Study Scheme & Syllabus of

Bachelor of Technology

Civil Engineering

Batch 2021 onwards

(3rd -8th Semester)

For

University Main Campus,
Constituent Campuses and
Affiliated colleges

Department of Academics

I.K. Gujral Punjab Technical University

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)	3	0	0	100	-	100	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	BTCE-432-18	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	100	-	100	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**

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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	OECE-701-18	Open Elective – III(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	Professional core course	BTCE-704-18	Project	0	0	8	40	60	100	7
6	Humanities and Social Sciences including Management courses HSMC255	HSMC-255	Professional Practice, Law & Ethics	2	0	0	40	60	100	2
7	Mandatory Courses (Non-credit)	BTMC-701-18	Management- I (Organizational Behavior)	2	0	0	50	-	50	0
			Total 27	**16**	**3**	**8**	**290**	**360**	**650**	**24**

Note * Metro system and Engg is compulsory open elective for Civil Students

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	Smart City	3	1	0	40	60	100	4
2	Project	BTCE-803-18	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 structure PECE -603A-18	Design of steel Structures PECE -603B-18	Advanced Structural Analysi 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 desig 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 La and Policy PECE-702A-18	Rural water Supply And onsite Sanitation System 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 Technologies PECE-702F -18
Track –VI	Design of Hydraulic structur 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 a hydraulics PECE-703F -18

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS

Offered by Civil Engineering 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

S.No.	Course Title	Subject Code	Semester	Hours Per Week			Credits
				L	T	P	
1	Metro system and Engg	OECE-701-18	ODD	3	0	0	3
2	Traffic Management	OECE- 702-18	ODD	3	0	0	3
3	Road Safety	OECE-703-18	ODD	3	0	0	3
4	Environmental Impact Assessment	OECE-704-18	ODD	3	0	0	3
5	Construction Materials	OECE-705-18	ODD	3	0	0	3

3rd Semester Syllabus

B. Tech Civil Engineering

Third Semester							
S. No.	Category	Code	Course Title	Hoursperweek			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

Third Semester							
S. No.	Category	Code	Course Title	Hoursperweek			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.

Third Semester

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

Third Semester							
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.

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Third Semester							
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.

Third Semester							
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

Third Semester							
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.

Third Semester							
S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
8	Professional Core courses	BTCE-307-18	**Fluid MechanicsLab**	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.

Third Semester							
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

Third Semester							
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.

Third Semester							
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 alreadyprepared 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 Semester Syllabus

B. Tech Civil Engineering

Fourth semester

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

Fourth semester

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. correspondingto 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)

Fourth semester							
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.

Fourth semester							
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.

Fourth semester							
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

Fourth semester

S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
7	Mandatory Courses (Non Credit)	EVS-101-18	**Environmental Science**	3	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 100 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) Cleanliness drive
i) Drive for segrega 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.

Fourth semester							
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.

Fourth semester							
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.

Fourth semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
8	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.

Fourth semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
9	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 Semester Syllabus

B. Tech Civil Engineering

Fifth 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

Fifth 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

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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**	
6	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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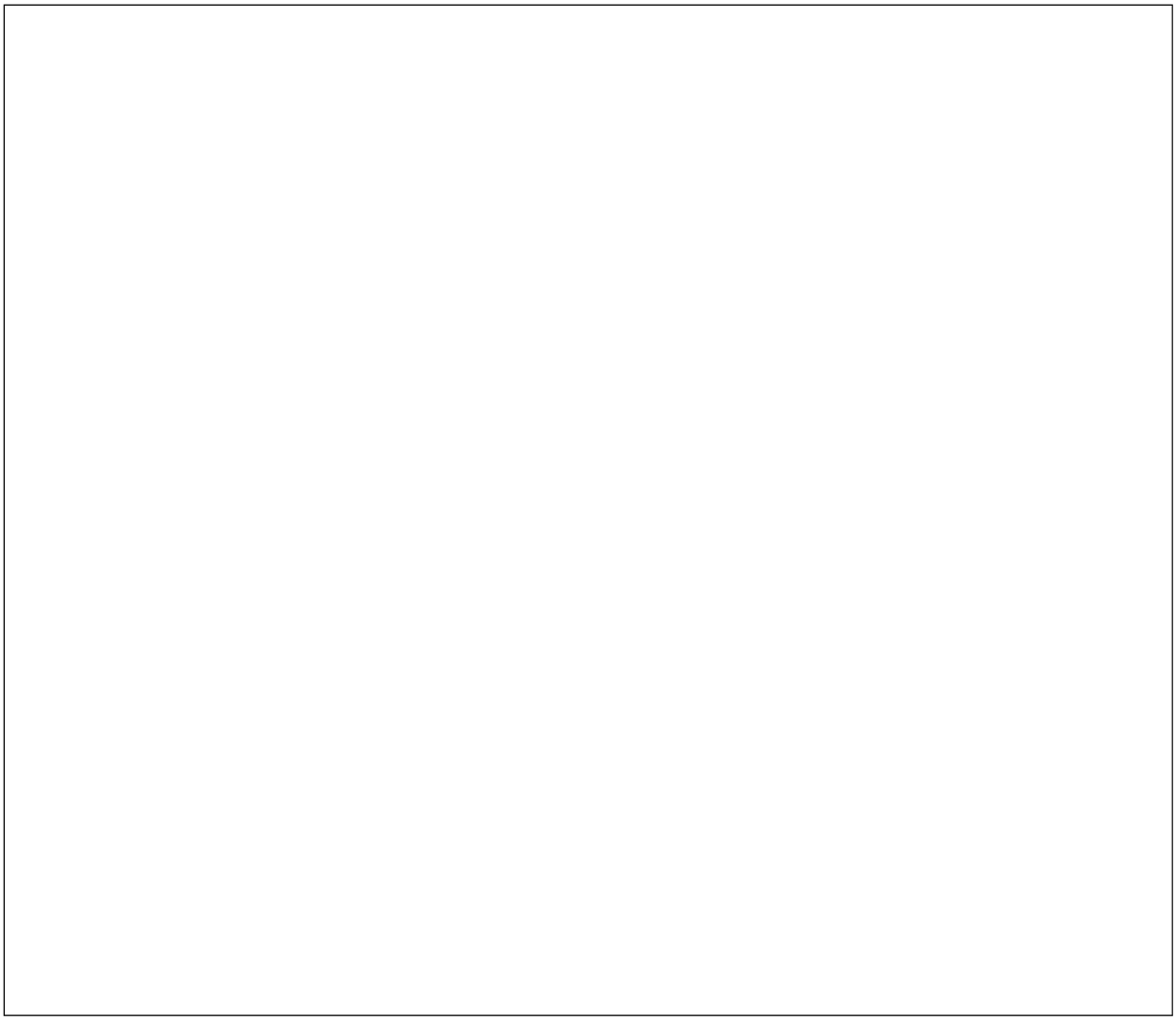
1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of 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

B. Tech Civil Engineering

Sixth Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	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

Sixth Semester

S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1		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

Track-1

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

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**	p	
	Professional Core courses#	PECE-603D-18	Structural Analysis and Design	3#	1	0	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**	
1	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

Track-1II

Construction Engineering.

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 availabletypes 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**	
1	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 potentialto 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 thn 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

7th & 8th Semester Syllabus

B. Tech Civil Engineering

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-1V

Transportation Engineering

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core courses	PECE -701A-18	**Pavement and geometric design of Highways**	3	1	0	4

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

1. Understand patterns of Traffic and its behaviour.
2. Develop an understanding for various sight distances and its affects
3. Analyse and design Horizontal and vertical curves
4. Design the cross-sectional elements for different types of highways.
5. Develop and appreciate the concept of intersections

Suggest the required facilities for pedestrians, bicycles, buses and parking

Unit 1 : Introduction to Design Elements: Objectives and requirements of highway geometric design, Sight distances - types, analysis, PIEV theory, factors affecting, measurements, Horizontal alignment – design considerations, stability at curves, super-elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, IRC standards and guidelines for design problems.

Unit 2 : Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

Unit 3 : Design of Intersections: Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections –Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.

Unit 4: Miscellaneous Elements: Traffic Signs and Markings. Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays –Types and Guide lines; Design of On-street and Off-street Parking facilities – Guidelines for lay out Design,

Books Recommended:

1. Khanna S.K. and C.E.G. Justo, "**Highway Engineering"**, Nemchand Bros(2012).
2. Kadyali L. R.; "**Highway Engineering"**, Nem Chand & Brothers, Roorkee (2004).
3. Rao G. V.; "**Transportation Engineering**", Tata McGraw Hill Publisher, New Delhi (1999).
4. Yoder E. J.; "**Principles of Pavement Design",** John Wiley & Sons (1975).

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
2	Professional Core courses	PECE -701B-18	**Airport planning and Design**	3	1	0	4

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

1. Understand the detail concepts of the airport engineering.
2. Able to design runway, taxiway and apron pavements.
3. Suggest the runway orientation and the runway length as per FAA & ICAO guidelines.
4. Conceptualise Pavement management system for maintenance

Unit 1. Airport Engineering: Components of airport: Classifications of obstructions, Imaginary surfaces, Approach zone and turning zone. Runway orientation, basic runway length, corrections for elevation, temperature & gradient, airport classification.

Unit 2. Runway & Taxiway Design: Wind-rose diagram, Geometric design of runway, airport capacity, factors controlling taxiway layout, geometric design standards for taxiway holding aprons,

Unit 3. Structural design of runway pavements LCN/PCN method of rigid pavement design, different LCN/PCN of aircrafts using runway. Pavement Evaluation for runway & taxiway, design of overlay, Terminal area, building area, parking area, apron, hanger typical airport layouts.

Unit 4. Design of flexible and rigid runways as per FAA procedure, Specifications for the different layers of runway and taxiway pavements, Pavement management systems for runway pavements. Benkelman Beam method for maintenance.

Books Recommended:

1. Khanna, Arora & Jain, **Airport Planning and Design**, Nem Chand & Brothers, Roorkee (1999).
2. Rangwala, **Airport Engineering**, Charotar Publishing House (2019).
3. Horenjeff Robert, **Airport Engineering**, McGraw Hill International Publisher (2010).

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
3	Professional Core courses	PECE -701C-18	**Intelligent Transportation systems**	3	1	0	4

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

1. Understand the concept of Intelligent Transportation system.
2. Analyse ITS's relevance with Smart growth and energy based planning.
3. Conceptualise the urban transportation systems using different models.
4. Explore methodology for smart city based Transit planning
5. Suggest road safety using ITS.

Unit 1. Overview of Intelligent Transportation Systems: Introduction to ITS, its history and future, Framework for analysing ITS relationships- Information technology, GPS.

Unit 2. Advanced Transportation Planning Process and Problems: Terminology of Transportation Planning, Functional Components, Brief Overview of Models used in Transportation Planning, Environmental concerns, Smart growth and sustainable alternatives, Energy based planning, Global Positioning Systems. Transportation System Impacts: Travel Facilities, Origin and Destination, Transit Surveys, Decision making Process, Transportation Demand Management (TDM). Use of GIS in Transport planning.

Unit 3. Land Use Transportation System: Urban system components, Urban Spatial Structure, Location Theory, Land use planning, Land use Models, Land use transport models – (Lowry and Garin), Lowry Models, Transit Oriented Development(TOD).

Unit 4. Urban Public Transportation: Urban Growth and Public Transport needs, Transit mode characteristics, transit characteristics, Fleet size and capacity estimation, Smart cities based Transit Planning.
Road Safety: Highway safety using ITS.

Books recommended:

1) Joseph M. Sussman, Perspectives on Intelligent Transportation systems

2) Kadyali, Traffic Engineering and Transport planning, Khanna publishers

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
4	Professional Core courses	PECE -701D18	**Highway Construction and Management**	3	1	0	4

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

1. Understand various materials and techniques used to construct pavements.
2. Design the bituminous pavement as per standards.
3. Design thickness and joints including drainage of concrete pavements.
4. Suggest maintenance of pavement.
5. Conceptualise pavement management systems.

Unit 1. Bituminous pavement: Various types of bituminous constructions and their selection, Construction of earth, gravel, water bound macadam, surface dressing, premixed carpet, bituminous macadam, bituminous concrete, mastic asphalt, cement concrete pavements.
Design of bituminous mixes: Requirement of bitumen mixes, design of bituminous mixes as per Marshall Stability & flow method, I.R.C & MORTH recommendations for the design mix of various layers of flexible pavements.

Unit 2. Concrete pavement: Components of concrete pavement-PQC**,** various joints- construction joints, longitudinal joints, transverse joint, thermal joints, tie bars, dowels; Construction techniques- alternate bay method, continuous bay method, expansion joint and strip method; slip form paving.
Drainage: Introduction, Importance & Principles of Highway Drainage, Surface Drainage, Sub Surface drainage.

Unit 3. Highway Maintenance: Introduction, Maintenance of Earth, gravel, WBM Roads, Bituminous Roads, Cement Concrete pavements. Use of Benkelman Beam method, Falling weight deflector-meter.

Unit 4. Pavement Management Systems: Concepts of Pavement life cycle, Pavement performance assessment, evaluation of pavement structural capacity and safety, combined measures of pavement quality, development of models for pavement deterioration, rehabilitation and maintenance strategies.

Books recommended:

1. Khanna S.K. and C.E.G. Justo, "Highway Engineering", Nemchand Bros, (2002)
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee(2002)
3. Haas R.C.G., Hudson W. Ronald., Zaniewski John P., Modern Pavement Management, Krieger Publishing Company, 1994.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
5	Professional Core courses	PECE -701E-18	**High Speed Rail Engineering**	3	1	0	4

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

1. Develop an understanding for high-speed Rails.
2. Outline the requirements for design.
3. Design of points, crossing and turnouts.
4. Suggest techniques to mechanize tracks,
5. Analyse signals inter locking devices for high-speed rails.

Unit 1. High Speed Railway(HSR) Engineering: Introduction, Key elements of HSR technology, History and Development of HSR: world and India, High Speed Trains: Present & Future.

Unit 2. Feasibility Studies: Basic traffic and volume feasibility studies related to HSR, Design requirements and construction of aspects of high- speed rail (HSR) passenger transport systems engineering. Geotechnical and structural requirements for track, bridges, viaducts and tunnels.

Unit 3. Geometric design: Alignment, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length of transition curve, gradients and grade compensation. Stations and yards, and their classification.
Points and crossings: introduction, necessity of points and crossings, turnouts, points and crossings, design of a simple turnout.

Unit 4. Track Recording: Requirements for track system, Basic design and construction of HSR stations and rolling stock maintenance facilities. Equipment, Mechanized Maintenance
Basic Signalling and interlocking: objects of signalling, engineering principle of signaling, classification of signalling, control of train movements, interlocking definition, necessity and function of interlocking, methods of interlocking, mechanical devices for inter locking. Traction and tractive resistance, stresses in track, modernization of railway track.

Books Recommended:

1. Arora and Saxena, **Railway Engineering**, Dhanpat Rai & Sons, New Delhi (2006)
2. Rangawala, **Railway Engineering**, Charotar Publishing House, Anan (1989).
3. Aggarwal M.M., and Satish Chandra **Railway Engineering**, Oxford University Press (2002).

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per week			Credits
				L	T	P	
6	Professional Core courses	PECE -701F -18	**Traffic Engineering and Management**	3	1	0	4

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

1. Understand the traffic flow parameters and measures related to traffic control and management.
2. Analyze the feasibility of different control devices for traffic management.
3. Create the solution of the problem related to traffic congestion and safety.
4. Outline the causes of road accidents and procedure to assess the road safety audit.
5. Apply the methods to identify the black spots and propose the solutions to improve road safety.
6. Assess the need of modernization in traffic management and road safety.

Unit 1. Fundamentals of Traffic Management: Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Unit 2. Traffic Regulation and Control: Road Signs and markings; Channelization; At-grade and Grade separated intersections; Traffic Rotary;
Design principles of traffic signals

Traffic Management techniques: Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in traffic management.

Unit 3. Road accidents: Causes of road accidents: Vehicle design factors & Driver characteristics influencing road safety, Road condition, Parking and its influence on traffic safety.

Road safety measures: Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Black spots; Road safety: 3 E measures.

Unit 4. Road safety audits: Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety.

Books Recommended:

1. Fred L. Mannering, Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis.7th Edition, Wiley, 2019.
2. Kadiyali, L. R., "**Traffic Engineering and Transport Planning"**, Khanna Publishers
3. Chakroborty Partha and Animesh Das, "**Principles of Transportation Engineering"**, Prentice hall
4. O'Flaherty C A**, "Transport Planning and Traffic Engineering",** Butterworth Heinemann, Elsevier, Burlington, MA

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-V

Environment Engineering

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
1	Professional Core courses[#]	PECE-702A-18	**Environmental Law and Policy**	3[#]	1	0	4

Unit 1

Basic Concepts in Environmental Law. An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL–liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts.

Unit 2

Forest, Wildlife and Biodiversity related laws Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence 2 Statutory frame work on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Module leopard.

Unit 3

Air, Water and Marine Laws National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. PollutionControl Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986

Unit 4

Environment protection laws and large Projects Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects

Unit 5

Hazardous Substances and Activities Legal framework: EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability

Reference Books:

1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Desai A. (2002) Environmental Jurisprudence, 2nd ed., Modern Law House, Allahabad.

3. Gadgil M. and Guha R. (1995) Ecology and Equity, Oxford, New Delhi.
4. Gadgil M. and Guha R. (1997) This Fissured Land, Oxford, New Delhi.
5. Guha R. (2000) Environmentalism: A Global History, Oxford, New Delhi.
6. Kamala S. and Singh U.K. (eds.) (2008) Towards Legal Literacy: An Introduction to Law in India, Oxford, New Delhi.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
2	Professional Core courses#	PECE-702B-18	**Rural water Supply And onsite Sanitation Systems**	3#	1	0	4

Syllabus Content:

Unit 1

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply- merits-National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies

Unit 2

Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality- methods for low cost water treatment-Specific contaminant removal systems

Unit 3

Rural Sanitation: Introduction to rural sanitation-Community and sanitary latrines-planning of wastewater

collection system in rural areas- Ecological sanitation approach – Grey water and storm water management- Compact and simple wastewater treatment systems in rural areas-catch basins-constructed wetlands- roughing filters- stabilization ponds - septic tanks – anaerobic baffled reactors-soak pits- low cost excreta disposal systems- Village ponds as sustainable wastewater treatment system-Wastewater disposal

Unit 4

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling- incineration- Biogas plants- Other specific issues and problems encountered in rural sanitation.

ReferenceBooks:

1. Eulers,V.M.,andSteel,E.W.,MunicipalandRuralSanitation,6thEd.,McGrawHillBookCompany,.
2. Wright, F.B.,Rural water Supply and Sanitation,E.Robert Krieger Publishing Company,Huntington,NewYork.
3. Juuti, P., Tapio S. K.,and Vuorinen H.,Environmental History of Water: Global Viewson Community Water Supply and Sanitation, IWA Publishing(IntlWaterAssoc).
4. Winbald,U.,andSimpson-Hebert,M.,EcologicalSanitation,SEI,Stockholm,Sweden.
5. Kadlec R.H.andWallace S.D.,TreatmentWetlands, CRCPress, BocaRaton
6. WastewaterEngineering–TreatmentandReuse,MetcalfandEddy,TataMcGrawHill

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
3	Professional Core courses[#]	PECE-702C-18	**Air and Water Quality Modeling**	3[#]	1	0	4

UNIT I

Modeling Concepts : Casual and statistical models-Characteristics- Steps in model development - Importance of model building.- conservation of mass and mass balance –calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT 2

Water Quality Modeling: Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling -Contaminant solute transport equation, Numerical methods.

UNIT 3

Air Pollution Modeling: Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants– Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self-cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

UNIT 4

Water Quality Index: Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

UNIT 5

Air Quality Index: Categories of air quality index. Determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.

Reference Books:

1. Steven C. Chapra, Surface Water Quality Modeling, Tata McGraw-Hill Companies,Inc., New Delhi, 1997.
2. J.L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
3. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport,(Ed.), (Third Ed.) Volume I , Academic Press, 2006.
4. Deaton and Wine Brake, Dynamic Modeling of Environmental Systems, Wiley &Sons, 2002
5. E.V. Thomson, Principles of Surface Water Quality Modeling and Control, Happer and Row Publishers New York, 1987.
6. M.D. Palmer, Water Quality Modeling, the World Bank Washington DC.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
4	Professional Core courses[#]	PECE-702D-18	**Solid and Hazardous Waste Management**	3	1	0	4

Unit-1

Introduction: Definition of solid wastes and hazardous wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management. **Collection, Storage and Transportation of Wastes:** Types of collection systems and their components, Concept of waste segregation at source and recycling and reuse of wastes.

Unit-2.

Solid Waste Processing and Treatment: Waste processing – processing technologies – biological and chemical conversion technologies–Composting-thermal conversion technologies-energy recovery.

Unit-3

Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Land farming; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.

Unit-4

Sanitary Landfills: Design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites.

Unit-5

Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc.

Reference Books:

1. Pichtel,J.,WasteManagementPractices–Municipal,HazardousandIndustrial,CRCPress
2. Vesilind, P.A., Solid Waste Engineering, Thomson Learning Inc.

3. Tchobanoglous,G.,Vigil,S.A.andTheisen,H.,IntegratedSolidWasteManagement:EngineeringPrinciplesand Management Issues, McGraw Hill
4. HowardS.Peavy,DonaldR.Rowe&GeorgeTchobanoglous,"EnvironmentalEngg.",McGrawHill
5. CPHEEO,*ManualonMunicipalSolidwastemanagement,CentralPublicHealthand Environmental Engineering Organization,* Government of India

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
5	Professional Course Courses	PECE-702E-18	**EIA and LCA**	3	1	0	4

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

Unit1

The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000),List of projects requiring Environmental clearance.

Unit2

Key Elements of an Initial Project Description and Scoping, Project Location(s), Risks to Environment and Human Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues. Criteria for the selection of EIA methodology, impact identification ,impact measurement, impact interpretation & Evaluation, Methods - Adhoc methods, Checklists methods, Matrices methods, Networks methods,

Unit3

Introduction: Life Cycle Assessment concepts, A brief history of Life-cycle Inventory analysis, overview of methodology, three components, identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis.

Unit 4

Procedural framework of Life-cycle inventory: Introduction, define the purpose and scope of inventory. General issues in Inventory analysis: Introduction, Using Templates, Data issues, special case boundary issues. Product design evaluation and analysis using LCA

Reference/TextBooks:

- Sadler,B.andMc Cabe M.,"Environmental Impact Assessment: Training Resource Manual",UNEP (2002).
- Wathern.P.,"Environmental Impact Assessment-Theory and Practice",Routledge Publishers, London(2004).
- Rau J.G.and Wooten D.C.,"Environmental Impact Analysis Handbook", TataMc Graw Hill (1980).
- CanterR.L.,"Environmental Impact Assessment",Tata McGraw-Hill (1981).

- Ciambrone D.F.,"Environmental Life Cycle Analysis",CRCPress (1997).

Ralph E Horne,Tim Grant,VergheeK,"Life Cycle Assessment: Principles, Practice and Prospects", CSIRO Publishers(2009).

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
6	Professional Course Courses	PECE-702F-18	**Sustainable Engg and Technologie**	3	1	0	4

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

Unit-1

Introduction:

Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements

Unit-2

Global Environmental Issue:

Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking and Protocols

Unit-3

Sustainable Design:

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design

Unit-4

Clean Technology and Energy

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy, Rainwater harvesting.

Unit-5

Green Engineering:

Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Text Books:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication

2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

SYLLABUS FOR BASKET OF ELECTIVE COURSE

Track-VI

Water Resources

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
1	Professional Course Courses	PECE-703A-18	Design of Hydraulic Structures	3	1	0	4

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

Content

Unit 1:Design of Storage Structures – Planning and investigations of reservoir and damsite, choice of dams, Analysis and Design of dams: Gravity dams, Earthen dams, rockfill dams, buttress dams. Spillway and Non-overflow sections and their design, Types of spillways, Flow characteristics of gated/ungated spillways. Types of energy dissipators Influence of tail water rating curve on choice of energy Dissipater, Backwater curve analysis for reservoirs.

Unit 2: Diversion Structures- Barrages and weirs on permeable foundations, Design of different types of weirs: Sharp crested weirs, broad crested weirs. Barrage components: Glacis, Rigid apron, Flexible (concrete block) apron, Design consideration of barrages for surface and sub-surface flows,causes of failure, Bligh's and Lane's creep theory,Khosla's theory and method of independent variables, standard profiles, corrections, exit gradient, plotting of HGL, Design of d/s and u/s protection works, length of pucca concrete floor.

Unit 3: Canal Structures- Head regulator, Cross regulator and Falls, Canal section design (unlined and lined); in cutting and filling, Aqueducts; Super passage; Syphon Aqueducts, Distribution structures for conveying water from canals to irrigation fields, Canal capacity determination from field water requirements. Design considerations for cross drainage works: hydraulic structures, including spillways, stilling basins, and embankment seepage; Design of canal falls, Canal Outlets**,** Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, Fluming the canal. Design of Channel Transition, Operation and maintenance of canals.

Text/Reference Books

1. David A. Chin (2013), "water-Resources Engineering", PEARSON.
2. Edward Kuiper "Water Resources Development", Springer
3. Novak, P., Moffat, A.I.B., Nalluri, C. and Narayanan, R. Hydraulic Structures Unwin Hyman Ltd., London 1989.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
2	Professional Course Courses	PECE-703B-18	River Engineering	3	1	0	4

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

Content

Unit 1: Introduction to River Engineering- River classifications, Primary functions of rivers, Rivers in India, Himalaya andPeninsular.River flow kinematics

Flow resistance in rivers- Physical properties of sediments, sediment movement in rivers, shear stress, shields diagram, scouring around bridge piers and embankments,Bed load and suspended load transport for uniform and non-uniform bed material, Total load equations, sediment sampling, Reservoir sedimentation, river flow and sediment-duration curves.

Unit 2: River Hydrology- River morphology:thresholds in river morphology, steady river flow, steady non-uniform river flow, river continuity equations, river momentum equations, River gauging, river flood waves, river flood routing.

River Mechanics- River Equilibrium: particle stability, Stability of Channel, regime relations, river bend equilibrium, downstream hydraulic geometry, meander plan form, geomorphic analysis of river channel responses; Fundamentals of alluvial channel flows, bars in alluvial rivers, Lateral river migration, River dynamics: degradation and aggradation of river bed,River Confluences and branches, River Database.

Unit 3: River Stabilization- River bank stability, Riverbank riprap revetment, river bank protection, Principles of stabilisation and rectification of rivers, River bank stability analysis, Design of river training works like Revetments, Dikesgroynes, guide banks, gabions, Hydraulic modelling of rivers,Diversion and Cofferdams; River regulations systems;

Dredging and Disposal, River restoration

Unit 4: River Models- dimensional model studies for rivers, rigid bed models, mobile bed river models, finite difference approximations, one-dimensional and multi-dimensional river models.

Text/Reference Books

1. Garde, R.J., (2006), "*River Morphology*", New Age International Publishers
2. Garde, R.J. and Ranga Raju, K.G., (2006), "*Mechanics of Sediment Transportation and Alluvial Stream Problems*", Wiley Eastern Limited
3. Julien, Pierre, Y., (2002), "*River Mechanics*", Cambridge University Press
4. Mechanics of Sediment transportation and Alluvial stream problem by R.J. Garde and K.G RangaRaju – New Age Int. Publications.
5. Sahnaz Tigrek and Tuce Aras "Reservoir Sediments Management", CRC Press

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
3	Professional Course Courses	PECE-703C-18	**Ground Water**	3	1	0	4

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

Content

Unit 1: Introduction- Groundwater in Hydrologic Cycle, Occurrence of groundwater, Hydrogeology, Hydrometeorology, Groundwater Systems, Planning and Management of Groundwater, Groundwater Sustainability, Groundwater protection: Concerns and Acts

Groundwater Properties- Vertical distribution of subsurface, characteristics and classification of aquifers, Determination of specific yield and permeability.Physical properties of groundwater and aquifers, principles and fundamental equations of porous media flow and mass transport, well hydraulics and pumping test analysis, role of groundwater in the hydrologic cycle, groundwater quality and contamination groundwater hydrology, well hydraulics and well construction, geo-physical explorations, Different types and procedures for analysis of geophysical studies, groundwater quality and management of groundwater resources

Unit 2: Groundwater Hydraulics- Groundwater movement: Darcy's law and its limitations, Dupuit–Forchheimer Theory

of Free-Surface Flow, Stream lines and Flow net analysis, Discharge and draw down for various condition of groundwater flow, Groundwater tracers, continuity equation, equation of motion in ground water,

Well hydraulics- steady/unsteady, uniform/radial flow to a well in a confined/unconfined/leaky aquifer, Well flow near aquifer boundaries/for special conditions, Evaluation of well loss parameters, Partial penetration of wells, Interference of wells, Collector wells and Infiltration galleries.Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic well losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: design, Construction; completion, development, protection and rehabilitation of wells;

Unit 3: Groundwater Quality- Groundwater constituents and contaminants, Water quality standards, Groundwater solubility, Disequilibrium and Saturation Index, sources of groundwater contamination, Mass Transport of Dissolved Contaminants.Groundwater Management: Basin management, investigations, conjunctive use, modelling, artificial recharge; Saline water intrusion

Unit 4: Impact of Climate change – Climate change impact on hydrological cycle, Climate change impact on Groundwater, impact on groundwater quality, climate change simulation, impact on availability of water in aquifer.

Text/Reference Books

1. Groundwater Hydrology by Todd, D. K. and Mays, L. W., John Wiley & Sons, Inc.
2. Ground and Surface Water Hydrology by Mays, L. W., John Wiley & Sons, Inc.
3. Bear J., Hydraulics of Groundwater, McGraw-Hill, New York, 1979.
4. Bouwer H., Groundwater Hydrology, McGraw-Hill, New York, 1978.
5. Driscoll, Groundwater and Wells, Johnson Filtration Systems, Inc., 1986.

Seventh/Eight Semester

S. No.	Category	Code	Course Title	Hours			Credits
				L	T	P	
4	Professional Course Courses	PECE-703D-18	**Hydraulic Modelling**	3	1	0	4

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

Content

Unit 1: Computational Methods- Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results), applications of computational methods for pipe flow, flow through porous media.

Unit 2: Groundwater Modelling-Role of instrumentation and data processing; Gravity dominated models (modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations);

Gravity friction models: (pumped flow models, ship models, surge tank models); Friction dominated models; River models

with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures; Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modellingGeophysical Subsurface Explorations, Well Hydraulics- Image well theory. Groundwater Modelling, Artificial Recharge of Groundwater, Groundwater Quality Modelling, contaminant transport model, Soil moisture simulation models.

***Water Supply Networks*:** Design and optimization of water distribution system- trial error method, cost-head loss ratio method. Optimization using linear programming techniques, surge analysis in water distribution system,Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modelling.

Unit 3: RS and GIS: Ideal Remote Sensing System, Spectral Signatures of Earth features, Principles of Interpretation, Use of Remote Sensing and GIS in Water Quality Modelling, vegetation mapping, runoff modelling, Drought and Flood Monitoring, water resource mapping.

Unit 4: Simulation Software in Water Resources:Introduction to Surface water models (HMS) - Storm Water Management Models (SWMM) -Water CAD, STORM CAD - Ground Water Flow models - Visual Modflow.

Text/Reference Books

1. Schilling, R.J., and S.L. Harris, (2007), *"Applied Numerical Methods for Engineering*", CENGAGE Learning, India Edition.
2. Abbot, M.A. and Vervey (1996), *"Computational Hydraulics",* Elsevier Publications.
3. Domenico (1972), "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc. N York
4. Anderson M.P., and Woessner W.W., Applied Groundwater Modelling : Simulation of flow and advective transport, Academic Press, Inc., 1992
5. Lynn E. Johnson, (2008), "*Geographical Information Systems in Water Resources Engineering*" CRC Press.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
5	Professional Course Courses	PECE-703E-18	**Transient in Closed Conduits**	3	1	0	4

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

Content

Unit 1: Transient Flow Equations- Wave propagations, wave reflection and transmission, Reynold Transport Theorem, Continuity equation, momentum equation, wave velocity, solution of governing equations, Unsteady friction, basic water hammer equations, causes of transient in closed conduits.Analysis of flow in water transmission and water distribution systems (pump & gravity); optimal design and operation of systems for achieving different goals (including latest tools

available for optimization); Extended period simulations, Software for WDN analysis and design,

Unit 2: Causes of Transients- Transients caused by opening and closing of valves, Transient caused by power failure of pumps.Rehabilitation of pipeline systems; Water auditing, online monitoring and control, leak and burst detection; transient analysis and surge protection; Appurtenances (valves / flow meters etc.); Selection of pipe material; Jointing details; Pipe laying and testing; Structural design for buried and surface mounted pipes unsteady flow in pipes (water hammer) and designing for surge protection**;** Differential equations for unsteady pipe flow.

Unit 3: Transient Control- Surge Tanks: Types of surge tanks, analysis of surge tanks, governing equations, solution of governing equations, surge oscillations in frictionless system, stability of tanks, design considerations. Air Chamber, Valves, Optimal transient control.transients in penstocks of hydro-electric schemes; analysis for transient control using surge tanks; air chambers; air valves; pressure regulating valves etc.; Emphasis should be on development of computer programs for transient analysis; awareness about commercially available software for transient analysis

Text/Reference Books

1. Chaudhry, H., Applied hydraulic transients, Springer, New York.
2. Hydraulic Transients by Streeter, V.L. and Wylie, E.B., McGraw Hill, New York.
3. Watters, G.Z, *Analysis and control of pipe flow in pipes*, Butter Worth Publishers, 1984.
4. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
6	Professional Course Courses	PECE-703F-18	**Urban Hydrology and Hydraulics**	3	1	0	4
External Marks: 60, Internal Marks: 40, Total Marks: 100							

Content

Unit 1: Introduction- Trends of Urbanization and Industrialization, Urban water supply demand forecast, urban hydrological cycle.

Unit 2: Urban water Management- Rain water harvesting, managed aquifer recharge, effect of water management practices on urban water infrastructure, hydrology and ground water regime, mapping of water supply and sewage networks.

Urban water Infrastructure- water supply, sanitation, sewerage and wastewater conveyance infrastructures, Water supply and sewerage network hydraulics, Structural safety and mitigating plans against natural and human caused threats.

Unit 3: Urban Storm water- Master drainage plans, Estimation of urban stormwater quantity, Wastewater collection systems, Design of storm sewer network systems, Storage facilities. Interaction between urban drainage and solid waste management, Stormwater Management, Operation and maintenance of urban drainage system.

Unit 4: Sustainable Design- Sustainable urban designs, Methodologies for assessing sustainability of urban water infrastructures, Emerging sustainable materials and design procedures for water supply and sewerage pipelines,determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts.

Text/Reference Books

1. Geiger, W.F., Marsalek, J. Zudima and Rawls, G.J (1987), *"Manual on Drainage in Urban Areas", 2 Volumes*, UNESCO, Paris.
2. Wanielista, M.P., and Yousef, Y.A. (1993), *"Storm water Management"* John Wiley and Sons, Inc., New York.
3. Hall, M.J., (1984), *"Urban Hydrology*", Elsevier Applied Science Publishers.
4. Mays, L.W., Hydraulic Design Handbook, McGraw-Hill, 1999

SYLLABUS FOR
Open Elective

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Open Elective	OECE-701-18	**Metro Systems and Engineering**	3	0	0	3

Syllabus Content:

PART-A

Introduction toMetro systems

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

Planning and Development

Overview and construction methods for: Elevated and underground Stations; Viaduct spansandbridges;Undergroundtunnels;Depots;CommercialandServicebuildings.InitialSurveys&Investigations;

Traffic Management Systems

Basics of Construction Planning &Management, Construction Quality& Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way.Facilities Management Module

PARTB

Signalling Systems

Introduction to Signalling systems; Automatic fare collection; Operation Control Centre(OCCand BCC);SCADA and other control systems; Platform Screen Doors.

Electrical Systems

OHE, Traction Power; Substations-TSSandASS;PowerSCADA;StandbyandBack-upsystems;Greenbuildings, Carbon credits and clear air mechanics.

Mechanical Systems
Ventilation systems; Air conditioning for stations and buildings;Fire control systems; Lifts and Escalators

TextBooks:

1. "ElectricTractionforRailwayTrains:ABookforStudents,ElectricalandMechanicalEngineers, Superintendents of Motive Power and Others"Edward Parris BurchPalala Press2018.
2. "Metropolitan Railways: Rapid Transit in America (Railroads Past and Present)",Middleton,IndianaUniversityPress2013.
3. "WorldMetroSystems",Garbutt,CapitalTransportPublishing;2ndRevisededition1997.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
2	Open Elective	OECE-702-18	**Traffic Management**	3	0	0	3

Unit-1 :Fundamentals of Traffic Management

Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Unit-2:Traffic Regulation and Control devices

Road Signs and markings; Channelization;At-grade and Grade separated intersections; TrafficRotary; Design principles of traffic signals

Unit-3: Traffic Management techniques
Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in traffic management

Unit-4 : Logistics for Traffic Management
Definition, domain, role and responsibility of traffic management agencies, Principles and systems of coordination in Traffic management; Intelligent transport system- concept, Traffic Management logistics - equipment's, vehicles and traffic control centre; Centralized Data Processing and Monitoring, Traffic personnel- skills & deployment systems.

TextBooks:

1. FredL.Mannering,ScottS.Washburn.PrinciplesofHighwayEngineeringandTrafficAnalysis.7thEdition, Wiley, 2019.
2. Kadiyali L.R.TrafficEngineering&TransportPlanning.KhannaPublications,2013.
3. KhistyC.J.andLallB.K.TransportationEngineering–AnIntroduction.3rdEdition,Pearson,2017.
4. KhannaS.K.,JustoC.E.GandVeeraragavanA.HighwayEngineering.Revised10thEdition,NemChand & Bros, 2017.

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
3	Open Elective	OECE-703-18	**Road Safety**	3	0	0	3

UNIT 1. Road Accidents

Causes of road accidents: Vehicle design factors &Driver characteristic s influencing road safety, Road condition, Parking and its influence on traffic safety

UNIT2. Road safety measures

Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Blackspots;Roadsafety:3,,E"measures

UNIT3. Road safety audits

Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in Road safety

UNIT4. Ensuring Traffic Safety in Road Operation:-Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.

REFERENCE BOOKS: 1. BABKOV, V.F. `Road conditions and Traffic Safety', MIR, publications,Mascow - 1975.
2. K.W. Ogden, `Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
4. C. JotinKishty& B. Kent Lall, "Transportation Engineering-An Introduction" , Thrid Edition, Prentice Hall of India Private Limited, New Delhi, 2006
5. Latest Editions of Relevant Indian Roads Congress (IRC) Publications for Design of Roads and Road Safety.
6. Khanna and Justo, 'Text book of Highway Engineering', Nemchand Brothers, Roorkee,2001

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
4	Open Elective	OECE-704-18	**Environmental Impact** Assessment	3	0	0	3

Course objectives

1. To learn the concept and methodology of EIA and its documentation
2. Understand the different steps within environmental impact assessment

Course outcomes

1. Knowledge about EIA tools & methodologies and identify the suitable methodology and prepare Rapid EIA.
2. Be able to access different case studies/examples of EIA in practice

Unit-1: Evolution of EIA; EIA at project; Regional and policy levels; Strategic EIA; EIA process; Screening and scoping criteria; Practical applications of EIA

Unit-2: Legislative and environmental clearance procedures in India and other countries, Siting criteria; CRZ; Socio Culture and Public participation; Resettlement and rehabilitation.

Unit-3: EIA methodologies; Baseline data collection; Prediction and assessment of impacts on physical, biological and socio-economic environment; Environmental management plan; Post project monitoring, EIA report and EIS; Review process.

Unit-4: Case studies on project, regional and sectoral EIA. Specialised areas like environmental health impact assessment; Environmental risk analysis; Economic valuation methods; Cost-benefit analysis; Expert system and GIS applications; Uncertainties.

Text/Reference Books:

1. Canter L. Environmental Impact Assessment, McGraw Hill.

2. Kiely G. Environmental Engineering, Tata McGraw Hill.
3. Rau G.J. and Wooten C.D. Environmental Impact Analysis Handbook, McGraw Hill.
4. Munn R.E. Environmental Impact Assessment, John Wiley & Sons.
5. Dhameja S.K. Environmental Engineering and Management, S. K. Kataria& Sons.MoEF Guidelines and amendments as updated onhttp://moef.gov.in

Seventh/Eight Semester							
S. No.	Category	Code	Course Title	Hours per			Credits
				L	T	P	
5	Open Elective	OECE-705-18	**Construction Materials**	3	0	0	3

Course Outcomes: On completion of this course the student will be able
•To Provides a brief description about different types of materials used in building construction for members like foundation, masonry, arches, lintels, balcony, roof, floor, doors, windows, stairs, plastering, painting and other general topics. Properties of various construction materials, their uses and different applications are discussed in this subject.

Unit-I: Introduction to building construction and basic building components (Foundation, plinth, wall, sill, lintel, roof, doors, windows, ventilators, staircases, sunshades etc.) along with the building materials., Role of materials in construction, Classifications of Construction Materials, green building materials.

Unit-II: Physical and chemical properties of Cement ,Lime and Supplementary Cementation materials , CC blocks, Fly ash Bricks, pozzolanic material, aggregates, water, admixtures - characteristics, properties and uses, Mortars, Ceramic Materials: Classification, Refractories, glass-(Toughened Glass, DU Glass, Security Glass), glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

Unit-III: Rubber and plastics, properties, Polymers, fibres and composites, Fibre reinforced plastic. Water Proofing Material. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Polymer foams, Aluminium Composite Panels (ACP), WPC (Wood Plastic Composite, UPVC (Unplasticized Polyvinyl

Chloride), Charcoal fibres.

Unit IV: Timber and its uses (Plywood, Block board, HPL- High Pressure Laminates, Laminates etc.) Metals in construction (Aluminium Alloys, Steel, Ferrous Metals, Copper etc.)

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
5. Neptel& Various Sites on Internet

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
6	Professional Core courses	HSMC -255	**Professional Practice, Law & Ethics**	2	0	0	2

Basic elements of civil engineering professional practice are introduced in this course. Rolesof all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers -are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced. The coursecovers professional relations, civic responsibilities, and ethical obligations for engineering practice. The course also describes contracts management, and various legal aspects related to engineering. Further, the course familiarizes students with elementary knowledge of laws that would be of utility in their profession, including several new areas of law such as IPR, ADR.

The course is designed to address the following:

- To make the students understand the types of roles they are expected to play in the
- society as practitioners of the civil engineering profession
- To develop some ideas of the legal and practical aspects of their profession

UNIT 1.Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in thewebsite of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

UNIT2:***General Principles of Contracts Management: Indian Contract Act, 1972 and amendments***covering General principles of contracting; Contract Formation & Law; Privacyof contract; Various types of contract and their features; Valid & Voidable Contracts; Primeand sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders ,Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions &Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed;Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays,Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance;Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping,Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public-Private Partnerships; International Commercial Terms;

UNIT 3 ***:Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system:*** Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996;UNCITRAL model law – Arbitration and expert determination; Extent of judicialintervention; International commercial arbitration; Arbitration agreements – essential andkinds, validity, reference and interim measures by court; Arbitration tribunal – appointment,challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and courtassistance; Award including Form and content, Grounds for setting aside an award,Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and GenevaConvention Awards;
Distinction between conciliation, negotiation, mediation and arbitration,confidentiality, resort to judicial

proceedings, costs; Dispute Resolution Boards; LokAdalats.

UNIT 4 :*Engagement of Labour and Labour& other construction-related Laws:*Role ofLabour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

UNIT 5 : *Law relating to Intellectual property:*Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relatingto Patents under Patents Act, 1970 including Concept and historical perspective of patentslaw in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Durationof patents – law and policy considerations, Infringement and related remedies;

Text/Reference Books:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. MeenaRao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. NeelimaChandiramani (2000), The Law of Contract: An Outline, 2nd Edn. AvinashPublications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R. (1979), Law of Contract, Oxford University Press
9. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
11. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
12. Bare text (2005), Right to Information Act
13. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
14. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
15. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per**			**Credits**
				L	**T**	**P**	
7	Mandatory Course (non credit)	BTMC-701-18	**Management- I (Organizational Behavior**)	2	0	0	0

Course objectives: This course is based on three themes;

- Individuals – Behaviour in an individual context
- Groups/teams – Behavior in a n organizational context
- Organizations – How do these artificial persons behave?

Course context:

Unit 1 Organizational behavior: What managers do, Definition of OB, contributing disciplines to OB, challenges and opportunities for OB, Foundations of Individual Behavior, biographical characteristics, Learning, Attitudes, Personality: Determinants of personality, Perception: Meaning and attribution Theory.

Unit II Motivation: Definition and Process of motivation, Theories of motivation, Application of motivation. Job Satisfaction: Nature and significance of Job Satisfaction. Leadership: Meaning and theories of Leadership, Leadership in Indian culture, Nature and significance of Leadership. Transaction analysis, life position, Johari window, Emotional Intelligence and Intellectual Intelligence.

Unit III Foundation of group behavior: Nature and concept of group formation, stages of group formation, difference between group and team, Group Discussion Making: Meaning and nature: Decision making process; Conflict management: definition of conflict, Functional vs Dysfunctional conflict, conflict process; individual and group level conflict; organization level conflict; Negotiations: Meaning and definition; Negotiations process, issues in Negotiations.

Unit IV Stress Management: Meaning and concept of stress, Stress in organization, Management of stress,Power and Politics in Organization: Nature and concepts, Sources and types of power, techniques of politics, Organizational culture: Meaning and concept, cultural differences and business ethics.

Suggested Readings/Books:

1. Robbins, Organizational behavior, Pearson Education.
2. Luthans, Organizational behavior, Tata McGraw Hill
3. Parikh, Gupta, Organizational behavior, Tata McGraw Hill
4. Locum, Fundamental of Organizational behavior, Cengage Learning
5. Saiyadain, M S.: Organizational behavior, Tata McGraw Hill

WIDELY USED BOOKS FOR Organizational behavior

- I'm O.K You're O.K., Thomas Harris.
- Games people play, Eric Berne

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**

***List of Software for Training to be learnt during Training Period**
Any software that enhances professional capability in civil engineering practice a partial indicative list is mentioned below:

1. GT STRUDAL
2. PRIMA VERA
3. GEOTECH
4. ARCVIEW GIS
5. GEO 5
6. Ansys
7. AUTOCAD CIVIL 3D
8. MX ROAD
9. GEOMATIC
10. STAAD PRO
11. HDM-4
12. PLAXIS
13. Abacus
13. Any other relevant software

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Core courses	BTCE 802-18	**Smart Cities**	3	1	0	4

Course objectives

To obtain basic knowledge of smart cities
To learn how to analyze and compare existing smart community projects.

Unit-1:
Definition and concept ofsmart city, Difference between: Intelligent city, Digital city, and E-city,Objectives, principles, stages in to smart city planning, Smart city planning schemes.Complexities of Smart cities, Smart cities in India.

Unit-2:
Structure plan, detailed smart city planning scheme and action plan, Estimating future needs, planning standards for different land use allocation for commerce, industries, public amenities, open areas etc.,

Unit-3:
Smart infrastructure with adaptive capabilities; smartinfrastructures of energy, mobility, health and sustainabilityand their growing interdependencies.Cybersecurity, Safety, and Privacy.

Unit-4
ICT for smart City, Internet of Things, Blockchain, Artificial Intelligence, Alternate Reality, Virtual Reality, Future of Smart cities, Smart City Informatics

Reference Books:

1. Jo Beall (1997); “A city for all: valuing differences and working with diversity”; Zed books limited, London (ISBN: 1-85649-477-2)

2. UN-Habitat; “Inclusive and sustainable urban planning: a guide for municipalities”; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978-92-1-132024-4)

3. Arup Mitra; “Insights into inclusive growth, employment and wellbeing in India”; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2)

4. William J. V. Neill (2004); “Urban Planning and cultural identity”; Routledge London (ISBN: 0-415-19747-3)

5. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); “Remaking the city: Social science perspective on urban design”; State University of New York Press, Albany (ISBN: 0-87395-678-8)

6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; NatašaPichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science

Seventh/Eight Semester							
S. No.	**Category**	**Code**	**Course Title**	**Hours**			**Credits**
				L	**T**	**P**	
3	Professional core	BMPD-803-18	**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.

End

I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. : IKGPTU/Reg/N/ *Dated :*

NOTIFICATION

Sub: **Regarding Pre-Ph.D Course work.**

This is for information of all concerned that Pre-Ph.D course work from 2016-17 will be conducted in the IKGPTU main campus Kapurthala in regular mode. The PhD course work will consists of minimum 15 credits. The structure of the course work is as under.

Sr. No.	Nature of course	Name of course	Credits	Remarks
1.	Core	1.Research Methodology	4	The syllabus of RM should be formulated faculty wise such as Engineering, Science, Management/ Humanities and Life sciences
		2.Subject related theory paper	4	Discipline specific related to advancements in theoretical methods for research
		3. Presentation	3	Discipline specific
2.	Interdisciplinary	4. Elective	4	From list of subjects from allied fields
	Total Minimum credits		**15**	

-Sd-
Registrar

Endorsement No: IKGPTU/REG/N/ 4244-4251 Dated: 22.08.2016

1. Secretary to Vice Chancellor: For kind information of Vice Chancellor
2. Dean (P&D)
3. Dean (RIC)
4. Dean (Academics)
5. Finance Officer
6. Controller of Examination
7. DR (Computers): For uploading on website
8. File Copy

Registrar 22/8/16

I. K. Gujral Punjab Technical University, Jalandhar
Jalandhar Kapurthala Highway, Near Pushpa Gujral Science City, Kapurthala - 144 603
Ph. No. 01822 - 662521. 662501 Fax No. : 01822-255506. 662526. Email : registrar@ptu.ac.in

Civil - E

4

Pre Ph.D. Course in Civil Engineering

Schematic and Syllabus

Sr. no.	Nature of Course	Name of course	Credits	Remarks
1.	Core	Research Methodology	4	The syllabus of RM should be formulated faculty wise
		Discipline Specific subjects	4	1.Transportation and Highway Technology 2. Foundation Design and Construction 3.Environment Engineering and Management 4.Pavement Design, Construction and Maintenance 5.Bridge Engineering 6.Advanced Construction Technology 7.Advanced Structural Engineering 8.Hydraulics Engineering 9.Geotechnical Engineering
		Presentation	3	Discipline specific
2.	Interdisciplinary	Elective	4	From list of subjects from allied fields 1.Town and Country Planning 2.Advanced Geoinformatics 3.Computer Aided Design Methods 4. Civil Engineering applications of Remote sensing and GIS
	Total Minimum credits		**15**	

Paper Title: Research Presentation

L T P

0 0 3

Research Scholar will have to present a seminar based upon his/her research area. Performance of the scholar and participation in seminar will be taken into consideration.

Pre Ph.D. Course in Civil Engineering

Research Methodology

L	T	P
4	0	0

1. Introduction Research Methodology: Definition of Research, Need of Research, Concept and steps of Research Methodology , Uses of Research Methodology, Research Techniques. Reviewing Literature: Need, Sources-Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.

2. Identifying and defining research problem: Locating. Analyzing stating and evaluating problem, Generating different types of hypotheses and evaluating them.

3. Data collection: Static and dynamic characteristics of instruments used in experimental set up, calibration of various instruments, sampling methods, methods of data collection, Selection of Appropriate Method for Data Collection, Data collection using a digital computer system, case studies of data collection

4. Data Analysis: Data processing, data analysis strategies and tools, data analysis with statistical packages, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis

5. Research reports and Thesis writing: Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, word processing tools such as Latex Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

6. Research ethics, IPR and publishing Ethics: ethical issues. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Books:

1. C.R. Kothari, "Research Methodology – Methods and Techniques", Wiley Eastern Ltd 2009.

2. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.

3. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan," Management Research Methodology: Integration of Methods and Techniques, Pearson, 2006 4. S.P Gupta,"Statistical Methods", Sultan Chand & Sons, 2006.

Pre Ph.D. Course in Civil Engineering

Transportation and Highway Technology

L	T	P
4	0	0

1. HIGHWAY MATERIALS Soil stabilization types, source, functions, requirements, properties, tests and specifications for use in various components of road, Soil compaction for use in fill and subgrade of roads. Soil stabilization – principle, methods and tests, proportioning of materials and mix design, application of Rotchfutch method. Marginal and waste materials in road construction, properties and scope in road construction. Bituminous Material (properties of the material) and marshall mix design (both wet and dry), Usage of Geosythentics and Geotextiles in construction of highways.

2. HIGHWAY CONSTRUCTION AND MAINTENANCE Components of road and pavement structure functions, requirements and sequence of construction operations. Plants and equipment for production of materials, Road construction equipment, Pre-construction surveys and marking on ground, Different types of granular base course, Different types of sub-base, Road maintenance works and quality control tests as per MORTH specification. SPECIAL PROBLEMS IN ROAD CONSTRUCTION Problems on construction on areas with marshy and weak soils, expansive clays and' water- logged – areas. Design and construction of filter drains and capillary cut-off. Vertical sand drains – application, design and construction method. Road construction on desert region and coastal areas.

3. ROAD SAFETY AND MANAGEMENT Road accidents, causes, scientific investigations and data collection. Road safety issues and various measures for road safety. Engineering, education and enforcement measures for improving road safety. Short term and long term measures. Traffic management techniques. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. Economic evaluation of roads.

4.TRAFFIC SURVEYS & APPLICATION OF REMOTE SENSING AND GIS IN HIGHWAY ENGINEERING Traffic studies- Trip distribution, generation assignment and model split (Statistical analysis). Design of the traffic signals at urban intersections. Level of service at intersections. Design of parking in urban areas and problems Concepts, components, working of GIS, data capture, data integration, data structures. Coordinate systems and map projections, Registration. GIS analysis and tasks – Input, manipulation, management, query and analysis, visualization, proximity analysis, overlay analysis, GIS and Remote sensing data integration. Overview of image processing softwares and GIS softwares, Introduction to GPS and its application (includes the recent software's used in the highway engineering)

Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress.

2. IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986.

3. IRC -37, IRC -58 , IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27- 1967, 29-1988, 34-1970, 36- 1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94- 1986, 95-1987, 98-1997, 105-1988

4. Peurifoy, R.L., and Clifford,JS "Construction Planning Equipment and Method"- McGraw Hill Book Co. Inc.

5. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA

6. Leonards G. A. "Foundation engineering" - McGraw Hill Book Company, New York, 1962

Pre Ph.D. Course in Civil Engineering

Advanced Foundation Design and Construction

L	T	P
4	0	0

1. General Principles of Foundation Design : Functions of foundations, essential requirements of a good foundation, types of foundations, principal modes of failure, estimation of allowable bearing pressures, calculation of ultimate bearing capacity by theoretical and empirical methods: Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis BIS Method (IS:6403), Settlement of foundations. Factors to be considered foundation design, numerical problem based in BIS method.

2. Pile Foundations : Purpose/uses of pile foundations, Classification of piles based on different criteria, Brief details of timber, concrete, steel piles their advantages and disadvantages , selection of pile type, pile action, behaviour of pile and pile groups under load. definition of failure load. Estimation of carrying capacity : Single driven pile in cohesion less soils - methods based of on SPT and CPT, ultimate load on driven and cast-in-place piles and bored and cast-in-place piles in cohesionless soils. Factors affecting pile capacity.- Numerical problems Ultimate capacity of single pile driven in cohesive soils; modification for driven and cast-in-place piles and bored and cast-in-place piles. Capacity of very long piles – Numerical problems Carrying capacity of piles on rocks.

3. Well Foundations: Basic Principles, Forces acting on Well foundations, Sinking of Wells, Tilts and Shifts. Soil Stability: Retaining walls – Introduction, types, Principles of design, Modes of failure, drainage of the back fill, problems related to design of gravity retaining wall and stability of retaining walls.. Unbraced excavations, braced excavations. Sheet piles - types anchors and tie backs. Shoring and Underpinning - necessity and methods

4. Improvement of Foundation Soils Purpose : (a) Improvement of granular soils : term used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods - Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact at depth. (b) Improvement of cohesive soils : preloading, or dewatering, methods of installing sand drains ,drain wicks, electrical and thermal methods. Grouting : purpose, functions, types of grouts ; soil bentonite - cement mix, cement mix, emulsions, solutions: grout injection methods. Geo-synthetics : types, functions, manufacturing of geo-textiles , Classification of geo-textiles. Specific Applications : Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and a case study.

5. Special Considerations in Foundation Design and Construction: Elementary principles of design and construction of foundations subjected to earthquake or dynamic loads, special measures for foundations constructed under water.

Books :

1. Tomlinson MJ, Foundation Design and Construction , ELBS-Longman, 6e,.

2. Bowles Joseph E, Foundation Analysis and Design, McGraw Hill.

3. Som, NN & Das S.C. , Theory and Practice of Foundation Design, Prentice Hall of India, 2003

4. Braja M. Das, Principles of Foundation Engineering, 6e, Thomson, 2007

5. Koerner, Robert M, Construction and Geotechnical Methods in Foundation Engineering , McGraw Hill,

6. Dinesh Mohan, Pile foundations, Oxford & IBH, 1998

7. Kurian, N.P. Modern Foundations, Tata McGraw Hill, 1982.

8. Fang H.Y. Foundation Engineering Handbook, Van Nostrand Reinhold, 23, 1991.

9. Kaniraj Shenbaga R, Design Aids in Soil Mechanics and Foundtion Engineering, Tata McGraw Hill,

Pre Ph.D. Course in Civil Engineering

Environment Engineering and Management

L	T	P
4	0	0

1. Environment & Ecology: Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community's inter-relationships in an ecosystem. Importance of clean environment.

2. Type of Pollutants and Protection of Environment :Water Pollution : Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers. Domestic and industrial Pollution : Sources, Standards for disposal of waste water and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies.

3. Air Pollution : Definition, principle materials causing pollution, types of air contaminants, their sources and ill effects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleansing, pollution control methods and various engineering devices to control particulate and gaseous pollutants, controlling air pollution from automobiles. Noise Pollution : Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures. Solid Waste Pollution: Sources, effects and treatment of solid wastes.

4. Degradation of Land Resources : 3.1 Deforestation and Wetlands : Forest land, deforestation and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation problems, erosion, salinization, water logging, land use management & planning.

Land Fills: Sitting Criteria, Waste containment Principles, types of Barrier materials, Planning and Design aspects relating to Waste disposal in landfills, Control and remediation of sub surface contamination. Case studies

5. Current Issues in Environmental Engineering : Global warming, ozone depletion, acid rain, oil pollution, radiation hazard and control, role of non- conventional sources of energy in environment.

6. Environment Impact Assessment : Definition and its importance for environment management, constituents of environment impact assessment , project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution.

7. Environmental Management System: Main clauses and basic steps for certification. Water pollution, air pollution and EPA and their salient features.

Books:

1. Peavy,Rowe,,Techobanoglous, Environmental Engg. Tata McGrawHill.

2. Mackenzie L Davis, Environmental Engg. Tata McGrawHill.

3. Baljeet S. Kapoor; Environmental Engg. An overview, Khanna Publishers.

4. Glbert H.Masters , Environmental Engineering and Science, Prentice Hall of India Pvt.Ltd.

5. GN Panday, GC Carney Environmental Engineering,Tata McGrawHill.

6. P.D. Sharma, Ecology and Environment Rastogi Publications.

7. Ray P.A Lcances Environmental Impact Assessment Hand Book, National Environmental Protection Council Manila.

8. P Venugopala Rao ; Text Book of Environmental engineering, PHI

Pre Ph.D. Course in Civil Engineering

Pavement Design, Construction and Maintenance

L	T	P
4	0	0

1. Introduction: Types of pavement structure, functions of pavement components. factors affecting pavement design. Design of Pavements: Methods for design of flexible pavements: CBR , Group Index Method , California bearing value method , Triaxial test method , Burmister method , McLeod's method.

2. Design considerations, methods for design of rigid pavements: Westergaard's method, F.A.A. method, types of joints and their design in cement concrete pavments. Thickness design for Airport pavement ,FAA method for Flexible and Rigid pavements, ESWL Concept , CBR method (USACE) , LCN system of pavement design,

3. Construction of Highways: Types of Highway Construction and their selection, materials for construction, construction procedure of different highways: Gravel roads, WBM , W.M.M., Bituminous pavements, cement concrete pavements, Joints in cement concrete pavements, introduction to various Equipment used for highway construction. Constructional features for Pre-Mix Carpet, Mix Seal Surfacing , B.M. , SDBC. Other higher quality pavement layers – DBM , BC (introduction only)

4. Maintenance of Highways: Pavement failures, their causes and remedial measures typical flexible and rigid pavement failures, types of highway maintenance: routine, periodic and special type, materials used for maintenance of different pavement such as bituminous pavements, cement concrete road, Slurry Seal, Liquid Seal, Fog Seal, Patching Defects/ Failures in Flexible Pavement- their types and causes, Remedial Measures Surface defects, Cracks, Deformation, disintegration, Cracks, Spalling , Slab Rocking , Joint Sealant Failure and Rectification

Books:

1.. Khanna and Justo ; Highway Engineering, Nemchand & Bros. Roorkee

2. Clarkson H.Oglesby and Gary Hicks; Highway Engineering. John Wiley & Sons, London,

3. Rao ; Airport Engineering , Tata McGraw Hill Publishing Co. New Delhi

4. Khanna and Arora.; Airport Planning and Design

5. Wright and Paquette; . Highway Engg , John Wiley and Sons, New York

6. Vaswani, Highway Engg Roorkee Publishing House, Roorkee

7. Sharma and Sharma.; Principles and Practices of Highway Engg., Asia Publishing House, New Delhi .

Pre Ph.D. Course in Civil Engineering

Bridge Engineering

L	T	P
4	0	0

1. Introduction Definition; components of a bridge; classification; importance of bridges.
2. Standard Specifications for Road Bridges: Indian Roads Congress Bridge Code; width of carriageway; clearances; loads to be considered; dead load; I.R.C. standard live load; impact effect; application of live load on decks; wind load; longitudinal forces; centrifugal forces; horizontal forces due to water current; Buoyancy effect ; earth pressure ; temperature effects ; seismic force.

3. Reinforced concrete Bridges : General arrangement and suitability : T-beam bridges; Balanced cantilever bridges ; Continuous girder bridges; Rigid frame bridges; Arch bridges; Steel bridges (Familiarization with MOST specifications and drawings)

4. Sub-Structure : Design of piers and abutments (Masonry & R.C.C).

5. Foundations : Types of foundations; Open; Piled and Well foundations; including construction details. Pile Foundations: Suitable Pile types for bridges, Pile Installation, Carrying capacity of bored and cast- in-situ pile (No numericals) Well Foundations in Components and brief description, Well Cap, Stability of a single well

6. Bearings, Joints, and Handrails : Different types of bearings, joints and handrails.

7. Construction and Maintenance of Bridges, Quality Assurance, Construction Method (brief) Steel bridges, Long span concrete bridge, Traditional method, Incremental Push launching method, Cantilever method, Maintenance, Maintenance of Bearings, Expansion Joints.

Reference Books:

1. Victor Johnson; Essentials of Bridge Engineering , Oxford & IBH Publishing Co, New Delhi.,2007

2. Khadilkar; C.H. , A text book of Bridge Construction, Allied Publisher, New Delhi.

3. Rangwala; Bridge Engg

4. Rowe, R.E., Concrete Bridge Design , John Wiley & Sons, Inc. New York

5. Raina , V.K. , C oncrete Bridges Practice Book , Tata McGraw Hill , New Delhi

6. Jagadeesh, Jayaram : Design of Bridge Structures , Prentice Hall.

7. Raina, V.K. Concrete Bridges Handbook, Galgotia Publications (P) Ltd, New Delhi

Pre Ph.D. Course in Civil Engineering

Advanced Construction Technology

L	T	P
4	0	0

1. Earthen Dams : Introduction, types ,design considerations/aspects to suit available materials, causes of failures , criteria for safe design ,section, d/s drainage system, seepage analysis, stability analysis, stability of d/s slope during steady seepage, stability of u/s slope during sudden draw down, stability of u/s and d/s slopes during construction, stability of foundation against shear, seepage control measures, design considerations in earthquake regions, design of earthen dam. Quality control in construction of embankments - monitoring of post - construction behaviour and instrumentation.

2. Special Foundations : Foundations for chimney, cooling towers, telecommunication/ transmission towers, foundations for underground structures, coastal and off shore structures in different soil conditions, foundations in expansive soils. dewatering and its various methods.

3. High Rise Construction : High rise buildings; architectural & structural aspects; special features of construction; tall chimneys, components, design aspects; slip form method , lift slab method; special problems of high rise construction.

4. Prefabricated Construction : Advantages of pre fabricated construction; selection of structural elements; design aspects; assembly of precast elements; jointing , modular co-ordination and tolerances; structural systems for buildings; single and multi- storey building systems; methods and equipments. For handling and placement. Basic concepts of prestressing.

5. Advanced Construction Materials: Geo-synthetics: Various, types; geo-textiles, geo-grids, geo-membranes, geo- composites functions and general applications, advantages , properties of geo-textiles , epoxy resins, polymers, grouts and anchors, special flooring materials ,sealants and adhesives, protective coatings.

Books :

1) Bharat Singh and Varshney RS , Engineering for Embankment Dams - Oxford and IBH.
2) Sharma RK and Sharma TK ; Dam Engineering - Oxford and IBH
3) RS Varshney, SC Gupta and RL Gupta. Theory and Design of Irrigation Structures
4) Naiman P Kurian , Modern Foundations - Introduction to Advanced Techniques Tata McGraw Hill
5) CBRI Roorkee-Application Potential of Geosynthetics in Civil ngineering, Proceedings of workshop January 4-6,1989 Tata McGraw Hill.
6) Bungale S Taranath; Structural Analysis and Design of Tall Buildings , Tata McGraw Hill

Pre Ph.D. Course in Civil Engineering

Advanced Structural Engineering

L	T	P
4	0	0

1. Three dimensional elasticity problems, Torsion of open section, Thermal Stresses, Fracture mechanics. Kirchoff and Mindlin theory of plates, higher order shear deformation theories, classical theories of skew plates, Shell surfaces, bending theory of shells.

2. Matrix methods of structural analysis and associated computer programme assembly of matrices. Solution equations. Flow charts. Stiffness and flexibility methods for analysis of beans and frames.

3. Finite Element Method, 2D and 3D applications in plane and three dimensional elasticity problems. Analysis of plate and shell structures. Applications using proper software.Nonlinear analysis of structural elements. Material and geometric nonlinearity. Applications for beam, plates and shells.

4. Multi- variable and Multi-objective optimization. Non linear and non traditional techniques of optimization. Design for reliability, reliability based optimization.Stability Analysis: Beam column, buckling of frames. Lateral buckling of beams, torsional buckling, energy criterion and energy based methods, dynamic stability

Books:

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications

2. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications

3. Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications

4. R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications

5. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications

6. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.

7. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill 8. Chandrashekhara K., Analysis of Plates, New Age International Edition.

Pre Ph.D. Course in Civil Engineering

Hydraulic Engineering

L	T	P
4	0	0

1. Water resources systems analysis, design and management for water supply, irrigation, drainage, hydropower, food control, droughts.Surface and ground water hydrology, stochastic hydrology, physical and numerical modeling, use of finite difference, finite element and boundary element methods.

2. Instrumentation and monitoring of hydraulic systems, computer simulation and optimization of hydrosystems.Computational fluid dynamics, coastal hydrodynamics, watershed management, application of numerical methods.

3. Ground water systems planning and management, ground water pollution investigation. Hydroinformatics, multi criterion decision support system, applications of ANN and GA.

4. Hydraulics of spillways and energy dissipators, pressure fluctuations in hydraulic jump, static and dynamic uplift pressures in stilling basins. Remote sensing and GIS applications, Dam break analysis using softwares.

Books:

1. Principles of water resources planning and management – Goodman

2. Applied hydrology – Linsley Kolhar and Paulhas (McGraw Hill)

3. Computational fluid dynamics – Anderson

4. Neural network fundamentals with graphs, algorithms, applications – Bose N.K. and Liang P (McGraw Hill)

5. Practical handbook of GA applications, Vol I – L. Chambers (CRC Press)

-Pre Ph.D. Course in Civil Engineering

Geotechnical Engineering

L	T	P
4	0	0

1. Advanced Geotechnical Engineering Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, etc. Advanced Foundation Engineering Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

2. Rock mechanics and Tunelling Deformation characteristics of rocks and its measurement. Instrumentation, Underground excavation and subsidence. Bearing capacity of homogeneous as well as discontinuous rocks. Soil Dynamics and Geotechnical Earthquake Engineering Soil behaviour under dynamic loads. Seismic response, strong ground motion, its parameters and their estimation, seismic hazard analysis, local site effects and design ground motion, seismic slope stability

3. Finite Element Methods in Geotechnical Engineering Stress deformation analysis: One-, Two, Three-dimensional formulations; Discretization; Analysis of foundations, dams, underground structures and earth retaining structures. Geo environmental Engineering

4. Soil Structure Interaction Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Interaction analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, Non-linear load-deflection response. Geotechnics for Infrastructure Exploration studies for different Infrastructure Projects, Investigation reports, Analysis and required measures

Books:

1. Aki K and Richards P G (2002), Quantitative Seismology, University Science Books

2. Bowles J E (1996), Foundation Analysis and Design, McGraw Hill.

3. Das B M (1997), Advanced Soil Mechanics, Taylor and Francis.

4. Das B M (1993), Principles of Soil Dynamics, Brooks/Cole

5. Coduto D P (2001), Foundation Design: Principles and Practices, Prentice -Hall

6. Kaniraj S R (1988), Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill

7. Poulos H G and Davis E H (1980), Pile Foundation Analysis and Design, John Wiley and Sons

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Computer Aided Design Methods

L	T	P
4	0	0

1. Introduction to CAD and its scope simple description of computer hardware. - Micro, mini etc. - memory, processor - Peripheral devices-disks, printer. Video terminals. Graphic floater, graphic screen digitizer.

2. Computer Graphics: introduction, point plotting techniques, line drawing displays, two-three dimensional transformation, clipping and windowing, segmentation geometric modeling. Three dimensional graphics, curves and surfaces, hidden surface elimination, shading. Graphic input devices. Graphic input technique, input functions. Raster graphic fundamentals, interactive raster graphics, raster graphic systems.

3. Computer aided linkage displays and synthesis, interactive acceleration analysis. Appreciation of graphic packages.

4. Basics of Design and Analysis Softwares like STAAD PRO, ETABS, ANSYIS, MATLAB.

5. Data base management , storing and retrieving of data

Books:

1. Principles of interactive computer graphics by William M. Newman & Robert F.Sproul.

2. Programming in Finite Element by Hunton and owan

3. Principles of Computer Aided design by Joe Rooney & Philips Steadman

4. Computer Fundamentals-P.K.Sinha, BPB Publications

Civil Engineering applications of Remote sensing and GIS

L	T	P
4	0	0

1. Photogrammetry and Aerial Photogrammetry Photogrammetry- Introduction, basic definitions, terrestrial photogrammetry, phototheodolite, horizontal and vertical angles from terrestrial photographs, horizontal position of a point from photographic measurements. Aerial Photogrammetry- advantages, vertical, tilted and obliquephotographs, geometry of vertical photographs, scale of vertical photographhover flat and variable terrain, ground coordinates, computation of length of aline, overlaps, flightplanning, computation of required number of photographs for a given area,ground control in photogrammetry, Basic elements inphotographic interpretation. Introduction to digital photogrammetry.

2. Remote sensing-Introduction, Ideal remote sensing system, basic principles ofelectromagnetic remote sensing, electromagnetic energy, electromagneticspectrum, interaction with earth's atmosphere, interaction with earth- surface Remote sensing platforms and sensors: Introduction, platforms- Indian satellite IRS and Land sat specifications, Sensors-active and passive,MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensorresolutions (spatial, spectral, radiometric and temporal).

3. GIS-Definition, Components of GIS, Data types, Sources of data, Data Structure , Types of Analysis and errors, Global positinating system GIS. Applications of Remote sensing: applications in land use land cover analysis, change detection, water resources, urban planning,Design of construction structures, and geological applications.

4. Environmental Applications of RS and GIS Re-modelling of water Distribution systems using GIS Ground water Vulnerability Modelling using GIS Urban Development Planning using RS and GIS Environmental Solid Waste and Degradation Assessment using RS and GIS RS and GIS site selection for Dams, Bridges, Reservoirs.

Books:

1. Mikhail E., J. Bethel, and J.C. McGlone, Introduction to modernphotogrammetry. Wiley, 2001.

2. Wolf P.R, and B.A. Dewitt, Elements of photogrammetry : withapplications in GIS. 3rd ed, McGraw-Hill, 2000.

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Town and Country Planning

L	T	P
4	0	0

1. Historic Development & Planning Theory-Origin ,evolution and contemporary developments in planning.,Formation of metropolitan areas &impacts of Industrial Revolution, Socio-economic & technological,impacts of growth of population; rura lurban migration, Characteristics of the urban environment: Land uses, physical structure ,The interim and comprehensive plans: Structure Plan, Master Plan, Zonal Development Plan - their purpose and contents, Surveys, analyses and design methods and practices in comprehensive planning, Residential Areas : Neighborhood and Sector Planning, Planning of New Towns in India and abroad. Spatial & Environmental Aspects of Planning-Environmental degradation and its impact, environmental impact

2. Transportation & Utility Services-Transportation systems; Land use-transportation interrelationships; transportation planning process;Traffic management., Recent innovations in technologies and its probable impacts,Transport policies and evaluation of transportation proposals,Water supply systems,Waste water disposal systems & Solid wastes collection and disposal,Reuse and recycle Techniques,

3. Planning for urban electrical distribution system and communication systems,Economic feasibility tests. Planning Administration & Professional Practices-Planning legislation ,Constitutional basis and provisions relating to land, Evolution of planning laws,Land Acquisition Act of India, MRTP Act 1966,UDPFI Guidelines (implications of 73rd and 74th amendment of the constitution),EPA, Conservation of natural resources, Conservation and Management of Ancient Monuments and Archaeological sites and ruins., Land Development Control,Urban Arts Commission Act, Transportation, Landscape, Housing and slum clearance legislation. ,Role in interdisciplinary groups

4. Social formation & Housing.Housing problems: Urbanization and Industrialization,Slums and squatters settlements - problems and possibilities,Residential layouts, housing densities, neighborhood unit, community facilities,Social aspects : built environment and human behavior, Evaluation of user's satisfaction,Finance for housing: priority in the national plans - role of public and private agencies, role of cooperatives and various institutions,Cost reduction techniques in housing,Housing norms and standards.

Reference Books :

1. K.S.Rangwala and P.S.Rangwala,. "Town Planning ",Charotar Publishing House,15th Edition,1999.
2. Michael Hord, R. Remote sensing methods and application, John Wiley and Sons, New York, 1986.
3. National Building Code of India- Part-III.
4. Municipal and Panchayat bye-laws, CMDA Rules and Corporation bye-laws.
5. KA. Ramegowda, Urban and regional planning , University of Mysor

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Advanced Geoinformatics

L	T	P
4	0	0

1. MINERALOGY:Description and identification of Rock forming minerals and Ores, based onphysical and special properties PETROLOGY: Rocks as fundamental units and building materials of the earth crust and theirengineering applications: As building stones, road metals and stones fordecoration, pavement, cladding, roofing, flooring, concreting and foundationengineering. Igneous rocks: Origin, classification (chemical and textural), mode of occurrence Sedimentary rocks: Origin, classification, primary structures Metamorphic rocks: Kinds of metamorphism, and classification.

2. ROCK MECHANICS: Epigene and Hypgene geological agents; rock weathering and its types; Soil formation, types, erosion and remedial measures Geological action of rivers with different drainage patterns; Geological action of wind. Stress, strain and deformational effects on different rocks; Out crop, Dip,strike and escarpment, Clinometer-compass- Joints, faults, folds andunconformities their effects on civil engineering structures.

3. Principles of Remote Sensing: Introduction to remote sensing, Remote sensing system, Electromagnetic spectrum, Black body Atmospheric windows, Spectral characteristics of earth's surface, Range of sensing system. Platforms, Sensors and Data Products: Ground aircraft, space aircraft platforms- photographic sensors, scanners, radiometers, Radar and Mission planning. Data types and format, Scale and Legend Photogrammetry: Photogrammetry basics – applications, applications of aerial photo interpretation to Water Resource Engineering. Photogrammetry and GIS:input of data from photogrammetry for GIS database, photogrammetric applications in GIS

4. Geographic Information System: Introduction, history if GIS, comparisons with CAD, Necessity of GIS, components of GIS, GIS Architecture-data input, data manipulation, data output, Operation-processes and capabilities, different types of GIS, GIS data-spatial and non spatial, data models with advantages and disadvantages. Types of Analysis and errors, Global positinating system GIS.

5. Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, Ndimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Classification techniques, airborne and space-borne hyperspectral sensors, applications. High resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications.

BOOKS:

1. Text book of Geology by P.K. Mukerjee, World Press Pvt. Ltd.Kolkatta.
2. Structural Geology (3rd Ed.)by M. P. Billings, Published by Prentice Hall of India Pvt. Ltd. New Delhi
3. Text of Engineering and General Geology by ParbinSingh,Published by S. K. Kataria and Sons, New Delhi.
4. Rock Mechanics for Engineers by DrB.P.Verma, Khanna Publishers, New Delhi

Pre Ph.D. Course in Civil Engineering

Schematic and Syllabus

Sr. no.	Nature of Course	Name of course	Credits	Remarks
1.	Core	Research Methodology	4	The syllabus of RM should be formulated faculty wise
		Discipline Specific subjects	4	1.Transportation and Highway Technology 2. Foundation Design and Construction 3.Environment Engineering and Management 4.Pavement Design, Construction and Maintenance 5.Bridge Engineering 6.Advanced Construction Technology 7.Advanced Structural Engineering 8.Hydraulics Engineering 9.Geotechnical Engineering
		Presentation	3	Discipline specific
2.	Interdisciplinary	Elective	4	From list of subjects from allied fields 1.Town and Country Planning 2.Advanced Geoinformatics 3.Computer Aided Design Methods 4. Civil Engineering applications of Remote sensing and GIS
	Total Minimum credits		**15**	

Paper Title: Research Presentation

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Research Scholar will have to present a seminar based upon his/her research area. Performance of the scholar and participation in seminar will be taken into consideration.

Pre Ph.D. Course in Civil Engineering

Research Methodology

L	T	P
4	0	0

1. Introduction Research Methodology: Definition of Research, Need of Research, Concept and steps of Research Methodology , Uses of Research Methodology, Research Techniques. Reviewing Literature: Need, Sources-Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.

2. Identifying and defining research problem: Locating. Analyzing stating and evaluating problem, Generating different types of hypotheses and evaluating them.

3. Data collection: Static and dynamic characteristics of instruments used in experimental set up, calibration of various instruments, sampling methods, methods of data collection, Selection of Appropriate Method for Data Collection, Data collection using a digital computer system, case studies of data collection

4. Data Analysis: Data processing, data analysis strategies and tools, data analysis with statistical packages, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis

5. Research reports and Thesis writing: Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, word processing tools such as Latex Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

6. Research ethics, IPR and publishing Ethics: ethical issues. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Books:

1. C.R. Kothari, "Research Methodology – Methods and Techniques", Wiley Eastern Ltd 2009.

2. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.

3. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan," Management Research Methodology: Integration of Methods and Techniques, Pearson, 2006 4. S.P Gupta,"Statistical Methods", Sultan Chand & Sons, 2006.

Pre Ph.D. Course in Civil Engineering

Advanced Foundation Design and Construction

L	T	P
4	0	0

1. General Principles of Foundation Design : Functions of foundations, essential requirements of a good foundation, types of foundations, principal modes of failure, estimation of allowable bearing pressures, calculation of ultimate bearing capacity by theoretical and empirical methods: Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis BIS Method (IS:6403), Settlement of foundations. Factors to be considered foundation design, numerical problem based in BIS method.

2. Shallow Foundations: Introduction, essential requirements, types and depth of footing like Strip footing, Isolated footing, Combined footing, Strap footing, Raft footing , electrically loaded footings; design features and construction details related to size and depth of footing problem of frost heave, its causes and prevention, effect of ground water and environmental considerations; Numerical problems related to size and depth of footings

2. Pile Foundations : Purpose/uses of pile foundations, Classification of piles based on different criteria, Brief details of timber, concrete, steel piles their advantages and disadvantages , selection of pile type, pile action, behaviour of pile and pile groups under load. definition of failure load. Estimation of carrying capacity : Single driven pile in cohesion less soils - methods based of on SPT and CPT, ultimate load on driven and cast-in-place piles and bored and cast-in-place piles in cohesionless soils. Factors affecting pile capacity.- Numerical problems Ultimate capacity of single pile driven in cohesive soils; modification for driven and cast-in-place piles and bored and cast-in-place piles. Capacity of very long piles – Numerical problems Carrying capacity of piles on rocks.

3. Well foundations: Basic principles, Forces acting on well foundations. Sinking of wells, tilts & shifts

4. Soil Stability: Retaining walls – Introduction, types, Principles of design, Modes of failure, drainage of the back fill, problems related to design of gravity retaining wall and stability of retaining walls.. Unbraced excavations, braced excavations. Sheet piles - types anchors and tie backs. Shoring and Underpinning - necessity and methods

5. Improvement of Foundation Soils Purpose : (a) Improvement of granular soils : term used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods - Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact at depth. (b) Improvement of cohesive soils : preloading, or dewatering, methods of installing sand drains ,drain wicks, electrical and thermal methods. Grouting : purpose, functions, types of grouts ; soil bentonite - cement mix, cement mix, emulsions, solutions: grout injection methods. Geo-synthetics : types, functions, manufacturing of geo-textiles , Classification of geo-textiles. Specific Applications : Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and a case study.

6. Special Considerations in Foundation Design and Construction: Elementary principles of design and construction of foundations subjected to earthquake or dynamic loads, special measures for foundations constructed under water.

Books :

1. Tomlinson MJ, Foundation Design and Construction , ELBS-Longman, 6e,.

2. Bowles Joseph E, Foundation Analysis and Design, McGraw Hill.

3. Som, NN & Das S.C. , Theory and Practice of Foundation Design, Prentice Hall of India, 2003

4. Braja M. Das, Principles of Foundation Engineering, 6e, Thomson, 2007

5. Koerner, Robert M, Construction and Geotechnical Methods in Foundation Engineering , McGraw Hill,

6. Dinesh Mohan, Pile foundations, Oxford & IBH, 1998

7. Kurian, N.P. Modern Foundations, Tata McGraw Hill, 1982.

8. Fang H.Y. Foundation Engineering Handbook, Van Nostrand Reinhold, 23, 1991.

9. Kaniraj Shenbaga R, Design Aids in Soil Mechanics and Foundtion Engineering, Tata McGraw Hill,

Pre Ph.D. Course in Civil Engineering

Environment Engineering and Management

L	T	P
4	0	0

1. Environment & Ecology: Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community's inter-relationships in an ecosystem. Importance of clean environment.

2. Type of Pollutants and Protection of Environment :Water Pollution : Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers. Domestic and industrial Pollution : Sources, Standards for disposal of waste water and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies.

3. Air Pollution : Definition, principle materials causing pollution, types of air contaminants, their sources and ill effects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleansing, pollution control methods and various engineering devices to control particulate and gaseous pollutants, controlling air pollution from automobiles. Noise Pollution : Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures. Solid Waste Pollution: Sources, effects and treatment of solid wastes.

4. Degradation of Land Resources : 3.1 Deforestation and Wetlands : Forest land, deforestation and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation

problems, erosion, salinization, water logging, land use management & planning. *

5 Current Issues in Environmental Engineering : Global warming, ozone depletion, acid rain, oil pollution, radiation hazard and control, role of non- conventional sources of energy in environment.

6 Environment Impact Assessment : Definition and its importance for environment management, constituents of environment impact assessment , project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution.

- 7* Land Fills: Sitting criteria. waste containment principles. types of barrier materials Planning and design aspects relating to waste disposal in landfills Control and remediation of subsurface contamination. Case studies

6. Environmental Management System: Main clauses and basic steps for certification. Water pollution, air pollution and EPA and their salient features.

Books:

1. Peavy,Rowe,,Techobanoglous, Environmental Engg. Tata McGrawHill.

2. Mackenzie L Davis, Environmental Engg. Tata McGrawHill.

3. Baljeet S. Kapoor; Environmental Engg. An overview, Khanna Publishers.

4. Glbert H.Masters , Environmental Engineering and Science, Prentice Hall of India Pvt.Ltd.

5. GN Panday, GC Carney Environmental Engineering,Tata McGrawHill.

6. P.D. Sharma, Ecology and Environment Rastogi Publications.

7. Ray P.A Lcances Environmental Impact Assessment Hand Book, National Environmental Protection Council Manila.

8. P Venugopala Rao ; Text Book of Environmental engineering, PHI

Pre Ph.D. Course in Civil Engineering

Pavement Design, Construction and Maintenance

L	T	P
4	0	0

1. Introduction: Types of pavement structure, functions of pavement components. factors affecting pavement design. Design of Pavements: Methods for design of flexible pavements: CBR , Group Index Method , California bearing value method , Triaxial test method , Burmister method , McLeod's method.

2. Design considerations, methods for design of rigid pavements: Westergaard's method, F.A.A. method, types of joints and their design in cement concrete pavments. Thickness . design for Airport pavement ,FAA method for Flexible and Rigid pavements, ESWL Concept , CBR method (USACE) , LCN system of pavement design,

3. Construction of Highways: Types of Highway Construction and their selection, materials for construction, construction procedure of different highways: Gravel roads, WBM , W.M.M., Bituminous pavements, cement concrete pavements, Joints in cement concrete pavements, introduction to various Equipment used for highway construction. Constructional features for Pre-Mix Carpet, Mix Seal Surfacing , B.M. , SDBC. Other higher quality pavement layers – DBM , BC (introduction only)

4. Maintenance of Highways: Pavement failures, their causes and remedial measures typical flexible and rigid pavement failures, types of highway maintenance: routine, periodic and special type, materials used for maintenance of different pavement such as bituminous pavements, cement concrete road, Slurry Seal, Liquid Seal, Fog Seal, Patching Defects/ Failures in Flexible Pavement- their types and causes, Remedial Measures Surface defects, Cracks, Deformation, disintegration, Cracks, Spalling , Slab Rocking , Joint Sealant Failure and Rectification

Books:

1.. Khanna and Justo ; Highway Engineering, Nemchand & Bros. Roorkee

2. Clarkson H.Oglesby and Gary Hicks; Highway Engineering. John Wiley & Sons, London,

3. Rao ; Airport Engineering , Tata McGraw Hill Publishing Co. New Delhi

4. Khanna and Arora.; Airport Planning and Design

5. Wright and Paquette; . Highway Engg , John Wiley and Sons, New York

6. Vaswani, Highway Engg Roorkee Publishing House, Roorkee

7. Sharma and Sharma.; Principles and Practices of Highway Engg., Asia Publishing House, New Delhi .

Pre Ph.D. Course in Civil Engineering

Bridge Engineering

L	T	P
4	0	0

1. Introduction Definition; components of a bridge; classification; importance of bridges.
2. Standard Specifications for Road Bridges: Indian Roads Congress Bridge Code; width of carriageway; clearances; loads to be considered; dead load; I.R.C. standard live load; impact effect; application of live load on decks; wind load; longitudinal forces; centrifugal forces; horizontal forces due to water current; Buoyancy effect ; earth pressure ; temperature effects ; seismic force.

3. Reinforced concrete Bridges : General arrangement and suitability : T-beam bridges; Balanced cantilever bridges ; Continuous girder bridges; Rigid frame bridges; Arch bridges; Steel bridges (Familiarization with MOST specifications and drawings)

4. Sub-Structure : Design of piers and abutments (Masonry & R.C.C).

5. Foundations : Types of foundations; Open; Piled and Well foundations; including construction details. Pile Foundations: Suitable Pile types for bridges, Pile Installation, Carrying capacity of bored and cast- in-situ pile (No numericals) Well Foundations in Components and brief description, Well Cap, Stability of a single well

6. Bearings, Joints, and Handrails : Different types of bearings, joints and handrails.

7. Construction and Maintenance of Bridges, Quality Assurance, Construction Method (brief) Steel bridges, Long span concrete bridge, Traditional method, Incremental Push launching method, Cantilever method, Maintenance, Maintenance of Bearings, Expansion Joints.

Reference Books:

1. Victor Johnson; Essentials of Bridge Engineering , Oxford & IBH Publishing Co, New Delhi.,2007

2. Khadilkar; C.H. , A text book of Bridge Construction, Allied Publisher, New Delhi.

3. Rangwala; Bridge Engg

4. Rowe, R.E., Concrete Bridge Design , John Wiley & Sons, Inc. New York

5. Raina , V.K. , C oncrete Bridges Practice Book , Tata McGraw Hill , New Delhi

6. Jagadeesh, Jayaram : Design of Bridge Structures , Prentice Hall.

7. Raina, V.K. Concrete Bridges Handbook, Galgotia Publications (P) Ltd, New Delhi

Pre Ph.D. Course in Civil Engineering

Hydraulic Engineering

L	T	P
4	0	0

1. Water resources systems analysis, design and management for water supply, irrigation, drainage, hydropower, food control, droughts.Surface and ground water hydrology, stochastic hydrology, physical and numerical modeling, use of finite difference, finite element and boundary element methods.

2. Instrumentation and monitoring of hydraulic systems, computer simulation and optimization of hydrosystems.Computational fluid dynamics, coastal hydrodynamics, watershed management, application of numerical methods.

3. Ground water systems planning and management, ground water pollution investigation. Hydroinformatics, multi criterion decision support system, applications of ANN and GA.

4. Hydraulics of spillways and energy dissipators, pressure fluctuations in hydraulic jump, static and dynamic uplift pressures in stilling basins. Remote sensing and GIS applications, Dam break analysis using softwares.

Books:

1. Principles of water resources planning and management – Goodman

2. Applied hydrology – Linsley Kolhar and Paulhas (McGraw Hill)

3. Computational fluid dynamics – Anderson

4. Neural network fundamentals with graphs, algorithms, applications – Bose N.K. and Liang P (McGraw Hill)

5. Practical handbook of GA applications, Vol I – L. Chambers (CRC Press)

-Pre Ph.D. Course in Civil Engineering

Geotechnical Engineering

L	T	P
4	0	0

1. Advanced Geotechnical Engineering Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, etc. Advanced Foundation Engineering Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

2. Rock mechanics and Tunelling Deformation characteristics of rocks and its measurement. Instrumentation, Underground excavation and subsidence. Bearing capacity of homogeneous as well as discontinuous rocks. Soil Dynamics and Geotechnical Earthquake Engineering Soil behaviour under dynamic loads. Seismic response, strong ground motion, its parameters and their estimation, seismic hazard analysis, local site effects and design ground motion, seismic slope stability

3. Finite Element Methods in Geotechnical Engineering Stress deformation analysis: One-, Two, Three-dimensional formulations; Discretization; Analysis of foundations, dams, underground structures and earth retaining structures. Geo environmental Engineering

4. Landfills, in ash ponds and tailing ponds, and in rocks. Detection, control and remediation of subsurface contamination; Engineering properties and geotechnical reuse of waste.

5. Soil Structure Interaction Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Interaction analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, Non-linear load-deflection response. Geotechnics for Infrastructure Exploration studies for different Infrastructure Projects, Investigation reports, Analysis and required measures

Books:

1. Aki K and Richards P G (2002), Quantitative Seismology, University Science Books

2. Bowles J E (1996), Foundation Analysis and Design, McGraw Hill.

3. Das B M (1997), Advanced Soil Mechanics, Taylor and Francis.

4. Das B M (1993), Principles of Soil Dynamics, Brooks/Cole

5. Coduto D P (2001), Foundation Design: Principles and Practices, Prentice -Hall

6. Kaniraj S R (1988), Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill

7. Poulos H G and Davis E H (1980), Pile Foundation Analysis and Design, John Wiley and Sons

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Civil Engineering applications of Remote sensing and GIS

L	T	P
4	0	0

1. Photogrammetry and Aerial Photogrammetry Photogrammetry- Introduction, basic definitions, terrestrial photogrammetry, phototheodolite, horizontal and vertical angles from terrestrial photographs, horizontal position of a point from photographic measurements. Aerial Photogrammetry- advantages, vertical, tilted and obliquephotographs, geometry of vertical photographs, scale of vertical photographhover flat and variable terrain, ground coordinates, computation of length of aline, overlaps, flightplanning, computation of required number of photographs for a given area,ground control in photogrammetry, Basic elements inphotographic interpretation. Introduction to digital photogrammetry.

2. Remote sensing-Introduction, Ideal remote sensing system, basic principles ofelectromagnetic remote sensing, electromagnetic energy, electromagneticspectrum, interaction with earth's atmosphere, interaction with earth- surface Remote sensing platforms and sensors: Introduction, platforms- Indian satellite IRS and Land sat specifications, Sensors-active and passive,MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensorresolutions (spatial, spectral, radiometric and temporal).

3. GIS-Definition, Components of GIS, Data types, Sources of data, Data Structure , Types of Analysis and errors, Global positinating system GIS. Applications of Remote sensing: applications in land use land cover analysis, change detection, water resources, urban planning,Design of construction structures, and geological applications.

4. Environmental Applications of RS and GIS Re-modelling of water Distribution systems using GIS Ground water Vulnerability Modelling using GIS Urban Development Planning using RS and GIS Environmental Solid Waste and Degradation Assessment using RS and GIS RS and GIS site selection for Dams, Bridges, Reservoirs.

Books:

1. Mikhail E., J. Bethel, and J.C. McGlone, Introduction to modernphotogrammetry. Wiley, 2001.

2. Wolf P.R, and B.A. Dewitt, Elements of photogrammetry : withapplications in GIS. 3rd ed, McGraw-Hill, 2000.

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Computer Aided Design Methods

L	T	P
4	0	0

1. Introduction to CAD and its scope simple description of computer hardware. - Micro, mini etc. - memory, processor - Peripheral devices-disks, printer. Video terminals. Graphic floater, graphic screen digitizer.

2. Computer Graphics: introduction, point plotting techniques, line drawing displays, two-three dimensional transformation, clipping and windowing, segmentation geometric modeling. Three dimensional graphics, curves and surfaces, hidden surface elimination, shading. Graphic input devices. Graphic input technique, input functions. Raster graphic fundamentals, interactive raster graphics, raster graphic systems.

3. Computer aided linkage displays and synthesis, interactive acceleration analysis. Appreciation of graphic packages.

4. Matrix methods of structural analysis and associated computer programme assembly of matrices. Solution of equilibrium equations. Flow charts. Typical listing as illustrations. Introduction to interactive computer programme for the design detailing of simple structural elements: RCC slab, beams, columns, isolated footings etc. Steel typical members and connections.

4. Basics of Design and Analysis softwans like STAAD PRO, ETABS, ANSYIS, MATLAB,

5. Data base management , storing and retrieving of data

New Topic

Books:

1. Principles of interactive computer graphics by William M. Newman & Robert F.Sproul.

2. Programming in Finite Element by Hunton and owan

3. Principles of Computer Aided design by Joe Rooney & Philips Steadman

4. Computer Fundamentals-P.K.Sinha, BPB Publications

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Advanced Geoinformatics

L	T	P
4	0	0

1. MINERALOGY:Description and identification of Rock forming minerals and Ores, based onphysical and special properties PETROLOGY: Rocks as fundamental units and building materials of the earth crust and theirengineering applications: As building stones, road metals and stones fordecoration, pavement, cladding, roofing, flooring, concreting and foundationengineering. Igneous rocks: Origin, classification (chemical and textural), mode of occurrence Sedimentary rocks: Origin, classification, primary structures Metamorphic rocks: Kinds of metamorphism, and classification.

2. ROCK MECHANICS: Epigene and Hypgene geological agents; rock weathering and its types; Soil formation, types, erosion and remedial measures Geological action of rivers with different drainage patterns; Geological action of wind. Stress, strain and deformational effects on different rocks; Out crop, Dip,strike and escarpment, Clinometer-compass- Joints, faults, folds andunconformities their effects on civil engineering structures.

3. Principles of Remote Sensing: Introduction to remote sensing, Remote sensing system, Electromagnetic spectrum, Black body Atmospheric windows, Spectral characteristics of earth's surface, Range of sensing system. Platforms, Sensors and Data Products: Ground aircraft, space aircraft platforms- photographic sensors, scanners, radiometers, Radar and Mission planning. Data types and format, Scale and Legend Photogrammetry: Photogrammetry basics – applications, applications of aerial photo interpretation to Water Resource Engineering. Photogrammetry and GIS:input of data from photogrammetry for GIS database, photogrammetric applications in GIS

4. Geographic Information System: Introduction, history if GIS, comparisons with CAD, Necessity of GIS, components of GIS, GIS Architecture-data input, data manipulation, data output, Operation-processes and capabilities, different types of GIS, GIS data-spatial and non spatial, data models with advantages and disadvantages. Types of Analysis and errors, Global positinating system GIS.

5. Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, Ndimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Classification techniques, airborne and space-borne hyperspectral sensors, applications. High resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications.

BOOKS:

1. Text book of Geology by P.K. Mukerjee, World Press Pvt. Ltd.Kolkatta.
2. Structural Geology (3rd Ed.)by M. P. Billings, Published by Prentice Hall of India Pvt. Ltd. New Delhi
3. Text of Engineering and General Geology by ParbinSingh,Published by S. K. Kataria and Sons, New Delhi.
4. Rock Mechanics for Engineers by DrB.P.Verma, Khanna Publishers, New Delhi

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Town and Country Planning

L	T	P
4	0	0

1. Historic Development & Planning Theory-Origin ,evolution and contemporary developments in planning.,Formation of metropolitan areas &impacts of Industrial Revolution, Socio-economic & technological,impacts of growth of population; rura lurban migration, Characteristics of the urban environment: Land uses, physical structure ,The interim and comprehensive plans: Structure Plan, Master Plan, Zonal Development Plan - their purpose and contents, Surveys, analyses and design methods and practices in comprehensive planning, Residential Areas : Neighborhood and Sector Planning, Planning of New Towns in India and abroad. Spatial & Environmental Aspects of Planning-Environmental degradation and its impact, environmental impact

2. Transportation & Utility Services-Transportation systems; Land use-transportation interrelationships; transportation planning process;Traffic management., Recent innovations in technologies and its probable impacts,Transport policies and evaluation of transportation proposals,Water supply systems,Waste water disposal systems & Solid wastes collection and disposal,Reuse and recycle Techniques,

3. Planning for urban electrical distribution system and communication systems,Economic feasibility tests. Planning Administration & Professional Practices-Planning legislation ,Constitutional basis and provisions relating to land, Evolution of planning laws,Land Acquisition Act of India, MRTP Act 1966,UDPFI Guidelines (implications of 73rd and 74th amendment of the constitution),EPA, Conservation of natural resources, Conservation and Management of Ancient Monuments and Archaeological sites and ruins., Land Development Control,Urban Arts Commission Act, Transportation, Landscape, Housing and slum clearance legislation. ,Role in interdisciplinary groups

4. Social formation & Housing.Housing problems: Urbanization and Industrialization,Slums and squatters settlements - problems and possibilities,Residential layouts, housing densities, neighborhood unit, community facilities,Social aspects : built environment and human behavior, Evaluation of user's satisfaction,Finance for housing: priority in the national plans - role of public and private agencies, role of cooperatives and various institutions,Cost reduction techniques in housing,Housing norms and standards.

Reference Books :

1. K.S.Rangwala and P.S.Rangwala,. "Town Planning ",Charotar Publishing House,15th Edition,1999.
2. Michael Hord, R. Remote sensing methods and application, John Wiley and Sons, New York, 1986.
3. National Building Code of India- Part-III.
4. Municipal and Panchayat bye-laws, CMDA Rules and Corporation bye-laws.
5. KA. Ramegowda, Urban and regional planning , University of Mysor

Pre Ph.D. Course in Civil Engineering

Schematic and Syllabus

Sr. no.	Nature of Course	Name of course	Credits	Remarks
1.	Core	Research Methodology	4	The syllabus of RM should be formulated faculty wise
		Discipline Specific subjects	4	1.Transportation and Highway Technology 2. Foundation Design and Construction 3.Environment Engineering and Management 4.Pavement Design, Construction and Maintenance 5.Bridge Engineering 6.Advanced Construction Technology 7.Advanced Structural Engineering 8.Hydraulics Engineering 9.Geotechnical Engineering
		Presentation	3	Discipline specific
2.	Interdisciplinary	Elective	4	From list of subjects from allied fields 1.Town and Country Planning 2.Advanced Geoinformatics 3.Computer Aided Design Methods 4. Civil Engineering applications of Remote sensing and GIS
	Total Minimum credits		**15**	

Paper Title: Research Presentation

L T P

0 0 3

Research Scholar will have to present a seminar based upon his/her research area. Performance of the scholar and participation in seminar will be taken into consideration.

Pre Ph.D. Course in Civil Engineering

Research Methodology

L	T	P
4	0	0

1. Introduction Research Methodology: Definition of Research, Need of Research, Concept and steps of Research Methodology , Uses of Research Methodology, Research Techniques. Reviewing Literature: Need, Sources-Primary and Secondary, Purposes of Review, Scope of Review, Steps in conducting review.

2. Identifying and defining research problem: Locating. Analyzing stating and evaluating problem, Generating different types of hypotheses and evaluating them.

3. Data collection: Static and dynamic characteristics of instruments used in experimental set up, calibration of various instruments, sampling methods, methods of data collection, Selection of Appropriate Method for Data Collection, Data collection using a digital computer system, case studies of data collection

4. Data Analysis: Data processing, data analysis strategies and tools, data analysis with statistical packages, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis

5. Research reports and Thesis writing: Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, word processing tools such as Latex Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

6. Research ethics, IPR and publishing Ethics: ethical issues. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Books:

1. C.R. Kothari, "Research Methodology – Methods and Techniques", Wiley Eastern Ltd 2009.

2. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.

3. K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan," Management Research Methodology: Integration of Methods and Techniques, Pearson, 2006 4. S.P Gupta,"Statistical Methods", Sultan Chand & Sons, 2006.

Pre Ph.D. Course in Civil Engineering

Transportation and Highway Technology

L	T	P
4	0	0

1. HIGHWAY MATERIALS Soil stabilization types, source, functions, requirements, properties, tests and specifications for use in various components of road, Soil compaction for use in fill and subgrade of roads. Soil stabilization – principle, methods and tests, proportioning of materials and mix design, application of Rotchfutch method. Marginal and waste materials in road construction, properties and scope in road construction. Bituminous Material (properties of the material) and marshall mix design (both wet and dry), Usage of Geosythentics and Geotextiles in construction of highways.

2. HIGHWAY CONSTRUCTION AND MAINTENANCE Components of road and pavement structure functions, requirements and sequence of construction operations. Plants and equipment for production of materials, Road construction equipment, Pre-construction surveys and marking on ground, Different types of granular base course, Different types of sub-base, Road maintenance works and quality control tests as per MORTH specification. SPECIAL PROBLEMS IN ROAD CONSTRUCTION Problems on construction on areas with marshy and weak soils, expansive clays and' water- logged – areas. Design and construction of filter drains and capillary cut-off. Vertical sand drains – application, design and construction method. Road construction on desert region and coastal areas.

3. PAVEMENT DESIGN AND MANAGEMENT Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution. Factors affecting design and performance of airport pavements. Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses, deflections / strains in single, two and three layer system. RURAL ROADS Problems associated with planning, design and construction of rural roads low volume rural roads in India. Principle, scope and construction method of various soil stabilization techniques in rural roads. Properties. Design, construction, and maintenance aspects, by resorting to appropriate technology.

4. ROAD SAFETY AND MANAGEMENT Road accidents, causes, scientific investigations and data collection. Road safety issues and various measures for road safety. Engineering, education and enforcement measures for improving road safety. Short term and long term measures. Traffic management techniques. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. Economic evaluation of roads.

5 .TRAFFIC SURVEYS & APPLICATION OF REMOTE SENSING AND GIS IN HIGHWAY ENGINEERING Traffic studies- Trip distribution, generation assignment and model split (Statistical analysis). Design of the traffic signals at urban intersections. Level of service at intersections. Design of parking in urban areas and problems Concepts, components, working of GIS, data capture, data integration, data structures. Coordinate systems and map projections, Registration. GIS analysis and tasks – Input, manipulation, management, query and analysis, visualization, proximity analysis, overlay analysis, GIS and Remote sensing data integration. Overview of image processing softwares and GIS

softwares, Introduction to GPS and its application (includes the recent software's used in the highway engineering)

Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress.

2. IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986.

3. IRC -37, IRC -58 , IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27- 1967, 29-1988, 34-1970, 36- 1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94- 1986, 95-1987, 98-1997, 105-1988

4. Peurifoy, R.L., and Clifford,JS "Construction Planning Equipment and Method"- McGraw Hill Book Co. Inc.

5. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA

6. Leonards G. A. "Foundation engineering" - McGraw Hill Book Company, New York, 1962

Pre Ph.D. Course in Civil Engineering

Foundation Design and Construction

L	T	P
4	0	0

1. General Principles of Foundation Design : Functions of foundations, essential requirements of a good foundation, types of foundations, principal modes of failure, estimation of allowable bearing pressures, calculation of ultimate bearing capacity by theoretical and empirical methods: Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis BIS Method (IS:6403), Settlement of foundations. Factors to be considered foundation design, numerical problem based in BIS method.

2. Shallow Foundations: Introduction, essential requirements, types and depth of footing like Strip footing, Isolated footing, Combined footing, Strap footing, Raft footing , electrically loaded footings; design features and construction details related to size and depth of footing problem of frost heave, its causes and prevention, effect of ground water and environmental considerations; Numerical problems related to size and depth of footings

3. Pile Foundations : Purpose/uses of pile foundations, Classification of piles based on different criteria, Brief details of timber, concrete, steel piles their advantages and disadvantages , selection of pile type, pile action, behaviour of pile and pile groups under load. definition of failure load. Estimation of carrying capacity : Single driven pile in cohesion less soils - methods based of on SPT and CPT, ultimate load on driven and cast-in-place piles and bored and cast-in-place piles in cohesionless soils. Factors affecting pile capacity.- Numerical problems Ultimate capacity of single pile driven in cohesive soils; modification for driven and cast-in-place piles and bored and cast-in-place piles. Capacity of very long piles – Numerical problems Carrying capacity of piles on rocks.

4. Soil Stability: Retaining walls – Introduction, types, Principles of design, Modes of failure, drainage of the back fill, problems related to design of gravity retaining wall and stability of retaining walls.. Unbraced excavations, braced excavations. Sheet piles - types anchors and tie backs. Shoring and Underpinning - necessity and methods

5. Improvement of Foundation Soils Purpose : (a) Improvement of granular soils : term used to describe degree of compactness – relative density, density ratio and degree of compaction; Methods - Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact at depth. (b) Improvement of cohesive soils : preloading, or dewatering, methods of installing sand drains ,drain wicks, electrical and thermal methods. Grouting : purpose, functions, types of grouts ; soil bentonite - cement mix, cement mix, emulsions, solutions: grout injection methods. Geo-synthetics : types, functions, manufacturing of geo-textiles , Classification of geo-textiles. Specific Applications : Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and a case study.

6. Special Considerations in Foundation Design and Construction: Elementary principles of design and construction of foundations subjected to earthquake or dynamic loads, special measures for foundations constructed under water.

Books :

1. Tomlinson MJ, Foundation Design and Construction , ELBS-Longman, 6e,.

2. Bowles Joseph E, Foundation Analysis and Design, McGraw Hill.

3. Som, NN & Das S.C. , Theory and Practice of Foundation Design, Prentice Hall of India, 2003

4. Braja M. Das, Principles of Foundation Engineering, 6e, Thomson, 2007

5. Koerner, Robert M, Construction and Geotechnical Methods in Foundation Engineering , McGraw Hill,

6. Dinesh Mohan, Pile foundations, Oxford & IBH, 1998

7. Kurian, N.P. Modern Foundations, Tata McGraw Hill, 1982.

8. Fang H.Y. Foundation Engineering Handbook, Van Nostrand Reinhold, 23, 1991.

9. Kaniraj Shenbaga R, Design Aids in Soil Mechanics and Foundtion Engineering, Tata McGraw Hill,

Pre Ph.D. Course in Civil Engineering

Environment Engineering and Management

L	T	P
4	0	0

1. Environment & Ecology: Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community's inter-relationships in an ecosystem. Importance of clean environment.

2. Type of Pollutants and Protection of Environment :Water Pollution : Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers. Domestic and industrial Pollution : Sources, Standards for disposal of waste water and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies.

3. Air Pollution : Definition, principle materials causing pollution, types of air contaminants, their sources and ill effects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleansing, pollution control methods and various engineering devices to control particulate and gaseous pollutants, controlling air pollution from automobiles. Noise Pollution : Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures. Solid Waste Pollution: Sources, effects and treatment of solid wastes.

3. Degradation of Land Resources : 3.1 Deforestation and Wetlands : Forest land, deforestation and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation

problems, erosion, salinization, water logging, land use management & planning.

4. Current Issues in Environmental Engineering : Global warming, ozone depletion, acid rain, oil pollution, radiation hazard and control, role of non- conventional sources of energy in environment.

5. Environment Impact Assessment : Definition and its importance for environment management, constituents of environment impact assessment , project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution.

6. Environmental Management System: Main clauses and basic steps for certification. Water pollution, air pollution and EPA and their salient features.

Books:

1. Peavy,Rowe,,Techobanoglous, Environmental Engg. Tata McGrawHill.

2. Mackenzie L Davis, Environmental Engg. Tata McGrawHill.

3. Baljeet S. Kapoor; Environmental Engg. An overview, Khanna Publishers.

4. Glbert H.Masters , Environmental Engineering and Science, Prentice Hall of India Pvt.Ltd.

5. GN Panday, GC Carney Environmental Engineering,Tata McGrawHill.

6. P.D. Sharma, Ecology and Environment Rastogi Publications.

7. Ray P.A Lcances Environmental Impact Assessment Hand Book, National Environmental Protection Council Manila.

8. P Venugopala Rao ; Text Book of Environmental engineering, PHI

Pre Ph.D. Course in Civil Engineering

Pavement Design, Construction and Maintenance

L	T	P
4	0	0

1. Introduction: Types of pavement structure, functions of pavement components. factors affecting pavement design. Design of Pavements: Methods for design of flexible pavements: CBR , Group Index Method , California bearing value method , Triaxial test method , Burmister method , McLeod's method.

2. Design considerations, methods for design of rigid pavements: Westergaard's method, F.A.A. method, types of joints and their design in cement concrete pavments. Thickness design for Airport pavement ,FAA method for Flexible and Rigid pavements, ESWL Concept , CBR method (USACE) , LCN system of pavement design,

3. Construction of Highways: Types of Highway Construction and their selection, materials for construction, construction procedure of different highways: Gravel roads, WBM , W.M.M., Bituminous pavements, cement concrete pavements, Joints in cement concrete pavements, introduction to various Equipment used for highway construction. Constructional features for Pre-Mix Carpet, Mix Seal Surfacing , B.M. , SDBC. Other higher quality pavement layers – DBM , BC (introduction only)

4. Maintenance of Highways: Pavement failures, their causes and remedial measures typical flexible and rigid pavement failures, types of highway maintenance: routine, periodic and special type, materials used for maintenance of different pavement such as bituminous pavements, cement concrete road, Slurry Seal, Liquid Seal, Fog Seal, Patching Defects/ Failures in Flexible Pavement- their types and causes, Remedial Measures Surface defects, Cracks, Deformation, disintegration, Cracks, Spalling , Slab Rocking , Joint Sealant Failure and Rectification

Books:

1.. Khanna and Justo ; Highway Engineering, Nemchand & Bros. Roorkee

2. Clarkson H.Oglesby and Gary Hicks; Highway Engineering. John Wiley & Sons, London,

3. Rao ; Airport Engineering , Tata McGraw Hill Publishing Co. New Delhi

4. Khanna and Arora.; Airport Planning and Design

5. Wright and Paquette; . Highway Engg , John Wiley and Sons, New York

6. Vaswani, Highway Engg Roorkee Publishing House, Roorkee

7. Sharma and Sharma.; Principles and Practices of Highway Engg., Asia Publishing House, New Delhi .

Pre Ph.D. Course in Civil Engineering

Bridge Engineering

L	T	P
4	0	0

1. Introduction Definition; components of a bridge; classification; importance of bridges.
2. Standard Specifications for Road Bridges: Indian Roads Congress Bridge Code; width of carriageway; clearances; loads to be considered; dead load; I.R.C. standard live load; impact effect; application of live load on decks; wind load; longitudinal forces; centrifugal forces; horizontal forces due to water current; Buoyancy effect ; earth pressure ; temperature effects ; seismic force.

3. Reinforced concrete Bridges : General arrangement and suitability : T-beam bridges; Balanced cantilever bridges ; Continuous girder bridges; Rigid frame bridges; Arch bridges; Steel bridges (Familiarization with MOST specifications and drawings)

4. Sub-Structure : Design of piers and abutments (Masonry & R.C.C).

5. Foundations : Types of foundations; Open; Piled and Well foundations; including construction details. Pile Foundations: Suitable Pile types for bridges, Pile Installation, Carrying capacity of bored and cast- in-situ pile (No numericals) Well Foundations in Components and brief description, Well Cap, Stability of a single well

6. Bearings, Joints, and Handrails : Different types of bearings, joints and handrails.

7. Construction and Maintenance of Bridges, Quality Assurance, Construction Method (brief) Steel bridges, Long span concrete bridge, Traditional method, Incremental Push launching method, Cantilever method, Maintenance, Maintenance of Bearings, Expansion Joints.

Reference Books:

1. Victor Johnson; Essentials of Bridge Engineering , Oxford & IBH Publishing Co, New Delhi.,2007

2. Khadilkar; C.H. , A text book of Bridge Construction, Allied Publisher, New Delhi.

3. Rangwala; Bridge Engg

4. Rowe, R.E., Concrete Bridge Design , John Wiley & Sons, Inc. New York

5. Raina , V.K. , C oncrete Bridges Practice Book , Tata McGraw Hill , New Delhi

6. Jagadeesh, Jayaram : Design of Bridge Structures , Prentice Hall.

7. Raina, V.K. Concrete Bridges Handbook, Galgotia Publications (P) Ltd, New Delhi

Pre Ph.D. Course in Civil Engineering

Advanced Construction Technology

L	T	P
4	0	0

1. Earthen Dams : Introduction, types ,design considerations/aspects to suit available materials, causes of failures , criteria for safe design ,section, d/s drainage system, seepage analysis, stability analysis, stability of d/s slope during steady seepage, stability of u/s slope during sudden draw down, stability of u/s and d/s slopes during construction, stability of foundation against shear, seepage control measures, design considerations in earthquake regions, design of earthen dam. Quality control in construction of embankments - monitoring of post - construction behaviour and instrumentation.
2. Special Foundations : Foundations for chimney, cooling towers, telecommunication/ transmission towers, foundations for underground structures, coastal and off shore structures in different soil conditions, foundations in expansive soils. dewatering and its various methods.
3. High Rise Construction : High rise buildings; architectural & structural aspects; special features of construction; tall chimneys, components, design aspects; slip form method , lift slab method; special problems of high rise construction.
4. Prefabricated Construction : Advantages of pre fabricated construction; selection of structural elements; design aspects; assembly of precast elements; jointing , modular co-ordination and tolerances; structural systems for buildings; single and multi- storey building systems; methods and equipments. For handling and placement
5. Advanced Construction Materials: Geo-synthetics: Various, types; geo-textiles, geo-grids, geo-membranes, geo- composites functions and general applications, advantages , properties of geo-textiles , epoxy resins, polymers, grouts and anchors, special flooring materials ,sealants and adhesives, protective coatings.

Books :

1) Bharat Singh and Varshney RS , Engineering for Embankment Dams - Oxford and IBH.

2) Sharma RK and Sharma TK ; Dam Engineering - Oxford and IBH

3) RS Varshney, SC Gupta and RL Gupta. Theory and Design of Irrigation Structures

4) Naiman P Kurian , Modern Foundations - Introduction to Advanced Techniques Tata McGraw Hill

5) CBRI Roorkee-Application Potential of Geosynthetics in Civil ngineering, Proceedings of workshop January 4-6,1989 Tata McGraw Hill.

6) Bungale S Taranath; Structural Analysis and Design of Tall Buildings , Tata McGraw Hill

Pre Ph.D. Course in Civil Engineering

Advanced Structural Engineering

L	T	P
4	0	0

1. Three dimensional elasticity problems, Torsion of open section, Thermal Stresses, Fracture mechanics. Kirchoff and Mindlin theory of plates, higher order shear deformation theories, classical theories of skew plates, Shell surfaces, bending theory of shells.

2. Mechanics of modern materials, laminated composites, functionally graded materials. Application to plate and shell structures.Structural dynamics, Forced and Damped vibration, modal analysis, response spectra, seismic design of multistoried buildings, codal provisions.

3. Finite Element Method, 2D and 3D applications in plane and three dimensional elasticity problems. Analysis of plate and shell structures. Applications using proper software.Nonlinear analysis of structural elements. Material and geometric nonlinearity. Applications for beam, plates and shells.

4. Multi- variable and Multi-objective optimization. Non linear and non traditional techniques of optimization. Design for reliability, reliability based optimization.Stability Analysis: Beam column, buckling of frames. Lateral buckling of beams, torsional buckling, energy criterion and energy based methods, dynamic stability

Books:

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications

2. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications

3. Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications

4. R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications

5. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications

6. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.

7. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill 8. Chandrashekhara K., Analysis of Plates, New Age International Edition.

Pre Ph.D. Course in Civil Engineering

Hydraulic Engineering

L	T	P
4	0	0

1. Water resources systems analysis, design and management for water supply, irrigation, drainage, hydropower, food control, droughts.Surface and ground water hydrology, stochastic hydrology, physical and numerical modeling, use of finite difference, finite element and boundary element methods.

2. Instrumentation and monitoring of hydraulic systems, computer simulation and optimization of hydrosystems.Computational fluid dynamics, coastal hydrodynamics, watershed management, application of numerical methods.

3. Ground water systems planning and management, ground water pollution investigation. Hydroinformatics, multi criterion decision support system, applications of ANN and GA.

4. Hydraulics of spillways and energy dissipators, pressure fluctuations in hydraulic jump, static and dynamic uplift pressures in stilling basins. Remote sensing and GIS applications, Dam break analysis using softwares.

Books:

1. Principles of water resources planning and management – Goodman

2. Applied hydrology – Linsley Kolhar and Paulhas (McGraw Hill)

3. Computational fluid dynamics – Anderson

4. Neural network fundamentals with graphs, algorithms, applications – Bose N.K. and Liang P (McGraw Hill)

5. Practical handbook of GA applications, Vol I – L. Chambers (CRC Press)

-Pre Ph.D. Course in Civil Engineering

Geotechnical Engineering

L	T	P
4	0	0

1. Advanced Geotechnical Engineering Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, etc. Advanced Foundation Engineering Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

2. Rock mechanics and Tunelling Deformation characteristics of rocks and its measurement. Instrumentation, Underground excavation and subsidence. Bearing capacity of homogeneous as well as discontinuous rocks. Soil Dynamics and Geotechnical Earthquake Engineering Soil behaviour under dynamic loads. Seismic response, strong ground motion, its parameters and their estimation, seismic hazard analysis, local site effects and design ground motion, seismic slope stability

3. Finite Element Methods in Geotechnical Engineering Stress deformation analysis: One-, Two, Three-dimensional formulations; Discretization; Analysis of foundations, dams, underground structures and earth retaining structures. Geo environmental Engineering

4. Landfills, in ash ponds and tailing ponds, and in rocks. Detection, control and remediation of subsurface contamination; Engineering properties and geotechnical reuse of waste.

5. Soil Structure Interaction Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Interaction analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, Non-linear load-deflection response. Geotechnics for Infrastructure Exploration studies for different Infrastructure Projects, Investigation reports, Analysis and required measures

Books:

1. Aki K and Richards P G (2002), Quantitative Seismology, University Science Books

2. Bowles J E (1996), Foundation Analysis and Design, McGraw Hill.

3. Das B M (1997), Advanced Soil Mechanics, Taylor and Francis.

4. Das B M (1993), Principles of Soil Dynamics, Brooks/Cole

5. Coduto D P (2001), Foundation Design: Principles and Practices, Prentice -Hall

6. Kaniraj S R (1988), Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill

7. Poulos H G and Davis E H (1980), Pile Foundation Analysis and Design, John Wiley and Sons

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Town and Country Planning

L	T	P
4	0	0

1. Historic Development & Planning Theory-Origin ,evolution and contemporary developments in planning.,Formation of metropolitan areas &impacts of Industrial Revolution, Socio-economic & technological,impacts of growth of population; rura lurban migration, Characteristics of the urban environment: Land uses, physical structure ,The interim and comprehensive plans: Structure Plan, Master Plan, Zonal Development Plan - their purpose and contents, Surveys, analyses and design methods and practices in comprehensive planning, Residential Areas : Neighborhood and Sector Planning, Planning of New Towns in India and abroad. Spatial & Environmental Aspects of Planning-Environmental degradation and its impact, environmental impact

2. Transportation & Utility Services-Transportation systems; Land use-transportation interrelationships; transportation planning process;Traffic management., Recent innovations in technologies and its probable impacts,Transport policies and evaluation of transportation proposals,Water supply systems,Waste water disposal systems & Solid wastes collection and disposal,Reuse and recycle Techniques,

3. Planning for urban electrical distribution system and communication systems,Economic feasibility tests. Planning Administration & Professional Practices-Planning legislation ,Constitutional basis and provisions relating to land, Evolution of planning laws,Land Acquisition Act of India, MRTP Act 1966,UDPFI Guidelines (implications of 73rd and 74th amendment of the constitution),EPA, Conservation of natural resources, Conservation and Management of Ancient Monuments and Archaeological sites and ruins., Land Development Control,Urban Arts Commission Act, Transportation, Landscape, Housing and slum clearance legislation. ,Role in interdisciplinary groups

4. Social formation & Housing.Housing problems: Urbanization and Industrialization,Slums and squatters settlements - problems and possibilities,Residential layouts, housing densities, neighborhood unit, community facilities,Social aspects : built environment and human behavior, Evaluation of user's satisfaction,Finance for housing: priority in the national plans - role of public and private agencies, role of cooperatives and various institutions,Cost reduction techniques in housing,Housing norms and standards.

Reference Books :

1. K.S.Rangwala and P.S.Rangwala,. "Town Planning ",Charotar Publishing House,15th Edition,1999.
2. Michael Hord, R. Remote sensing methods and application, John Wiley and Sons, New York, 1986.
3. National Building Code of India- Part-III.
4. Municipal and Panchayat bye-laws, CMDA Rules and Corporation bye-laws.
5. KA. Ramegowda, Urban and regional planning , University of Mysor

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Advanced Geoinformatics

L	T	P
4	0	0

1. MINERALOGY:Description and identification of Rock forming minerals and Ores, based onphysical and special properties PETROLOGY: Rocks as fundamental units and building materials of the earth crust and theirengineering applications: As building stones, road metals and stones fordecoration, pavement, cladding, roofing, flooring, concreting and foundationengineering. Igneous rocks: Origin, classification (chemical and textural), mode of occurrence Sedimentary rocks: Origin, classification, primary structures Metamorphic rocks: Kinds of metamorphism, and classification.

2. ROCK MECHANICS: Epigene and Hypgene geological agents; rock weathering and its types; Soil formation, types, erosion and remedial measures Geological action of rivers with different drainage patterns; Geological action of wind. Stress, strain and deformational effects on different rocks; Out crop, Dip,strike and escarpment, Clinometer-compass- Joints, faults, folds andunconformities their effects on civil engineering structures.

3. Principles of Remote Sensing: Introduction to remote sensing, Remote sensing system, Electromagnetic spectrum, Black body Atmospheric windows, Spectral characteristics of earth's surface, Range of sensing system. Platforms, Sensors and Data Products: Ground aircraft, space aircraft platforms- photographic sensors, scanners, radiometers, Radar and Mission planning. Data types and format, Scale and Legend Photogrammetry: Photogrammetry basics – applications, applications of aerial photo interpretation to Water Resource Engineering. Photogrammetry and GIS:input of data from photogrammetry for GIS database, photogrammetric applications in GIS

4. Geographic Information System: Introduction, history if GIS, comparisons with CAD, Necessity of GIS, components of GIS, GIS Architecture-data input, data manipulation, data output, Operation-processes and capabilities, different types of GIS, GIS data-spatial and non spatial, data models with advantages and disadvantages. Types of Analysis and errors, Global positinating system GIS.

5. Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, Ndimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Classification techniques, airborne and space-borne hyperspectral sensors, applications. High resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications.

BOOKS:

1. Text book of Geology by P.K. Mukerjee, World Press Pvt. Ltd.Kolkatta.
2. Structural Geology (3rd Ed.)by M. P. Billings, Published by Prentice Hall of India Pvt. Ltd. New Delhi
3. Text of Engineering and General Geology by ParbinSingh,Published by S. K. Kataria and Sons, New Delhi.
4. Rock Mechanics for Engineers by DrB.P.Verma, Khanna Publishers, New Delhi

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)
Computer Aided Design Methods

L	T	P
4	0	0

1. Introduction to CAD and its scope simple description of computer hardware. - Micro, mini etc. - memory, processor - Peripheral devices-disks, printer. Video terminals. Graphic floater, graphic screen digitizer.

2. Computer Graphics: introduction, point plotting techniques, line drawing displays, two-three dimensional transformation, clipping and windowing, segmentation geometric modeling. Three dimensional graphics, curves and surfaces, hidden surface elimination, shading. Graphic input devices. Graphic input technique, input functions. Raster graphic fundamentals, interactive raster graphics, raster graphic systems.

3. Computer aided linkage displays and synthesis, interactive acceleration analysis. Appreciation of graphic packages.

4. Matrix methods of structural analysis and associated computer programme assembly of matrices. Solution of equilibrium equations. Flow charts. Typical listing as illustrations. Introduction to interactive computer programme for the design detailing of simple structural elements: RCC slab, beams, columns, isolated footings etc. Steel typical members and connections.

5. Data base management , storing and retrieving of data

Books:

1. Principles of interactive computer graphics by William M. Newman & Robert F.Sproul.

2. Programming in Finite Element by Hunton and owan

3. Principles of Computer Aided design by Joe Rooney & Philips Steadman

4. Computer Fundamentals-P.K.Sinha, BPB Publications

Pre Ph.D. Course in Civil Engineering (Interdisciplinary Course)

Civil Engineering applications of Remote sensing and GIS

L	T	P
4	0	0

1. Photogrammetry and Aerial Photogrammetry Photogrammetry- Introduction, basic definitions, terrestrial photogrammetry, phototheodolite, horizontal and vertical angles from terrestrial photographs, horizontal position of a point from photographic measurements. Aerial Photogrammetry- advantages, vertical, tilted and obliquephotographs, geometry of vertical photographs, scale of vertical photographhover flat and variable terrain, ground coordinates, computation of length of aline, overlaps, flightplanning, computation of required number of photographs for a given area,ground control in photogrammetry, Basic elements inphotographic interpretation. Introduction to digital photogrammetry.

2. Remote sensing-Introduction, Ideal remote sensing system, basic principles ofelectromagnetic remote sensing, electromagnetic energy, electromagneticspectrum, interaction with earth's atmosphere, interaction with earth- surface Remote sensing platforms and sensors: Introduction, platforms- Indian satellite IRS and Land sat specifications, Sensors-active and passive,MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensorresolutions (spatial, spectral, radiometric and temporal).

3. GIS-Definition, Components of GIS, Data types, Sources of data, Data Structure , Types of Analysis and errors, Global positinating system GIS. Applications of Remote sensing: applications in land use land cover analysis, change detection, water resources, urban planning,Design of construction structures, and geological applications.

4. Environmental Applications of RS and GIS Re-modelling of water Distribution systems using GIS Ground water Vulnerability Modelling using GIS Urban Development Planning using RS and GIS Environmental Solid Waste and Degradation Assessment using RS and GIS RS and GIS site selection for Dams, Bridges, Reservoirs.

Books:

1. Mikhail E., J. Bethel, and J.C. McGlone, Introduction to modernphotogrammetry. Wiley, 2001.

2. Wolf P.R, and B.A. Dewitt, Elements of photogrammetry : withapplications in GIS. 3rd ed, McGraw-Hill, 2000.

Pre Ph.D. Course in Civil Engineering

Transportation and Highway Technology

L	T	P
4	0	0

1. HIGHWAY MATERIALS Soil stabilization types, source, functions, requirements, properties, tests and specifications for use in various components of road, Soil compaction for use in fill and subgrade of roads. Soil stabilization – principle, methods and tests, proportioning of materials and mix design, application of Rotchfutch method. Marginal and waste materials in road construction, properties and scope in road construction. Bituminous Material (properties of the material) and marshall mix design (both wet and dry), Usage of Geosythentics and Geotextiles in construction of highways.

2. HIGHWAY CONSTRUCTION AND MAINTENANCE Components of road and pavement structure functions, requirements and sequence of construction operations. Plants and equipment for production of materials, Road construction equipment, Pre-construction surveys and marking on ground, Different types of granular base course, Different types of sub-base, Road maintenance works and quality control tests as per MORTH specification. SPECIAL PROBLEMS IN ROAD CONSTRUCTION Problems on construction on areas with marshy and weak soils, expansive clays and' water- logged – areas. Design and construction of filter drains and capillary cut-off. Vertical sand drains – application, design and construction method. Road construction on desert region and coastal areas.

3. PAVEMENT DESIGN AND MANAGEMENT Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution. Factors affecting design and performance of airport pavements. Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses, deflections / strains in single, two and three layer system. RURAL ROADS Problems associated with planning, design and construction of rural roads low volume rural roads in India. Principle, scope and construction method of various soil stabilization techniques in rural roads. Properties. Design, construction, and maintenance aspects, by resorting to appropriate technology.

4. ROAD SAFETY AND MANAGEMENT Road accidents, causes, scientific investigations and data collection. Road safety issues and various measures for road safety. Engineering, education and enforcement measures for improving road safety. Short term and long term measures. Traffic management techniques. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. Economic evaluation of roads.

5 .TRAFFIC SURVEYS & APPLICATION OF REMOTE SENSING AND GIS IN HIGHWAY ENGINEERING Traffic studies- Trip distribution, generation assignment and model split (Statistical analysis). Design of the traffic signals at urban intersections. Level of service at intersections. Design of parking in urban areas and problems Concepts, components, working of GIS, data capture, data integration, data structures. Coordinate systems and map projections, Registration. GIS analysis and tasks – Input, manipulation, management, query and analysis, visualization, proximity analysis, overlay analysis, GIS and Remote sensing data integration. Overview of image processing softwares and GIS

softwares, Introduction to GPS and its application (includes the recent software's used in the highway engineering)

Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress.

2. IS 73, revised 2006, IS 2720, IS 2386, IS 1201 to 1220, IS 8887- 1995, IS 217- 1986.

3. IRC -37, IRC -58 , IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27- 1967, 29-1988, 34-1970, 36- 1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94- 1986, 95-1987, 98-1997, 105-1988

4. Peurifoy, R.L., and Clifford,JS "Construction Planning Equipment and Method"- McGraw Hill Book Co. Inc.

5. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA

6. Leonards G. A. "Foundation engineering" - McGraw Hill Book Company, New York, 1962

Scheme & Syllabus of
Master of Technology

(M. Tech – Civil Engineering)

Specialization: Structural Engineering

Batch 2018 onwards

By
Board of Study Civil Engineering
Department of Academics
I.K. Gujral Punjab Technical University

I.K. Gujral Punjab Technical University

Master of Technology in Civil Engineering

Specialization: Structural Engineering

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)
Eligibility for Admission : B. Tech / B.E Civil Engineering
Courses & Examination Scheme:

Program Outcomes (POs):

After completion of the program graduates will be able to

A. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude

B. Identify, formulate and solve engineering problems in the domain of structural engineering field.

C. Use different software tools for Analysis and Design structural engineering domain.

D. Design and conduct experiments, analysis and interpret data, for development of simulation experiments.

E. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

First Semester

Course Type	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Core Theory	MTST101-18 Advanced Structural Analysis	3	0	0	40	60	100	3
Core Theory	MTST102-18 Advanced Solid Mechanics	3	0	0	40	60	100	3
Program Elective I	Elective I MTST901- 18 Theory of Thin Plates and Shells MTST902- 18 Theory and Applications of Cement Composites MTST903- 18 Theory of Structural Stability	3	0	0	40	60	100	3
Program Elective II	Elective II MTST904- 18 Analytical and Numerical Methods for Structural Engineering MTST905- 18 Structural Health Monitoring MTST906- 18 Structural Optimization	3	0	0	40	60	100	3
Core Lab I	MTST 111 - 18 Structural Design Lab	0	0	4	60	40	100	2
Core Lab II	MTST 112 - 18 Advanced Concrete Lab	0	0	4	60	40	100	2
MLC	Research Methodology and IPR	2	0	0	40	60	100	2
Audit 1	Audit Course	2	0	0	0	0	0	0
	MTST113 - 18 Technical Seminar - I	0	0	2	60	40	100	1
Total		**16**	**0**	**10**	**380**	**420**	**800**	**19**

Second Semester

Course Type	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Core 3	MTST201-18 FEM in Structural Engineering	3	0	0	40	60	100	3
Core 4	MTST202-18 Structural Dynamics	3	0	0	40	60	100	3
Program Elective III	Elective – III MTST907- 18 Advanced Steel Design MTST908- 18 Design of Formwork MTST909- 18 Design of High Rise Structures MTST910- 18 Design of Masonry Structures	3	0	0	40	60	100	3
Program Elective IV	Elective – IV MTST911- 18 Design of Advanced Concrete Structures MTST912- 18 Advanced Design of Foundations MTST913- 18 Soil Structure Interaction MTST914 - 18 Design of Industrial Structure	3	0	0	40	60	100	3
Core Lab III	MTST 113 - 18 Model Testing Lab	0	0	4	60	40	100	2
Core Lab IV	MTST 114 - 18 Numerical Analysis Lab	0	0	4	60	40	100	2
CORE	MTST231 - 18 Mini Project	0	0	4	60	40	100	2
Audit 2	Audit Course-2	2	0	0	0	0	0	0
	MTST 115 – 18Technical Seminar - II	0	0	2	60	40	100	1
Total		**14**	**0**	**14**	**400**	**400**	**800**	**19**

Third Semester

Course Type /Code	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Program Elective-V	Elective - V	3	0	0	40	60	100	3
	MTST915 - 18 Design of Prestressed Concrete Structures							
	MTST916 - 18 Analysis of Laminated Composite Plates							
	MTST917 - 18 Fracture Mechanics of Concrete Structures							
	MTST918 - 18 Design of Plates and Shells							
Open Elective	MTST919 - 18 Business Analytics	3	0	0	40	60	100	3
	MTST920 - 18 Industrial Safety							
	MTST921 - 18 Operations Research							
	MTST922 - 18 Cost Management of Engineering Projects							
	MTST923 - 18 Composite Materials							
	MTST924 - 18 Waste to Energy							
Dissertation	MTST232 - 18 Dissertation Phase – I	0	0	20	60	40	100	10
	Total	**6**	**0**	**20**	**140**	**160**	**300**	**16**

Forth Semester

Course Type /Code	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Dissertation	MTST233 - 18 Dissertation Phase – II	**0**	**0**	**32**	**-**	**-**	**S/US**	**16**

List of Audit Course
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Addition
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester I

MTST101 - 18 Advanced Structural Analysis (Credits - 3:0:0 = 3)

Course outcomes: At the end of the course, students will be able to
1. Analyze the skeleton structures using stiffness analysis code.
2. Use direct stiffness method understanding its limitations

Syllabus Contents:
Influence Coefficients: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.
Stiffness Method applied to Large Frames: Local Coordinates and Global Coordinates.
Stiffness Matrix Assembly of Structures: Stiffness Matrix in Global Coordinates, Boundary Conditions ,Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.
Applications to Simple Problems: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.
Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems ,Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.
Linear Element: Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.

References:

• Matrix Analysis of Framed Structures, Weaver and Gere.
• The Finite Element Method, Lewis P. E. and Ward J. P., Addison-Wesley Publication Co.
• Computer Methods in Structural Analysis, Meek J. L., E and FN, Span Publication.
• The Finite Element Method, Desai and Able, CBS Publication.

MTST102 – 18Advanced Solid Mechanics (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to
1. Solve simple problems of elasticity and plasticity understanding the basic concepts.
2. Apply numerical methods to solve continuum problems.

Syllabus Contents:
Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.
Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.
Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain Displacement And Compatibility Relations, Boundary Value Problems, Co-axialityof the Principal Directions.
Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy'sstress unction, Two-Dimensional Problems in Polar Coordinates.
Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of rectangular Bar, Torsion of Thin Tubes.
Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, Von - Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.
References:

• Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
• Elasticity,SaddM.H.,Elsevier,2005.
• Engineering Solid Mechanics, RagabA.R., Bayoumi S.E., CRC Press,1999.
• Computational Elasticity, AmeenM., Narosa,2005.
• Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
• Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

Program Elective I

MTST901 - 18 Theory of Thin Plates and Shells (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use analytical methods for the solution of thin plates and shells.
2. Use analytical methods for the solution of shells.
3. Apply the numerical techniques and tools for the complex problems in thin plates.
4. Apply the numerical techniques and tools for the complex problems in shells.

Syllabus Contents:

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle ofVirtual Work, Boundary Conditions.

Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

Static Analysis of Shells: Membrane Theory of Shells- Cylindrical, Conical and Spherical Shells,

Shells of Revolution: with Bending R**esistance** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

Thermal Stresses in Plate/ Shell

References:

• Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
• Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
• Thin Elastic Shells, KrausH., John Wiley and Sons.
• Theory of Plates, ChandrashekharaK., Universities Press.
• Design and Construction of Concrete Shells, RamaswamyG.S.

Program Elective I

MTST902 - 18- Theory and Applications of Cement Composites (Credits- 3:0:0=3)

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.

2. Classify the materials as per orthotropic and anisotropic behaviour.

3. Estimate strain constants using theories applicable to composite materials.

4. Analyse and design structural elements made of cement composites.

Syllabus Content:

Introduction: Classification and Characteristics of Composite Materials- Basic Terminology,Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, EngineeringConstants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem,Biaxial Strength, Theories for an Orthotropic Lamina.

Mechanical Behaviour: Mechanics of Materials Approach to Stiffness- Determination ofRelations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques ofElasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations,Comparison of approaches to Stiffness.

Cement Composites: Types of Cement Composites, Terminology, Constituent Materialsandtheir Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement,SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

Mechanical Properties of Cement Composites: Behavior of Ferrocement, Fiber ReinforcedConcrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

Application of Cement Composites: FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour,Constitutive relationship, Elastic Constants.

Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON and Fibre Reinforced Concrete.

Reference Books:

- Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1st Ed., Blackie, Academic and Professional, Chapman Hall, 1983.

Program Elective I

MTST903 - 18 - Theory of Structural Stability (Credits- 3:0:0 = 3)

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analysing discrete and continuous systems,

Syllabus Contents:
Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.
Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.
Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.
Stability of Beams: lateraltorsion buckling.
Stability of Plates: axialflexural buckling, shearflexural buckling, buckling under combinedloads.
Introduction to Inelastic Buckling and Dynamic Stability.

Reference Books:

- Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
- Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
- Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
- Strength of Metal Structures,Bleich F. Bucking, Tata McGraw Hill, New York.

Program Elective II
MTST904– 18- Analytical and Numerical Methods for Structural Engineering (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Solve ordinary and partial differential equations in structural mechanics using numerical methods.
2. Write a program to solve a mathematical problem.

Syllabus Contents:

Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations andInterpolations, **Curve Fitting;** Interpolation and extrapolation.
Solution of Nonlinear Algebraic and Transcendental Equations
Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems.
Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations.
Finite Difference scheme: Implicit & Explicit scheme.
Computer Algorithms: Numerical Solutions for Different Structural Problems, Fuzzy Logic andNeural Network.

Reference Books:

- An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
- Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (ShaumSeries), 1988.
- Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Program Elective II

MTST905 - 18– Structural Health Monitoring (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure

Syllabus Contents:

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.
Structural Health Monitoring: Concepts ,Various Measures, Structural Safety in Alteration.
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
Dynamic Field Testing : Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.
Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

- Structural Health Monitoring, Daniel Balageas, ClausPeterFritzen, Alfredo Güemes, John Wiley and Sons, 2006.
- Health Monitoring of Structural Materials and Components Methods with Applications,
- Douglas E Adams, John Wiley and Sons, 2007.
- Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan,Taylor and Francis Group, London, UK, 2006.
- Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.

Program Elective II
MTST906 - 18 – Structural Optimization (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use Variational principle for optimization
2. Apply optimization techniques to structural steel and concrete members.
3. Design using frequency constraint.

Introduction: Simultaneous Failure Mode and Design, Classical External Problems.
Calculus of Variation: Variational Principles with Constraints,
Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,
Geometric Programming **and** Stochastic Programming.
Applications: Structural Steel and Concrete Members, Trusses and Frames.
Design: Frequency Constraint, Design of Layouts.

Reference Books:

- Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer.
- Variational methods for Structural optimization, Cherkaev Andrej, Springer

Core Lab1

MTST111– 18–Structural Design Lab (Credits - 0:0:4 = 2)

Teaching Scheme
Lab: 4hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design and Detail all the Structural Components of Frame Buildings.
2.Design and Detail complete Multi-Story Frame Buildings.

Syllabus Content:
Design and detailed drawing of complete+ 3 structures by individual student using latest relevant IS codes.

Core Lab2

MTST112– 18– Advanced Concrete Lab (Credits - 0:0:4 = 2)

Teaching Scheme
Lab: 4hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non-Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behavior of structural/ elements.

List of Experiments/Assignments:
1.Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Effect of cyclic loading on steel.
3. Non-Destructive testing of existing concrete members.
4. Behavior of Beams under flexure, Shear and Torsion.

Reference Books:

- Properties of Concrete, Neville A. M., 5^{th} Edition, Prentice Hall, 2012.
- Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Research Methodology and IPR

Teaching Scheme
Lectures: 2 hrs/week

Course Outcomes:
At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but
- tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals
- & nation, it is needless to emphasis the need of information about Intellectual Property
- Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research
- work and investment in R & D, which leads to creation of new and better products, and
- in turn brings about, economic growth and social benefits.

Syllabus Contents:
Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.
Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.
Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.
Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
Unit 6: New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for
- science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for
- beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.
- Asimov , "Introduction to Design", Prentice Hall, 1962.

- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New
- Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Semester II
Core 3 –
MTST201 - 18 Finite Element Method in Structural Engineering (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.

Syllabus Contents:

Introduction: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.
Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.
Method of Weighted Residuals: GalerkinFinite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.
Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoperimetric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.
Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.
Computer Implementation: FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

Reference Books:

- Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
- Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
- Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
- Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
- Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
- Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice HallIndia, 1991.

Core 4

MTST202 - 18 – Structural Dynamics (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Analyze and study dynamics response of single degree freedom system using fundamental equation of motion.
2. Analyze and study dynamics response of Multi degree of freedom system using fundamental theoryand equation of motion.
3. Use the available software for dynamic analysis.

Syllabus Contents:

Introduction: Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling ofDynamic Systems.
Single Degree of Freedom System: Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.
Numerical Solution to Response using Newmark _ Method and Wilson _ Method, Numerical Solution for State Space Response using Direct Integration.
Multiple Degree of Freedom System (Lumped parameter): Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.
Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System.
Special Topics in Structural Dynamics(Concepts only): Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.

Reference Books:

- Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
- Structural Dynamics andIntroduction to Earthquake Engineering, Chopra A. K.
- Vibration ofStructures - Application in Civil Engineering Design, Smith J. W., Chapman andHall.
- Dynamics of Structures, Humar J. L., Prentice Hall.
- Structural Dynamics - Theory andComputation, Paz Mario, CBS Publication.
- Dynamics ofStructures, Hart and Wong.

Program Elective III

MTST907 - 18– Advanced Steel Design (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design steel structures/ components by different design processes.
2. Analyze and design beams and columns for stability and strength, and drift.
3. Design welded and bolted connections.

Syllabus Contents:

Properties of Steel: Mechanical Properties, Hysteresis, Ductility.
HotRolled Sections: compactness and non-compactness, slenderness, residual stresses.
Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.
Stability of Beams: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.
Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.
Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;
Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor,Effective Length,PM Interaction, Biaxial Bending, Joint Panel Zones.
Drift Criteria: P Effect, Deformation Based Design;
Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

Reference Books:

- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand Bros., Roorkee.
- The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., HeymanJ., ELBS.
- Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
- IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
- SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987.

Program Elective III
MTST908 - 18 – Design of Formwork (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Select proper formwork, accessories and material.
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures.
4. Understand the working of flying formwork.
5. Judge the formwork failures through case studies.

Syllabus Content:
Introduction: Requirements and selection of Formwork.
Formwork Materials- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.
Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.
Formwork Design for Special Structures: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.
Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.
Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.

Reference Books:

- Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
- Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
- IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.

Program Elective III

MTST909 - 18 – Design of High Rise Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

2. Analyse, design and detail the RC and Steel Chimney.

3. Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

Syllabus Content:

Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.

Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

Applicationof software in analysis and design.

Reference Books:

- Structural Design of Multi-storeyed Buildings, VaryaniU. H., 2nd Ed., South Asian Publishers,New Delhi, 2002.
- Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
- Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R.,Structures Publications, Pune, 2013.
- Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
- Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
- High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
- Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Program Elective III

MTST910 - 18 – Design of Masonry Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to

1. Understand the masonry design approaches.
2. Analyse Reinforced Masonry Members.
3. Determine interactions between members.
4. Determine shear strength and ductility of Reinforced Masonry members.
5. Check the stability of walls
6. Perform elastic and Inelastic analysis of masonry walls.

Syllabus Contents:

Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.
Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading.
Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation.
Shear Strength and Ductility of Reinforced Masonry Members.
Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.
Elastic and In - elastic Analysis, Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.

Reference Books:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings,Tomaevi Miha, Imperial College Press, 1999.

Program Elective IV

MTST911 - 18– Design of Advanced Concrete Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Analyse the special structures by understanding their behaviour.
2. Design and prepare detail structural drawings for execution citing relevant IS codes.

Syllabus Contents:

Design philosophy, Modeling of Loads, Material Characteristics.
Reinforced Concrete - P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beamand Corbel, Design of Shear Walls, Compression Field Theory for Shear Design, Design againstTorsion; IS, ACI and Eurocode.
Steel Structures -- Stability Design, Torsional Buckling - Pure, Flexural and Lateral, Design of Beam-Columns, Fatigue Resistant Design, IS code, AISC Standards and Eurocode.

References Books:

- Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999.
- Design of Steel Structures, SubramaniamN., Oxford University Press, 2008.
- Reinforced Concrete Structures, Park R.andPaulayT. , John Wiley & Sons, 1995.
- Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.
- Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
- Steel Structures Design and Behavior Emphasizing Load and Resistance Factor Design, Salmon
- C. G., Johnson J. E. and Malhas F. A., Pearson Education, 5th Ed, 2009.
- Design ofSteel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Plastic Methods of Structural Analysis, Neal B.G., Chapman and Hall London.

Program Elective IV
MTST912 - 18 – Advanced Design of Foundations (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Decide the suitability of soil strata for different projects.
2. Design shallow foundations deciding the bearing capacity of soil.
3. Analyze and design the pile foundation.
4. Understand analysis methods for well foundation.

Syllabus Contents:
Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.
Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.
Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations,Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load-Settlement Behaviorof Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.
Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.
Tunnels and Arching in Soils, Pressure Computations around Tunnels.
Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.
Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structureInteraction

Reference Books:

- Design of foundation system, N.P. Kurian, Narosa Publishing House
- Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
- Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, NewDelhi.

Program Elective IV
MTST913 - 18 – Soil Structure Interaction (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Understand soil structure interaction concept and complexities involved.
2. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
3. Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.
4. Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.
5. Evaluate action of group of piles considering stress-strain characteristics of real soils.

Syllabus Contents:
Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.
Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.
Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.
Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.
Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.
Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

Reference Books:

- Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., NewYork, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw HillBook Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17,Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific
- Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Program Elective IV
MTST914 - 18 - Design of Industrial Structure (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student will be able to:
1. Design Steel Gantry Girders.
2. Design Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks.

Syllabus Contents:
Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.
Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures
Steel Bunkers and Silos – Design of square bunker – Jansen's and Airy's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.
Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.
Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchorbolts –
Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

Reference Books:

- Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
- Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
- Design of Steel Structures, Subramaniyam.

Core Lab 3 –
MTST113 – 18 - Model Testing Lab(Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week,

Course Outcomes: At the end of the course, students will be able to
1. Understand the response of structures.
2. Prepare the models.
3. Conduct model testing for static loading
4. Conduct model testing for free and forced vibrations

Syllabus Content:

- Response of structures and its elements against extreme loading events.
- Model Testing: Static - testing of plates, shells, and frames models.
- Model Testing: Free and forced vibrations, Evaluation of dynamic modulus.
- Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.

Core Lab 4

MTST114 – 18 – Numerical Analysis Lab (Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Find Roots of non-linear equations by Bisection method and Newton's method.
2. Do curve fitting by least square approximations
3. Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method
4. To Integrate Numerically Using Trapezoidal and Simpson's Rules
5. To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method.

Syllabus Contents:

- Find the Roots of Non-Linear Equation Using Bisection Method.
- Find the Roots of Non-Linear Equation Using Newton's Method.
- Curve Fitting by Least Square Approximations.
- Solve the System of Linear Equations Using Gauss - Elimination Method.
- Solve the System of Linear Equations Using Gauss - Seidal Iteration Method.
- Solve the System of Linear Equations Using Gauss - Jorden Method.
- Integrate numerically using Trapezoidal Rule.
- Integrate numerically using Simpson's Rules.
- Numerical Solution of Ordinary Differential Equations By Euler's Method.
- Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

Core

MTST231 – 18 Mini Project (Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week

Course Outcomes: At the end of the course, the student will be able to:

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. work on the solutions given and present solution by using his/her technique applying engineering principles.

Syllabus Contents:

- Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Program Elective V

MTST915 – 18 - Design of Prestressed Concrete Structures(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to

1. Find out losses in the prestressed concrete. Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes.
2. Analyses prestressed concrete deck slab and beam/ girders.
3. Design prestressed concrete deck slab and beam/ girders.
4. Design of end blocks for prestressed members.

Syllabus Contents:

Introduction to prestressed concrete: types of prestressing, systems and devices, materials,losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer andservice loads, ultimate strength in flexure, code provisions.

Statically determinate PSC beams: design for ultimate and serviceability limit states forflexure, analysis and design for shear and torsion, code provisions.

Transmission of prestress in pretensioned members; Anchorage zone stresses for posttensionedmembers.

Statically indeterminate structures - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordance.

Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations

Analysis and design of prestressed concrete pipes, columns with moments.

References:

• Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
• Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
• Limited State Design of PrestressedConcrete,GuyanY., Applied Science Publishers, 1972.
• IS: 1343- Code of Practice for Prestressed Concrete
• IRC: 112

Program Elective V
MTST916 – 18 - Analysis of Laminated Composite Plates(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course out comes: At the end of the course, students will be able to
1. Analyse the rectangular composite plates using the analytical methods.
2. Analyse the composite plates using advanced finite element method.
3. Develop the computer programs for the analysis of composite plates.

Syllabus Contents:
Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bendingof Rectangular Laminated Plates using CLPT.
Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.
Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT.
Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.
Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0Element Formulation, Post Computation of Stresses. Analysis of Rectangular Composite Plates using Analytical Methods.

References:

Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.

Program Elective V
MTST917 – 18 - Fracture Mechanics of Concrete Structures(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to
1. Identify and classify cracking of concrete structures based on fracture mechanics.
2. Implement stress intensity factor for notched members
3. apply fracture mechanics models to high strength concrete and FRC structures.
4. Compute J-integral for various sections understanding the concepts of LEFM.

Syllabus Contents:
Introduction: Basic Fracture Mechanics, Crack in a Structure, Mechanisms ofFracture and rack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted racking, Service Failure Analysis.
Stress at Crack Tip: Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD.
Material Models: General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling.

Reference Books:
1. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
2. Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
3. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.

Program Elective V
MTST918 – 18- Design of Plates and Shells(Credits- 3:0:0 = 3)

Teaching Scheme

Lectures: 3 hrs/week.

Course Outcomes: At the end of the course, the student will be able to:
1. Analyse and design prismatic folded plate systems.
2. Analyse and design shells using approximate solutions
3. Analyse and Design Cylindrical Shells
4. Design Doubly Curved Shells using Approximate Solutions.

Syllabus Contents:

Prismatic folded Plate Systems
Shell Equations
Approximate Solutions
Analysis and Design of Cylindrical Shells
Approximate Design methods for Doubly Curved Shells.

Reference Books:

- Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill
- Edition, 2010.
- Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005.
- Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI.
- Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

Core –

MTST – 232 – 18 Dissertation I (Credits- 0:0:20 = 10)

Teaching Scheme
Lectures: 3hrs/week Mid Sem Evaluation weightage - 30%
End Sem Evaluation weightage - 70%

Course Outcomes: At the end of the course, the student will be able to:

- Identify structural engineering problems reviewing available literature.
- Identify appropriate techniques to analyze complex structural systems.
- Apply engineering and management principles through efficient handling of project
-

Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester
- presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be evaluated by the departmental committee.

Core –
MTST233 – 18 - Dissertation II (Credits- 0:0:32 = 16)

Teaching Scheme
Contact Hours: 3hrs/week

Course Outcomes: At the end of the course, the student will be able to:
1. Solve complex structural problems by applying appropriate techniques and tools.

2. Exhibit good communication skill to the engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I.Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc.There will bepre - submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

OPEN ELECTIVES
MTST919 – 18 Business Analytics

Teaching scheme
Lecture: - 3 h/week

Course objective
1. Understand the role of business analytics within an organization.

2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit1:
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review ofprobability distribution and data modelling, sampling and estimation methods overview.
Unit 2:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Businessanalytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
Unit 3:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes.Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analyticsanalysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
Unit 4:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Unit 6:
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.
COURSE OUTCOMES

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep
- analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling
- to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
- Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

OPEN ELECTIVES
MTST920 – 18 Industrial Safety

Teaching scheme
Lecture: - 3 h/week

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressurevessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.
Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:
1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES
MTST9241 – 18 Operations Research

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to
1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.

2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, SimplexTechniques, Sensitivity Analysis, Inventory Control Models.

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming.

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective
MTST922 – 18 -Cost Management of Engineering Projects

Teaching scheme
Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre-project execution main clearances and

documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective

MTST923 – 18 Composite Materials

Teaching scheme

Lecture: - 3 h/week

Advantages and application of composites. Functional requirements of reinforcement and matrix.

Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective

MTST924 – 18 Waste to Energy

Teaching scheme

Lecture: - 3 h/week

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kineticconsideration in gasifier operation.
Unit-IV: Biomass Combustion: Biomass stoves – Improved challahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:
1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II,
Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section

3. Understand the skills needed when writing a Title
Ensure the good quality of paper at very first-time submission

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness (4 Hours)

Unit 2 : Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction (4 Hours)

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, (4 Hours)

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions(4 Hours)

Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission(4 Hours)

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3.Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.Highman'sbook.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple
perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in

specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Introduction
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughtsand Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.
Disaster Prone Areas in India
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic And Coastal Hazards With Special Reference to Tsunami; Post-Disaster Diseases And Epidemics
Disaster Preparedness and Management
Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.
Risk Assessment
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation inRisk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival.
Disaster Mitigation
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

SUGGESTED READINGS:
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power

4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Content

Unit 1

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

Unit 2

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

Unit 3

- Technical concepts of Engineering-Electrical, Mechanical,
- Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1**.**Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit 1 (4 Hours)

- Values and self-development –Social values and individual attitudes.
- Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

Unit 2 (6 Hours)

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration.
- Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism, Love for nature, Discipline

Unit 3(6 Hours)

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

Unit 4 (6 Hours)

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested*Reading*

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi.

Course outcomes

Students will be able to1.Knowledge of self-development
2.Learn the importance of Human values
3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1 (4 Hours)

- **History of Making of the Indian Constitution:**
  History, Drafting Committee, (Composition& Working)

Unit 2 (4 Hours)

- **Philosophy of the Indian Constitution:**

Preamble
Salient Features

Unit 3 (4 Hours)

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit 4 (4 Hours) Organs of Governance:

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit 5 (4 Hours)

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of
- Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.

- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- **Importance of grass root democracy**

Unit 6 (4 Hours)

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed thenceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1 (4 Hours)

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and
- terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

Unit 2 (4 Hours)

- Thematic overview: Pedagogical practices are being used by teachers in formal

- and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3 (4 Hours)

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school
- curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical
- practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4 (4 Hours)

- Professional development: alignment with classroom practices and follow up
- support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5 (4 Hours)

- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:
Students will be able to understand:
1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives
1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit 1 (8 Hours)

- Definitions of Eight parts of yog. (Ashtanga)

Unit 2 (8 Hours)

- Yam and Niyam.
- Do`s and Don't's in life.
- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3 (8 Hours)

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency.

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENTSKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit 1 (8 Hours)

- Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit 2 (8 Hours)

- Approach to day to day work and duties.
- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,

- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,
- 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit 3 (8 Hours)

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarup AnandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.