ACADEMIC PROGRAMME GUIDE

BACHELOR OF ENGINEERING
(CIVIL ENGINEERING)

Batch 2018

Department of Civil Engineering
Chitkara University School of Engineering and Technology
Chitkara University, Himachal Pradesh, India

Index

1. General Information

The academic program Guide is a comprehensive document detailing course scheme, associated credits per course and the distribution of each course in lecture, tutorial and Practical hours. It also details the eligibility criteria for admission, for award of degree, the assessment and evaluation procedures along with a glimpse of the pedagogical aspects of the programs. This Guide is to be used in association with the Academic Regulations of the University to make a complete rule set. The course schemes given in this document are approved by respective Board of Studies and the Academic Council of Chitkara University. The first year of all Bachelor of Engineering programs is common and is detailed in the Section 9 of this guide.

2. Eligibility for Admission

The student seeking admission in BE program should have minimum 60%marks in 12^{th} grade or equivalent exam as declared by AIEEE / CBSE, with Maths and Physics as compulsory subjects. He/She should have appeared in AIEEE. The admission is based purely on merit. During admission process, the University follows reservation policy as decided by the State.

3. Duration and Stages

The duration of the BE program is four years – divided into 8 semesters. There is University end term examination at the end of each semester, except in the case of Industry Oriented Hands on Experience (IOHE) or Internship at Industry, which is evaluated by a jury appointed by the University. The maximum duration of completion of degree is 6 years.

4. Rules for attendance

As detailed in Academic Regulations section 6, a minimum attendance of 75% is compulsory for the student to be eligible to appear for end semester examination. 10% concession in this mandatory requirement is possible only in extreme circumstances and at the sole discretion of the Vice Chancellor.

There is no weightage for attendance in evaluation criteria.

Students are encouraged to participate in co-curricular activities conducted by prestigious institutions at national/International level. Such students would be eligible for grant of special Duty Leaves (limited by a cap decided by the Vice Chancellor) to make up for the attendance, in case any class work is missed during this period. This privilege extended to students will not be termed as right and is limited to just the attendance benefit.

5. Special Courses

Engineering Exploration: During Exploration course, the students identify their team members (team size 4 to 5) and the teams would be working on Problem description EPICS/EPIP (community based or campus based problems), Solution scope (Full problem/ Module), Overview of the proposed solution. The teams should complete the following

phases with the deadlines. The process for competing in this course is divided into three phases.

Industry Oriented skills are imparted to students in three types of courses:

IOHT (Industry Oriented Hands-on Training)

IOHC (Industry Oriented Hands – on Courses)

IOHE (Industry Oriented Hands on Experience)

Industry Oriented hands on Training (IOHT) is designed to impart very basic industry skills in their branch of study. Industry oriented hands on Courses (IOHC) are designed to impart state of art technology/tools/platforms/skills/certifications to students. IOHC also have industry representatives as trainers. During Industry Oriented Hands on Experience (IOHE), the students go to the Industry and obtain extensive experience to work there. All IOHT, IOHC and IOHE together supplement the Course scheme, thereby, make students Industry Ready and prepare them to be Day-one, Hour-one professionals.

MOOC (Massive Open Online Course)

A Massive Open Online Course (MOOC) is taught over the internet, usually via a series of videos, assignments and quizzes, with interaction between the teacher (other than internal) and students via a forum or similar web-based community tool. The courses usually last several months and can be self-paced. These courses offer a global learning environment to the students.

6. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided in lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is 55minutes.

Lecture sessions: Lectures are delivered by traditional – chalk board method, supplemented by modern Information Communication technology (ICT) methods. The students are encouraged to ask questions and involve in group discussion to the extent allowed by the teacher. In some subjects where case study based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application oriented analytical problems. The tutorial sessions are very interactive and inculcate problem solving skills in the students.

Lab / Practical Sessions: During lab / practical sessions, the students work on prescribed list of experiments and do what they have learnt in the Lecture / Tutorial sessions.

Engineering Exploration: During Exploration course, the students identify their team members (team size 4 to 5) and the teams would be working on Problem description EPICS/EPIP (community based or campus based problems), Solution scope (Full problem/ Module), Overview of the proposed solution. The teams should complete the following phases with the deadlines. The process for competing in this course is divided into three phases listed below:

Phase 1 – Submission of Expression of Interest Criteria taken into account
Phase 2 – Submission of Proof of Concept Criteria taken into account
Phase 3 – Prototype and Final Showdown Criteria taken into account
Each year, best performers in EPICS/EPIP vertical will have option to work on paid summer internship in CEED / CURIN. Extraordinary performers qualify to work on one year paid internship in CEED / CURIN in their IV Year. Thus, the students can work through this vertical from I Year to IV Year to actually find a solution to the problem and also earn credit for their project.

Industry Oriented skills: Industry oriented skills are imparted to students in three types of courses:
IOHT (Industry Oriented Hands-on Training)
IOHC (Industry Oriented Hands – on Courses)
IOHE (Industry Oriented Hands on Experience)

IOHT: IOHT are very basic and low level industry skills which are essential for the students to build up their engineering profession on. The IOHT is placed just after I year of graduate level degree.

IOHC: IOHC are short term skill oriented courses and are more often than not, offered in association with an industry. They aim to train the students in a specific skill / platform/ tool/ technology which are stat-of-art. It fills the gap between present curricula and the specific industry needs. It also circumvents the problem of revising the curricula time and again, to align it to current industry requirements. The short duration IOHCs (2-5 days) can be offered during the academic semester and long duration IOHCs (4-6weeks) are offered as summer courses. Summer IOHCs can be taken up at the campus or at the Industry. The IOHC may result in certification by Industry in a specific skill set. HoD in consultation with Dean of the School has the authority to offer and assign IOHCs, as the case may be, for appropriate semesters or during summer, at various industries or at the campus. The students are may be given freedom to choose his/her own IOHC, but the decision of HoD is final while allotment.

IOHE: IOHE is a real Experience at the Industry. This may or may not be in a specific skill set. The placement of IOHE is in the final year of graduation. HoD in consultation with Dean of the School and the Office of External affairs (optional) has the authority to assign IOHEs, at appropriate industries. The students may be given freedom to choose his/her own IOHE, but the decision of HoD is final while allotment.

MOOC: MOOC Courses are offered to the students in their summer and winter break. The student can enroll in any of the MOOC course suggested by the department and attend the course at his/her own pace. The Students have to submit assessments online only. The evaluation strategy is different for different courses.

7. Assessment and Evaluation

The evaluation will be continuous and the weightage of various components are as given in Table 1 (For Theory courses) and in Table 2 (for Practical Courses).

Table 1: Evaluation components for Theory Courses

For Theory Courses	
Quizzes /Assignments/ Presentation/Class Test/ Open Book Test/ Case Study	10
Sessional Tests (STs)	30
End Term Examination	60
Total	**100**

There are three Sessional Tests (STs) for all theory papers, the average of best two are considered. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments' is decided by the course coordinator and HoD and is announced separately for each course. The End Term examination for practical courses includes conduct of experiment and an oral examination (viva voce).

Table 2: Evaluation Components for Practical Courses

For Lab Courses	
Lab Performance / File work	30
Lab File	10
Internal Viva – Voce	20
End Term	40
Total	100

Table 3: Evaluation Components for Engineering Exploration

For Engineering Exploration	
Identification of the Problem	10
Review the literature / Model	10
Weekly Performance	20
Working / Presentation / Project report	20
End Term Project / Working Model Display	40
Total	**100**

The medium of examination is English.

Criteria to Pass Examination: Based on the marks obtained by the student in a particular course as described in tables above, the grade in that course is obtained, in accordance with the table 4.

Table 4: Grading Scheme

Marks Range	Grade	Grade Weightage	Qualitative Meaning
80 - 100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	AB		Absent

If a student obtains grade P or above, he is declared pass in that subject. The grade F is equivalent to being fail in that subject, in which case, the student has to reappear in the end term examination of that subject again, whenever its exam is conducted again with the regular examination, after payment of appropriate examination fee.
If the student is detained from appearing in the end term examination because of shortage of attendance in the regular semester or is absent in the end term exam, his grade in that subject is 'I', till he/she appears again in the end term examination and obtains a new grade.

8. Eligibility for award of degree: In addition to conditions given in section 8 of Academic Regulations, a CGPA of 4 is required to receive degree in any of the Engineering Programs. The minimum credits to be earned are given in table 5.

Table 5: Minimum credits to be earned for award of degree in BE

Course / Year	BE in Civil Engineering
Year I	42
Year II	54
Year III	41
Year IV	45
Total	182

Acronyms	
BS	Basic Science Courses
ESC	Engineering Science courses
HU	Humanities and Social Sciences
PW	Project work
PCC	Professional core courses
PE	Professional Elective courses

9. Program Overview

This undergraduate program in Civil Engineering prepares students for the ever expanding Civil engineering fields. The graduates will have required knowledge to work in industries and will also be able take up research in related and interdisciplinary areas. The program prepares students on basic and applied sciences and also builds necessary engineering skills in areas of Structural engineering, Geotechnical engineering, Water resource engineering, and Environmental. The students get an overview of basic as well as advanced engineering concepts and also learn them to apply in real life applications. Training the students with help of a 100 % application oriented and project based learning approach remains the key strength of the program.

10. Program Outcome (POs)

The Student Outcomes for the B.E. Civil Engineering Program are the following:

- PO-01: An ability to apply knowledge of mathematics, science, and engineering
- PO-02: An ability to design and conduct experiments, as well as to analyse and interpret data
- PO-03: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- PO-04: An ability to function on multidisciplinary teams
- PO-05: An ability to identify, formulate, and solve engineering problems
- PO-06: An understanding of professional and ethical responsibility
- PO-07: An ability to communicate effectively
- PO-08: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- PO-09: A recognition of the need for, and an ability to engage in life-long learning
- PO-010: A knowledge of contemporary issues
- PO-011: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

11. Program Specific Outcomes (PSOs)

The objectives for the B.E. Civil Engineering program focus mainly on preparing engineers capable of entering and developing successfully in the workplace or on pursuing graduate studies not only in India but also in foreign companies and institutions in areas related to discipline. During the initial years of their careers, Civil Engineering graduates will:

- PSO-01: Have a successful career in Civil Engineering by demonstrating technical proficiency in the theoretical and practical knowledge of the discipline.
- PSO-02: Have a successful career in Civil Engineering and become effective communicators, team members, decision makers and leaders.

PSO-03: Understand the global impact of the profession and recognize the social responsibility of Civil Engineers.

PSO-04: Recognize the relevance of life-long learning and commit to professional development.

12. Course Scheme: Year I (Semester I) of all BE programs

Semester I				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
AM101	Engineering Mathematics I	BS	4+1+0=5	5
PH101	Engineering Physics	BS	3+1+0=4	4
ME102	Engineering Graphics	ESC	2+0+4=6	4
GEL4101	Environmental Sciences	ESC	3+0+0=3	3
CL101	English-I	HU	0+0+4=4	2
PH103	Engineering Physics Lab	BS	0+0+2=2	1
ME153	Engineering Graphics Lab	ESC	0+0+2=2	1
ASE101	Engineering Exploration (One year duration)	PW	3+1+0=4	Credits Offered Next
Total			**30**	**20**

Course Code	**Course Name**	**L-T-P**	**Credits**
AM101	**Engineering Mathematics-I**	**4-1-0**	**5**
Course Learning Outcomes (CLO)*:			
CLO1:	Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.		
CLO2:	Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.		
CLO3:	Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.		
CLO4:	Synthesize and apply multivariable vector-valued functions, their derivatives and integrals to live problems, graphically and analytically.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

AM101 Engineering Mathematics I (4-1-0), 5 Credits

Matrices, Elementary row and column transformation, Rank of matrix, Linear dependence, Consistency of linear system of equations and their solution, Characterstic equation, Cayley-Hamition theorem (without proof),Eigen values and Eigen vectors. Functions of several variables – Limit, Continuity, Partial derivatives, Total derivative, Euler's Theorem for homogeneous functions, Composite functions, Jacobians, Taylor's theorem, Errors and Increments, Maxima and minima. Double and triple integral, Change of order, Change of variables, improper Integral of 1st and 2nd kind (Beta and Gamma functions), Application to area, volume and surface, Point function, Gradient, divergence and curl of a vector and their physical interpretations, Directional Derivatives, Line, surface and volume integrals, Green's, Stoke's and Gauss divergence theorem.

Suggested Book(s):

1. The Engineering Mathematics', Vol.-1, Chitkara University Publication
2. Ramana, B. V. (2006). Higher Engineering Mathematics. Tata McGraw-Hill Education.

Course Code	Course Name	L-T-P	Credits
PH101	**Engineering Physics**	**3-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	After completing this course, the students will be able to analyze and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.		
CLO2:	The students will be able to differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.		
CLO3:	The students will be able to differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.		
CLO4:	The students will be able to describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

PH101 Engineering Physics (3-1-0), 4 Credits

Introduction, characteristics laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping, Einstein's coefficient (no derivation), various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser, Carbon dioxide laser, Semiconductor laser, concepts of Holography. Basic principle of optical fibre,

step index and graded index fibers, parameters of optical fibers, acceptance angle, acceptance cone, numerical aperture, Normalized Frequency, No. of modes, Attenuation in optical fibers, intermodal and intramodal dispersion (no derivation), optical fibers in communication. Vector and scalar fields, Gradient, divergence, curl and their physical interpretation, Gauss's theorem and Stoke's theorem (Statement only), Equation of continuity, Maxwell's equations in free space, Propagation of electromagnetic waves in free space. Frames of reference, postulates of special theory of relativity, Galilean transformation equations. Lorentz's transformation equations, inverse Lorentz's transformation equations (no derivation), length contraction, time dilation Relativistic velocity addition formula, Variation of mass with velocities (concept only), Mass energy relation. Introduction to Quantum Mechanics, Group velocity and phase velocity (No relation), de-Broglie waves, Uncertainty principle (statement only), Wave function and its significance, Normalised wave function, Schrodinger wave equations (Time dependent and Time Independent), Particle in a one dimensional box. Free electron theory (quantum theory) density of states, Fermi energy, Fermi Dirac function, Band theory of solids (introduction): metals, semiconductors, insulator, doping Intrinsic and extrinsic semiconductors, carrier concentration of semiconductors (no derivation), Hall effect (Quantitative idea). Magnetic materials, terminology and classification, Magnetic moments of an atom; orbital, spin and total, Lande's g-factor, Ferro-magnetism and related phenomena, the domain structure, the hysteresis loop, Types of magnetic materials: soft magnetic materials, hard magnetic materials. Superconductivity, introduction, Meissner effect, critical field, Critical current and Isotope effect, Types of superconductors: type-I superconductors, type II superconductors, London equations, penetration depth, Cooper pair and BCS theory, high temperature superconductors.

Suggested Book(s):

1. Malik, H. K., & Singh, A. K. (2010). Engineering physics. McGraw-Hill Education.

Course Code	Course Name	L-T-P	Credits
ME102	**Engineering Graphics**	**2-0-4**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Understand the basic sketching and drawing techniques & communicate through Engineering		
CLO2:	Construct & develop the imagination and acquire drawing skills to prepare orthographic projections of points, lines, planes and solid objects in various positions.		
CLO3:	Communicate the technical ideas through isometric drawings & orthographic projections.		
CLO4:	Develop & create the concepts of development of surfaces and sectioning of solids		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

ME102 Engineering Graphics (2-0-4), 4 Credits

Drawing of Various types of lines, principles of dimensioning, symbols, conventions, scales (plane and diagonal) Vertical and inclined lettering as per IS code of practice (SP-46) for general Engineering, Projection of points, lines, planes and solids. Sectioning of solids, Isometric Projection, Orthographic projections and development of surfaces.

Suggested Book(s):

1. Dhananjay, A. J. (2010). 'Engineering Drawing: With An Introduction To Auto Cad'. Tata McGraw Hill Education Private Limited, New Delhi.
2. Giesecke, F. E., Hill, I. L., Spencer, H. C., Mitchell, A. E., Dygdon, J. T., Novak, J. E., & Goodman, M. (2016). Technical drawing with engineering graphics. Peachpit Press, USA.
3. Madsen, D. A., & Madsen, D. P. (2016). 'Engineering drawing and design', Nelson Education, Canada.

Course Code	Course Name	L-T-P	Credits
GEL4101	**Environmental Sciences**	**3-0-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Understand the intellectual flexibility necessary to view environmental questions from multiple perspectives, prepared to alter their understanding as they learn new ways of understanding.		
CLO2:	Apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena.		
CLO3:	When faced with questions that lie beyond their current knowledge base, students will actively research data, concepts, histories, and narratives necessary for adequate consideration of the issue.		
CLO4:	Students will have mastered foundational knowledge enabling them to make sound life decisions as well as enter a career in an environmental profession or graduate school.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

GEL4101 Environmental Sciences (3-0-0), 3 Credits

Definition, Scope and Importance of environmental studies, natural resources, its types, conservation and associated problems, Equitable use of resources for sustainable lifestyles, Concept, Structure, functions and Energy flow in an ecosystem, Ecological succession, Introduction, types, characteristic features, structure and functions of Forest, Grassland , Desert and Aquatic ecosystem, Biodiversity, its types, values , threats and its conservation, study at global, National and local levels, India as a mega diversity nation ,Hot-spots of biodiversity, Bio-geographical classification and Endangered and endemic species of India, Pollution definition, Causes, effects and control measures of Air, Water, Soil, Marine ,Noise, Thermal, and Radioactive pollution, Solid waste Management–Causes, effects and control measures, Disaster management ,Water conservation, rain water harvesting, and watershed

management, Urban problems related to energy ,concern of Resettlement and rehabilitation of people, Environmental Issues and its possible solutions, Environment Protection Act, Air (Prevention and Control of Pollution) Act,-Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act ,Public awareness for Population growth, Family Welfare Programme, Environment and Human Rights, HIV/AIDS, Women and Child Welfare programs, Role of information Technology in Environment and human health, Visit to a local area to document environmental assets/River /forest grassland/hill/mountain/ /Urban/Rural/industrial/ Agricultural or any local polluted site /Study of simple eco systems/ pond, river, hill slopes, etc.

Suggested Book(s):

1. Bharucha, E. (2005). Textbook of Environmental Studies for Undergraduate Courses, Mapin Publishing Pvt. Ltd, India.
2. Rajagopalan, R. (2015). Environmental studies: from crisis to cure (No. Ed. 3), Oxford University Press, UK.
3. Masters, G. M., & Ela, W. P. (1991). Introduction to environmental engineering and science (Vol. 3), Englewood Cliffs, NJ: Pearson, USA.

Course Code	Course Name	L-T-P	Credits
PH103	**Engineering Physics Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Students will be able to co-relate practical knowledge with therotical studies.		
CLO2:	Students will achieve perfectness in experimental skills.		
CLO3:	The study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment's.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

PH103 Engineering Physics Lab (0-0-2), 1 Credit

Susceptibility of FeCl3 by Quinke's Method , e/m ratio of electron using Thomson method, Plateau curve for a GM counter, Dead time of G M counter, Absorption of beta particles in aluminum using a G M Counter, Ionization potential of mercury using a gas filled diode, Wavelength of light using Michelson's Interferometer., Resolving power of a plane transmission grating, Specific rotation of cane sugar solution using Laurent's half shade polarimeter, Laser beam characteristics like wave length, Aperture & divergence etc., Diffraction using Laser beam, Numerical aperture of a optical fiber, Attenuation & propagation losses in optical fibres.

Suggested Book(s):

1. Malik, H. K., & Singh, A. K. (2010). 'Engineering physics', McGraw-Hill Education, New Delhi.

2. Halliday, D., Resnick, R., & Merrill, J. (1981). 'Fundamentals of physics (Vol. 3)', John Wiley & Sons, New York.
3. Gersten, J. I., & Smith, F. W. (2001). 'The physics and chemistry of materials', John Wiley & Sons, New York.

Course Code	Course Name	L-T-P	Credits
ME153	**Engineering Graphics Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Introduce CAD (computer aided drafting) software and its utilities in the engineering field		
CLO2:	Perform initial software setting and able to draw 2D entities. Edit the edit the drawings using modify commands skills.		
CLO3:	Draw basic isometric drawings using auto CAD will achieve perfectness in experimental		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

ME153 Engineering Graphics Lab (0-0-2), 1 Credit

Introduction of the CAD (computer aided drafting) software and its utilities in the engineering software. Study of the various toolbar options and exercises to familiarize all the drawing tools, Study the basic initial setting and viewing of the drafting software interfaces, Use of basic entities in 2D, Uses of various modify commands of the drafting software, Dimensioning in 2D and 3D entries, Study and implementing of coordinate systems .

Suggested Book(s):

1. Dhananjay, A. J. (2010). 'Engineering Drawing: With An Introduction To Auto Cad', Tata McGraw Hill Education Private Limited, New Delhi.
2. Giesecke, F. E., Hill, I. L., Spencer, H. C., Mitchell, A. E., Dygdon, J. T., Novak, J. E., & Goodman, M. (2016). Technical drawing with engineering graphics. Prentice Hall, New York.

13. Course Scheme: Year I (Semester II) and Year II, III and IV of BE (Civil Engineering)

Semester II				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
AML102	Engineering Mathematics II	BS	4+1+0=5	5
CE101	Engineering Mechanics	PCC	4+2+0=6	4
EE103	Basics of Electrical & Electronics Engineering	ESC	3+1+0=4	3
CE102	Surveying	PCC	3+1+0=4	3
CE104	Introduction to Civil Engineering	PCC	2+0+0=2	2
EE104	Basics of Electrical & Electronics Engineering Lab	ESC	0+0+2=2	1
CE103	Surveying Lab	PCC	0+0+3=3	1
AS101	Engineering Exploration	PW	2+0+0=2	3
Total			**28**	**22**

Course Code	**Course Name**	**L-T-P**	**Credits**
AML102	**Engineering Mathematics-II**	**4-1-0**	**5**
Course Learning Outcomes (CLO)*:			
CLO1:	To analyze and correlate many real life problems mathematically and thus find the appropriate solution for them using Fourier series and Transforms (Fourier and Laplace transform).		
CLO2:	Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.		
CLO3:	Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.		
CLO4:	Student will be able to analyze functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

AML102 Engineering Mathematics-II (4-1-0), 5 Credits

Differential equations of first order and first degree – exact, linear and Bernoulli. Applications to Newton's Law of cooling, Law of natural growth and decay, orthogonal

trajectories. Second and higher order ordinary linear differential equations with constant coefficients –complementary function – Particular integrals (standard types) – Cauchy-Euler differential equation. Simultaneous liner differential equations (two variables) with constant coefficients.Solutions of second order ordinary linear differential equations with variable coefficients ,application to SHM,RLC circuit, Simple pendulum, Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series. Laplace Transform, Inverse transforms properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and Integration of transforms,. Limits, Continuity, Derivative of Complex Functions, Analytic Function, Cauchy Riemann Equation, Harmonic Functions, Conformal Mapping, Complex Integration, Cauchy's Theorem, Cauchy Integral formula, Taylors and Laurent's Expansion, Singular points, Poles Residue, Complex Integration using the method of Residue, Formation of partial differential equations – Equations of first Order – Lagrange's linear equation – Charpit's method – Standard types of first order non-linear partial differential equations.Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral – classification of PDE of second order – parabolic, elliptic and hyperbolic equations – Solution by separation of variables. Solutions of one-dimensional heat and wave equations and two-dimensional Laplace equation using Fourier series.

Suggested Book(s):

1. Ramana, B. V. (2006). Higher Engineering Mathematics. Tata McGraw-Hill Education, New Delhi.
2. Kreyszig, E. (2010). Advanced Engineering Mathematics. John Wiley & Sons, USA.

Course Code	Course Name	L-T-P	Credits
CE101	**Engineering Mechanics**	**4-1-0**	**5**
Course Learning Outcomes (CLO)*:			
CLO1:	Determine resultants and apply conditions of static equilibrium to plane force systems		
CLO2:	Identify and quantify all forces associated with a static framework		
CLO3:	Solve problems in kinematic and dynamic systems		
CLO4:	Understand basic kinematics concepts – displacement, velocity and acceleration.		
CLO5:	Understand basic dynamics concepts – force, momentum, work and energy.		
CLO6:	Undertake laboratory practical and report results		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE101 Engineering Mechanics (4-2-0), 6 Credits

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples

and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy
Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;
Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;
Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.
Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.
Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).
Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;
Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;
Tutorials from the above modules covering,
To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack.

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
8. Bansal R.K. (2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications.

Course Code	Course Name	L-T-P	Credits
EE103	**Basics of Electrical & Electronics Engineering**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Compute the Current and voltages in DC circuits using Mesh & Nodal analysis.		
CLO2:	Solve numerical problems based on digital number systems and Boolean algebra		
CLO3:	Identify & analyze the RL, RC & RLC circuit parameters like current, voltage, impedance, power factor & phase angle.		
CLO4:	Differentiate single phase & three phase systems used in homes & industries and understand the working principle of different motors and concept of electrical protection.		
CLO5:	Describe the principle behind the working of Semiconductor diode.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

EE103 Basics of Electrical & Electronics Engineering (3-1-0), 3 Credits

Analysis of DC Circuits: Ohm's law, Kirchhoff's law – KCL and KVL, Analysis of DC circuits using Mesh and Nodal analysis,

Analysis of AC Circuits: Introduction to Alternating Voltage and Current—Waveform terms and Definitions. Root mean square, peak value, average value of A.C, phasor representation, and rectangular and polar forms of alternating quantities. Analysis of pure resistive, inductive and capacitive circuits. Analysis of series R-L, R-C and R-L-C circuits. Introduction to three phase systems-types of connections

Electromechanics: Definition of emf, mmf, flux and reluctance, Faraday's laws, self and mutual inductance. Transformer – principle, construction & working, DC Motor: Principle, Construction, Working, Three Phase

Induction Motors: Principle, Construction, Working

Electrical Protection: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing, Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup

Electronic Components and Devices: Introduction to semiconductor theory & PN junction. Working principle of Light Emitting Diode, Photodiode.

Digital Electronics and linear ICs: Number Systems: binary, octal and hexadecimal. Logic gates (74XX series), Implementation of Boolean expression using Universal gates.

Text/Reference Books:

1. M.S. Sukhija, T.K. Nagsarkar, 2012 'Basic Electrical and Electronics Engineering', Oxford University.

'2. Muthusubramanian, R., & Salivahanan, S. (2000). Basic Electrical and Electronics Engineering (Vol. 107, p. 6). Tata Mcgraw Hill, New Delhi.

3. 'Kulshreshtha, D. C. (2012). Basic Electrical Engineering. Tata McGraw Hill.

Course Code	Course Name	L-T-P	Credits
CE102	**Surveying**	**3-1-0**	**4**
Course Learning Outcomes (CLO)*:			
	On the completion of this course, students will be able to:		
CLO1:	Skill enhanced to carry out preliminary surveying in the field of civil engineering applications such as structural, highway engineering and geotechnical engineering.		
CLO2:	Plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.		
CLO3:	Use various conventional instruments involved in surveying with respect to utility and precision.		
CLO4:	Plan a survey for applications such as road alignment and height of the building.		
CLO5:	Undertake measurement and plotting in civil engineering		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE102 Surveying (3-1-0), 3 Credits

Introduction to Surveying: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, 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. Triangulation and Trilateration (6 Hours)**:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station -

reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

Curves (6 hours) Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Modern Field Survey Systems (8 Hours): 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, Co-ordinate transformation, accuracy considerations.

Photogrammetry Surveying (8 Hours): Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper
prints, mapping using stereo plotting instruments, mosaics, map substitutes.

Text/Reference Books:

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011.
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.
4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5. Anji Reddy, M., Remote sensing and Geographical information system, B.S.Publications, 2001.
6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Course Code	Course Name	L-T-P	Credits
CE104	**Introduction to Civil Engineering**	**2-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Introduction to what constitutes Civil Engineering.		
CLO2:	Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering.		
CLO3:	Student will be able to illustrate the types, uses and properties of various building materials		
CLO4:	Providing inspiration for doing creative and innovative work.		
CLO5:	Student will be able to explain the method of construction of different components of a building.		
CLO6:	Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE104 Introduction to Civil Engineering (2-0-0), 2 Credits

Basic Understanding: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career

History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers.

Overview of National Planning for Construction and Infrastructure Development: Position of construction industry vis-à-vis other industries, five-year plan outlays for construction; current budgets for infrastructure works;

Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities.

Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes

Basics of Construction Management & Contracts Management: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management

Environmental Engineering & Sustainability: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction;

Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling

Hydraulics, Hydrology &Water Resources Engineering: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects

Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures

Power Plant Structures: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects

Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;

Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;

Traffic &Transportation Engineering: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under

heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.

Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non- Destructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs.

Computational Methods, IT, IoT in Civil Engineering: Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD, GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …)

Industrial lectures: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning;

Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction.

Text/Reference Books:

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract
2. The National Building Code, BIS, (2017)
3. RERA Act, (2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications 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. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.
11. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency
13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
14. Bare text (2005), Right to Information Act
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
16. K.M. Desai (1946), The Industrial Employment (Standing Orders) Act
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
18. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd

19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
20. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
21. Engineering Ethics, National Institute for Engineering Ethics, USA
22. www.ieindia.org
23. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri -CEIBS
25. CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm
26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
27. Contract &Agreements , http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
28. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
29. Business & Personal Law. Chapter 7. "How Contracts Arise", http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
30. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
31. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.html.

Course Code	Course Name	L-T-P	Credits
EE104	**Basics of Electrical & Electronics Engineering Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Students would know the basics components of electrical elements, equipment's and their functionality with applications.		
CLO2:	Possess an ability to analyse and characterize the electrical equipment's and instruments basics for their implementation.		
CLO3:	Possess an ability to analyse and characterize the Logic circuits for their implementation.		
CLO4:	Possess an ability to perceive the concept of Fuse/MCB characteristics for different fault currents		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

EE104 Basics of Electrical & Electronics Engineering Lab (0-0-2), 1 Credit

Introduction to various basic electronic components and use of multimeter.

Verification of Kirchhoff's laws in D.C circuits

(A) Analysis of AC Circuits:

To find the voltage, current relationship and power factor of a given R-L-C series circuit.

Measurement of Power.

To start and reverse the direction of rotation of three phase induction motors.

Measurement of self-inductance, mutual inductance and coupling coefficient of windings.
Analyze the truth tables of various basic digital gates.
Plot and analyze the forward and reverse characteristics of PN junction Si and Ge diodes and determine their knee and breakdown voltages.
To plot the temperature versus resistance characteristics for RTD.
To study the concept of electrical protection devices such as Fuse and MCB.
To perform open- circuit and short circuit test on a transformer and determine (i) efficiency, (ii) voltage regulation.
To analyze Zener diode as voltage regulator.

Text/Reference Books:

1. Kulshreshtha, D. C. (2009) Basic Electrical Engineering, Tata McGraw Hill.

Course Code	Course Name	L-T-P	Credits
CE103	**Surveying Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Survey an area under various topography and obstructions.		
CLO2:	Prepare the plan or map of the area surveyed.		
CLO3:	Analyse, report and where appropriate distribute the survey errors.		
CLO4:	Perform instruments checks to ensure they meet the specifications.		
CLO5:	Acquire skills in surveying practice.		
CLO6:	To make student for industry ready in field of surveying and thus enhances employability.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE103 Surveying Lab (0-0-2), 1 Credit

1. Measurement of distance and determination of area of polygon by chaining.
2. Traversing with prismatic compass (Open & Closed traverse)
3. Plane table surveying by radiation method and Intersection method
4. Profile Leveling
5. Carry out the Fly Leveling
6. Carry out the Contouring in the field
7. Measurement of horizontal and vertical angles using theodolite
8. Setting out the simple curve in different methods (Chord & Rankine's method)
9. Measurement of Horizontal, Vertical Angles and area using Total Station
10. Observations using GPS

Text/Reference Books:

1. Lab manual Geodesy- I (surveying- I), Chitkara University
2. Lab Manual Geodesy- II (Surveying- II), Chitkara University

SEMESTER III				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
CE201	Fluid Mechanics	PCC	3+1+0=4	3
CE202	Mechanics of solids	PCC	3+1+0=4	3
CE203	Building Material and Construction	PCC	3+0+0=3	3
CE204	Structural Analysis I	PCC	4+1+0=5	4
HU201	Human Rights and values	HU	2+0+0=2	2
CE205	Fluid Mechanics lab	PCC	0+0+2=2	1
CE206	Mechanics of solids lab	PCC	0+0+2=2	1
CE207	Building Material and Construction Lab	PCC	0+0+2=2	1
CE208	Structure analysis-I Lab	PCC	0+0+2=2	1
CE209	Computer Aided Design I	PCC	One week course	2
CL201	English-II	HU	0+0+4=4	2
GE111	Environmental Geotechnics	PCC	One week course	2
AS102	Engineering Exploration II (One year duration)	PW	0+0+1=1	Credits Offered Next semester
	Total		**32**	**25**

Summer Courses

ME152	Manufacturing Practices Lab	ESC	0+0+4=4	2
CE210	Survey Camp	PCC	Summer Camp	5

Course Code	**Course Name**	**L-T-P**	**Credits**
CE201	**Fluid Mechanics**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	After completion of course student will be able to:		
CLO1:	Solve hydrostatic problems.		
CLO2:	Describe the physical properties of a fluid		
CLO3:	Calculate the pressure distribution for incompressible fluids.		
CLO4:	Calculate the hydrostatic pressure and force on plane and curved surfaces.		
CLO5:	Demonstrate the application point of hydrostatic forces on plane and curved surfaces		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE201 Fluid Mechanics, (3-1-0), 3 Credits

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; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

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; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber *Number and Euler Number; Buckingham's* π-Theorem.

Text/Reference Books:

1. Ojha, C., Berndtsson, R., & Chandramouli, P. (2010). Fluid mechanics and Machinery. Oxford University Press.

2. Modi P.N. & Seth S.M. (2002), 'Hydraulics & Mechanics', Standard Book House, New Delhi.

3. Subramanya, K. (1993). Theory and applications of fluid mechanics. Tata McGraw-Hill.

4. Finnemore, E. J., & Franzini, J. B. (2002). Fluid mechanics with engineering applications (Vol. 10, p. 707). New York: McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CE202	**Mechanics of solids**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Determine resultants and apply conditions of static equilibrium to plane force systems.		
CLO2:	Identify and quantify all forces associated with a static framework.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE202 Mechanics of solids, (3-1-0), 3 Credits

Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

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.

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined
loading of bending and torsion. Analysis of close-coiled-helical springs.

Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

Text/Reference Books:

1. Timoshenko, S., & MacCullough, G. H. (1949). Elements of strength of materials.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, "R. C. (2004). Mechanics of Materials", 6th ed. East Rutherford, NJ: Pearson Prentice Hall.
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner (1979). "An Introduction to the Mechanics of Solids" New York, NY: McGraw Hill.
5. Laboratory Manual of Testing Materials - William Kendrick Hall

6. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. (2018). Mechanics of Materials. Instructor.
7. Subramanian, R. (2016) "Strength of Materials", Oxford University Press, New Delhi.

Course Code	Course Name	L-T-P	Credits
CE203	**Building Material and Construction**	**3-0-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Evaluate various properties of concrete		
CLO2:	Evaluate various properties of the basic construction materials such as brick, stone timber, metals		
CLO3:	Develop skills to work in field of building materials quality control.		
CLO4:	Evaluate the properties of miscellaneous materials such as bitumen, paints, distempering, materials for structural repairs		
CLO5:	Perform various quality control tests for the various civil engineering materials by performing different lab tests on materials.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE203 Building Material and Construction, (3-3-0), 3 Credits

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection; Sub Structure Construction- Techniques of Box jacking – Pipe Jacking – under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation; Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks; Design, production, application, specification, and quality control of construction materials unique to civil engineering. Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes.

Text/Reference Books:

1. Brian Cooke (2011) "Construction Practice", Wiley-Blackwell,.

2. Gurcharan Singh, (2017) “Building Construction And Material”, Standard Book House.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain (2016). “Building Construction”, Laxmi Publications.

Course Code	Course Name	L-T-P	Credits
CE204	**Structural Analysis I**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Calculate deformation of statically determinate structures using geometric and energy methods.		
CLO2:	Analyze statically indeterminate beams using classical and conventional methods.		
CLO3:	Develop qualitative diagrams showing the displaced shape, bending moments and support reactions for an indeterminate plane frame.		
CLO4:	Develop effective structural analysis skills for building design activities.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE204 Structural Analysis I (4-1-0), 4 Credits

Degree of static and kinematic indeterminacies for plane frames - analysis of indeterminate pin-jointed frames - rigid frames – Virtual work and energy principles – Moving loads for determinate beams – Different load cases - Influence lines for reactions in statically determinate structures – influence lines for member forces in pin jointed frames – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads. - influence lines of indeterminate beams using Muller Breslau principle. – Arches as structural forms – Examples of arch structures – Types of arches – Analysis of three hinged, two hinged – Slope and Deflection method - Continuous beams and rigid frames (with and without sway) – Symmetry and antisymmetry –Simplification for hinged end –Support displacements – Moment distribution method - Distribution and carryover of moments –Stiffness and carry over factors – Application of simple problems of beams and frames.

Text/Reference Books:

1. Wang C.K., (1983). 'Intermediate Structural Analysis’, Tata McGraw Hill, New Delhi.
2. Punmia B.C, Jain R.K., (2005). ‘Strength of Materials and theory of structures Vol I & II’, Laxmi Publication New Delhi.
3. W. SPENCER, (1988). “Fundamental Structural Analysis”, Springer-Verlag New York.
4. Todd, Joseph Derwent, (1974). “Structural Theory and Analysis”, Palgrave Macmillan UK.

Course Code	Course Name	L-T-P	Credits
HUL201	**Human Values & Professional Ethics/(Human Rights and values)**	**2-0-0**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	The students will be able to get awareness on human values and professional ethics		
CLO2:	The students will understand the core values that shape their ethical behaviour.		
CLO3:	The Students will be able to take active part in social, political, economic and cultural activities with responsibility.		
CLO4:	The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

HUL201 Human Rights and values (2-0-0) 2 Credits

Concept of human values and value education, Personal development, Character formation towards positive personality, Value education towards national and global development - national , Professional, Religious and Social Values, Impact of global development on ethics and values, Therapeutic measures, Human rights – general, Human rights of women and children, Institutions for implementation.

Suggested Book(s):

1. Freeman, Michael (2002). 'Human rights: An interdisciplinary approach', Cambridge: Polity Press, Cambridge.
2. Grose, D. N. (2005). 'A text book of value education' Dominant Publishers and Distributors, New Delhi.
3. Austrian Development Agency (2010). 'Human Rights Manual', Vienna.

Course Code	Course Name	L-T-P	Credits
CE205	**Fluid Mechanics lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
	Students who successfully complete this course will have demonstrated an ability to:		
CLO1:	Identify, name, and characterize flow patterns and regimes.		
CLO2:	Understand basic units of measurement, convert units, and appreciate their magnitudes.		
CLO3:	Utilize basic measurement techniques of fluid mechanics.		
CLO4:	Discuss the differences among measurement techniques, their relevance and applications.		
CLO5:	Prove good understanding of concepts and their applications in the		

	laboratory.
CLO6:	Compare the results of analytical models introduced in lecture to the actual behaviour of real fluid flows and draw correct and sustainable conclusions.
CLO7:	Understand ethical issues associated with decision making and professional conduct.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE205 Fluid Mechanics lab (0-0-2), 1 Credit

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli's Theorem
6. Venturimeter
7. Orifice meter
8. Flow Visualisation -Ideal Flow
9. Velocity distribution in pipes
10. Laminar Flow

Text/Reference Books:

1. Ojha, C.S.P., Berndtsson, Chadramouli, P. N., R (2010). Fluid Mechanics and Machinery, Oxford University Press.
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.
3. Subramanya, K. (2001) Theory and Applications of Fluid Mechanics, Tata McGraw Hill
4. Daugherty, R.L., Franzini, J.B ., Finnemore, E.J., (2001). Fluid Mechanics with Engineering Applications, Mc Graw Hill**.**

Course Code	Course Name	L-T-P	Credits
CE206	**Mechanics of solids lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
	At the end of the course, the student will be able to:		
CLO1:	Conduct tension test on Materials like steel etc.		
CLO2:	Conduct compression tests on spring, wood and concrete		
CLO3:	Conduct flexural and torsion test to determine elastic constants		
CLO4:	Determine hardness of metals		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE206 Mechanics of solids lab (0-0-2), 1 Credit

1. Tension test
2. Bending tests on simply supported beam and Cantilever beam.

3. Compression test on concrete
4. Impact test
5. Shear test
6. Determination of torsion and deflection,
7. Determination of shear forces in beams,
8. Determination of bending moments in beams,
9. Measurement of strain in a bar
10. Bend test steel bar;
11. Yield/tensile strength of steel bar;

Text/Reference Books:

1. Timoshenko, S. and Young, D. H, (1968) "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., (1976) "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C., (2004) "Mechanics of Materials". 6th ed. East Rutherford, NJ: Pearson Prentice Hall,
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. (1979) "An Introduction to the Mechanics of Solids". 2nd ed. New York, NY: McGraw Hill.
5. Laboratory Manual of Testing Materials - William Kendrick Hall

Course Code	Course Name	L-T-P	Credits
CE207	**Building Material and Construction Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Able to check the quality of building materials		
CLO2:	Able to impart the knowledge about the characteristics, sources and defects in various materials used for construction purposes.		
CLO3:	Able to design and test the materials either in the laboratory or in the field beforetheir actual use at the site.		
CLO4:	Able to attain the knowledge of different building materials, their classification.		
CLO5:	Enhances skills in quality control and thus helps in employability.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE207 Building Material and Construction Lab, (0-0-2), 1 Credit

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality control
3. Compressive strength test on aggregates
4. Tension III - Heat Treatment
5. Torsion test
6. Hardness tests (Brinnel's and Rockwell)

7. Tests on closely coiled and open coiled springs
8. Theories of Failure and Corroboration with Experiments
9. Concrete Mix Design as per BIS

Text/Reference Books:

1. Bhavikatti, S. S. (2009). 'Design Of Steel Structures (By Limit State Method As Per Is: 800 2007)', IK International Pvt Ltd, India.
2. Kuldeep Saluja, (2015), 'Building Construction', Diamond Pocket Books, India.
3. Allen, E., & Iano, J. (2013). 'Fundamentals of building construction: materials and methods', John Wiley & Sons, New Jersey.

Course Code	Course Name	L-T-P	Credits
CE208	**Structure Analysis-I Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
	Students who successfully complete this course will be able to:		
CLO1:	Distinguish between statically determinate and indeterminate structures.		
CLO2:	Apply equations of equilibrium to structures and compute the reactions.		
CLO3:	Draw the shearing force and bending moment diagrams.		
CLO4:	Calculate the internal forces in cable and arch type structures.		
CLO5:	Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.		
CLO6:	Calculate the deflections of truss structures, beams, and portal frames.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE208 Structure Analysis-I Lab (0-0-2), 1 Credit

Deflection of a pine connected truss, Flexural rigidity (E1) of a given beam, Moment-Area Theorems for slope and deflection of a beam, Different types of struts, Experimentally the influence line for the horizontal thrust in a two hinged arch, Elastic displacement of curved members, Displacement of the roller end in a curved beam, Theoretical verification of the above experiments.

Suggested Book(s):

1. Wang C.K., (1983). 'Intermediate Structural Analysis', Tata McGraw Hill, New Delhi.
2. Punmia B.C, Jain R.K., (2005). 'Strength of Materials and theory of structures Vol I & II', Laxmi Publication New Delhi.
3. W. SPENCER, (1988). "Fundamental Structural Analysis", Springer-Verlag, New York.
4. Todd, Joseph Derwent, (1974). "Structural Theory and Analysis", Palgrave Macmillan UK.

Course Code	Course Name	L-T-P	Credits
GE111	**Environmental Geotechnics**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
	Students who successfully complete this course will be able to:		
CLO1:	To provide main concepts and information on environmental Geotechnics (soil compaction, slope stability analysis, mechanical properties of Geosynthetic, geotechnical aspects of landfill design and construction).		
CLO2:	Evaluate the factor of safety of a slope;		
CLO3:	Design the main geotechnical works involved in a landfill;		
CLO4:	Chose and use Geosynthetic in a properly manner.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

GE111 Environmental Geotechnics, 2 Credits

Landfill clay liners and Geosynthetics, Contaminated land assessment, Soil remediation, Groundwater remediation, Evaluation – Project presentations and examination.

Suggested Text/Reference Books:

1. Environmental Geotechnics by D. N. Singh, Indian Institute of Technology, Bombay
2. Environmental Geotechnics in Practice: Introduction and Case Studies by R. W. Sarsby, ICE Publishing, 2019

Course Code	Course Name	L-T-P	Credits
CE391	**Computer Aided Design I**	**One week**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Demonstrate basic concepts of the AutoCAD software		
CLO2:	Apply basic concepts to develop construction (drawing) techniques		
CLO3:	Ability to manipulate drawings through editing and plotting techniques		
CLO4:	Understand geometric construction		
CLO5:	Produce template drawings		
CLO6:	Produce 2D Orthographic Projections		
CLO7:	Understand and demonstrate dimensioning concepts and techniques		
CLO8:	Understand Section and Auxiliary Views		
CLO9:	Become familiar with the use of Blocks, Design Center, and Tool Palettes		
CLO10:	Become familiar with Solid Modeling concepts and techniques.		
CLO11:	To acquire skills in Drafting and thus make student industry ready.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

Computer Aided Design I, 2 credits

Syllabus Content

Basic concepts of AutoCAD tools-Basic drawing-drawing of various building elements like slab, beam, columns, footing and stair cases etc.-Building plans and elevation-design projects.

Course Code	Course Name	L-T-P	Credits
ME152	**Manufacturing Practices Lab**	**0-0-4**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Explain the use of measuring and bench fitting tools.		
CLO2:	Show the use of safety equipment during workshop practice.		
CLO3:	Describe the basic concepts of different types of welding.		
CLO4:	Display the ability to use different basic machining operations keeping all safety precautions in mind.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

ME152 Manufacturing Practices Lab, (0-0-4), 2 Credits

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
2. CNC machining, Additive manufacturing.
3. Fitting operations & power tools
4. Electrical & Electronics
5. Carpentry
6. Plastic moulding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, (2002) "Manufacturing Engineering and Technology", Pearson Education India Edition.
3. Gowri P. Hariharan and A. Suresh Babu, (2008) Manufacturing Technology – I Pearson Education.
4. Roy A. Lindberg, (1998) "Processes and Materials of Manufacture", 4th edition, Prentice Hall India.

Course Code	Course Name	L-T-P	Credits
AS102	**Engineering Exploration**	**0-0-4**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Students will able to apply material from their discipline to the design projects.		
CLO2:	Students will get an appreciation of the role that their discipline can play in social contexts.		
CLO3:	To get awareness of professional ethics and responsibility.		
CLO4:	Demonstrate the ability to work in a team based small projects and effectively use.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

SEMESTER IV				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
CE211	Design of Concrete Structures I	PCC	4+1+0=5	4
CE212	Structural Analysis II	PCC	4+1+0=5	4
CE213	Hydrology and Water Resources Engineering	PCC	3+1+0=4	3
CE214	Environmental Engineering	PCC	4+1+0=5	4
HU211	Cyber Security	ESC	2+0+0=2	2
CE215	Hydraulic Engineering	PCC	3+1+0=4	3
CE216	Design of Concrete structures lab	PCC	0+0+2=2	1
CE217	Environmental Engineering Lab	PCC	0+0+2=2	1
AS102	Engineering Exploration II	PW	0+0+1=1	2
	Total		**28**	**22**

Course Code	Course Name	L-T-P	Credits
CE211	**Design of Concrete Structures I**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
	Students who successfully complete this course will be able to:		
CLO1:	Identify and compute the main mechanical properties of concrete and steel.		
CLO2:	Identify and calculate the design loads and distribution.		
CLO3:	Apply the strength method to design R.C. structural members.		
CLO4:	Analyze and design R.C. beams for flexure and shear.		

CLO5:	Analyze and design short and slender R.C. columns.
CLO6:	Analyze and design R.C. slabs, footings.
CLO7:	Apply relevant IS Code provisions to ensure safety and serviceability of structural elements.
CLO8:	To acquire skills in basic civil engineering design practice.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE211 Design of Concrete Structures I (4-1-0), 4 Credits

Study of the strength, behavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method, Rectangular and T-sections, Beams with reinforcement in compression, One-way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept, Development length of bars; Design of sections in torsion. Design of two-way slabs; Design of flat slab – direct method; Circular slab; Slab type staircase, Placement of reinforcement in slabs; Voided slab. Design of compression members, Short column, Columns with uni-axial and bi-axial bending; Long columns, use of design charts. Design of foundation; Wall footing, Isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable.

Suggested Book(s):

1. Jain A.K., (2009) 'Reinforced Concrete Design - Limit State Method', Nem Chand Brothers, Roorkee.
2. Sinha S.N., (2002). 'RC Design', Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Gu, Xianglin, Jin, Xianyu, Zhou, Yong. (2016), "Basic Principles of Concrete Structures", Springer-Verlag Berlin Heidelberg, China.
4. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.

Course Code	**Course Name**	**L-T-P**	**Credits**
CE212	**Structural Analysis II**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
	The student after undergoing this course will be able to:		
CLO1:	To understand analysis of indeterminate structures and adopt an appropriate structural analysis technique		
CLO2:	Determine response of structures by classical, iterative and matrix methods		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE212 Structural Analysis II (4-1-0), 4 Credits

Analysis of building frames – Kani's method – Stiffness matrix method - Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two) – Flexibility matrix method –Application to simple problems of beams and frames - Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two) – Cables and suspension bridges - Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables – suspension bridges with two and three hinged stiffening girders – Introduction to finite element method for plane stress and plane strain - Introduction – Discretisation of a structure – Displacement functions – Truss element –Beam element.

Suggested Book(s):

1. Yuan Yu Hsieh (1987). Elementry Theory of Structures, 3rd edition, Prentice Hall, New York.
2. Ghali, A., Neville, A. M., (1987). 'Structural Analysis (Unified Classical and Matrix Approach)', Chapman and Hall Ltd, Uk.
3. Menon, Devdas., (2008). 'Structural Analysis Structural Analysis', Narosa Publishing House Pvt. Ltd., New Delhi.
4. Menon, Devdas., (2009). 'Advanced Structural Analysis', Narosa Publishing House, New Delhi. House, New Delhi.

Course Code	Course Name	L-T-P	Credits
CE213	**Hydrology and Water Resources Engineering**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Provide a background in the theory of hydrological processes and their measurement		
CLO2:	Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management		
CLO3:	An ability to manipulate hydrological data and undertake widely-used data analysis. a systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure, analyze and forecast their variability; and the appropriate contexts for their application.		
CLO4:	Can define the key components of a functioning groundwater, can determine the main aquifer properties – permeability, transmissivity		

	and storage Identify geological formations capable of storing and transporting groundwater.
CLO5:	Different methods and importance of rain water harvesting.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE213 Hydrology and Water Resources Engineering (3-1-0), 3 Credits

Introduction - hydrologic cycle, water-budget equation, history of hydrology, 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, deptharea- duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual 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.

Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

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. 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.Subramanya, K. (2013). Engineering Hydrology, 4e. Tata McGraw-Hill Education, India.
2. Mutreja, K. N. (1986). Applied Hydrology Tata McGraw Hill Publication Cooperative Ltd. New Delhi, 40-109.
3.K Subramanya, 1990, "Water Resources Engineering through Objective Questions", Tata Mc-Graw Hill.
4. Asawa, G. L. (1993). Irrigation engineering. Wiley Eastern Limited.
5. Mays, L. W. (2010). Water resources engineering. John Wiley & Sons.
6. Zimmerman, J. D. (1966). Irrigation. In Irrigation. New York, London, Sydney: John Wiley and Sons, Inc.
7. C S P Ojha, R Berndtsson and P Bhunya, 2008, "Engineering Hydrology", Oxford.

Course Code	Course Name	L-T-P	Credits
CE214	**Environmental Engineering**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Understand different methods are used to purify the water and rectify the waterwhich improves the standard and living style of the community.		
CLO2:	Able to determine the population forecast for a city to meet its water requirement.		
CLO3:	Able to design water and waste water treatment plant by different methods.		
CLO4:	Able to know about the drainage and plumbing system in commercial, residentialand industrial area		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE214 Environmental Engineering (4-1-0), 4 Credits

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

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, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Air - Composition and properties of air, Quantification of air pollutants, monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Noise- Basic concept, measurement and various control methods.

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. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Text/Reference Books:

1. Gilbert M Masters (1997), Introduction to Environmental Engineering and Science (2nd Edition), Prentice Hall.

2. Vesilind P Aarne (1997), Introduction to environmental engineering, PWS Publishing Company, Boston

3. Tchobanoglous, G., Peavy, H. S., & Rowe, D. R. (1985). Environmental engineering. McGraw-Hill Interamericana.

4. Metcalf, I. N. C. (2003). Wastewater engineering; treatment and reuse. McGraw-Hill.

5. India. Ministry of Urban Development. Expert Committee, Central Public Health, & Environmental Engineering Organisation (India). (1999). Manual on water supply and treatment. Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development.

6. S.M. Patil, 1999, "Plumbing Engineering. Theory, Design and Practice", Entrepreneurial Development: Khanka S.S. S.Chand.

7. Tchobanoglous, G., Theisen, H., Vigil, S. A., & Alaniz, V. M. (1993). Integrated solid waste management: engineering principles and management issues (Vol. 4). New York: McGraw-Hill.

8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Course Code	Course Name	L-T-P	Credits
HU211	**Cyber Security**	**2-0-0**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	An ability to analyze a problem, and to identify and define the computing requirements appropriate to its solution.		
CLO2:	An ability to design, implement and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.		
CLO3:	An ability to communicate effectively with a range of audiences about technical information.		
CLO4:	An ability to make informed judgements in computing practice based on legal and ethical principles.		
CLO5:	An ability to analyze and evaluate systems with respect to maintaining operations in the presence of risks and threats.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

HU211 Cyber Security (2-0-0), 2 Credits

Introduction to Cyber Crime, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Classifications of Cybercrimes, Legal Perspectives, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Survival Mantra for the Netizens.

Cyber offenses: Introduction, How Criminals Plan the Attacks? Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnetsthe Fuel for Cybercrime; Cloud Computing Cybercrime: Proliferation of Mobile and Wireless devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era.

Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Security Implications for Organizations, 3 14% Organizational Security Polices and Measures in Mobile Computing Era.

Laptops Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and D DoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Cost of Cybercrimes and IPR Issues: Lessons for Organizations, Web Threats for Organizations, Security and Privacy Implications from Cloud Computing, Social Media Marketing: Security Risks and Perils for Organizations, Social Computing and the Associated Challenges for Organizations, Protecting People's Privacy in the Organization,

Organizational Guidelines for Internet Usage, Safe Computing Guidelines and Computer Usage Policy, Incident Handling: An Essential Component of Cyber Security.
Forensics: Best Practices for Organizations, Media and Asset Protection, Importance of Endpoint Security in Organizations, Cybercrime and Cyber terrorism: Social, Political, Ethical and Psychological Dimensions, Introduction, Intellectual Property in the Cyberspace, The Ethical Dimension of Cybercrimes, and The Psychology, Mindset and Skills of Hackers and Other Cyber criminals. Cybercrime: Illustrations, Examples and Mini-Cases.

Suggested Book(s):

1. 'Introduction to cyber security: stay safe online', The Open University, Asia Pacific Holdings Private Limited (India).
2. Perry, A. M., 'Online Safety: Scams, SPAM, Viruses and Clouds', Asia Pacific Holdings Private Limited (India).
3. 'The Quick Guide to Cloud Computing and Cyber Security ' Pistorious, Marcia, R.T., Asia Pacific Holdings Private Limited (India).

Course Code	Course Name	L-T-P	Credits
CE215	**Hydraulic Engineering**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Ability to develop the open channel flow equations from the basic conservation equations.		
CLO2:	Ability to explain the terms of the open channel flow equations and explain the interactions among the terms.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE215 Hydraulic Engineering (3-1-0), 3 Credits

Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.
Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.
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.
Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "*Most economical section of ch*annel. Computation of Uniform flow, Normal depth.

Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

Hydraulic Jump- 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, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow- Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation,

Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem.

Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web based modelling in water resources engineering.

Text/Reference Books:

1. Modi P.N. & Seth S.M. (2002), 'Hydraulics & Mechanics', Standard Book House, New Delhi.

2. Subramanya, K. (1993). Theory and applications of fluid mechanics. Tata McGraw-Hill.

3. Subramanya, K. (1982). Flow in Open Channels, 3e. Tata McGraw-Hill Education.

4. Perry, B. (1960). Open-Channel Hydraulics. Ven Te Chow. McGraw-Hill, New York, 1959. xviii+ 680 pp. Illus. $17.

5. Burnside, C.D., 1971 "*Electromagnetic Distance Measurement*," Beekman Publishers.

Course Code	Course Name	L-T-P	Credits
CE216	**Design of concrete structure lab**	**0-0-2**	**1**

Course Learning Outcomes (CLO)*:	
CLO1:	Able to check quality of constituent material of concrete.
CLO2:	Able to design a concrete mix.
CLO3:	Able to perform laboratory tests for properties of fresh and hardened concrete.
CLO4:	Students will achieve perfectness in experimental skills.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE216 Design of concrete structure lab (0-0-2), 1 Credit

Syllabus Content

1. Workability test of Concrete by Slump test
2. Workability test of Concrete by compaction factor test
3. Workability test of Concrete by flow table test
4. Cube test of concrete (Nominal mix)
5. Cylinder test for concrete (Nominal mix).
6. Split tensile strength test of concrete
7. Prism test for determining modulus of rupture of concrete
8. Design of Concrete Mix (As per Indian Standard Method)
9. Failure of RC beams in bending by two point and one point loading
10. Failure of RC beam under shear with shear reinforcement

Course Code	Course Name	L-T-P	Credits
CE217	**Environmental Engineering Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
	Students who successfully complete this course will be able to:		
CLO1:	Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems, and thus enhances skills of students and make them industry read.		
CLO2:	Statistically analyze and interpret laboratorial results.		
CLO3:	Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.		
CLO4:	Understand and use the water and wastewater sampling procedures and sample preservations.		
CLO5:	Obtain the necessary background for subsequent courses in environmental engineering.		

CLO6:	Understand the impact of water and wastewater treatment on people and the environment.
CLO7:	Understand and apply ethical issues associated with decision making and professional conduct in the laboratorial and field environment.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE217 Environmental Engineering Lab (0-0-2), 1 Credit

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile,inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Gilbert M Masters (1997), Introduction to Environmental Engineering and Science (2nd Edition), Prentice Hall.
2. Vesilind P Aarne (1997), Introduction to environmental engineering, PWS Publishing Company, Boston
3. Tchobanoglous, G., Peavy, H. S., & Rowe, D. R. (1985). Environmental engineering. McGraw-Hill.
4. Metcalf, I. N. C. (2003). Wastewater engineering; treatment and reuse. McGraw-Hill.
5. India. Ministry of Urban Development. Expert Committee, Central Public Health, & Environmental Engineering Organisation (India). (1999). Manual on water supply and treatment. Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development.
6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
7. Tchobanoglous, G., Theisen, H., Vigil, S. A., & Alaniz, V. M. (1993). Integrated solid waste management: engineering principles and management issues (Vol. 4). New York: McGraw-Hill.
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

SEMESTER V				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
CE301	Transportation Engineering	PCC	3+1+0=4	3
CE302	Geotechnical Engineering	PCC	4+1+0=5	4
CE303	Design of Steel Structures	PCC	4+1+0=5	4
CE304	Engineering Economics, Estimation & Costing	PCC	3+1+0=4	3
CE305	Computer Aided Design II	PCC	0+0+2=2	1
CE306	Transportation Engineering lab	PCC	0+0+2=2	1
CE307	Geotechnical Engineering lab	PCC	0+0+2=2	1
ASE301	Engineering Exploration III (One year duration)	PW	0+0+1=1	Credits Offered Next semester
Track 1	Structural Engineering	**Professional Electives,** Student need to select any one track	3+1+0=4	3
Track 2	Environmental Engineering			
Track 3	Geotechnical Engineering			
Track 4	Transportation Engineering			
	Total		**29**	**20**

Course Code	**Course Name**	**L-T-P**	**Credits**
CE301	**Transportation Engineering**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Given basic information, prepare a horizontal and vertical alignment, including superelevation, which complies with AASHTO standards.		
CLO2:	Understand the relationship between the environment and transportation infrastructure and the importance the environment plays in project development of transportation projects.		
CLO3:	Utilize CAD software to prepare a plan, profile, and x-sections depicting a typical roadway design.		
CLO4:	Prepare well written design narratives documenting the various parameters and standards used in the design process so another individual could review the work and understand what decisions and assumptions were used and why.		
CLO5:	Understand the mathematics behind the development of tables and charts for determining highway design criteria.		
CLO6:	Familiar with professional and ethical issues related to liability and conduct.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE301 Transportation Engineering (3-1-0), 3 Credits

Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems

Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems

Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

Text/Reference Books:

1. L.R. Kadiyali, (2013) 'Traffic Engineering & Transport Planning', Khanna Publishers, India.
2. Khanna & Justo, (1973) 'Highway Engineering", Nemchand & Bros-Roorkee (UA).
3. Chakroborty, P., & Das, A. (2017). Principles of transportation engineering. PHI Learning Pvt. Ltd.
4. Mannering, F., Kilareski, W., & Washburn, S. (2007). Principles of highway engineering and traffic analysis. John Wiley & Sons.
5. Srinivasa Kumar, R., 2011, "Textbook of Highway Engineering", Universities Press.

Course Code	Course Name	L-T-P	Credits
CE302	**Geotechnical Engineering**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	To understand the origin of soil and to identify different types of soil.		
CLO2:	To understand the various physical and engineering characteristics of different types of soil.		
CLO3:	To understand the concept of slope stability.		
CLO4:	To appreciate the use of modern technology in the field of geotechnical engineering		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE302 Geotechnical Engineering (4-1-0), 4 Credits

Introduction - Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering.

Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content-specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method. On completion of this module, the students must be able to:

- ✓ Understand the different types of soil based on their formation mechanism;
- ✓ Understand the various phase diagrams and derive various phase relationships of the soil;
- ✓ Perform various laboratory experiments to determine moisture content, specific gravity;
- ✓ Perform field experiments to estimate the field density of the soil mass.

Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups. On completion of this module, the students must be able to:

- ✓ Understand the behaviour of soils based on their moisture contents;
- ✓ Perform laboratory experiments to estimate various Atterberg limits and evaluate index properties of soils;
- ✓ Classify any soils based on their particle size distribution and index properties;

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. On completion of this module, the student must be able to:

- ✓ Determine the permeability of soils through various laboratory and field tests;
- ✓ Analytically calculate the effective permeability of anisotropic soil mass;
- ✓ Determine the seepage quantities and pore water pressures below the ground;
- ✓ Graphically plot the equipotential lines and flow lines in a seepage flow.

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. On completion of this module, the student must be able to:

- ✓ Understand the physical significance of effective stress and its relation with pore pressure;
- ✓ Plot various stress distribution diagrams along the depth of the soil mass;
- ✓ Understand the effect of capillary action and seepage flow direction on the effective stress at a point in the soil mass.

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. On completion of this module, the student must be able to:

Perform laboratory test to determine the maximum dry density and optimum moisture content of the soil;

- ✓ Variation in compaction curve with compaction effort and soil type;
- ✓ Determine the compactive effort required to obtain necessary degree of compaction in-situ;
- ✓ Differentiate among various field methods of compaction and their usage based on the type of soil.

Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory. On completion of this module, the student must be able to:

- ✓ Analytically compute the vertical stress in a semi-infinite soil mass due to various loading conditions;
- ✓ Plot isobars due various loading conditions.

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, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation. On completion of this module, the student must be able to:

- ✓ Understand the basic mechanism of consolidation of soil;
- ✓ Determine various consolidation parameters of soil through laboratory test;
- ✓ Evaluate ground settlements against time.

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 On completion of this module, the student must be able to:

- ✓ Determine graphically and analytically the stress state in any plane of the soil mass;
- ✓ Perform various shear strength tests and appreciate the different field conditions which they simulate;

- ✓ Understand the significance of shear strength parameters in various geotechnical analyses;
- ✓ Evaluate the stiffness of soil using shear strength parameters

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. On completion of this module, the student must be able to:

- ✓ Differentiate various modes of slope failure;
- ✓ Evaluate factor of safety of infinite slopes based on different ground conditions;
- ✓ Understand various methods for computation of factor of safety for finite slopes.

Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods. On completion of this module, the student must be able to:

- ✓ Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;
- ✓ Understand various site investigation techniques and their in-situ applications;
- ✓ Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, etc.

Text/Reference Books:

1. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
2. Taylor, 1949, "Fundamentals of Soil Engineering", John Wiley & Sons.
3. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (1981). An introduction to geotechnical engineering (Vol. 733). Englewood Cliffs, NJ: Prentice-Hall.
4. Das, B. M., & Sobhan, K. (2013). Principles of geotechnical engineering. Cengage learning.
5. Das, B. M. (2015). Principles of foundation engineering. Cengage learning.
6. McCarthy, D. F., & McCarthy, D. F. (1977). Essentials of soil mechanics and foundations (p. 505). Virginia: Reston Publishing Company.
7. Terzaghi, K., Peck, R. B., & Mesri, G. (1996). Soil mechanics in engineering practice. John Wiley & Sons.
8. Murthy, V. N. S. (2002). Geotechnical engineering: principles and practices of soil mechanics and foundation engineering. CRC press.

Course Code	Course Name	L-T-P	Credits
CE303	**Design of Steel Structures**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Learn the basic elements of a steel structure		
CLO2:	Learn the fundamentals of structural steel fasteners		

CLO3:	Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns
CLO4:	Able to design column splices and bases.
CLO5:	Ability to analyze and design of simple bolted and welded connections
CLO6:	Ability to design steel framing system and connections of a building in a team setting
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE303 Design of Steel Structures (4-1-0), 4 Credits

Properties of materials; loads and stresses, Design of semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member, Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders; Introduction to Plastic analysis; Simple cases of beams and frames; All design steps/process to as per the most recent BIS code of practices Prerequisite:

Suggested Book(s):

1. Arya A.S. and Ajmani J.L., (1974). 'Design of Steel Structure', Nemchand & Brothers, Roorkee.
2. Duggal S.K. 'Design of Steel Structure', Tata McGraw-Hill Publishing Co. Ltd, India.
3. Kazmi and Jindal, (2002). ‘Design of Steel Structures’, Prentice Hall of India, New Delhi.
4. Abu-Saba, Elias G, (1995). “Design of Steel Structures”, Springer US.

Course Code	Course Name	L-T-P	Credits
CE304	**Engineering Economics, Estimation & Costing**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Will have a basic knowledge on methods and types of estimation and its merits and demerits.		
CLO2:	Have knowledge on specifications and tendering process for contracts		
CLO3:	Will have the ability to understand the types, formation, terms and conditions in contracts and arbitration		
CLO4:	Will have the knowledge of rate analysis of different item of work and MB and bill of quantities		
CLO5:	Will able to value a property, price escalation recommendations and auditing		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE304 Engineering Economics, Estimation & Costing (3-1-0), 3 Credits

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

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

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

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

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.

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

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

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

Introduction to 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. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. Chakraborti, M (2006) Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, (2011) Building & Engineering Contracts, Mrs. S.B.Patil.
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration.
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, 2016.
14. Dutta, B.N., (2016). Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers.

Course Code	Course Name	L-T-P	Credits
CE305	**Computer Aided Design II**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Apply/develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering.		
CLO2:	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.		
CLO3:	Review and document the knowledge developed by scholarly predecessors and critically assess the relevant technological issues.		
CLO4:	Formulate relevant research problems; conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.		
CLO5:	Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE305 Computer Aided Design II (0-0-2), 1Credit

Syllabus Content

Concept of computer aided design and introduction of software packages used for analysis and design of structures including STAAD.Pro.

Model generation for a building, assigning material properties, loads, creating load combination, analysis and design of a double storied building frame using STAAD.Pro and check by any of analytical methods.
Introduction to MATLAB, MATLAB tool box and MATLAB functions.
Hands on Civil Engineering problems using MATLAB.

Text/Reference Books:

1.Staad Pro V8i for Beginners: With Indian Examples by T.S.Sarma
2. Exploring Bentley STAAD.Pro V8i (SELECTseries 6) by Sham Purdue University Northwest.

Course Code	Course Name	L-T-P	Credits
CE306	**Transportation Engineering lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Identify engineering properties of aggregate.		
CLO2:	Indentify the grade & properties of bitumen.		
CLO3:	Find out peak hour traffic & peak time for a given location on the road.		
CLO4:	Calculate design speed, maximum speed & minimum speed limits of a location through spot speed.		
CLO5:	Draw parking accumulation curve and find out parking duration & turnover of parking lot/stretch		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE306 Transportation Engineering lab (0-0-1), 1Credit

1. Los- Angeles abrasion testing machine
2. Marshall stability apparatus
3. Viscosity test
4. Ductility test
5. Impact test machine
6. Flakiness and elongation index Apparatus
7. Sample container and weights
8. Ring and ball apparatus
9. Bitumen penetration testing
10. Apparatus with brass cone

Text/Reference Books:

1. L.R. Kadiyali, (2013) ‘Traffic Engineering & Transport Planning’, Khanna Publishers, India.
2. Khanna & Justo, (1973) ‘Highway Engineering”, Nemchand & Bros-Roorkee (UA).
3. Chakroborty, P., & Das, A. (2017). Principles of transportation engineering. PHI Learning Pvt. Ltd.

4. Mannering, F., Kilareski, W., & Washburn, S. (2007). Principles of highway engineering and traffic analysis. John Wiley & Sons.
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon,(2009) Highway Engineering, Wiley Student Edition.

Course Code	Course Name	L-T-P	Credits
CE307	**Geotechnical Engineering lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Have thorough knowledge about the procedures of laboratory tests used for determination of physical, index and engineering properties of soils		
CLO2:	Have the capability to classify soils based on test results and interpret engineering behaviour based on test results		
CLO3:	Be able to evaluate the permeability and shear strength of soils		
CLO4:	Be able to evaluate settlement characteristics of soils		
CLO5:	Be able to evaluate compaction characteristics required for field application		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE307 Geotechnical Engineering lab (0-0-2), 1 Credit

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Triaxial Test (UU)
18. Vane shear test
19. Direct Shear Test
20. Unconfined Compression Strength Test.

Text/Reference Books:

1. Craig, R.F., (1983). 'Soil Mechanics' by ELBS and Van Nostrand Reinhold Co. Ltd., Berkshire.
2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
3. Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (1981). An introduction to geotechnical engineering (Vol. 733). Englewood Cliffs, NJ: Prentice-Hall.
4. Das, B. M., & Sobhan, K. (2013). Principles of geotechnical engineering. Cengage learning.
5. Das, B. M. (2015). Principles of foundation engineering. Cengage learning.
6. McCarthy, D. F., & McCarthy, D. F. (1977). Essentials of soil mechanics and foundations (p. 505). Virginia: Reston Publishing Company.
7. Terzaghi, K., Peck, R. B., & Mesri, G. (1996). Soil mechanics in engineering practice. John Wiley & Sons.
8. Murthy, V. N. S. (2002). Geotechnical engineering: principles and practices of soil mechanics and foundation engineering. CRC press.

Course Code	Course Name	L-T-P	Credits
AS301	**Engineering Exploration III**	**0-0-4**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Students will able to apply material from their discipline to the design projects.		
CLO2:	Students will get an appreciation of the role that their discipline can play in social contexts.		
CLO3:	To get awareness of professional ethics and responsibility.		
CLO4:	Demonstrate the ability to work in a team based small projects and effectively use.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

SEMESTER VI				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
CE308	Design of Concrete Structures- II	PCC	4+1+0=5	4
CE309	Construction Planning And Management	PCC	3+1+0=4	3
CE310	Geo-informatics	PCC	3+0+0=3	3
CE311	Geo-informatics Lab	PCC	0+0+2=2	1
ASE301	Engineering Exploration III (One year duration)	PW	0+0+1=1	2
CL301	Language Skills - II	HU	0+0+4=4	2
GTI301	Numerical Ability and Logical Reasoning	PE	3+0+0=3	3
Track 1	Structural Engineering	**Professional Electives,** Student need to follow the selected track in previous semester	3+1+0=4	3
Track 2	Environmental Engineering			
Track 3	Geotechnical Engineering			
Track 4	Transportation Engineering			
	Total		**26**	**21**

Course Code	**Course Name**	**L-T-P**	**Credits**
CE08	**Design of Concrete Structures – II**	**4-1-0**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Apply principles of engineering mechanics and use appropriate tools to solve problems in structural engineering.		
CLO2:	Design and evaluate structural components and systems to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.		
CLO3:	Plan, compose, and integrate verbal, written, and graphical communication to technical and non-technical audiences.		
CLO4:	Function effectively as a member of an engineering team.		
CLO5:	Discuss professional responsibility in light of social context of engineering problems.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE308 Design of Concrete Structures – II (4-1-0), 4 Credits

Design of continuous beams and building frames, Moment redistribution, Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, detailing for earthquake resistant construction – ductility criteria; Water tank and staging; Introduction, Design criteria, Design of rectangular and circular water tank, Design of Intze tank, Staging for overhead tank; Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert; Design of Masonry walls and columns; Prestressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders, Design of end block; Design of staircases; Design of cantilever and counterfort type retaining wall; All design steps/process to as per the most recent BIS code of practices

Suggested Book(s):

1. Bhavikatti, S. S. (2007). Design of RCC Structural Elements (Vol. 1). New Age International, India.
2. Punmia, B. C., Jain, A. K., & Jain, A. K. (1992). Reinforced concrete structures (Vol. 1). Firewall Media, India.
3. Varghese, P. C. (2009). Advanced reinforced concrete design. PHI Learning Pvt. Ltd, India.
4. Gu, Xianglin, Jin, Xianyu, Zhou, Yong. (2016), "Basic Principles of Concrete Structures", Springer-Verlag Berlin Heidelberg, China.
5. Setareh, Mehdi, Darvas, Robert, (2017), "Concrete Structures", Springer International Publishing, Switzerland.

Course Code	Course Name	L-T-P	Credits
CE309	**Construction Planning and Management**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Apply theoretical and practical aspects of project management techniques to achieve project goals.		
CLO2:	Possess organizational and leadership capabilities for effective management of construction projects		
CLO3:	Be able to apply knowledge and skills of modern construction practices and techniques		
CLO4:	Have necessary knowledge and skills in accounting, financing, risk analysis and contracting		
CLO5:	Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE309 Construction Planning and Management (3-1-0), 3 Credits

Basics *of* Construction- Unique features of construction, construction projectstypes and features, phases of a project, agencies involved and their methods of execution;

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.

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.

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 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 levelling. Common Good Practices in Construction

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.

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.

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

Text/Reference Books:

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

Course Code	Course Name	L-T-P	Credits
CE310	**Geo-informatics**	**3-0-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Explain basic physical principles of remote sensing		
CLO2:	Understand the basic difference between various kinds of satellites and sensors		
CLO3:	Know the appropriate use of satellite data for different applications		
CLO4:	Explain the principles of thermal and microwave satellites, sensors and their nature of the data		
CLO5:	Apply remote sensing in different thematic studies		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE310 Geoinformatics (3-0-0), 3 Credits

Remote Sensing: Introduction - Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Photogrammetry Surveying: Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.

Investigation of geographic information systems (GIS) and science (GIScience) including theory and applications areas. A major portion of the course will be based on use of a current widely-used GIS computer software

system. Aspects of geographic data entry and editing, spatial analysis, and map development and display will be considered. Relationship of GIS to the Global Positioning System (GPS) and satellite generated data will be addressed.

Text/Reference Books:

1. Gopi, Satheesh., Sathikumar, R and Madhu, N (2007). Advanced Surveying, Total Station, GIS and Remote Sensing, Dorling Kindersly, India.
2. Manoj, K. Arora and Badjatia, 2011 "Geomatics Engineering", Nem Chand & Bros.
3. Bhavikatti, S. S. (2010). Surveying and levelling (Vol. 1). IK International Pvt Ltd.
4. Chandra, A. M. (2005). "Higher Surveying", New Age International.
5. Anji Reddy, M., 2001, "Remote sensing and Geographical information system", B.S. Publications.
6. Arora, K.R., 2015, "Surveying, Vol-I, II and III", Standard Book House.

Course Code	Course Name	L-T-P	Credits
CE311	**Geo-informatics Lab**	**0-0-2**	**1**
Course Learning Outcomes (CLO)*:			
CLO1:	Interpret hard copy satellite FCC images		
CLO2:	Understand the effect of different resolutions of satellite image on identifying different terrestrial features.		
CLO3:	Generate field spectra for various land cover features and draw inferences.		
CLO4:	Extract different features from satellite image		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE311 Geoinformatics Lab (0-0-2), 1 Credit

Tutorial on Spatial data generation, management, modelling, analysis and applications; on satellite image georeferencing, enhancement and filtering, transformations, classification and accuracy assessment and applications Laboratory sessions involving use of state-of-the-art GIS and image processing software to get familiarized with handling and analyzing spatial datasets including satellite images Reading and discussing papers/reports on image processing / GIS / applications.

Text/Reference Books:

1. ArcGIS documentation, 2009, ESRI Press.
2. Rencz, A.N. (ed.), Manual of Remote Sensing, American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, 2004
3. ERDAS Field Guide, 2009, ERDAS.
4. Selected papers from journals and conference proceedings.

SEMESTER VII				
Course Code	**Title of the Course**		**Hours (L+T+P)**	**Credits**
CE401	Environmental Impact Assessment and Life cycle Analysis	PCC	3+0+0=3	3
CE402	Programming for Problem Solving	ESC	2+0+4=6	4
CE403	Disaster Preparedness & Planning Management	PCC	2+0+0=2	2
CE404	Computer Aided Design III	PCC	0+0+4=4	2
ASE401	Engineering Exploration IV (One year duration)	PW	0+0+1=1	2
CE404	Professional Practices (Entrepreneurship / Gate)	PE	4+0+0=4	2
CL401	Language Skills - III	HU	0+0+4=4	2
Track 1	Structural Engineering	Professional Electives, Student need to follow the selected track in previous	3+1+0=4	3
Track 2	Environmental Engineering			
Track 3	Geotechnical Engineering			
Track 4	Transportation Engineering		**28**	**20**

Course Code	**Course Name**	**L-T-P**	**Credits**
CE401	**Environmental Impact Assessment and Life Cycle Analysis**	**3-0-0**	**3**
Course Learning Outcomes (CLO)*:			
	After completion of the course student will:		
CLO1:	Be able to find the necessary information/legislation/procedures for an assessment of environmental impact of a "Project"		
CLO2:	Be able to conduct an EIA on a proposed project		
CLO3:	Be able to conduct an environmental audit on a selected company/industry		
CLO4:	Be able to develop a waste reduction and minimization plan for a selected company/industry		
CLO5:	Be able to develop an EMS for a Project		
CLO6:	Be able to conduct a LCA on a selected process		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE401 Environmental Impact Assessment and Life Cycle Analysis (3-0-0), 3 Credits

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

Suggested Book(s):

1. Canter, R.L., (1996), "Environmental Impact Assessment", McGraw Hill Inc., New Delhi.
2. Shukla, S.K. and Srivastava, P.R., (1992), "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi.
3. Lerche, Ian, Glaesser, Walte, (2006), "Environmental Risk Assessment", Springer-Verlag Berlin Heidelberg.

Course Code	Course Name	L-T-P	Credits
CE402	**Programming for Problem Solving**	**2-0-4**	**4**
Course Learning Outcomes (CLO)*:			
CLO1:	Describe the basics of computer and understand the problem solving aspect.		
CLO2:	Demonstrate the algorithm and flow chart for the given problem.		
CLO3:	Design and develop C program to evaluate simple expressions and logical operations.		
CLO4:	Develop & Implement C programs with suitable modules to solve the given problem.		
CLO5:	Demonstrate the concept of pointer and perform I/O operations in files.		
CLO6:	Design and develop solutions to real world problems using C.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

CE402 Programming for Problem Solving (2-0-4), 4 Credits

Unit 1: Introduction to Programming (2 hrs)

Introduction to Programming (Flow chart/pseudocode, compilation etc.), Variables (including data types)

Unit 2: Arithmetic expressions and precedence (2 hrs)

Unit 2: Conditional Branching and Loops (8 hrs), Writing and evaluation of conditionals and consequent branching, Iteration and loops

Unit 3: Arrays (6 hrs), Arrays (1-D, 2-D), Character arrays and Strings
Unit 4: Basic Algorithms (6 hrs), Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity
Unit 5: Function and Recursion (8 hrs), Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.
Unit 6: Structure and Pointers (6 hrs), Pointers, Structures (including self referential structures e.g., linked list, notional introduction)
Unit 7: File handling (2 hrs)
Tutorial and Lab:
Tutorial 1: Problem solving using computers: Lab1: Familiarization with programming Environment
Tutorial 2: Variable types and type conversions: Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions: Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops: Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting: Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings, memory structure: Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value: Lab 7: Simple functions
Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration): Lab 8 and 9: Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls: Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation Lab 11: Pointers and structures
Tutorial 12: File handling: Lab 12: File operations
Text/Reference Books:
1. Byron Gottfried, Schaum's 2017, "Outline of Programming with C", McGraw-Hill.
2. E. Balaguruswamy, 1998, "Programming in ANSI C", Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, 1988, "The C Programming Language", Prentice Hall of India.

Course Code	Course Name	L-T-P	Credits
CE403	**Disaster Preparedness & Planning Management (DM101DisasterManagement)**	**2-0-0**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Acquire the knowledge disaster management.		
CLO2:	Understand the vulnerability of ecosystem and infrastructure due to a disaster.		
CLO3:	Acquire the knowledge of disaster management Phases.		

CLO4:	Understand the hazard and vulnerability profile of India
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

CE403 Disaster Preparedness & Planning Management (2-0-0), 2 Credits

Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation).

Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.

Course Code	Course Name	L-T-P	Credits
CE704	**Computer Aided Design III**	**0-0-4**	**2**
Course Learning Outcomes (CLO)*:			
CLO1:	Demonstrate basic concepts of the Staad Pro and AutoCAD software		
CLO2:	Apply basic concepts to develop design and analysis techniques		
CLO3:	Ability to manipulate drawings through editing and plotting techniques		
CLO4:	Understand geometric construction		
CLO5:	Produce 3D drawings		
CLO6:	To acquire skills in design-analysis and thus make student industry ready.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

Syllabus Content

Basic concepts of AutoCAD and STAAD Pro tools- Analysis and design of various building elements - Design projects

14. Specialization Tracks (Professional Electives)

Track 1 Structural Engineering

Course Code	Course Name	L-T-P	Credits
	Engineering Materials for Sustainability	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	Students should be able to:		
CLO1:	Compare the advantages and disadvantages of current and potential energy conversion and storage processes		
CLO2:	Identify critical materials challenges associated with current and potential energy conversion and storage processes.		
CLO3:	Compare the environmental impact of products		
CLO4:	To acquire skills in sustainable practice.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

1. Engineering Materials for Sustainability (3-1-0), 3 Credits

Environmental impact of materials; life-cycle assessment; material selection to optimize performance; design, evaluation, and production of green construction materials.

Text/Reference Books:

1. Materials and Sustainable Development, by Michael F. Ashby, Butterworth-Heinemann
2. Sustainable Materials, by Julian Allwood, Jonathan Cullen, UIT Cambridge, 2011.

Course Code	Course Name	L-T-P	Credits
	Wood Structures	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Ability to perform detail modeling of vertical and lateral loads on structures		
CLO2:	Understanding of properties of sawn lumber, glued laminated timber, and structural panels		
CLO3:	Ability to analyze and design beams		
CLO4:	Ability to analyze and design columns and members under combined bending and axial force		
CLO5:	Ability to analyze and design simple nailed and bolted connections		
CLO6:	Ability to design the wood framing system and connections of a building		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

2. Wood Structures (3-1-0), 3 Credits

Mechanical properties of wood, stress grades and working stresses; effects of strength-reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued- laminated timber and plywood; behaviour and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses, rigid frames, arches, and pole-type buildings; and prismatic plates and hyperbolic paraboloids.

Text/Reference Books:

1. Donald E Breyer, 1993, "Design of wood structure", Mcgraw-Hill,.
2. Judith J, Stalnaker, 2012, "Structural design and wood", Springer
3. Ram S. Gupta, 2014, "Principles of Structural Design: Wood, Steel, and Concrete, CRC Press.

Course Code	Course Name	L-T-P	Credits
	Masonry Structures	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Able to design masonry structures		
CLO2:	Able to analyze masonry structures		
CLO3:	Design skills enhanced		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

3. Masonry Structures (3-1-0), 3 Credits

Introduction to analysis, design and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile,

flexural, and shear behavior of masonry structural components. Strength and behaviour of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems.

Text/Reference Books:

1. Dayaratnam, P. (1987). Brick and reinforced brick structures. South Asia Books.
2. Jagadish K. S., 2015, "Structural Masonry", I K International Publishing House Pvt. Ltd,
3. Hendry, A. W., Sinha, B. P., & Davies, S. R. (2003). Design of masonry structures. CRC Press.

Course Code	Course Name	L-T-P	Credits
	Prestressed Concrete	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Understanding of the behaviour of prestressed concrete structures which is an advanced topic of civil engineering.		
CLO2:	Knowledge of calculation of effect of prestressing on statically determinate structures and statically indeterminate structures.		
CLO3:	Design, analysis, detailing and construction of prestressed concrete structural.		
CLO4:	Develop knowledge of contemporary issues		
CLO5:	Use the techniques, skill, and modern engineering tools necessary for pre-tensioning technology and post-tensioning technology		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

4. Prestressed Concrete (3-1-0), 3 Credits

Study of strength, behaviour, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretensioned, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing.

Text/Reference Books:

1. N. Krishna Raju, 2018, "Prestressed Concrete", McGraw Hill Education.
2. G.S. Pandit, S.P. Gupta, 2008, "Prestressed Concrete", CBS Publishers and Distributors Pvt Ltd.
3. N C Sinha, Sujit Kumar Roy, S., 2011, "Fundamentals of Pre-Stressed Concrete", Chand Publishing.

Course Code	Course Name	L-T-P	Credits
	Bridge Engineering	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	The students are expected to be able		
CLO1:	To understand the load-carrying capacity of various types of bridges,		

	upon learning the structural responses to different kinds of loads.
CLO2:	To design short and medium span bridges, with confidence using existing codes of practice, taking into account of the structural strength, service life and durability.
CLO3:	To judge the limitations of the design methods used.
CLO4:	To acquire skills in basic bridge design
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

5. Bridge Engineering (3-1-0), 3 Credits

General; classification of bridges, site selection, geometric and hydraulic design consideration, loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, extrados bridges; arch bridge; Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats; seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance.

Text/Reference Books:

1. T R Jagadeesh & M A Jayaram, 2004, "Design of Bridge structure", PHI Learning Pvt. Ltd.
2. Krishna Raju, 2005, "Design of Bridges", Oxford & Ibh.
3. Ramesh Shah, 2014, "Bridge Engineering", Random Publications.

Course Code	Course Name	L-T-P	Credits
	Earthquake Engineering	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.		
CLO2:	The students will get a diverse knowledge of earthquake engineering practices applied to real life problems		
CLO3:	The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

6. Earthquake Engineering (3-1-0), 3 Credits

Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization -

Equations of motion of SDOF system for mass as well as base excitation - Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration - Natural frequencies - Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations); Elements of Seismology; Causes of Earthquake – Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes; Response of Structures to Earthquake;Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes - Base isolation techniques - Vibration control measures – Important points in mitigating effects of earthquake on structures.

Text/Reference Books:

1. Roberto Villaverde, 2009, "Fundamental Concepts of Earthquake Engineering", CRC Press.
2. Shashikant K, 2013, Duggal Earthquake Resistant Design of Structures, Oxford.
3. Srinivas Vasam & Dr. K. Jagannadha Rao, 2018, "Structural Dynamics and Earthquake Engineering", S.K. KATARIA & SONS.

Track 2: Environmental Engineering

Course Code	Course Name	L-T-P	Credits
	Environmental Laws and Policy	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Be familiar with the laws, policies and institutions in the field of environment		
CLO2:	Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective		
CLO3:	Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

1. Environmental Laws and Policy (3-1-0), 3 Credits

Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment. International environmental laws, Right to Environment as Human Right, International Humanitarian Law

and Environment, environment and conflicts management, Famous international protocols like Kyoto.

Text/Reference Books:

1. Divan Shyam, Rosencranz Armin, 2002, "Environmental Law and Policy in India: Cases, Material & Statutes", Oxford.
2. Jane Holder and Maria Lee, 2012, "Environmental Protection, Law and Policy", Cambridge University Press.

Course Code	Course Name	L-T-P	Credits
C	**Rural Water Supply and Onsite Sanitation Systems**	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Knowledge about water supply scheme in rural areas.		
CLO2:	Knowledge about environmental sanitation methods and design in rural areas.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

2. Rural Water Supply and Onsite Sanitation Systems (3-1-0), 3 Credits

Attributes of water supply systems, drinking water quality. Relationships between diseases and water quality, hygiene and sanitation. Need for water treatment. Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron. Onsite sanitation systems: Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets. Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.

Text/Reference Books:

1. Environmental Engineering. Authors: H. Peavy, D. Row and G. Tchobanoglous. Publisher: Tata McGraw-Hill.
2. Warren Viessman Jr. and Mark J. Hammer, 2005, "Water Supply and Pollution Control", Pearson Education.
3. Metcalf & Eddy, 1995, "Wastewater Engineering; Treatment, Disposal, Reuse"., Tata McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
	Solid and Hazardous Waste Management	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	After completion of the course students should be able		
CLO1:	To-do sampling and characterization of solid waste; analysis of hazardous waste constituents including QA/QC issues;		
CLO2:	To understand health and environmental issues related to solid waste		

	management;
CLO3:	To apply steps in solid waste management-waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques; economics of the onsite vs. offsite waste management options
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

3. Solid and Hazardous Waste Management (3-1-0), 3 Credits

Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and

Transformation Techniques, Final Disposal. Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

Text/Reference Books:

1. M.N. Rao, Razia Sultana and Sri Harsha Kot, 2017, "Solid and Hazardous Waste Management Science and Engineering", Elsevier.

Course Code	**Course Name**	**L-T-P**	**Credits**
	Sustainable Design Engineering & Technology	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	Students should be able to:		
CLO1:	Compare the advantages and disadvantages of current and potential energy conversion and storage processes		
CLO2:	Identify critical materials challenges associated with current and potential energy conversion and storage processes.		
CLO3:	Compare the environmental impact of products		
CLO4:	To acquire skills in basic sustainable practice.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

4. Sustainable Design Engineering & Technology (3-1-0), 3 Credits

Quantitative sustainable design (QSD) and how to navigate engineering decision-making. Economic (life cycle costing, techno economic assessment) and environmental (life cycle assessment: LCA) sustainability assessments, and how to link these tools to design decisions under uncertainty. Design of engineered technologies individually and in teams, with special attention to water infrastructure and bio energy production. Semester-long design project that includes components from two of the following three CEE sub-disciplines: environmental, hydraulic, geotechnical.

Text/Reference Books

1. Dejan Mumovic, Mat Santamouris, 2004, "A Handbook of Sustainable Building Design and Engineering", Routledge.
2. Anthony Johnson Andy Gibson, 2014, "Sustainability in Engineering Design", Academic Press.

Track 3: Geotechnical Engineering

Course Code	Course Name	L-T-P	Credits
	Geotechnical Design	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering.		
CLO2:	The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.		
CLO3:	The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

1. Geotechnical Design (3-1-0), 3 Credits

Subsurface site evaluation; integrated design of retaining walls, foundations, pavements, and materials for airports, highways, dams, or other facilities.

Reference books:

1. Swami Saran, 2006, "Analysis and Design of Substructures: Limit State Design", CRC Press.

Course Code	Course Name	L-T-P	Credits
	Offshore Engineering	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			

CLO1:	The students will gain an experience in the offshore Engineering concepts which are applied in field Geotechnical Engineering.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

2. Offshore Engineering (3-1-0), 3 Credits

Introduction to offshore structures, codes of practice, offshore project management, deep water, offshore site investigations, geophysical methods; offshore sediment sampling, in-situ testing, geological aspects; development of design stratigraphies.

Reference books:

1. T.V. Ramakrishnan, 2007, "Marine and Offshore Engineering", Gene-Tech Books.
2. Subrata K. Chakrabarti, 2005, "Handbook of Offshore Engineering", Elsevier.

Course Code	Course Name	L-T-P	Credits
	Rock Mechanics	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Student will become conversant with various rock mechanics and apply appropriate repair strategy for a distressed structure		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

3. Rock Mechanics (3-1-0), 3 Credits

Determination of physical properties of rocks, failure criterion, rock mass classification, stress around mine openings, strain and displacement of the rock mass, rock reinforcement and support, subsidence.

Reference books:

1. J. A. Hudson and J. P. Harrison, 2000, "Engineering Rock Mechanics: An Introduction to the Principles", Elsevier.
2. Barry H.G. Brady, "Rock Mechanics: For Underground Mining", Elsevier
3. John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman, 2007, "Fundamentals of Rock Mechanics, 4th Edition" Wiley-Blackwell.

Course Code	Course Name	L-T-P	Credits
	Ground Improvement Techniques	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Students learn the various types of satellite remote sensing and its engineering application.		
CLO2:	Gain knowledge in modern image interpretation and recent analysis techniques to be used		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

5. Ground Improvement Techniques (3-1-0), 3 Credits

Introduction, ground modification by vibro replacement, stone columns, preloading and prefabricated drains, Reinforced earth structures, Introduction to geotextiles and geo membranes, applications of geotextiles, design methods using geotextiles, geogrids, geonets, geomembranes, geotubes, grouting, deep mixing, PVDs, vacuum consolidation.

Reference books:

1. Principles and Practice of Ground Improvement by Jie Han
2. Ground Improvement Techniques by P. Purushothama Raj.

Track 4: Transportation Engineering

Course Code	Course Name	L-T-P	Credits
	Airport Planning and Design	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Design & evaluate the various airport pavements.		
CLO2:	Develop the Pavement Management System for airport pavements.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

1. Airport Planning and Design (3-1-0), 3 Credits

Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection; Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity - Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity; Air Traffic Management: Navigational aids: ground based systems, satellite based systems – Air traffic control and surveillance facilities – Airfield lighting – air traffic management.

Reference books:

1. Khanna Sk, Nem Chand, 1999, "Airport Planning and Design", **Nem Chand** Brothers.
2. Asheesh Kumar, 2016, "Planning and Design of Airport", Vayu Education Of India.

Course Code	Course Name	L-T-P	Credits
	Railway Engineering	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Design the permanent way sections for the railways.		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

2. Railway Engineering (3-1-0), 3 Credits

Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers; ballast; subgrade and formation, rack fittings

and fastenings, creep of rails, geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards; railway tunneling; signaling and interlocking; maintenance of railways and high speed trains.

Reference books:

1. S.C. Saxena., S.P. Arora, Dhanpat Rai, 2010, "A Text Book Of Railway Engineering", Publications (p) Ltd.-new Delhi,.
2. JS Mundrey, 2017, "Railway Track Engineering", McGraw Hill Education,

Course Code	Course Name	L-T-P	Credits
	Intelligent Transportation Systems	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	After the completion of this course the student would be able to:		
CLO1:	Implement the ITS in public transportation systems.		
CLO2:	Use ITS for the travel demand management.		
CLO3:	Use ITS for evaluation of bridge performance		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

3. Intelligent Transportation Systems (3-1-0), 3 Credits

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS); ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Reference books:

1. Pradip Kumar Sarkar, Amit Kumar, 2017, "Jain Intelligent Transport Systems", PHI Learning Private Limited.

2. Paolo Pagano, 2016, "Intelligent Transportation Systems: From Good Practices to Standards", CRC Press.

Course Code	Course Name	L-T-P	Credits
	Port and Harbour Engineering	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
CLO1:	Design, plan and integrate port and harbour infrastructure.		
CLO2:	Explain the construction, maintenance and renovation aspects of ports and inland waterways		
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01			

4. Port and Harbour Engineering (3-1-0), 3 Credits

Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile; Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

Reference books:

1. Adrian Jarvis, Routledge, 1998, "Port and Harbour Engineering". CRC Press.
2. R. P. Rathaliya, , 2019, "Harbour Airport Engineering", Atul Prakashan.

Course Code	Course Name	L-T-P	Credits
	Infrastructure Planning and Design	**3-1-0**	**3**
Course Learning Outcomes (CLO)*:			
	After the completion of this course the students would be able to		
CLO1:	Design integrated framework for infrastructure planning and		

	management.
CLO2:	Analyse the strategies for Infrastructure Project implementation.
CLO3:	Perform Infrastructure modelling and Life Cycle Analysis Techniques.
The mapping of CO/ PO attainment/ Graduate Attributes are at Annexure -01	

5. Infrastructure Planning and Design (3-1-0), 3 Credits

Introduction: Definition of basic terminologies, role of infrastructure in economic development, types of infrastructure, measurement of infrastructure capacity, bases for quantification of demand and supply of various types of infrastructure, Indian scenario in respect of adequacy and quality. Infrastructure Planning: Goals and objectives of infrastructure planning; Identification and quantification of the casual factors influencing the demand for infrastructure; review and application of techniques to estimate supply and demand for infrastructure; use of econometric, social and land use indicators and models to forecast the demand and level of service of infrastructure and its impact on land use; critical review of the relevant forecasting techniques; infrastructure planning to identify and prioritize preferred areas for development; Integration of strategic planning for infrastructure at urban, regional and national levels; case studies in infrastructure planning. Infrastructure Management: Concepts, Common aspects of urban and rural infrastructure management systems; pavement and bridge management systems, Integrated infrastructure management, Case studies; Emerging trends in infrastructure: Overview of Public-Private Sector Participation in infrastructure projects, Understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects, public policy for infrastructure Sectoral Overview: Highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply, sanitation – case study examples.

Reference books:

1. Karen Firehock, Island Press, 2015, "Strategic Green Infrastructure Planning: A Multi-Scale Approach" Island Press.
2. Alvin Goodman, 2015, "Makarand Hastak Infrastructure Planning, Engineering and Economics", McGraw-Hill Education.

SEMESTER VIII		
Corse Code	**Title of Course**	**Credits**
CET 9403	IOHE	25
CET 9410	Coopt Training Module	-

CET9403 Industry Oriented Hands- on Experience 25 Credits

Six Months industrial training

Total credits at the end of 4th year: 20+22+25+29+20+21+20+25 =182

15. Calculation of CGPA

The CGPA (calculated on a 10 point scale) system will be used to describe the overall performance of a student (from the semester of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. GPA will indicate the performance of student for any particular semester. Formulas for calculation of GPA and CGPA have been provided as below:

$$GPA_i = \frac{\sum_{j=1}^{n} C_{ij} G_j}{\sum_{j=1}^{n} C_{ij}} \qquad CGPA = \frac{\sum_{i=1}^{N}\left(GPA_i * \sum_{j=1}^{n} C_{ij}\right)}{\sum_{i=1}^{N}\left(\sum_{j=1}^{n} C_{ij}\right)}$$

Where n = number of subjects in the semester; N = number of semesters; GPAi = GPA for the ith semester; Cij = number of credits for the jth course in ith semester; and Gj = Grade point corresponding to the grade obtained in the jth course.

I' grade will be awarded to those students, who due to some reason have not been able to appear in certain required number of evaluation components conducted for a course. Also, 'I' grade is awarded to students whose examination has been cancelled for UMC or any other reason by the University and are permitted to appear for the Examination on a later date during the same Semester or a subsequent Semester. Later 'I' grade will be changed to a relevant grade, once student has fulfilled the requirement of appearing in certain number of evaluation components for a course.

Grading scheme –

Marks Range	Grade	Grade Weightage	Qualitative Meaning
80 - 100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	AB		Absent

Example to understand the calculation of CGPA:

Semester-1

Suppose a student is registered in eight courses 'C1', 'C2', 'C3', 'C4', 'C5', 'C6', 'C7' and 'C8' in 1ST semester as mentioned below in the Column – I of the table-1. Column – II in the table below depicts the number of credits, which those courses carried. At the end of the semester, student was awarded with the grades as mentioned in Column – III in the table

given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Table-1

Courses in which student registered (Column – I)	**Credits (Column – II)**	**Letter Grade Column – III**	**Grade Value (Column – IV)**	**Credit Value (Column – V)**	**Grade Points (Column – VI)**
C1	3	A	8	3 x 8	24
C2	3	O	10	3 x 10	30
C3	3	A+	9	3 x 9	27
C4	2	B	6	2 x 6	12
C5	1	C	5	1x 5	5
C6	4	P	4	4x 4	16
C7	4	B	6	4x 6	24
C8	4.5	C	5	4.5x 5	22.5
Total	24.5	-------	-------	-------	160.5

Thus, the total SGPA of the student would be =

$$SGPA = \frac{Total\ grade\ \ pts.}{Total\ \ no.of\ \ credits} = \frac{(3x8.0)+(3x10)+(3x9)+(2x6)+(1x5)+(4x4)+(4x6)+(4.5x5)}{3+3+3+2+1+4+4+4.5} = \frac{160.5}{24.5} = 6.55102$$

Semester-2

Now Suppose a student is registered in eight courses ‘D1’, ‘D2’, ‘D3’, ‘D4’, ‘D5’, ‘D6’, ‘D7’ and ‘D8’ in 2nd semester as mentioned below in the Column - I of the table-2. Column - II in the table below depicts the number of credits, which those courses carried. At the end of the semester, student was awarded with the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Table-2

Courses in which student registered (Column – I)	**Credits (Column – II)**	**Letter Grade Column - III**	**Grade Value (Column – IV)**	**Credit Value (Column – V)**	**Grade Points (Column – VI)**
D1	4	B	6	4 x 6	24

D2	4	A+	9	4 x 9	36
D3	2	A	8	2 x 8	16
D4	3	C	5	3 x 5	15
D5	1	F	0	1x 0	0
D6	4	O	10	4x 10	40
D7	4	P	4	4x 4	16
D8	4.5	C	5	4.5x 5	22.5
Total	**26.5**	-------	-------	-------	**169.5**

Thus, the total SGPA of the student would be =

$$SGPA = \frac{Total\ grade\ \ pts.}{Total\ \ no.of\ \ credits} = \frac{(4\,x\,6)+(4\,x\,9)+(2\,x\,8)+(3x\,5)+(1x\,0)+(4\,x\,10)+(4\,x\,4)+(4.5\,x\,5)}{4+4+2+3+1+4+4+4.5} = \frac{169.5}{26.5} = 6.39623$$

As the SGPA of the student in two successive semesters is 6.55 and 6.40 with respective course credits being 24.5 and 26.5, then the

$$CGPA = \frac{(6.55102 \times 24.5)+(6.39623 \times 26.5)}{24.5+26.5} = \frac{160.50+169.50}{51} = \frac{330}{51} = 6.47$$