. Lining of Canals, Types of Lining. Drainage of Irrigated Lands: Necessity, Methods.

Dams and spillways - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

Text/Reference Books

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J. D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
4	Professional Core courses	BTCE-404-18	**Transportation Engineering**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Appreciate the importance of different modes of transportation and characterize the road transportation.
2. Alignment and geometry of pavement as per Indian Standards according to topography.
3. Assess the properties of highway materials in laboratory
4. Understand the importance of railway infrastructure planning and design.
5. Identify the functions of different component of railway track.
6. Outline the importance of Airport Infrastructure

Course Content

Unit I: ***Introduction:*** Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport.

Transportation Systems*:* Multi modal transportation system, Characteristics of Mass Transit systems including technical, demand operational and economic problems, fixed Track Facility, Mass Rapid Transit System-Elevated, Surface and Underground construction, Express Bus System, integrated Operating Characteristics of Terminal and Transfer facilities.

Unit II: ***Highway Development & Planning****:* Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys; Highway Construction: Right of way; Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements

Unit III: ***Railway Engineering****:* History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge.

Railway Track*:* Requirements of a Good Track, Track Specifications, Detailed Cross-Section of Single/Double Track used in Indian Railways. Components of permanent way - Rails, Sleepers, Ballast, Sub-grade and Formation, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.

Unit IV: ***Airport Engineering*****:** Introduction, Air Transport Scenario in India and Stages of Development, National and International Organizations; Airport planning - Site selection, runway orientation, etc. Concept of Head Wind, Cross Wind, Wind Rose Diagram, Runway Configuration.

Aircraft Parking System & Visual Aids*:* Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.

References

•Khanna S.K., and Justo, C.E.G. “Highway Engineering”, Nem Chand and Brothers, Roorkee,1998.
•Kadiyali, L.R. “Principles and Practice of Highway Engineering”, Khanna Publishers, New Delhi, 1997.
•Flaherty, C.A.O. “Highway Engineering”, Volume 2, Edward Arnold, London, 1986.
•Sharma, S.K. “Principles, Practice & Design of Highway Engineering”, S. Chand & Company Ltd., New Delhi, 1985.
•Mannering, “Principles of Highway Engineering & Traffic Analysis”, Wiley Publishers, NewDelhi.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
5	Professional Core courses	BTCE-405-18	**Disaster Preparedness & Planning**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify various types of disasters, their causes, effects & mitigation measures.
2. Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.
3. Understand the use of emergency management system to tackle the problems.
4. Discuss the role of media, various agencies and organisations for effective disaster management.
5. Design early warning system and understand the utilization of advanced technologies in disaster management.
6. Compare different models for disaster management and plan & design of infrastructure for effective disaster management.

Content

Unit I: ***Introduction to Disaster Management:*** Define and describe disaster, hazard, vulnerability, risk-severity, frequency and details, capacity, impact, prevention, mitigation.

Disasters*:* Identify and describe the types of natural and manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender, age, special needs), Lessons and experiences from important disasters with specific reference to civil engineering.

Unit II: ***Disaster Mitigation and Preparedness:*** Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non structural measures; Preparedness for natural disasters in urban areas.

Risk Assessment*:* Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.

Unit III : ***Post disaster response****:* Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.

Unit IV: ***Integration of public policy****:* Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.

Books and References

1. www.http//ndma.gov.in
2. http://www.ndmindia.nic.in
3. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill, Publisher
4. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester 92
5. Singh B.K., 2008, Handbook of disaster management: Techniques & Guidelines, Rajat Publications.
6. Disaster Management, R.B. Singh (Ed), Rawat Publications
7. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
7	Mandatory Courses (Non Credit)	EVS-101-18	**Environmental Science**	2	0	0	0

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory**

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects this ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.

2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.

4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Detailed Contents

Unit- I : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. Land resources
: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources, Equitable use of resoureces for sustainable lifestyles.

Unit-II : Ecosystems : Concept of an ecosystem, Structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems: a. Forest ecosystem b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-III : Biodiversity and its conservation : Introduction – Definition : genetic, species and ecosystem diversity, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India

Unit-IV : Social Issues and the Environment : From Unsustainable to Sustainable development, Resettlement and rehabilitation of people; its problems and concerns., Environmental ethics : Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust, Case Studies, Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).Videography/ photography/ information collections on specialties/unique features of different types of common creatures. Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1 ***(A) Awareness Activities:***

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste

b) Slogan making event

c) Poster making event

d) Cycle rally

e) Lectures from experts

f) Plantation

g) Gifting a tree to see its full growth

h) h***i)***)

$C_Dl_re_{iv}a_{n_e}l_fi_on_re_{s_s}s_eg_dr_re_{iv_g}e_a$

i) tion of waste

i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess

j) To know about the different varieties of plants

k) Shutting down the fans and ACs of the campus for an hour or so

l) Visit to a local area to document environmental assets

river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural

n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

References & Books

1. Textbook of Environmental studies, Erach Bharucha, UGC
Weblink: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

2. Environmental Studies by Poonia, M.P and Sharma, S.C, Khanna publishing

3. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd

4. Environment Biology by Agarwal, K. C., Nidi Publ. Ltd. Bikaner.

5. Principle of Environment Science by Cunninghan, W.P.

6. Essentials of Environment Science by Joseph.

7. Perspectives in Environmental Studies by Kaushik, A.

8. Elements of Environment Science & Engineering by Meenakshi.

9. Elements of Environment Engineering by Duggal.

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
6	Professional Core courses	BTCE-406-18	**Concrete Testing Lab**	0	0	2	1

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes

1. Evaluate properties of building materials, such as cement and aggregates.
2. Conduct experiments and check the acceptance criteria (if any).
3. Design concrete mixes as per BIS provisions.
4. Analyze the properties of concrete in fresh and hardened state.
5. Create a well organized document and present the results appropriately.
6. Understand and apply non destructive testing (NDT) for evaluating concrete quality.

Content

1. Tests on cement
   - Fineness
   - Consistency
   - Setting time
   - Soundness
   - Specific gravity
   - Strength
2. Tests on aggregates (fine and coarse)
   - Specific gravity
   - Bulk Density
   - Fineness Modulus
   - Moisture content
   - Water Absorption
   - Bulking of sand
3. Design mix of concrete as per BIS method.
4. Workability tests on concrete
   - Slump test
   - Compaction Factor test
   - Vee-Bee test
5. Strength tests on concrete
   - Compressive strength (Cube and Cylinder)
   - Split Tensile strength
   - Flexural strength
   - Abrasion resistance
6. Non-Destructive Techniques
   - Rebound hammer test
   - Ultra sonic pulse velocity test

Text/Reference Books

1. 'Concrete Lab Manual', M. L. Gambhir, Dhanpat Rai & Sons, New Delhi.
2. 'Concrete Lab Manual', TTTI Chandigarh.

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
7	Professional Core courses	BTCE-407-18	**Transportation Lab**	0	0	2	1

External Marks: 40, Internal Marks: 60, Total Marks: 100

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to:

1.Characterize the pavement materials as per the Indian Standard guidelines.
2. Evaluate the strength of subgrade soil by CBR test.
3.Conduct experiments to evaluate aggregate properties.
4.Determine properties of bitumen material and mixes
5.Evaluate the pavement condition by rough meter and Benkelman beam test.
6.Create a well organized report and present the results appropriately

Course Content

I Tests on Sub-grade Soil

1.. California Bearing Ratio Test

II Tests on Road Aggregates

2. Crushing Value Test
3. Los Angles Abrasion Value Test
4. Impact Value Test
5. Shape Test (Flakiness and Elongation Index)

III *Tests on Bituminous Materials and Mixes*

6. Penetration Test
7. Ductility Test
8. Softening Point Test
9. Flash & Fire Point Test
10. Bitumen Extraction Test

IV *Field Tests*

11. Study of Roughometer/Bump Indicator
12. Study of Benkelman Beam Method

References

Khanna S.K., and Justo, C.E.G. “Highway Material & Pavement Testing”, NemChand andBrothers, Roorkee.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional Skill enhancement	BTCE-432-18	**Training-II**	-	-	-	S/US

Content

Module I – Survey camp of an area (2 weeks)

1. Hands-on-training of modern surveying equipment such as Digital Theodolite, Total Stations, Autolevel, and GPS.
2. On-site application of traversing, etc. for preparation of topographical maps of an area.

Module II – 4 week Summer Internship in Industry/ Construction site/ Appropriate workplace

Note:

1. The students need to submit a topographical maps preaperd in Survey Camp and a report of the summer internship.
2. The viva exam for the subject will be conducted alongwith the practical exams of the End-Semster Examination of Fifth Semester.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-401-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty in charges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

5th Sem Syllabus

Fourth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	BTCE-501-18	Engineering Geology	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students understand:

1. The basic concepts of geological processes and their importance in civil Engineering
2. Identification of rocks and minerals and their characteristics
3. Significance of geological structures and processes in civil engineering projects
4. Site characterization and geologic considerations in construction

Content

Unit-I: General Geology: Scope of geology in Civil Engineering - the earth, its structure and environment - Standard geological time scale, unit & fossils. physiographic, stratigraphic and tectonic divisions of India - geomorphological (surface) processes – weathering – types , weathered products, assessment of degree of weathering , Fluvial processes, glaciation, wind action, and their significance in Civil Engineering

Unit-II: Mineralogy and Petrology: Physical properties of minerals – classification - study of important rock forming minerals – Quartz family, feldspar family, Augite, Hornblend, Mica family, calcite, Iron oxide minerals, Augite, Hornblend, and Clay minerals and their behaviour and significance in the field of Civil Engineering . Classification of rock - mode of formation - distinction between igneous, sedimentary and metamorphic rocks. Formation, textures, structure, Classification, and Engineering, Characteristic of rocks. Study of imp rocks granite, syenite, diorite, gabbro, pegmatite, dolerite , basalt , sand stone, limestone, shale, breccia , conglomerate , gneiss, quartzite, marble, slate, schist, phyllite and conglomerate

Unit -III: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Unit IV:Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence

Unit V: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design.Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

Unit VI: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).
4. Reddy,D.," Engineering Geology for Civil Engineers", Oxford & IBH , 1995
5. Leggot, R.F.," Geology and Engineers ", McGraw Hill , New York.2002 2.
6. Blyth, F.G.M., " A Geology for Engineers", Arnold, Londo,(2003.
7. Bell.F.G, " Fundamentals of Engineering Geology" Butterworth, 1983

Fifth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
2	Professional Core courses	BTCE-502-18	**Elements of Earthquake Engineering**	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i) Appreciate the role of earthquake forces in structural design of building.
ii) Apply various codal provisions related to seismic design of buildings.
iii) Acquire new basic knowledge in earthquake engineering

Content

Unit 1: Introduction to Earthquakes, Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters.

Unit 2: Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings.

Unit 3: Introduction to theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, Spring action and damping, Equation of motion of S.D.O.F. systems, Undamped, Damped system subjected to transient forces, general solution, green's function.

Unit 4: Lateral Force analysis, Floor Diaphragm action, moment resisting frames, shear walls.

Unit 5: Concepts of seismic design, Lateral Strength, Stiffness, ductility and structural configuration.

Unit 6: Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake.

Unit 7: Introduction to provisions of IS 4326.

Unit 8: Introduction to provision of IS 13920.

Text /Reference Books :

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
7. IS 1893-2016Indian Standard Criteria for Earthquake Resistant Design of Structures.
8. IS 4326-1993 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
9. IS 13920:2016- Ductile design and detailing of Reinforced Concrete Structures subjected to Seismic Forces- code of practice

Fourth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
3	Professional Core courses	BTCE-503-18	Construction Engineering & Management	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

An idea of

how structures are built and projects are developed on the field

i. An understanding of modern construction practices

ii. A good idea of basic construction dynamics- various stakeholders, project objectives,

iii. processes, resources required and project economics

iv. A basic ability to plan, control and monitor construction projects with respect to time

v. and cost

vi. An idea of how to optimise construction projects based on costs

vii. An idea how construction projects are administered with respect to contract structures and issues.

viii. An ability to put forward ideas and understandings to others with effective communication processes

Contents

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

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

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

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

Unit 5: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow,sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

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

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

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

Text/Reference Books:

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

Fifth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
4	Professional Core courses	BTCE-504-18	**Environmental Engineering**	4	0	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i. Understand the impact of humans on environment and environment on humans
ii. Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
iii. Be able to plan strategies to control, reduce and monitor pollution.
iv. Be able to select the most appropriate technique for the treatment of water, wastewater ,solid waste and contaminated air.
v. Be conversant with basic environmental legislation.

Contents

Unit1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. *Water Treatment:* aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Unit 2: *Sewage*- Domestic and Storm water, Quantity of Sewage, Sewage flow variations.Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Unit 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution-Occupational hazards, Urban air pollution automobile pollution, Air quality standards, Control measures for Air pollution

Unit 4: *Noise*- Basic concept, measurement and various control methods.

Unit 5:*Solid waste management*-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management.

Unit 6: *Building Plumbing*-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

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Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw -Hill International Editions, New York 1985.
4. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
5	Professional Core courses	BTCE-505-18	**Structural Engineering**	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcome

The course will enable the students to:

i. The students will be able to apply their knowledge of structural mechanics in addressing design problems of structural engineering
ii. They will possess the skills to analyse and design concrete and steel structures
iii. They will have knowledge of structural engineering

Unit 1: Introduction

Structural Engineering, role of structural engineer, engineer, architect, builder; Objectives of designing a structure,safety,sustainable development in performance.

Unit 2: Structural Analysis

Concept of determinacy and indeterminacy, Analyses of indeterminate beams, frames and trusses using Slope deflection method, Moment distribution method, unit load method and castiglano's theorem.

Unit 3: Design of concrete Elements

Design Philosophies of Working Stress Method and Limit State Method, Design of Reinforced Concrete Beams for Flexure, Shear; Bond, Anchorage, development length and torsion; Reinforced Concrete Axially Loaded Columns, Reinforced Concrete Slabs: One Way and Two Way.

Unit 4: Design of Steel Elements

Properties of structural steel, I.S. rolled sections, I.S. specifications; Connections- Bolted and welded connections for axial loads; Tension members: Design of members subjected to axial tension; Compression members: Design of axially loaded members, built-up columns, laced and battened columns; Flexural members: Design of laterally restrained and un-restrained rolled section beams.

Text/Reference Books:

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
3. Intermediate Structural Analysis - C K Wang, McGraw hill publications.
4. Limit state design of steel structures: S K Duggal, Mc Graw Hill.
5. Design of Reinforced Concrete Structures: S. Ramamrutham, Dhanpat Rai Publications.
6. Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
7. NBC, National Building Code, BIS (2017).
8. Theory of structures - S Ramamurtham, Dhanpat Rai Publications.
9. Theory of structures - B.C. Punima, Laxmi Publications.
10. Reinforced concrete design - Pillai & Menon, Tata McGrawHill publications

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16
3. *IS 800: 2007 (General construction in steel-Code of practice)*
4. *SP: 6(1) (Handbook for structural engineers-Structural steel sections
5. Explanatory hand book SP24.
6. Detailing of Reinforcement SP 34

Note: The codes marked with * are permitted in examination.

Fifth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	BTCE-506-18	**Geotechnical Engineering#**	3	0	0	3

After studying this course, students shall be able to:

1. Comprehend the various geotechnical field challenges and understand their fundamental, index and engineering properties and then use (apply) the soil as an engineering material.
2. Investigate and write the laboratory reports for soil design properties and parameters by apply the concept of permeability, total and effective stress approaches in soil strength determination
3. Apply the various specifications of compaction of soils in the construction of highways and earthen dams.
4. Able to apply the knowledge of consolidation, soil deformation parameters, and calculate settlement magnitude and rate of settlement.
5. Design the embankment slopes and check the stability of finite slopes.

Unit-I:*Basic Concepts*- Definition of soil, Comparison between soil mechanics, rock mechanics and geotechnical engineering, Scope of soil mechanics problems in Civil Engineering. Principal types of soils in India. Characteristics of main Clay mineral groups. Soil as three phase system: weight volume relationship and determination of moisture content from nuclear method, alcohol method and sensors. Determination of Specific gravity by density bottle method, pycnometer method. Field density from sand replacement method and other methods.

Index Properties: Grain size analysis. Stokes's law and Hydrometer analysis. Consistency and sensitivity of Clay, Atterbeg Limits, Flow Index and Toughness Index. Underlying theory of shrinkage limit determination. Classification of coarse and fine grained soils as per Indian Standard.

Unit-II :*Permeability of Soil*- Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

Effective Stress Principle- Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.

Unit-III:*Compaction of Soil*-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.

Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, Concept of various consolidation characteristics i.e. av, mv and cv, primary and secondary consolidation concept of cv, tv& U. Consolidation test: determination of cv from curve fitting methods, Pre consolidation pressure determination. Normally consolidated and over consolidated clays. Causes of over-consolidation. Effect disturbance on e-Log σ curves of normally consolidated clays, importance of consolidation settlement in the design of structures. final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

Unit-IV: *Shear Strength*- Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test

Stability of Slopes- Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
4. Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
5. Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
6. Principle of Geotechnical Engineering by B.M.Das Cengage Publisher

7. Basic and applied Soil Mechanics by Gopal Ranjan and A.S. R. Rao New Age International Publishers
8. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
7	Professional Core courses	BTCE-507-18	**Geotechnical Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. Determination of in-situ density by core cutter method and Sand replacement method.
2. Determination of Liquid Limit & Plastic Limit.
3. Determination of specific gravity of soil solids by pyconometer method.
4. Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).
5. Compaction test of soil.
6. Determination of Relative Density of soil.
7. Determination of permeability by Constant Head Method.
8. Determination of permeability by Variable Head method.
9. Unconfined Compression Test for fine grained soil.
10. Direct Shear Test
11. Triaxial Test
12. Swell Pressure Test

Books Recommended:-

Soil Testing Engineering, Manual By Shamsher Prakash and P.K. Jain. Nem Chand & Brothers

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
8	Professional Core courses	BTCE-508-18	**Environmental Engineering Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of a given sample of water.
7. Determination of Hardness of a given water sample
8. Determination of total solids, dissolved solids, suspended solids of a given water sample.
9. To determine the concentration of sulphates in water/wastewater sample.
10. To find chlorides in a given sample of water/waste water.
11. To find acidity/alkalinity of a given water sample
12. To determine the COD of a wastewater sample.

Books Recommended:

1. Chemistry for Enviromental Engg. and Science by Sawyer & McCarty, TMH, New Delhi
2. Standard Methods for the examination of water & wastewater, APHA, AWWA, WE

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	Professional Core courses	BTCE-509-18	**Structural Lab**	0	0	2	1

External Marks: 20, Internal Marks: 30, Total Marks: 50

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1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the Flexural Rigidity of a given beam.
3. Deflection of a fixed beam and influence line for reactions.
4. Deflection studies for a overhang beam and influence line for reactions.
5. Structural Drawings of Reinforced Concrete Elements such as Beams, Slabs.
6. Structural Drawings of Steel Elements such as Connections, Tension Members, Compression Members, Beams,

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
10	Professional core	BMPD-501-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

6th semester Syllabus

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	**BTCE-601-18**	Engineering Economics, Estimation &Costing	3	1	0	4

Course outcomes: On completion of the course, the students will:

1. Have an idea of basic principles and elements of economics in general.
2. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
3. Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
4. Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
5. Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

Unit-1: Basic Principles of Economics

Demand/Supply – elasticity – Basic Macroeconomic Concepts (including GDP/GNP/NI/ Disposable Income), Aggregate demand and Supply (IS/LM), Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

Unit-2: Elements of Business/Managerial Economics

Cost & Cost Control -Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money.

Unit-3: Estimation / Measurements for various items

Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying.

Unit-4: Specifications

Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

Unit-5: Rate analysis:

Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

Unit-6: Tender:

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

Unit-7: Introduction to Acts:

Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Text/Reference Books:

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

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Open Elective	OECE-609-18	Remote Sensing and GIS	3	0	0	3

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Objectives

- To introduce the concepts of remote sensing, satellite image characteristics and its components.
- To expose the various remote sensing platforms and sensors and to introduce the concepts of GIS, GPS and GNSS.

Course Outcome

The course will enable the students understand:

- The characteristics of Remote sensing satellites and Applications of remote sensing.
- The GIS and its Data models.
- The Global Navigation Satellite System.

Content

Unit-I: Remote Sensing: Physics of remote sensing, Remote sensing satellites, and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

UNIT – II: Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Elements of interpretation, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing

UNIT - III Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications

UNIT - IV Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Static, Kinematic and Differential GPS, GPS Applications

Text/Reference Books:

1. T M Lillesand et al: Remote Sensing & Image Interpretation
2. Higher Surveying by A M Chandra New Age International Publisher
3. Remote Sensing & GIS by B. Bhatta Oxford University Press
4. Introduction to GPS by A. E Rabbany Library of congress cataloging in Publication data
5. Geomatics Engineering - Modern Surveying, GPS, Astronomy, Photogrammetry, Remote Sensing & GIS by: Dr. Manoj K.Arora& Prof. R.C.Badjatia

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
		BMPD-601-18	**Mentoring and professional development**	-	-	2	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B.

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-1

Geotechnical Engineering

Geotechnical Engineering

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
	Professional Core courses	PECE-602A-18	Foundation Engineering	3	1	0	4

Course Outcome: On completion of this course, the students will be able to
1 - Understand the methods of surface and subsoil exploration and to prepare investigation report.
2 - Estimate the stresses in soils and bearing capacity of soil for shallow foundation.
3 - Design various types of shallow foundation and to estimate settlement. 4
4 - Apply the concepts of deep foundation and solve problems related with pile foundation.

Unit-I :Soil Exploration

Object of soil investigation for new and existing structures. Depth of exploration for different structures. Spacing of bore Holes. Methods of soil exploration and relative merits and demerits. Types of soil sample. Design features of sampler affecting sample disturbance. Essential features and application of the following types of samples- Open Drive samples, Stationery piston sampler,. Rotary sampler,.- standard penetration test - static and dynamic cone penetration test ,Bore Hole log for S.P.T. Geophysical exploration by seismic and resistivity methods

Stresses Distribution: Bosussinesq equation for a point load, uniformly loaded circular and rectangular area,Newmark's chart and its construction. 2:1 method of load distribution. Comparison of Bosussinesq and Westerguard analysis for a point load. Pressure Bulb and Isobar. Related Numerical Problems

Unit-II: Earth Pressure

Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest. Rankine states of plastic equilibrium, Ka and Kp for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition. Coulomb's method for cohesion less backfill. Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load).

Unit-III: Shallow Foundation

Type of shallow foundations, Depth and factors affecting it.Definitionof ultimate bearing capacity, safe bearing capacity and

allowable bearing capacity. Rankine'sanalysis and Terzaghi's analysis.Types of Shear failures. Factors affecting bearing capacity. B.I.S.recommendations for shape, depth and inclination factors. Plate Load test and standard penetrationTest. Causes of settlement of structures, Comparison of immediate and consolidation settlement, calculation of settlement by Plate load Test and Static Cone penetration test data. Allowable settlement of various structures according to I.S. Code.

Unit-IV: Pile Foundations

Types and function of pile - factors influencing the selection of pile - carrying capacity of single pile in cohesionless and cohesive soil by static formula.Determination of point resistance and frictional resistance of a single pile by Static formulas. Piles in Clay, Safe load on a Friction and point Bearing pile- dynamic formulae (Engineering News and Hileys) Types of pile driving hammers & their comparison.Limitations of pile driving formulae. Negative skin friction - Carrying capacity of Pile group - Pile load test Cyclic Pile Load Test, Separation of skin friction and point resistance using cyclic pile load test. Pile in sand, Spacing of piles in a group, Factors affecting capacity of a pile group, Efficiency of pile group by converse – Labare formula and feeds formulas. Bearing capacity of a pile group in clay by block failure and individual action approach. Calculation of settlement of friction pile group in clay. Settlement of pile groups in sand, Negative skin friction. Related Numerical problems

Well foundations-shapes, depth of well foundations, components, factors affecting well foundation design, Scour Depth, construction procedure, sinking of wells, rectification of tilts and shifts, recommended values of tilts & shifts as per I.S.3955.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
4. Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
5. Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
6. Principle of Geotechnical Engineering by B.M.Das Cengage Publisher
7. Basic and applied Soil Mechanics by Gopal Ranjan and A.S. R. Rao New Age International Publishers
8. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE -602B-18	Ground Improvement Techniques	3[#]	1	0	4

UNIT I: Introduction

Role of ground improvement in foundation engineering– Geotechnical problems in alluvial, lateritic and black cotton soils, Methods of ground improvement Selection of suitable ground improvement techniques based on soil conditions.

UNIT II: Insitu densification of cohesion

less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles and deep compaction. Consolidation: Preloading with sand drains, and fabric drains, Stone columns and Lime piles-installation techniques – simple design – relative merits of above methods and their limitations.

UNIT III: Soil improvement with the addition of materials

lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils – settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting – commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting - introduction - application and limitations - plant for preparing grouting materials - jet grouting – jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone columns

UNIT IV: Soil improvement using reinforcing elements

introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls.

UNIT V: Geotextiles

Behaviour of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls – pavements

Reference books:

1. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall
2. Boweven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5. Donald .H. Gray& Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6. Rao G.V. & Rao G.V.S., Text Book On Engineering With Geotextiles, Tata McGraw Hill
7. Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill
8. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
9. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
10. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE-602C-18	Advance Soil Mechanics	3[#]	1	0	4

Course Outcome: On completion of this course, the students will be able to:

1. Do earth dam design and stability analysis for all kind of drainage conditions
2. Do stability analysis of any kind of slope and its protection
3. Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions
4. Evaluate depth of embedment for cantilever as well as anchored sheet piles.
5. Learn the concept of machine foundation

Unit-I

Drainage & Dewatering: Introduction, ditches and sumps, well point systems, shallow well system, deep well drainage, vacuum method, Electro-osmosis, consolidation by sand piles.

Drilled Piers and Caisson Foundations: Drilled piers-types, uses, bearing capacity, settlement, construction procedure. Caissons-Types, bearing capacity and settlement, construction procedure.

Unit-II

Braced Cuts Depth of unsupported vertical cut, sheeting and bracing for deep excavation, movements associated with sheeting and bracing, modes of failure of braced cuts, pressure distribution behind sheeting.

Cofferdams Introduction, types of cofferdams, design and lateral stability of braced cofferdams, design data for Cellular cofferdams, stability analysis of cellular cofferdams on soil and rock, interlocking stresses.

Unit -III

Cantilever Sheet Piles Purpose of sheet piles, cantilever sheet piles, depth of embedment in granular soils-rigorous method, simplified procedure, cantilever sheet pile penetrating clay.

Anchored Bulkheads Methods of design, free earth support method in cohesionless and cohesive soils, fixed earth support method in cohesionless soils.

Unit-IV

Basics of Machine Foundations Terminology, characteristics elements of vibratory systems, analysis of vibratory motions of single degree freedom system-undamped free vibrations, undamped forced vibrations, criteria for satisfactory action of a machine foundation, degrees of a freedom of a block foundation, Barken's soil spring constant, Barken's method of a determining natural frequency of a block foundation subjected to vertical oscillations.

Reference Books:

1 S.Prakash, Gopal Ranjan&S.Saran, Analysis and Design of Foundation and Retaining Structures, SaritaPrakashan Meerut, 1977.

2 Swami Saran, Analysis and Design of Sub Structures, IBH Oxford

3 Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers- N.Delhi, Edition No. - 3 rd, 2016.

4 Shamsher Prakash, Soil Dynamic, McGraw Hill, 1981.

5 Teng, Foundation Design, Prentice Hall, Edition No. - 10th, 1984.

6 P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No.- I, 1995 7 DebashisMoitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE -602D-18	Geosynthetics Engineering	3[#]	1	0	4

Course Outcome: On completion of this course, the students will be able to:

1 Identify the functions of geosynthetics
2 Select the geosynthetic products
3 Identify the testing methods for geosynthetics
4 Design withgeosynthetic products

Contents

UNIT I:

Basic Description of Geosynthetics Historical Development, the Nomenclature, Function, Use Around the World, Applications, Development in India.

UNIT II:

Raw Materials – Their Durability and Ageing Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance.

UNIT III:

Manufacturing Methods Fibers, Yarn, Nonwoven Geotextiles, Woven geotextiles, D.S.F. Fabrics.

UNIT IV:

Geogrids – Testing And Evaluation Factors Influencing Testing, Sampling, Physical Properties, Mechanical Properties under Uniaxial loading, Creep Testing.

UNIT V:

Erosion Control WithGeogrids: Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrid.

UNIT VI:

Bearing Capacity Improvement with Geogrids Advantages, Mechanism. Modes of Failure, Friction Coefficient, Experimental Studies.

UNIT VII

Application of Geosynthetics in Water Resources Projects Case Studies: Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarapar Canal.

Reference Books:

1. Robert M. Koerner, Designing with Geosynthetics, Prentice-Hall
2. G.V. Rao & G.V.S. Raju, Engineering with Geosynthetics, Tata McGraw-Hill
3. DebashisMoitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE-602E-18	Geo Environmental engineering	3#	1	0	4

UNIT I

Soil Contamination: Introduction to Geo environmental engineering, Development of environmental geotechnologysources, Environmental cyclesproduction and classification of waste, Waste Containment.

Contaminant's movements in soil, Contaminant transport in sub surface : advection, diffusion, dispersion, governing equations.

UNIT II

Groundwater contamination, Water quality standards, Sources of contamination, Hydro chemical behavior of contaminants - Trace metals - Trace nonmetals - Nitrogen, organic substances - Measurement of parameters - Velocity - Dispersivity - chemical partitioning

UNIT III

Remediation of contaminantsfrom soil and Ground water: contaminant transformation: sorption, biodegradation, ion exchange, precipitation: ex-situ and in-situ remediation – solidification, bio–remediation, soil washing, electro kinetics, soil heating, verification, bio venting, Ground water remediation – pump and treat, air spraying, reactive well.

UNIT IV

Solid waste disposal and stabilization: Hazardous waste control and storage system 3 mechanism of Stabilization, incineration, organic and inorganic stabilization reutilization of solid waste for soil improvement.

UNIT V

Engineered landfill: Site selection, dumping, Design of landfill: CNS layer, leachate and air collection units, Case studies. CPCB rules and regulations on waste handling and management - Criteria for selection of sites for waste disposal - Disposal techniques -Disposal systems for typical wastes.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE -602F-18	Rock Mechanics	3	1	0	4

Course Outcome: On completion of this course, the students will be able to:

1 Identify the problems associated with underground excavations
2 Classify the rock mass using the reference data
3 Understand the failure criteria of rock
4 Determine in-situ stresses from field test data

UNIT I: Introduction

Importance of rock mechanics, composition of rocks, geological and lithological classification of rocks, classification of rocks for engineering purposes, R.Q.D. method of classification of rocks. Theories of Brittle failure.

UNIT II: Laboratory Testing of Rocks

Various methods of obtaining rock cores, methods of sample preparation, methods of removing end friction of the rock samples. Compression testing machine, uniaxial compression strength of rock samples, methods of finding tensile strength-direct and indirect methods, Brazilian test, shear box test, triaxial shear test, punch shear test

UNIT III: In-situ Testing of Rocks

Field direct shear test on rock blocks, field triaxial strength, use of flat jacks, chamber test, plate load test, cable jacking test.

UNIT IV: Stress Evaluation in Field Stress-
relief technique(over coring), use of strain gauges, bore hole, deformation cell, photoelastic stress meter, stress measurement with flat jack. Hydraulics Fracturing Techniques.

UNIT V: Stabilization of Rocks
Rock bolting, principle of rock bolting, various types of rock bolts, application of rock bolting. Field testing of rock bolts and cable anchors.

UNIT VI: Elastic and Dynamic
Properties of Rocks Stress-strain behaviour dynamic properties, resonance method and ultra-sonic pulse method.

UNIT VII: Pressure on Roof of Tunnels
Trap door experiment, Terzaghi's theory, Bieraumer, kommerel, Protodyakanov theory.

UNIT VIII: Stress Around the Tunnels
Basic design and Principles of tunnels in rocks, design of pressure tunnels in rocks.

Reference Books
1 Lama,et.al Rock Mechanics, Vol.I,II,III,IV
2 Jaeger and Cook, Fundamentals of Rock Mechanics
3 Stagg & Zienkiewiez, Rock Mechanics
4 Obert & Duvell, Rock Mechanics & Design of Structures in Rocks
5 Jaeger, Rock Mechanics & Engineering
6 Schzy, Art of Tunneling

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-1I

Structural Engineering

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE - 603A-18	Design of Concrete Structures	3#	1	0	4

Course outcomes: On completion of this course the students will be able:

1. To apply the loads on building frames and analyse them using direct and indirect methods.
2. To analyse the concrete components i.e. continuous beams, flat slabs, tanks and retaining walls, etc
3. To design and detail the concrete components i.e. curved beams, flat slabs, tanks and retaining walls, etc
4. To analyse and design the special foundations i.e. raft, pile and machine foundations.

Unit-I: Building frames:

Types, Analysis for vertical loads (Kani's method, Substitute frame method), Analysis for lateral loads (Portal and Cantilever), concept of redistribution of moments, design and detailing of various components (continuous beams and columns with uni or bi-axial bending)

Unit-II: Liquid retaining structures:

Introduction, Design criteria, Design of rectangular and circular concrete water tank resting on ground, Design of Intze tank, Staging for overhead tank.

Unit-III: Flat slabs:

Advantages and disadvantages of flat Slabs, basic action of Flat Slabs, Direct Design Method, Equivalent frame method, Codal provisions

Unit-IV: Design of special structures:

Retaining walls- cantilever and counter-fort type, curved beams (IS code method).

Unit-V: Foundations:

Design of raft foundation, pile foundation; Introduction to machine foundation, vibration characteristics, design consideration of foundation to rotary machine and impact machine.

 # Note: Design as per the relevant IS codes.

Reference Books:

1. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
2. Advanced Reinforced Concrete design; Varghese P C; PHI Pvt.Ltd.
3. Advanced Reinforced concrete design, Krishnaraju
4. Jain, A.K., Reinforced Concrete-Limit State Design, Nem Chand & Bros
5. Advanced RCC Design, SS Bhavikatti.
6. Design of concrete structures, B C Punmia
7. Prestressed concrete by Krishna Raju, TMH

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000*- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *IS 3370- Code of practice for concrete structures for storage of liquids
3. *IS1343-2012- Code of practice for Prestresed concrete
4. *Design Aid SP 16

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE-603B-18	Design of Steel Structures	3#	1	0	4

Course outcomes: On completion of this course student will be able :

1. To apply the knowledge for analysis and design of various components of a plate girder.
2. To analyse , evaluate and design the different types of beam-column connections.
3. To design the column bases and footings for a steel structure under various loading conditions.
4. To analyse the loads and design various elements of industrial buildings.
5. To demonstrate the basic knowledge of plastic analysis of simple steel elements.

Unit-I: Design of Plate girders:

Elements of a plate girder, design of plate girder, curtailment of flanges, various type of stiffeners.

Unit-II: Beam-column connections:

Types of beam-column connections, Design of shear resistant connections - Design of bracket connections, seat connections and framed connections.

Unit-III: Column bases and footings

Types, slab base, gusseted base, bases for eccentrically loaded columns, Grillage footing.

Unit-IV: Industrial Buildings:

Types, elements of industrial buildings/sheds, structural planning, analysis and design of trussed roof/bents, crane/gantry girders, column brackets, transverse and longitudinal bracings.

Unit-V: Plastic analysis:

Introduction to Plastic analysis; plastic hinge mechanism, collapse load, analysis of simple beams and frames.

 # Note: Design procedure as per the relevant IS codes and guidelines.

Reference Books:

1. Limit state design of steel structures: S K Duggal, TMH
2. Design of steel structures (Vol. 2): Ram Chandra
3. Design of steel structures by BC Punmia
4. Design of steel structures, Vazirani and Ratwani
5. Planning of Industrial Structures, Dunham, C.W., John Wiley and Sons
6. Design of steel structures, Arya and Azmani.

BIS Codes of practice and Design Handbooks:

1) IS 800: 2007 (General construction in steel-Code of practice)*
2) IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice- wind loads]*
3) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

Note: The codes marked with * are permitted in examination.

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T		
	Professional Core courses#	PECE-603C-18	Advanced Structural Analysis	3#	1		Professional Core courses#

Course Outcomes: On completion of this course students will be able:

1. To evaluate the indeterminacy of different types of building frames.
2. To develop and relate stiffness and flexibility matrices for beams and frames.
3. To analyse beams and fames using flexibility and stiffness matrix method.
4. To apply the concept of finite element method to basic civil engineering structures.

Unit-I: Analysis of building frames

Static and kinematic indeterminacies of rigid and pin-jointed frames, action and displacement equations, generalized system of coordinates, Kani's method, and other approximate methods-Portal, cantilever and substitute frame method.

Unit-II: Flexibility matrix method

Development of flexibility matrices for statically determinate and in determinate beams, rigid-jointed and pin-jointed plane frames using physical approach. Analysis of simple problems of beams and frames and its computer applications.

Unit-III: Stiffness matrix method

Relation between flexibility and stiffness matrices, transformation of element stiffness matrices to system stiffness matrix, development of stiffness matrices for statically determinate and indeterminate structures using physical and element approach, Analysis of simple problems of beams and frames and its computer applications

Unit-IV: Finite element method:

Review of principle of virtual work, Ritz method, Basic concept, elementary applications of principles and formulation of

problems, the element characteristic matrix - element assembly and solution for unknowns, basic equations of elasticity, strain displacement relations, steps of FEM, Basic element shape, Discretization process; Application of finite element method to one and two dimensional plane stress strain elements.

Unit-V: Model analysis:
Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations.

Reference Books:

1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural Analysis, Devdas Menon, Narosa Publishers.
4. Structural analysis- A matrix approach - GS Pandit and SP Gupta
5. Matrix analysis of framed structures - William weaver, Jr. James M. Gere
6. Finite element analysis - C.S. Krishnamurthy
7. Finite element methods - O.C. Zeincwicz

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**		
	Professional Core courses#	PECE-603D-18	Structural Analysis and Design	3#	1		Professional Core courses#

Course Outcomes: On completion of this course the students will be able:
1. To understand and determine the indeterminacy of different types of structures.
2. To calculate forces and moments in indeterminate structures due to static as well as moving loads.
3. To analyse and design concrete structures i.e. column subjected to moments, foundations, retaining walls, etc.
4. To analyse and design the steel structures i.e. column bases, beam-column joints, plate girders and roof trusses.

Unit-I: Review of indeterminacy:
Static and kinematic indeterminacies of beams, rigid-jointed and pin-jointed plane frames.

Unit-II: Analysis of indeterminate structures:
Analysis indeterminate beams and frames by Kani's method, Theorem of three moments and other approximate methods-Portal, Cantilever and Substitute frame method.

Unit-III: Moving loads and influence lines:
Analysis of moving Loads for determinate beams, Influence lines for indeterminate beams, trusses and frames. Muller Breslau principle.

Unit-IV: Design of Concrete structures:
Columns with moments: Design of short columns with uni-axial and bi-axial bending; Design of Long columns, use of design charts; **Foundations**: Isolated and combined footing for columns; **Staircases**, Introduction, types and design;

Retaining walls - Cantilever and Counter-forte type retaining wall.

Unit-V: Design of Steel Structures:

Column bases: Slab base, Gusseted base; **Beam-column connections:** bracket connections, seated and framed connections.; **Plate girders:** Elements of a plate girder, design of plate girder section, intermediate and bearing stiffeners, **Roof trusses:** Types, Design loads, design of members and joints.

Reference Books

1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural analysis - S Ramamurtham,
4. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
5. Limit state Design of Reinforced Concrete; Varghese P C; PHI Pvt.Ltd.
6. Design of concrete structures, B C Punmia
7. Limit state design of steel structures: S K Duggal, TMH
8. Design of steel structures: N Subramanian, Oxford publications
9. Design of steel structures (by limit state method as per IS: 800-2007), S S Bhavikatti

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16.
4. *IS 800: 2007 (General construction in steel-Code of practice)
5.* IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice- wind loads]
6. *SP: 6(1) (Handbook for structural engineers-Structural steel sections)

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE-603D-18	Structural Analysis and Design	3[#]	1	0	4

Course Outcomes: On completion of this course the students will be able:

1. To understand and determine the indeterminacy of different types of structures.
2. To calculate forces and moments in indeterminate structures due to static as well as moving loads.
3. To analyse and design concrete structures i.e. column subjected to moments, foundations, retaining walls, etc.
4. To analyse and design the steel structures i.e. column bases, beam-column joints, plate girders and roof trusses.

Unit-I: Review of indeterminacy:

Static and kinematic indeterminacies of beams, rigid-jointed and pin-jointed plane frames.

Unit-II: Analysis of indeterminate structures:

Analysis indeterminate beams and frames by Kani's method, Theorem of three moments and other approximate methods-Portal, Cantilever and Substitute frame method.

Unit-III: Moving loads and influence lines:

Analysis of moving Loads for determinate beams, Influence lines for indeterminate beams, trusses and frames. Muller Breslau principle.

Unit-IV: Design of Concrete structures:

Columns with moments: Design of short columns with uni-axial and bi-axial bending; Design of Long columns, use of design charts; **Foundations**: Isolated and combined footing for columns; **Staircases**, Introduction, types and design; **Retaining walls** - Cantilever and Counter-forte type retaining wall.

Unit-V: Design of Steel Structures:

Column bases: Slab base, Gusseted base; **Beam-column connections:** bracket connections, seated and framed connections.; **Plate girders:** Elements of a plate girder, design of plate girder section, intermediate and bearing stiffeners, **Roof trusses:** Types, Design loads, design of members and joints.

Reference Books

1 Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Structural analysis - S Ramamurtham,
4. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
5. Limit state Design of Reinforced Concrete; Varghese P C; PHI Pvt.Ltd.
6. Design of concrete structures, B C Punmia
7. Limit state design of steel structures: S K Duggal, TMH
8. Design of steel structures: N Subramanian, Oxford publications
9. Design of steel structures (by limit state method as per IS: 800-2007), S S Bhavikatti

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *Design Aid SP 16.
4. *IS 800: 2007 (General construction in steel-Code of practice)
5.* IS 875-2015 Part -3 [Design loads (other than earthquake) for buildings and structures — code of practice- wind loads]
6. *SP: 6(1) (Handbook for structural engineers-Structural steel sections)

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE-603E-18	Prestressed Concrete	3[#]	1	0	4

Course outcome: On completion of this course the student will be able to:

1. Recognize the materials for prestressed concrete and its properties, advantages and applications in contrast to normally reinforced concrete.
2. Comprehend the concept of pre-tensioning and post-tensioning of prestressed concrete, types of prestressed members, prestressing systems and its components.
3. Analyse the prestress, its losses, and determine the strength of a prestressed concrete sections using Indian Standards (IS) guidelines under flexure, shear and torsion.
4. Evaluate the strength and serviceability requirements of different prestresed concrete members i.e. beams, slab and anchor blocks.
5. Design the sections and the reinforcement for prestressed concrete beams, prestressed slabs and anchorage zones as per the IS specifications.

Unit-I: Materials for prestressed concrete

Introduction to prestressing concrete; High strength concrete- strength, creep and shrinkage, permissible stresses; High tensile prestressing steel –treatments, forms of prestressing steel, strength, relaxation of steel, permissible stresses.

Unit-II: Prestressing devices and systems

Types of prestressing, tensioning devices and equipments, pre-tensioning systems, post- tensioning systems (advantages and disadvantages, procedure, applications)

Unit-III: Analysis of prestress and bending stresses

Analysis of prestress, resultant stresses at a section, pressure line or thrust line concept and internal resisting couple, concept of load balancing, losses of prestress, deflection of beams.

Unit-IV: Strength of prestressed concrete sections

Types of flexural failure, strain compatibility method, IS:1343 code procedure for flexural strength, design for limit state of shear and torsion and codal provisions for detailing.

Unit-V: Design of prestressed concrete beams and slabs

Transfer of prestress in pre tensioned and post tensioned members, design of anchorage zone reinforcement, design of simple beams/gorders, cable profiles, design of slabs.

Reference Books

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH
4. R. Rajagopalan, Prestressed Concrete.

BIS Codes of practice

1. * IS 1343 2012, Code of Practice for Prestressed Concrete
2. * IS 456-2000, Code of practice for design of reinforced concrete

Note: The codes marked with * are permitted in examination.

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	P	
	Professional Core courses#	PECE-603F-18	Bridge Engineering	3#	1	0	4

Course Outcomes: On completion of this course the student will be able:

1. To evaluate the basic design considerations for different types of bridge structure.
2. To analyse the concrete and steel bridges as per the various loading standards of India.
3. To design the main structure of the concrete and steel bridges.
4. To design the various types sub-structure and bearings for a bridge.
5. To demonstrate the various construction and maintenance methods for a bridge structure.

Unit-I: Planning and General design consideration

Classification of bridges, Factors considered for planning of Concrete and Steel Bridges site selection; Design consideration - geometric and hydraulic considerations, optimum spans; Design aids and Codes of practice, loading standards for highway and railway bridges (IS, IRC, RDSO, AASHTO).

Unit-II: Concrete Bridges

Culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, arch bridge; Bridge deck and approach slabs - Slab design methods - bridge deck systems - Slab-beam systems - Box girder systems - Detailing of box girder systems. (not design), Special requirements for Prestressed Concrete bridges.

Unit-III: Steel Bridges

Plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge; Analysis and design of Truss bridge and plate girder bridge

Unit-IV: Substructures:

Design of Piers - Columns and towers; Caissons, pile and well foundations; abutments and retaining walls.

Unit-V: Bearings and expansion joints

Types and functions of bearings, design of elastomeric bearings, rocker and roller type bearings, general requirements for provisions of expansion joints.

Unit-VI: Construction techniques and maintenance

Construction techniques: Cast in-situ, Prefabricated, Incremental launching, Free cantilever construction, provisions for inspection and maintenance.

 # Note: Design as per the relevant IS, IRC codes and guidelines for bridges.

Reference Books

1. Krishna Raju N., "Design of Bridges", 4th Edition, Oxford and IBH Publishing Co., Ltd., 2008
2. Ponnu Swamy, "Bridge Engineering", 4th Edition, McGraw-Hill Publication, 2008.
3. Swami Saran, "Analysis and Design of sub-structures",2nd Edition, Oxford IBH Publishing co ltd., 2006.
4. Vazirani, Ratvani & Aswani, "Design of Concrete Bridges",5th Edition, Khanna Publishers,2006.
5. D.J. Victor, "Essentials of Bridge Engineering," Oxford & IBH Publishing, New Delhi, 2001.

BIS Codes of practice and Design Handbooks:

1) IS 800: 2007 (General construction in steel-Code of practice)*
2) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*
3) IS 456:2000 Code of practice for design of concrete structures*
3) Relevant IRC and IS guidelines for bridge design.

Note: The codes marked with * are permitted in examination.

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

Track-1II

Construction Engg.

Construction Engg

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE-604A-18	Construction Equipment & Automation	3	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes

1. Understand Equipments & Automation and key features of its performance
2. Know automation systems in detail, including its evolution, objectives, criteria, levels of benefits, and shortcomings
3. Know a series of case studies representing diverse project types, sizes, certification levels, and climate regions
4. Know what are innovations in construction equipments

Content

UNIT-I : Construction Equipment

Introduction, significance of equipment in construction industry - laboratory setting including plan reading, specification reading, construction scheduling and estimating, Job layout and its importance. Study of equipments with reference to available types and their types and their capacities, factors affecting their performance.

UNIT – II: Construction Equipment Management

Equipment Management- Introduction, Differences between men and manpower, Extent of Mechanisation, Equipment planning, Selection of equipment, Forward planning, Purchase of Equipment, Specifications for ordering equipment

Unit –III: Equipment for Earthwork

Fundamentals of Earth Work Operations - Earth Moving Operations - Types–Excavation equipment- Power Shovels, Back Hoe, Drag line, Clamshell – Scrapers, Bull Dozers, Tractors, Hauling Equipment – Dump trucks, Dumpers Loaders, trucks, Earth Compaction Equipment-Tamping Rollers, Smooth Wheel Rollers, Sheepsfoot Roller, Pneumatic-tyred Roller, Vibrating Compactors, Vibrocompaction methods.

UNIT-IV: Other Construction Equipment

:Pile driving Equipment - Erection Equipment – Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveller cranes, Tower cranes - Types of pumps used in Construction - Grouting - Material Handling Conveyors –Industrial Trucks, Forklifts and related equipment.

Unit-V : Equipment for Concrete and Road laying

Aggregate production equipment- Different Crushers – Feeders - Screening Equipment -Handling Equipment - Batching and Aggregate Mixing Equipment - Asphalt Plant, AsphaltPavers, Asphalt compacting Equipment – Ready mix concrete equipment, Concrete mixers,Concrete batching and mixing plant, Transportation of concrete mix, Concrete pouring and pumps, concrete compaction equipment.

UNIT-VI: Automation:

Introduction & Technical terms of Automation and robotics; advantages & disadvantages,Need for construction automation, Applications, Automation in precast construction industry, Autonomous Machines on the Construction Site, Drones to Survey Working Areas , Robotics in Concrete Works, IoT Sensors to Collect and Process Data, Virtual Reality During Project Planning and Training **,** Automatic Concrete Screeding Machine, Concrete Surface Finishing Robot, Automation in High Rise Building Construction, Automation in prefabrication of masonry and on site masonry construction, partially automated masonry element prefabrication, automated manufacture of brick wall masonry blocks, Automation in timber construction, Automation in production of steel components, Transformable welding robot.

Reference Books

1 Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988.
3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
4. Dr.MaheshVarma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 1983.

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
	Professional Core courses#	PECE-604B-18	Sustainable Construction Methods	3#	1	0	4

External Marks: 60, Internal Marks: 40, Total Marks: 100

Course Outcomes:

1. Create new engineering materials to improve the performance of infrastructure
2. Characterize and mitigate natural and man-made hazards
3. Improve fundamental knowledge of the inter-relationships between the built environment and natural systems.
4. Develop the technological innovations needed to safeguard, improve, and economize infrastructure

Content

UNIT-I : INTRODUCTION

Definitions- Various types - Pillars of Sustainability - Circle of Sustainability - Need - systems and their sustainability - Green Buildings -Difference between Green and Sustainability - Climate Change, Global warming - National and International policies and Regulations. Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.

UNIT – II: BUILDING CONSTRUCTION METHODS

Conventional vs modular construction methods, development , Engineering principles, benefits**,** Modular construction methods for repetitive works, Green Roofs, Cool Roofs, Passive House, Rammed Earth Brick**,** Passive Solar, Greywater Plumbing Systems, Solar Thermal Cladding, Solar Power, Water Efficiency Technologies, Sustainable Indoor Environment Technologies.

UNIT –III: PRECAST CONSTRUCTION METHODS

Modular construction methods for repetitive works; Precast concrete construction methods; Benefits , Sustainability in Concrete Mix Design, Greener, Faster and Sustainable Construction Practices Through Precast Solutions, Use of secondary cementitious material (SCM's) like GGBS, fly ash, ultra-fine GGBS in the production of the concrete, Basics of Slip forming for tall structures, Structural 3D Printing, Self-healing

Concrete**,** Green Insulation, Sustainable Resource Sourcing, Environmental Sustainability Benefits From Precast Concrete.

UNIT-IV: CONSTRUCTION METHODS OF BRIDGES

Types of foundations and construction methods; Basics of Formwork and Staging; Proactive Maintenance**,** Prefabrication/Modular Construction, balance between environment and construction activities, reducing problems at site with minimal staging, increasing safety etc, Constructions are sustainable with reduced use of natural resources, Costs of Construction/Assembly and Transportation, Lifespan, Environmental Impact, harmful emissions during bridge construction, Reducing waste, solar panels to power LED lights to illuminate its deck, water-powered light system powered by the currents of the river, development that meets the needs of the present.

UNIT-V: NEW CONSTRUCTION MATERIALS TECHNOLOGIES Introduction to new construction materials & technologies, **Synthetic Roof Underlayment, Electro chromic Glass,** Biodegradable Materials, Reduction of water consumption, Impact on environment, Concepts of climate responsive building, Sustainability assessment using standard approaches- LEED/GRIHA rating evaluation process

Text/Reference Books

1. Margaret Robertson, Sustainability Principles and Practice, Routledge, 2014
2. Martin A. A. Abraham , Sustainability Science and Engineering: Defining Principles, Elsevier Science, 2005
3. Tony Clayton, Nicholas J. Radcliffe, Anthony M. H. Clayton, Sustainability: A Systems Approach, Routledge, 1996
4. Stephen M. Stephen, Stephen M. Wheeler, Climate Change and Social Ecology: A New Perspective on the Climate Challenge, Routledge, 2012
5. Gursharan Singh Kainth, Climate Change, Sustainable Development and India, LAP Lambert Academic Publishing, 2011

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses[#]	PECE-604C-18	Repair and Rehabilitation **of Structures**	3[#]	1	0	4

Objectives:-

To understand the knowledge on quality of concrete, durability aspects, causes of deterioration, repairing of structures and demolition procedures.

Course Outcomes After studying this course, students will be able to

1. Understand the cause of deterioration of concrete structures.
2. Able to assess the damage for different types of structure.
3. Summarize the principles of repair and rehabilitation of structures.
4. Recognize the ideal material for different repair and retrofitting techniques.

Content

Unit-I: Introduction to Rehabilitation of Structures

Aging of Structures, Performance of Structures, Need for rehabilitation of structural members, Maintenance, Facets of Maintenance, Importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.

Unit-II: Evaluation and Deterioration of Concrete Buildings

Visual Integration, Destructive Testing Systems, Non Destructive Testing Techniques, Semi Destructive Testing Techniques, Chemical Testing, Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal effects, Structural effects, Faulty construction, Distress in structure due to corrosion, fire, leakage, earthquake and effects, case studies, damage assessment and evaluation models.

Unit III: Strength and Durability of Concrete

Quality assurance for concrete – Strength, Durability and Thermal properties of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness and cracking, Methods of corrosion protection, Corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection, Special concretes -- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

Unit IV: Surface Repair and Retrofitting

Strategy and Design, Selection of Repair Materials, Surface Preparation, Bonding Repair Materials to existing concrete, Placement methods, Epoxy bonded replacement concrete, Preplaced aggregate concrete, Shotcrete/Gunite, Grouting, Injection Grouting, Micro concrete, Mortar repair for cracks, shoring and underpinning.

Unit V: Strengthening Techniques and Seismic Rehabilitation

Beam Shear capacity Strengthening, Shear Transfer Strengthening between members, Column Strengthening, Flexural Strengthening and Crack Stabilization, Seismic strengthening of structures, Guidelines for Seismic Rehabilitation, Seismic Vulnerability and Strategies for Seismic Retrofit.

Reference's Books

1. R.T. Allen and SC Edwards, "Repair of Concrete Structures", Blakie and Sons, 1987
2. FEMA273, NEHRP Guidelines for Seismic Rehabilitation of Buildings, 1997
3. DovKominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
4. Emmons, P.H., "Concrete Repair and Maintenance", Galgotia Publication,2001
5. Ravishankar.K, Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
6. Malhotra, V.M. and Carino, N.J., " Handbook on Non Destructive Testing of Concrete", CRC press, 2004
7. Bohni, H., "Corrosion in Concrete Structures", CRC Press., 2005
8. ShettyM.S., "Concrete Technology – Theory and Practice", S.Chand and Company, 2008.
9. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
10. P.C. Varghese , "Maintenance Repair and Rehabilitation and Minor Works of Bridges", PHI learning Pvt.Ltd, 2014.

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
	Professional Core courses[#]	PECE-604D-18	Construction Cost Analysis **Methods**	3	1	0	4

Course Outcomes: Student shall be able to

1. To Prepare Capital budgeting of a Construction site.
2. To Prepare a Performance statement of a company'
3. To estimate various financial instrumental such as IRR, Break even analysis
4. To prepare a Job Cost report of a Construction Site.

Unit-I: Project Appraisal

Project appraisal, government and private project evaluators, significance of social benefit – cost analysis, commercial profitability, national economic profitability, measurement of direct and indirect benefit and costs. Calculation of benefit cost ratio.

Unit-II : Engineering economics

Time value of money, discounted cash flow, decision making among the alternatives, replacement analysis, break even analysis.

Project capital: Cash flow of a project, estimation of minimum capital required, internal rate of return (IRR), Multiple IRR, estimation of annualized cost.

Unit-III: Depreciation

Importance, classification, types – straight line, sum of year method, double rate declining balance method.

Capital Budgeting: Element of budgeting – men, materials, equipment, overhead, profits – preparation of capital budget.

Unit-IV: Cost Control:

Understanding control, operating cycles, cost account codes, Job cost report, Projected Cost Estimates, status reporting, variance and earned value.

Unit-V: Performance statement

Capital gearing ratio, shares, debentures, PBT, PAT, PBIT, Earning per share, preparation of company's performance statement, Inflation.

REFERRENCE BOOKS:

1. M Pandey, Financial Management, Vikas Publishing house pvt ltd9th Edition.
2. Donald Newnan, Engineering Economics analysis, Oxford University Press
3. R Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd.
4. Frank Harris & Ronald Mc CafferModern Construction ManagementBlackwell science4th Edition.
5. Roy PilcherPrinciples of Construction Management, Mc Graw Hill London.
6. United Nations Guidelines for Project Evaluation Oxford & IBH Publishing Co. Pvt. Ltd.
7. A.H. Taylor & H Shearing, Financial & Cost Accounting for Management Mac Donald & Evans

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
	Professional Core courses[#]	PECE-604E-18	Contract Management	3	1	0	4

Course Outcomes:

To make Civil Engineering students able to analyze, evaluate and design construction contract documents.

UNIT I: Construction Contract:
Terminology, Importance, Agreement, Contract, essential conditions, Elements, nature, Features, Suitability. Subcontracts and supply contracts, Indian Contracts Act. Types of contract: Lump sum contract, Item rate contract, Cost plus fixed fee contract, Cost plus percentage contract, Special contracts.
Execution of Works: Direct execution by Department, Muster Roll, Piece work Agreement, Work Order.

UNIT II: Construction Specifications
Standard specifications, general specification, development, interpretation. Tender and tender documents: tender form, Types of bidding, tender notice, tendering procedure, submission and opening of tender.

UNIT III: Contract document
Design of Contract Documents –Contract document: Drafting of clauses, development, and interpretation, CPWD conditions of contract, FIDIC conditions of contract. International Contract Document, Standard Contract Document.

UNIT IV: Construction claims
Extra item, excess quantity, deficit quantity, price escalation. Dispute resolution mechanism: litigation, arbitration, conciliation, mediation, dispute resolution board. Contractual Problems: Possible contractual problems, creation of claims, development of disputes.
BOT contract: Types of contract, PPP framework, types of risk, concession agreement, drafting of clauses, development, and interpretation.

UNIT V: Legal requirements
Labour Laws, Child Labour Act, Sales Tax, VAT, Service Tax, Excise Duty, Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration, Insurance and Bonding, Insurance and Safety Regulations.

REFERRENCE BOOKS:

1. L.S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India January 2008.
2. C. J. Schexnayder and R. E. Mayo,Construction Management Fundamentals,McGraw Hill, New Delhi.2003
3. General Conditions of Contract,Central Public Works Department, New Delhi,2010
4. S. Ranaga Rao,Contract Management & Dispute Resolutions,Engineering staff College of India,January 2008
5. D.S. Berrie and B.c. Paulson,Professional construction management including C.M.,Design construct and general contracting,McGraw Hill InternationaL,Third Edition 1992..
6. V. K. Raina,Construction & Contract Management Practices,SPD, New Delhi

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Professional Core courses#	PECE-604F-18	Construction Engineering Materials	3	1	0	4

Course Outcomes: On completion of this course the student will be able

•To Provides a broad understanding of the composition, microstructure, and engineering behavior of various materials used in civil engineering applications.

•To Introduces various modifications possibilities in construction materials.

•To Understand and Explain Special Concrete.

Unit-I: Construction Materials

Classifications of Construction Materials. Consideration of physical, Mechanical, thermo-physical Properties, characteristics behaviour under stress, Selection criteria for construction materials, green building materials.

Unit-II: Materials for making Mortar and concrete

Lime manufacture, properties, hardening of lime, types of lime, lime concrete uses. Cement, pozzolanic material, aggregates, water, admixtures - characteristics, properties and uses .Types of mortars, special mortars,their properties and applications.

Ceramic Materials: Classification, Refractories, glass, glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

Unit-III: Polymers in civil engineering

Rubber and plastics, properties, effect of temperature on mechanical properties. Uses and application.Polymers, fibres and composites, Fibre reinforced plastic. Architectural use and aesthetics of composites. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

Unit IV: Metals

Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel, Corrosion of concrete and reinforcing steel in various environments. Electro-chemical process and measures of protection during construction. Ferro-cement, composition and properties.

Unit V: Modified Materials

Modified bitumen using plastic or polymers, Modified cement concrete using various industrial ashes, soil stabilised using slag, polymers - their properties, advantages and applications as per Indian conditions.

Unit-VI: Special concretes

Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self- compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

REFERENCES BOOKS:

1. Rangawala S.C. Engineering Materials Chortor Publications 1991.
2. S.K. Duggal Building Materials, New Age International Publications 2006.
3. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
4. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973.

Mandatory Course

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
	Mandatory Course (Non Credit)	BTMC-101-18	Constitution of India	3	0	0	S/US

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

Course content

Meaning of the constitution law and constitutionalism
Historical perspective of the Constitution of India
Salient features and characteristics of the Constitution of India
Scheme of the fundamental rights
The scheme of the Fundamental Duties and its legal status
The Directive Principles of State Policy – Its importance and implementation
Federal structure and distribution of legislative and financial powers between the Union and the States
Parliamentary Form of Government in India – The constitution powers and status of the President of India
Amendment of the Constitutional Powers and Procedure
The historical perspectives of the constitutional amendments in India
Emergency Provisions : National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India
Scheme of the Fundamental Right to Equality
Scheme of the Fundamental Right to certain Freedom under Article 19
Scope of the Right to Life and Personal Liberty under Article 21