Semester I						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH 102	Concepts & Applications of Chemistry	3	0	0	6
2	MA 109	Calculus I (1st Half)	3	1	0	4
3	MA 121	Calculus II (2nd Half)	3	1	0	4
4	PH 101	Quantum Physics and Applications	2	1	0	6
5	BB 103	Introduction to Modern Biology	2	1	0	6
6	CS 103	Introduction to Programming - 1 (Using C) (1st Half)	2	1	0	4
7	EE 103	Introduction to Programming - 2 (Using Python) (2nd Half)	2	1	0	4
8	PH 113	Hands-on Science Laboratory - I	0	0	3	3
9	HS 103	Introduction to Fine Arts				PP/NP
10	HS 106	Design Thinking and Creativity				PP/NP
11	NO 101/ NO 103	National Sports Organization (NSO)/National Service Scheme (NSS)				PP/NP
		Total Credits				**37**

1	**Title of the course** (L-T-P-C)	**Calculus I** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Review of limits, continuity, differentiability. Mean value theorem, Taylor's Theorem, Maxima and Minima. Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume. Convergence of sequences and series, power series.
4	**Texts/References**	1. B. V. Limaye and S. Ghorpade, A Course in Calculus and Real Analysis, Springer International Publishing (2004) 2. James Stewart, Calculus (5th Edition), Thomson Brooks/Cole (2003) 3. T. M. Apostol, Calculus, Volume 1, Wiley Eastern (1980)

1	**Title of the course** (L-T-P-C)	**Calculus II** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Calculus I
3	**Course content**	Partial Derivatives, gradient and directional derivatives, Chain rule, Maxima and Minima, Lagrange multipliers. Double and Triple integration, Jacobians and change of variables formula. Parametrization of Curves and Surfaces, Vector fields, Line and Surface integrals. Divergence and Curl, Theorems of Green, Gauss, and Stokes.
4	**Texts/References**	1. B.V. Limaye and S. Ghorpade, A Course in Multivariable Calculus and Real Analysis, Springer International Publishing (2010) 2. James Stewart, Calculus (5th Edition), Thomson Brooks/Cole (2003) 3. T. M. Apostol, Calculus, Volume 2, Wiley Eastern (1980) 4. Marsden and Tromba, Vector calculus (First Indian Edition), Springer (2012)

1	**Title of the course** (L-T-P-C)	**Quantum Physics and Applications** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	• Quantum nature of light: Photoelectric Effect and Compton Effect. • Stability of atoms and Bohr`s rules. • Wave particle duality: De Broglie wavelength, Group and Phase velocity, Uncertainty Principle, Double Slit Experiment. • Schrödinger Equation. • Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-value Problem. • Solution of Schrödinger equation for simple boundary value problems. • Reflection and Transmission Coefficients. Tunneling. • Particle in a three dimensional box, Degenerate states. • Exposure to Harmonic Oscillator and Hydrogen Atom without deriving the general solution. • Quantum Statistics: Maxwell Boltzmann, Bose Einstein and Fermi Dirac Statistics by detailed balance arguments. • Density of states. • Applications of B-E statistics: Lasers. Bose-Einstein Condensation. • Applications of F-D statistics: Free electron model of electrons in metals. Concept of Fermi Energy. • Elementary Ideas of Band Theory of Solids. • Exposure to Semiconductors, Superconductors, Quantum Communication and Quantum Computing.
4	**Texts/References**	1. Quantum Physics: R. Eisberg and R. Resnick, John Wiley 2002, 2nd Edition. 2. Introduction to Modern Physics: F. K. Richtmyer, E. H. Kennard and J.N. Cooper, Tata Mac Graw Hill 1976, 6th Edition. 3. Modern Physics: K. S. Krane, John Wiley 1998, 2nd Edition. 4. Introduction to Modern Physics: Mani and Mehta, East-West Press Pvt. Ltd. New Delhi 2000. 5. Elements of Modern Physics: S. H. Patil, Tata McGraw Hill, 1984. 6. Concepts of Modern Physics, A Beiser, Tata McGraw Hill, 2009.

1	**Title of the course** (L-T-P-C)	**Introduction to Modern Biology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Quantitative views of modern biology. Importance of illustrations and building quantitative/qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems – a glimpse. Management and transformation of energy in cells. Mathematical view – binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication. Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity. Systems biology and illustrative examples of applications of Engineering in Biology.
4	**Texts/References**	Campbell Biology 12th edition, Pearson publication by Lisa Urry,Michael Cain,Steven Wassserman

1	**Title of the course** (L-T-P-C)	**Introduction to Programming – 1** **(2-1-0-4)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	This course provides an introduction to problem solving with computers using C Topics covered will include: **Utilization**:Developer fundamentals such as editor, integrated programming environment, Unix shell, modules, libraries. **Programming features**: Machine representation, data types, arrays and records, objects, expressions, control statements, iteration, procedures, functions and recursion, Pointers, Structures and basic I/O. **Applications**: Sample problems in engineering, science, text processing, and numerical methods.
4	**Texts/References**	The C Programming Language Brian W Kernighan, Dennis M Ritchie, Prentice Hall India , 2nd edition, 1988 Programming with C (Second Edition) Byron Gottfried, Schaum's Outlines Series, Tata-Mcgraw Hill, 2011 How to Solve It by Computer, by G. Dromey, Prentice- Hall, Inc., Upper Saddle River, NJ, 1982. How to Solve _It (2nd ed.), by Polya, G., Doubleday and co, 1957. Let Us C, by Yashwant Kanetkar, Allied Publishers, 1998.

1	**Title of the course** (L-T-P-C)	**Introduction to Programming-II** **(2-1-0-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	This is a continuation of the CS101 (first half semester) course. In the first half semester, the students are introduced to basic programming. This course (second half semester) provides an introduction to problem-solving with computers using python language. Topics covered will include: Basic python programming: variables, expression and statements, Functions, conditional and recursions, iterations, strings, lists/NumPy, and dictionaries. Other topics: Introduction to object oriented programming, classes and objects in python, polymorphisms, introduction to different libraries in python. Applications: Sample problems in engineering, data pre- processing, and plotting tools.
4	**Texts/References**	1.Python Programming: An Introduction to Computer Science, 3rd edition by John M. Zelle, Franklin, Beedle and Associates. 2.Think Python: How to Think Like a Computer Scientist, 2nd edition, by Allen B. Downey, O'Reilly, 2015.

1	**Title of the course** (L-T-P-C)	**Introduction to Fine Arts: Urban Dance in India: A Brief & Partial Introduction in Theory & Practice**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Body and Movement, Classical Dance in India, Contemporaneity: Modern & Postmodern Forms & Modes of Sustenance for a Dancer, Experimenting, Making Your Own Dance Work (Dance-pieces)
4	**Texts/References**	--

1	**Title of the course** (L-T-P-C)	**Design thinking and Creativity** **(1-0-0-0)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1.Problem Exploration- Students move around and find problems that need solutions. 2.They analyse the problem (not solution) and evolve a problem space. The problem space is converted into a story boar and presented in a poster session. 3.Feedback at the poster session is used to refine the problem definition(s). 4.Solution Exploration: Creative solutions (solution space) are now explored and presented using story boards. 5.The solutions are converted into "embodiments"
4	**Texts/References**	1."Stuff Matters" Prof. Mark Miodownik, Penguin 2. "Design and Technology" by James Garratt, Cambridge University Press. 3. How it works in the home: Walt Disney :9780894340482- Amazon.com. 4. How it works in the City (Walt Disney available on Amazon.com) 5. Change by design – Tim Brown There are some additional books in this "How it Works" series.

1	**Title of the course** (L-T-P-C)	**Concepts &Applications of Chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	**Organic and Inorganic (Inorganic): a. Harness the power of periodic table** Periodic properties: trends in size, electron affinity, ionization potential and electronegativity • Role of chemical elements in water contamination • Hardness of water • Desalination of brackish and sea water • Role of silicon in semiconducting applications • metal atom (Cu, Au, Pt, Pd etc.) based nanoparticles **b. Coordination complexes** Transition metal chemistry: inorganic complexes, bonding theories, magnetism, bonding aspects and structural distortion **(Organic): a. M.O. theory and π-conjugated compounds** Molecular orbitals of common functional groups, Qualitative Huckel MOs of conjugated polyenes and benzene. Aromaticity. Configuration, molecular chirality and isomerism, Conformation of alkanes and cycloalkanes **b. Polymers** Types and classification of polymers • polymerization techniques • Structure-property relationships of polymers • Conducting polymers **Physical Chemistry:** **a. Quantum chemistry** Schrodinger equation, Origin of quantization, Born interpretation of wave function, Hydrogen atom: solution to □-part, Atomic orbitals, many electron atoms and spin orbitals. Chemical bonding: MO theory: LCAO molecular orbitals, Structure, bonding and energy levels of diatomic molecules. Concept of sp, sp^2 and sp^3 hybridization; Bonding and shape of many atom molecules; Intermolecular Forces; Potential energy Surfaces-Rates of reactions; Steady state approximation and its applications; Concept of pre-equilibrium; Equilibrium and related thermodynamic quantities **b. Electrochemistry** Electrochemical cells and Galvanic cells • EMF of a cell Single electrode potential • Nernst equation • Electrochemical series • Types of electrodes • Reference electrodes • Batteries • Modern batteries • Fuel cells • corrosion
4	**Texts/References**	1. J. D. Lee, "Concise Inorganic chemistry" 5th Edition. Wiley India. Ed. 2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, "Inorganic Chemistry: Principles of structure and reactivity" 4th Edition, Person. 3. P. Atkins, J. de Paula, "physical chemistry" 5th Edition, Oxford. 4. J. Clayden, N. Greeves, S. Warren, "Organic chemistry" 2th Edition, Oxford. 5. George Odian, Principles of polymerization, 4th edition, Wiley student edition, Wiley India Pvt Ltd. 6. F. W. Billmeyer, Text book of Polymer Science, 3rd edition, Wiley student edition, Wiley India Pvt Ltd. 7. A. K. De, Environmental Chemistry, 8th edition, New Age International publishers. 8. B. K. Sharma, Environmental Chemistry, 16th edition, Krishna Prakashan Media Pvt Ltd. 9. A. R. West, Solid State Chemistry and Its Applications, Wiley student edition, Wiley India Pvt Ltd. 10. T. Pradeep, Nano: The essentials, McGraw-Hill Education publishers. 11. Geoffrey A Ozin and André Arsenault, Nanochemistry: A Chemical Approach to Nanomaterials, 2nd edition, RSC publishing.

Semester II						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 101	Introduction to Civil Engineering	2	1	0	6
2	MA 206	Introduction to Numerical Methods (1st Half)	3	1	0	4
3	MA 103	Differential Equations - I (2nd Half)	3	1	0	4
4	ME 111	Engineering Graphics Laboratory	0	1	3	5
5	CS 106	Data Structures and Algorithms	3	0	0	6
6	CS 111	Data Structures and Algorithms Laboratory	0	0	3	3
7	ME 113	Hands on Engineering Laboratory	0	0	3	3
8	ME 201	Engineering Mechanics	2	1	0	6
9	NO 102/ NO 104	National Sports Organization (NSO)/National Service Scheme (NSS)				PP/NP
		Total Credits				**37**

1	**Title of the course** (L-T-P-C)	**Introduction to Civil Engineering** **2-1-0-6**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	**Introduction and Scope of Civil Engineering**: Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, History of Civil Engineering: Early constructions and developments over time, ancient monuments of the world, Civil Engineering aspects of Indian heritage structures. Civil Engineering Specializations: Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, Transportation Engineering, Construction Management, Ocean Engineering, Remote Sensing and GIS, Energy and Sustainable Infrastructure. **Megastructures of Civil Engineering**: Design, Construction and Structural Details of Some of the Megastructures of the World. Mega Civil Engineering Projects of India. Failure Case Studies in Civil Engineering: Structures, Foundations, Dams, Pavement Systems, and the Geo-environment. Some Major Civil Engineering Challenges **Materials in 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, Sustainable Building Materials. **Introduction to Plan Reading, and Construction Techniques**: Scale drawings of floor plans, sections, and elevations; Plan types, Interpretation of plans. Components of a building. Typical loads and forces in Civil Engineering structures. Introduction to estimation and costing. **Smart Cities and Current Trends in Construction Industry**: Application of Machine Learning (ML) and Artificial Intelligence (AI) in Civil Engineering. Position of construction industry vis-à-vis other industries, plan outlays for construction; current budgets for infrastructure works; Possible scopes for a career, Importance of ethics in engineering.
4	**Texts/References**	Reading: 1. J. E. Gordon, “STRUCTURES: Or Why Things Don't Fall Down”, Da Capo Press; Reprint edition, 2003. 2. Paul A. Bosela, Pamalee A. Brady, Norbert J. Delatte, M. Kevin Parfitt “Failure Case Studies in Civil Engineering: Structures, Foundations, and the Geoenvironment”, American Society of Civil Engineers; 2nd edition 2013. 3. P.C. Varghese “Building Materials”, Prentice Hall India Learning Private Limited; 2nd edition, 2015. 4. Gary Anglin, “Introduction to Estimating, Plan Reading and Construction Techniques”, Routledge; 1st edition, 2019. 5. You-Lin Xu, Jia He “Smart Civil Structures”, CRC Press; 1st edition, 2019. References: 1. Pijush Samui, Dookie Kim, Nagesh Iyer, Sandeep Chaudhary, “New Materials in Civil Engineering”, 1st edition, Elsevier, 2020. 2. Saeed Moaveni, “Engineering Fundamentals: An Introduction to Engineering” Cengage Learning India Pvt. Ltd.; Fourth edition, 2011. 3. J. E. Gordon, “The New Science of Strong Materials – Or Why You Don`t Fall through the Floor”, Princeton University Press, 2020. 4. BIS, “National Building Code of India”, Bureau of Indian Standards, 2017. 5. M.W.Martin and R.Schinzinger, “Ethics in Engineering” McGraw Hill Education; Fourth edition, 2017. 6. S.S. Bhavikatti and M.V. Chitawadagi “Building Planning and Drawing”, Dreamtech Press, 2019.

1	**Title of the course** (L-T-P-C)	**Introduction to Numerical Methods** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Calculus, MA101 & Linear Algebra, MA 106
3	**Course content**	Interpolation by polynomials, divided differences, error of the interpolating polynomial, piecewise linear and cubic spline interpolation. Numerical integration, composite rules, error formulae. Solution of a nonlinear equation, bisection and secant methods. Newton's method, rate of convergence, solution of a system of nonlinear equations, Numerical solution of ordinary differential equations, Euler and Runge-Kutta methods, multi-step methods, predictor-corrector methods, order of convergence, Finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations. Exposure to MATLAB
4	**Texts/References**	S. D. Conte and Carl de Boor, Elementary Numerical Analysis- An Algorithmic Approach (3rd Edition), McGraw-Hill, 1980

1	**Title of the course** (L-T-P-C)	**Differential Equations -I** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Exact equations, integrating factors and Bernoulli equations. Orthogonal trajectories. Lipschitz condition, Picard's theorem, examples on non-uniqueness. Linear differential equations generalities. Linear dependence and Wronskians. Dimensionality of space of solutions, Abel-Liouville formula. Linear ODE's with constant coefficients, the characteristic equations. Cauchy-Euler equations. Method of undetermined coefficients. Method of variation of parameters. Laplace transform generalities. Shifting theorems. Convolution theorem.
4	**Texts/References**	1. E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999) 2. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)

1	**Title of the course** (L-T-P-C)	**Engineering Graphics Lab** **(0-1-3-5)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Engineering Graphics with mini-drafter: Around half a semester and bit more with following topics to be covered. • Introduction to Engineering Graphics • Curves • Projections of Points • Projection of Lines • Projection of Planes • Projections on Auxiliary Planes • Projections of Solids • Sections of Solids • Intersections of Solids Engineering Graphics with 2D Drafting Software: 5 weekly computer laboratory sessions covering above using AutoCAD® as a drafting software, 5th session on Isometric Projections.
4	**Texts/References**	1. N. D. Bhatt, revised and enlarged by V. M. Panchal and P. R. Ingle, Engineering Drawing, 53rd Edition, 2014, Charotar Publishers, Anand. 2. Warren J. Luzadder and Jon M. Duff, Fundamentals of Engineering Drawing, Prentice-Hall of India. 3. Gopalakrishna K. R., Engineering Drawing Vol. I & II Combined., Subhas Stores, 25th Edition, 2017. 4. Narayana. K. L., and Kannaiah, P. E., Text Book on Engineering Drawing, 2nd Edition, 2013, Scitech Publications, Chennai. 5. Venugopal K. and Prabhu Raja V., Engineering Drawing + AutoCAD, New Age International Publishers, 5th Edition, 2011.

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming
3	**Course content**	Introduction: data structures, abstract data types,analysis of algorithms. Creation and manipulation of data structures: arrays,lists, stacks, queues, trees, heaps, hash tables, balanced trees, tries, graphs. Algorithms for sorting and searching, order statistics, depth-first and breadth-first search, shortest paths and minimum spanning tree.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Pressand McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael T. Goodrich, Roberto Tamassia, and David M. Mount,Wiley, 2004.

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming (CS 102)
3	**Course content**	Laboratory course for CS 211 is based on creatingand manipulating various data structures and implementation of algorithms.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Press and McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael T.Goodrich, Roberto Tamassia, and David M. Mount, Wiley, 2004.

1	**Title of the course** (L-T-P-C)	**Hands on Engineering Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	**List of Experiments (Mechanical Workshop)** • To make a Square-fit from the given mid steel pieces (Fitting) • To make a V-fit from the given mid steel pieces (Fitting) • To make a rectangular tray as per required dimensions (Sheet Metal) • To build a transition piece (Sheet Metal) • To make a Butt joint using the given two M.S pieces (Arc welding) • To make a lap joint using the given two M.S pieces (Arc welding) • To build a pipe-line using fittings for given flow circuit (Plumbing) **List of Experiments (Electrical Workshop)** • To control one lamp by a one switch with provision for plug socket with switch control (Electrical wiring) • To do stair case wiring (i.e. control of one lamp by two switches fixed at two different places) (Electrical wiring) • Measurement of hot and cold resistance of filament • Improvement of Power Factor • Calibration of Energy meter • Measurement of Power using three ammeter/voltmeter method **List of Experiments (Electronics)** • Understanding breadboard, One-way traffic • Introduction to Arduino and Buzzer • Using Arduino speed measurement of motor/ glowing of LED • Control of water level using Arduino Line follower using Arduino
4	**Texts/References**	Elements of Workshop Technology Vol. 1 (2015), S. K. Hajra Choudhary, A. K. Hajra Choudhary and Nirjhar Roy, Media Promoters and Publishers Pvt. Ltd. W. A. J. Chapman, Workshop Technology, Vol. 1 (2006), Vol 2 (2007), and (1995), CBS Publishers.

1	**Title of the course** (L-T-P-C)	**Engineering Mechanics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	**Module 1:** 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 **Module 2:** Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; **Module 3:** 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; **Module 4:** 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; **Module 5:** 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. Module 6: Particles dynamics- Kinematics of Particles: Rectilinear motion, Plane curvilinear motion - rectangular coordinates, normal and tangential coordinates, polar coordinates, Space curvilinear - cylindrical, spherical (coordinates), Relative and Constrained motion. Kinetics of Particles: Force, mass and acceleration – rectilinear and curvilinear motion, work and energy, impulse and momentum – linear and angular; Impact – Direct and Oblique. Kinetics of System of Particles: Generalized Newton's Second Law, Work-Energy, Impulse-Momentum, Conservation of Energy and Momentum Module 7: Introduction to Rigid body dynamics Kinematics of Planar Rigid Bodies: Equations for rotation of a rigid body about a fixed axis, General plane motion, Instantaneous Center of Rotation in Plane Motion Plane Motion of a Particle Relative to a Rotating Frame. Coriolis Acceleration Kinetics of Planar Rigid Bodies: Equations of Motion for a Rigid Body, Angular Momentum of a Rigid Body in Plane Motion, Plane Motion of a Rigid Body and D'Alembert's Principle, Systems of Rigid Bodies, Constrained Plane Motion; Energy and Work of Forces Acting on a Rigid Body, Kinetic Energy of a Rigid Body in Plane Motion, Systems of Rigid Bodies, Conservation of Energy, Plane Motion of a Rigid Body - Impulse and Momentum, Systems of Rigid Bodies, Conservation of Angular Momentum. Module 8: 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
4	**Texts/References**	**Textbooks:** 1. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008. 2. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006. References: 1. S. P. Timoshenko and D. H. Young, Engineering Mechanics. Fourth Edition. McGraw-Hill,

		New York, 1956. 2. I. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002. 3. Robert W. Soutas-Little; Daniel J. Inman; Daniel Balint, Engineering Mechanics: Dynamics – Computational Edition, 1st Ed., Cengage Learning, 2007 4. Robert W. Soutas-Little; Daniel J. Inman; Daniel Balint, Engineering Mechanics: Statics- Computational Edition, 1st Ed., ,Cengage Learning, 2007

Semester III						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	ME 203	Fluid Mechanics	2	1	0	6
2	ME 222	Mechanics of Materials	2	1	0	6
3	CE 201	Building and Construction Materials	1	1	2	6
4	HS 201	Economics	2	1	0	6
5	CE 202	Surveying and Geomatics	2	1	0	6
6	CE 203	Building Planning and Drawing	2	0	2	6
		Total Credits				**36**

1	**Title of the course** (L-T-P-C)	**Mechanics of Materials** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**Module 1:** Basics: Fundamentals of mechanics of deformable solids. Concepts of stress and strain and their relationships. Axially loaded members - Normal stress and strain, Simple (direct) shear stress and strain, Hooke's law, Stresses on inclined planes under axial loading, thermal stresses and strains, statically indeterminate problems. Elastic strain energy under axial loads. **Module 2:** Torsion: torsion of circular cross-section shafts (Solid and hollow sections): Deformation field, Torsion formulae for stresses and angular deflection, Elastic strain energy under torsion, Closely-wound helical springs – stresses and deflections. **Module 3**: Bending: Euler – Bernoulli model: normal and shear stresses, deflections for symmetric bending. Statically indeterminate problems, Elastic strain energy under flexure. **Module 4:** Combined stresses: State of stress and strain at a point , transformation laws , Mohr's circle diagram for stress and principal stresses, thin walled structures : thin cylinders and spheres. Theories of failure: Maximum Normal-Stress theory, Maximum shear-stress theory and Maximum Distortional-energy theory. **Module 5:** Energy methods – Castigliano's theorem and its applications, fictitious-load method. Stability of structures – Buckling of idealized and elastic columns
4	**Texts/References**	**TEXTBOOKS:** 1) S.H Crandall, N.C Dahl and S.J Lardner, An Introduction to Mechanics of Solids, Tata McGraw Hill, Third Edition, 2012. 2) E.P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, 2nd edition, 2012. **REFERENCES:** 1. J. M. Gere and Goodno, Mechanics of Materials, 7th ed, Cengage Learning India, 2012. 2. J.P Den Hartog, Strength of Materials, Dover, 1949. 3. J.M Gere and S.P Timoshenko, Mechanics of Materials, CBS Publishers, 1986 4. R. C. Hibbeler, Mechanics of Materials, Pearson, 10th edition, 2016 . 5. S.P Timoshenko and D.H Young, Elements of strength of Materials, 5th ed, Affiliated East West Press, 1976. 6. F. P. Beer, E. R. Johnston Jr., John T. DeWolf , D. F. Mazurek, Mechanics of Materials, McGraw-Hill Education; 7th edition, 2014 7. M. Salvadori and R. Heller, Structure in Architecture, Prentice Hall Inc, 1963. 8. S.P Timoshenko, History of Strength of Materials, Dover, 1983. 9. M. H. Sadd, Elasticity: Theory, Applications, and Numerics, 1st ed, Elsevier India, 2006.

1	**Title of the course** (L-T-P-C)	**Fluid Mechanics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Introduction :Scope, definition of fluid as continuum, fluid properties.(2hr) Fluid Statics: Pressure at a point, basic equation for pressure field, pressure variation(fluid at rest):standard atmosphere, Measurement of pressure manometer,Hydrostatics force on a plane and curve surface, Buoyancy, flotation and stability, pressure variation in a fluid with rigid body motion linear motion, rigid body rotation(4hr) Elementary Fluid Dynamics: Statics, stagnation pressure, Bernoulli Equation assumptions(4hr) Fluid Kinematics The velocity filed : Eulerian and Largrangian flow descriptions, steady and deformation, Acceleration field: material derivative, unsteady and convective effects. Control volume and system representation : Reynolds' Transport Theorem, physical interpretation, steady, unsteady effects, moving control volume, potential function(6Hr) Integral approach Conservation of mass derivation of continuity, fixed, non-deforming control volume, moving non-deforming control volume, deforming control volume. Conservation of momentum: linear momentum and moment of momentum equation and their application., comparison of energy equation with Bernoulli's equation(6hr) Differential approach : linear motion and angular motion with deformation, Conservation of mass: differential form of continuity equation, stream function, Conservation of linear momentum, Inviscid flows, Irrotational flow(6hr) Viscous flow : Stress relationships,NS Equations, Simple solutions for viscous flows(4hr) Dimensional analysis Buckingham's II-theorem,Dimensionless groups & their importance (3hr) Viscous Flow in Pipes : General characteristics of pipe flow, fully developed laminar and turbulent flow, turbulent shear stress, turbulent velocity profile, Pipe Flow rate measurement.(4hr) Boundary layer: Boundary layer characteristics boundary layer structure and thickness on a plate, Blasius boundary layer, momentum integral boundary layer equation for a flat plate(4hr)
4	**Texts/References**	1.Yunus A. Cengel, John M. Cimbala, Fluid Mechanics, Tata McGraw Hill Education,2011 2.F.M.White Fluid Mechanics, Seventh Edition, Tata McGraw Hill Education,2011, 3.Kundu,Pijush K., and Ira M.Cohen.Fluid Mechanic, Elsevier,2001

1	**Title of the course** (L-T-P-C)	**Building and Construction Materials** **(1-1-2-6)**
2	**Pre-requisite courses(s)**	-
3	**Course content**	UNIT I STONES – BRICKS – CONCRETE BLOCKS 9 Stone as building material – Criteria for selection – Tests on stones –Deterioration and Preservation of stonework – Bricks – Classification –Manufacturing of clay bricks – Tests on bricks Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Concrete blocks – Lightweight concrete blocks. UNIT II LIME – CEMENT – AGGREGATES – MORTAR 9 Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar –Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading. UNIT III CONCRETE 9 Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Mix specification. UNIT IV TIMBER AND OTHER MATERIALS 9 Timber – Market forms – Industrial timber– Plywood – Veneer – Thermocol – Panels of laminates Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumen's. UNIT V MODERN MATERIALS 9 Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products Refractories – Composite materials – Types – Applications of laminar composites – Fibre textile Geomembranes and Geotextiles for earth reinforcement.
4	**Texts/References**	Textbooks 1. Varghese.P.C. (2015). Building Materials, 2nd Ed., PHI Learning Pvt. Ltd, New Delhi, India. 2. Rajput. R.K. (2008). Engineering Materials,3rd Ed., S. Chand andCompany Ltd. New Delhi, India. 3. Gambhir.M.L.(2004). Concrete Technology, 3rd Ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, India. 4. Duggal.S.K. (2008). Building Materials, 4th Ed.,, New Age International, New Delhi, India. REFERENCES: 5. Jagadish K.S., Venkatarama Reddy B.V., and Nanjunda Rao K.S. (2007). Alternative Building Materials Technology, New Age International, New Delhi, India. 6. Gambhir M.L., & Neha Jamwal (2012). Building Materials, products, properties and systems, Tata McGraw Hill Education Pvt. Ltd, New Delhi, India. 7. IS456 – 2000 (2021): Plain and reinforced concrete-code of practice. Bureau of Indian Standards, New Delhi. 8. IS4926 - 2003: Indian Standard specification for ready–mixed concrete, Bureau of Indian Standards, New Delhi. 9. IS383 – 1970 (2011): Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, Bureau of Indian Standards, New Delhi. 10. IS1542-1992(2009): Indian standard specification for sand for plaster, Bureau of Indian Standards, New Delhi. 11. IS 10262-2009: Indian Standard Concrete Mix Proportioning – Guidelines, Bureau of Indian Standards, New Delhi.

1	**Title of the course** (L-T-P-C)	**Surveying & Geomatics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	-
3	**Course content**	UNIT I: INTRODUCTION TO PLANE & GEODETIC SURVEYING 9 Fundamental Principles, Traversing, Leveling, Instrumentation UNIT II: DIGITAL LEVELS AND TOTAL STATION 9 Basics, Different types of surveying methods, Different sources of errors, Error adjustments UNIT III: CONTOUR SURVEYING 9 Characteristics and uses of Contours, methods of contour surveying, applications of contour mapping UNIT IV: GNSS BASED SURVEYING 9 Basic concepts, Different types of GPS errors, Different types of GNSS based surveying techniques. UNIT V: LiDAR AND UAS BASED SURVEYING 9 LiDAR concepts- Terrestrial LiDAR, Airborne LiDAR overview. Unmanned Aerial System (UAS) Photogrammetry & Remote Sensing overview
4	**Texts/References**	1. B.C. Punmia, A.K. Jain and A.K. Jain (2015), Surveying, Vol. 1 and II, 5th Ed., Laxmi Publications, New Delhi, India 2. Chandra A. M.(2007), Higher Surveying, New Age International Publishers New Delhi, India 3. Chandra A. M.(2007), Plane Surveying, New Age International Publishers, New Delhi, India 4. James, M Anderson & Edward M Mikhail (2012)., Surveying Theory and Practice, Tata Mc Graw Hill Education, New Delhi, India 5. Charles D Ghilani, Paul R Wolf.(2012), Elementary Surveying, Prentice Hall Pvt. Ltd., New Delhi, India. 6. Satheesh Gopi, R. Sathikumar, and N. Madhu (2007). Advanced Surveying: Total Station, GIS and Remote Sensing, 1st Ed.,Pearson Publishers., New Delhi, India 7. Charles D. Ghilani (2017), Elementary Surveying: An Introduction to Geomatics, 15th Ed.,Pearson Publishers, New Delhi, India 8. Pinliang Dong, Qi Chen (2017). LiDAR Remote Sensing and Applications, 1st Ed.,, CRC Press, New Delhi, India. 9. Harry M. Jol (2009). Ground Penetrating Radar Theory and Applications, 1 st Ed.,Elsevier publications. Journal articles as informed by the instructor

1	**Title of the course** (L-T-P-C)	**Building Planning and Drawing** **(2-0-2-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	UNIT I FUNCTIONAL PLANNING OF BUILDINGS 9 Sustainability and concept of green building, General aspects to consider for planning, bye-laws and regulations, Selection of the site for building construction, Principles of planning, Orientation of building and its relation to the outside environment UNIT II COMPONENTS OF BUILDINGS 9 Foundation, and its functional requirements, Characteristics of soil, types of foundations, construction of the foundation; Masonry: Definitions of terms used in masonry, materials used, stone masonry, brick masonry, different bonds used for brick masonry, permissible stress of brick masonry work; Floors and Roofs: Components of a floor, materials used for floor construction, different types of flooring, types of roofs, basic roofing elements, and roof coverings; Staircases: Functional requirements of a good stair, type of steps, type of stairs, planning a staircase, guidelines for accessible buildings UNIT III FUNCTIONAL REQUIREMENTS TO BE CONSIDERED FOR DESIGN AND CONSTRUCTION OF BUILDINGS 9 Damp proofing, fire protection, and thermal insulation, causes and effects of dampness on buildings, materials and methods used for damp proofing, fire hazards, grading of buildings according to fire resistance, fire resisting properties of common building materials, fire-resistant construction, general methods of thermal insulation and thermal insulating materials. UNIT IV CIVIL ENGINEERING DRAWING 9 Drawing various plans and elevations, isometric views & perspective views of civil engineering structures like buildings, bridges, retaining walls, dams, pipelines, and water tanks with design notations, Drawing staircases in 3D, UNIT V DETAILING 9 Detailing of reinforcement in concrete structures
4	**Texts/References**	Reading: 1. Arora S. P., and Bindra S. P (2010), Building Construction, 2nd Ed., Dhanpat Rai Publications, Ltd, New Delhi, India. 2. Varghese P. C (2016), Building Construction, 2nd Ed., PHI Learning Pvt. Ltd., New Delhi, India. 3. S.S. Bhavikatti and M.V. Chitawadagi (2019), Building Planning and Drawing, Dreamtec Press, New Delhi, India. 4. AutoCAD 2020 (2020), A Project-Based Tutorial- Floor Plans, Elevations, Printing, 3D Architectural Modeling, and Rendering; Illustrated edition, Kishore Publications. References: 1. N. Kumara Swamy and A. Kameswara Rao (2019), Building Planning and Drawing, 9th Ed., Charotar Publishing House Pvt. Ltd. New Delhi,India 2. BIS, “National Building Code of India”, Bureau of Indian Standards,2017. 3. Rangwala (2017), Civil Engineering Drawing, 3rd Ed., Charotar Publishing House Pvt. Ltd. New Delhi, India. 4. Francis D. K. Ching (2020),Building Construction Illustrated, 6th Ed., Wiley Publisher Pvt. Ltd., New Delhi, India. 5. AutoCAD Manual (2011), Autodesk, Inc.

1	**Title of the course** (L-T-P-C)	**Economics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Basic economic problems. resource constraints and Welfare maximizations. Nature of Economics: Positive and normative economics; Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures; New Economic Policy in India. Theory of utility and consumer's choice. Theories of demand, supply and market equilibrium. Theories of firm, production and costs. Market structures. Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, savings, and investments. Commercial and central banking. Relationship between money, output and prices. Inflation - causes, consequences and remedies. International trade, foreign exchange and balance payments, stabilization policies : Monetary, Fiscal and Exchange rate policies.
4	**Texts/References**	. 1. P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995. . 2. A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan Publishing Company, NY, 1989. 6. R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987. . 4. William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. . 5. R.S. Pindyck and D.L. Rubinfeld. Microeconomics Th (7 Edition), Pearson Prentice Hall, New Jersey,2009. . 6. R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004.

Semester IV						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 204	Hydraulics Engineering	2	1	0	6
2	CE 205	Structural Analysis	2	1	0	6
3	ME 218	Solid Mechanics Laboratory	0	0	3	3
4	CE 211	Fluid Mechanics and Hydraulics Laboratory	0	0	3	3
5	CE 212	Surveying and Geomatics Laboratory	0	0	3	3
6	CE 301	Environmental Studies	3	0	0	6
7	CE 206	Water Resources Engineering	2	1	0	6
8		Institute Elective-I	2	1	0	6
		Total Credits				**39**

1	**Title of the course** (L-T-P-C)	**Hydraulic Engineering** **2-1-0-6**
2	**Pre-requisite courses(s)**	
3	**Course content**	Module 1: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Module 2: 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. Module 3: 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. Module 4: 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. Module 5: 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. Module 6: 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 "n". Most economical section of channel. Computation of Uniform flow, Normal depth. Module 7 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. Module 8: 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, Module 9: 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. Module 10: 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 modeling in water resources engineering.
4	**Texts/References**	1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House 2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill. 3. Open channel Flow, K. Subramanya, Tata McGraw Hill. 4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill. 5. Burnside, C.D., “Electromagnetic Distance Measurement,” Beekman Publishers, 1971.

1	**Title of the course** (L-T-P-C)	**Surveying and Geomatics Laboratory** **0-0-3-3**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Introduction to Survey Instruments 2. Compass Traverse 3. Theodolite Traverse 4. Differential Levelling 5. Profile and Cross Section Survey 6. Trigonometric Levelling 7. Tacheometric Surveying 8. Total Station Surveying 9. GPS Surveying 10. Surveying & Mapping using Global Navigation Satellite System (GNSS)
4	**Texts/References**	1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2015 2. James, M Anderson & Edward M Mikhail., Surveying Theory and Practice, Tata Mc Graw Hill, 2012 3. Charles D. Ghilani, Elementary Surveying: An Introduction to Geomatics (15th Edition) Pearson Publishers. 2017

1	**Title of the course** (L-T-P-C)	**Structural Analysis** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. **Method of consistent deformation**: Indeterminate beams - Propped cantilever, Fixed and Continuous beams - Analysis for shear force and bending moment - Clapeyron's theorem of three moments - Slope and deflection - effect of sinking of supports. 2. **Slope - Deflection Method**: Analysis and application to continuous beams - portal frames (single bay - Single storey). 3. **Moment-Distribution Method**: Analysis of continuous beams and portal frames (single storey single bay). 4. **Analysis of pin jointed frames** (one degree redundancy); Forces in indeterminate pin jointed frames due to temperature variation and lack of fit; 5. **Influence lines and Moving Loads for beams**: Maximum bending moment and shear force diagrams for simply supported spans traversed by single point load - two concentrated loads - Uniformly distributed load, shorter and longer than the span - enveloping parabola and equivalent uniformly distributed load, determination of maximum bending moment and shear force for a system of concentrated loads on simply supported girders - focal length of a girder - counter bracing. 6. **Influence lines and Moving Loads for trusses**: Influence lines for simple trusses, Muller - Breslau Principle, Influence lines for reactions, shear force at a point and bending moment at a section of beams with fixed ends and two span continuous beams.
4	**Texts/References**	**References:** 1. Hibbeler, R. C. (2016). *Structural Analysis*, 8th Edition, Pearson Education, London, United Kingdom. 2. Junarkar. S. B and Shah H.J. (2008). *Mechanics of Structures,* Vol 1 & Vol.2 – 27th Edition, Charotar Publishers, New York, United States. 3. Wang C.K. (2010). *Intermediate Structural Analysis*, Tata McGraw Hill, New York, United States. 4. Negi, L.S. (1997). *Theory and Problems in Structural Analysis*, Tata McGraw Hill Publishers, New York, United States. 5. Reddy, C. S. (2017*). Basic structural analysis*, 3rd Ed., Tata McGraw Hill Publishers, New York, United States.

1	**Title of the course** (L-T-P-C)	**Solid Mechanics Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**List of Experiments:** • Calibration of photoelastic material using a disk under diametral compression, a beamunder four-point bending and an uni-axial tensile specimen; and SCF evaluation in a circular ring, acrane hook and a plate with hole. • Stresses in thin pressure vessels using strain gauges; • Deflection of curved beams – a ring, a semi-circular ring, a quadrant and an angular davit • Stability of columns – To evaluate the buckling load for different materials (Steel, Copper,Aluminium and Brass) under different end conditions (Hinge-Hinge and Hinge-fixed condition) • Hardness test – Rockwell, Vickers and Brinell Hardness test • Impact testing machine: Izod and Charpy test • Torsion testing machine Tests of UTM: Tension (Ductile and Brittle), compression (brittle and ductile),bending ofbeam, leaf spring characteristics
4	**Texts/References**	S. Crandall, N. Dahl, S. Lardner, An Introduction to Mechanics of Solids, Tata MGHill, 2012. E.P. Popov, Engineering Mechanics of Solids, Prentice Hall, 2012. Gere abd Goodno, Mechanics of Materials, 7th ed., Cengage Learning India, 2012.Gere and Timoshenko, Mechanical of Materials, CBS Publishers,1986.

1	**Title of the course** (L-T-P-C)	**Fluid Mechanics and Hydraulics Laboratory** **0-0-3-3**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Flow over circular cylinder 2. Measurement of jet forces 3. Bernoulli's Principle 4. Stability of floating bodies 5. Horizontal flow from a tank 6. Pipe friction for laminar and turbulent flow 7. Turbulent velocity profile in a circular pipe 8. Calibration of orifice-meter and Venturimeter 9. Performance characteristics of centrifugal pump 10. Performance characteristics of Francis turbine 11. Performance analysis of Pelton wheel 12. Performance characteristics of reciprocating pump 13. Performance characteristics of centrifugal pump in series and parallel configuration
4	**Texts/References**	1. YA Çengal, JM Cimbala, Fluid Mechanics: Fundamentals and Applications, McGraw-Hill, 2006 2. SL Dixon, and CA Hall, Fluid Mechanics and Thermodynamics of Turbomachinery, Elsevier, 2014.

1	**Title of the course** (L-T-P-C)	**Environmental studies** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Module A: Natural Resources, Ecosystems, Biodiversity and its conservation: Natural resources and ecosystems, Forest, grassland, desert and aquatic ecosystems, biodiversity at global, national and local levels, conservation of biodiversity Module B: Air Pollution Introduction to understanding air quality management, fundamental processes of meteorology, Air Pollutants – Gaseous and particulate, Criteria for pollutants, ambient and source standards, Aerosols: Characterisation of aerosols, size distributions, measurement methods; Transport behaviour: diffusion, sedimentation, inertia; Visibility; principles of particulate control systems. Module C: Water Treatment Discussion of water quality constituents and introduction to the design and operation of water and wastewater treatment processes. Module D: Solid Waste Management and Climate Change Different aspects of solid and hazardous waste management. Climate change and greenhouse gas emissions, technologies would reduce the greenhouse gas emissions. Climate change and its possible causes. Module E: Sociology/Environmentalism Description: Environmentalism in sociological tradition, Sustainability, North-South divide, Political economy approaches in environmental studies, Debates over environmental issues Module F: Economics Energy economics and financial markets, Market dynamics, Energy derivatives, Energy Efficiency; Sustainable Development: Concept, Measurement & Strategies, Interaction between Economic Development and the Environment Module G: Philosophy Environmental ethics, Deep ecology, Practical ecology, Religion and attitude towards environmental ethics, Ecofeminism and its evolution. Module H: Field work and project: visit to a local area to document environmental assets, case studies of a simple ecosystem and group discussions on current environmental issues.
4	**Texts/References**	1) Cunningham W.P. and Cunningham M.A. (2002), Principles of Environmental Science, Tata McGraw-Hill Publishing Company, New Delhi. 2) Dasgupta, P. and Maler, G. (eds.), (1997), The Environment and Emerging Development Issues, Vol. I, Oxford University Press, New Delhi. 3) Jackson, A.R.W. and Jackson, J.M. (1996), Environmental Sciences: The Environment and Human Impact, Longman Publishers. 4) Nathanson, J.A., (2002), Basic Environmental Technology, Prentice Hall of India, New Delhi. 5) Redclift, M. and Woodgate, G. (eds.), (1997), International Handbook of Environmental Sociology. 6)Srivastava, K.P. (2002), An Introduction to Environmental Study, Kalyani Publishers, Ludhiana. 7) Review articles from literature

1	**Title of the course** (L-T-P-C)	**Water Resources Engineering** **2-1-0-6**
2	**Pre-requisite courses(s)**	
3	**Course content**	*Module 1: Introduction* - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. *Module 2: Precipitation* - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India. *Module 3: 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. *Module 4: 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. *Module 5: 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. *Module 6: 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. *Module 7: 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. *Module 8: 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.
4	**Texts/References**	1. K Subramanya, Engineering Hydrology, Mc-Graw Hill. 2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill. 3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill. 4. G L Asawa, Irrigation Engineering, Wiley Eastern 5. L W Mays, Water Resources Engineering, Wiley. 6. J D Zimmerman, Irrigation, John Wiley & Sons 7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 302	Design of Concrete Structures	2	1	0	6
2	CE 303	Geotechnical Engineering	2	1	0	6
3	CE 304	Transportation Engineering	2	1	0	6
4	CE 311	Transportation Engineering Laboratory	0	0	3	3
5	CE 312	Geotechnical Engineering Laboratory	0	0	3	3
6	CE 305	Environmental Engineering	2	1	0	6
7	CE 313	Environmental Engineering Laboratory	0	0	3	3
8	CE 314	Civil Engineering Software Laboratory	0	0	3	3
		Total Credits				**36**

1	**Title of the course** (L-T-P-C)	**Design of Concrete Structures** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. Design philosophy - Working stress and limit state methods. 2. Design of RC beam sections for flexure using working stress method 3. Design of RC beam sections for flexure, shear and torsion using limit state methods 4. Design of RC beam elements - detailing, curtailment and serviceability 5. Design of one-way slabs, design of two-way slabs, design of slabs for serviceability, design of continuous slab systems. 6. Design of short columns under pure compression, design of short columns under compression, and uniaxial and biaxial bending 7. Principles of structural design of footings, design of isolated RC footings 8. Design of cantilever Retaining walls- Design of RC Circular Water tank. 9. Principles of Reinforcement Detailing
4	**Texts/References**	References: 1. Krishnaraju N. (2016). Design of Reinforced Concrete Structures, 4th Edition, CBS Publishers & Distributors CBS, New York. 2. Subramanian N. (2013). Design of Reinforced Concrete Structures, Oxford University Press, Maryland, USA. 3. Pillai S. U., Menon D. (2021). Reinforced Concrete Design, 4th Edition, McGraw Hill.

1	**Title of the course** (L-T-P-C)	**Geotechnical Engineering (2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**Introduction:** Soil formation- Major soil deposits of India. Basic Definitions and Relationships: 3-phase soil system, Volumetric relationships, and weight - volume relationships. Determination of Index Properties: Water content, Specific gravity, Grain size distribution by sieve and hydrometer analysis, Relative density, Atterberg limits and indices. Classification of Soils: Classification of soil systems – Particle size classification, Textural classification, AASHTO classification, Unified soil classification and Indian soil classification- Field identification of soils. **Soil-Water:** Types of soil water, Capillarity in soils, Permeability of soils, Darcy's law, Determination of permeability of soils, Permeability of stratified soils, Field permeability determination, Seepage velocity, Absolute coefficient of permeability, Factors affecting permeability- Effective stress principle- Effective stress under different field conditions- Seepage Pressure-Flow nets, Quicksand condition. **Compaction and Consolidation o f Soils:** C o m p a c t i o n : Definition a n d importance of compaction – Standard P r o c t o r compaction test, Modified compaction test- Factors affecting compaction- Influence of compaction on soil properties – Field compaction and its control, Relative compaction. Stress distribution in Soils: Importance of estimation of stresses in soils – Boussinesq's and Westergaard's theories for point loads, uniformly loaded circular and rectangular areas, pressure bulb, variation of vertical stress under point load along the vertical and horizontal planes – Newmark's influence chart, Contact pressure distribution in sands and clays. Consolidation: Types of compressibility – Immediate settlement – Primary consolidation and secondary consolidation – Stress history of clay, Normally consolidated soil, Over consolidated soil and under consolidated soilpreconsolidation pressure and its determinationConsolidation test, Estimation of settlements - Terzaghi's 1-D consolidation theory – Coefficient of consolidation and its determination - Spring analogy. **Shear Strength:** Definition and use of shear strength - Source of shear strength Normal and Shear stresses on a plane – Mohr's stress circle- Mohr-Coulomb failure theory- Measurement of shear strength, Drainage conditions -Direct shear test, Triaxial shear test, Office of Dean (Academic Programme), IIT Dharwad Assigned Course-Code: New Course Approval Form version 1.4 Page 21 of 115 Last updated: 13/01/2022 Unconfined compression test and vane shear test – Factors affecting shear strength of granular soils and cohesive soils. Skempton's pore pressure parameters. Introduction to stress paths. **Stability of Soil Slopes:** Types of slopes – Types of slope failures – Slip circle method, Determination of centre of critical slip circle – Taylor's stability charts and their use, Stabilization of soil slopes
4	**Texts/References**	**Reading:** 1. Ranjan G. and Rao A.S.R. (2016). Basic and Applied Soil Mechanics, Third edition, New Age International Pvt Ltd. 2. Budhu M. (2016). Soil Mechanics and Foundations, India edition, Wiley. 3. Venkataramaiah C. (2018). Geotechnical Engineering, Sixth edition, New Age International. 4. Murthy V.N.S., (2018). Soil Mechanics and Foundation Engineering, CBS Publishers. 5. Arora K.R. (2020). Soil Mechanics and Foundation Engineering, Standard Publishers Distributors. **Reference:** 1. Terzaghi K., Peck R.B. and Mesri G. (2009). Soil Mechanics in Engineering Practice, Third edition, Wiley India Pvt Ltd. 2. Lambe T.W. and Whitman R.V. (2012). Soil Mechanics, Wiley India Pvt Ltd. 3. Powrie W. (2013). Soil Mechanics: Concepts and Applications, 3rd edition, CRC Press. 4. Knappett J. and Craig R.F. (2019). Craig's Soil Mechanics, 9th edition, CRC Press.

1	**Title of the course** (L-T-P-C)	**Transportation Engineering** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Highway Network Planning: Different modes of transportation, role of highway transportation, classification, network patterns, planning surveys, preparation of plans, final report, master plan, evaluation by saturation system, 20 year road development plans, salient features, determination of road lengths, introduction to highway economics. 2. Highway Alignment And Geometric Design: Principles of highway alignment, requirements, controlling factors, engineering surveys, importance of geometric design, design controls and criteria, cross section elements, pavement surface characteristics, camber, carriageway, kerbs, road margins, formation, right of way, typical cross sections, sight distance, stopping sight distance, overtaking sight distance, sight distance at intersections, design of horizontal alignment, super elevation, transition curves, design of vertical alignment, gradients, vertical curves. 3. Traffic Engineering Principles: Traffic characteristics; components of traffic stream: flow- speed-Density, measurement and analysis, q-k-v relationships, design hourly volume, concept of EPCU, capacity and level of service, parking studies and road safety. 4. Pavement Materials and Mix Design: Types of pavement structures, functions of pavement component layers, materials used in pavements, basic soil properties relevant to pavement applications, properties of aggregate, blending of aggregates, tests on bitumen, grading of bitumen, bituminous mix design using Marshall method. 5. Design of Pavements: Stresses in flexible pavements: layered system concepts, stress solution for one, two and three layered systems, fundamental design concepts; variables considered in pavement design: axle types, standard and legal axle loads, ESWL, EWLF, vehicle Office of Dean (Academic Programme), IIT Dharwad Assigned Course-Code: New Course Approval Form version 1.4 Page 26 of 115 Last updated: 13/01/2022 damage factor, ADT, AADT, growth factor, lane distribution factor, directional distribution factor, tyre pressure, contact pressure, design life; design of flexible pavement using IRC method; stresses in rigid pavements: Westergaard's theory and assumptions, stresses due to curling, stresses and deflections due to loading, frictional stresses, design of joints; design of rigid pavement using IRC method.
4	**Texts/References**	1. Kadiyali L.R. (2017). Traffic Engineering and Transport Planning, Ninth Edition, Khanna Publishers, New Delhi, India. 2. Khanna, S.K., Justo C.E.G. and Veeraragavan. (2017). Highway Engineering, Tenth Edition, Nem Chand and Bros., Roorkee, India. 3. Huang, Y.H. (2008) Pavement Analysis and Design, Pearson Prentice Hall, New Jersey, USA. 4. Khisty C. J. and Lall. B. K. (2002) Transportation Engineering – An Introduction, Third Edition, Prentice Hall of India Pvt. Ltd, New Delhi, India. 5. Kandhal, P.S. (2016). Bituminous Road Construction in India, PHI Learning Pvt. Ltd., New Delhi, India. 6. Papacostas C.S. and Prevedouros. P.D. (2002) Transportation Engineering and Planning, Third Edition. Prentice Hall of India Pvt. Ltd, New Delhi, India. 7. Yoder, E.J. and Witczak. M.W. (2012) Principles of Pavement Design, Second Edition, John Wiley and Sons, New York, USA..

1	**Title of the course** (L-T-P-C)	**Transportation Engineering Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Tests on Aggregate: aggregate gradation, combined flakiness and elongation tests, specific gravity test, water absorption test, aggregate impact test, Los Angeles abrasion test, demonstration of soundness test. 2. Tests on Bitumen: penetration test, flash and fire point tests, ductility test, softening point test, specific gravity test, demonstration of absolute and kinematic viscosity tests, demonstration of rolling thin film oven test, bitumen grading. 3. Tests on Bituminous Mixtures: bituminous mix design using Indian and International practices, stripping value of aggregates, demonstration of retained tensile strength test, demonstration of bitumen extraction, resilient modulus. 4. Tests on Soil: California bearing ratio test. 5. Field tests: pavement unevenness using MERLIN, and pavement layer density using sand replacement method, deflection studies, pavement evaluation studies. 6. Traffic Studies: traffic volume studies for mid-block section and intersection, spot speed studies, headway distribution studies, parking usage survey
4	**Texts/References**	1. Khanna S. K. and Justo C.E.G, Highway Material Testing (Laboratory Manual), Nem Chand & Bros, Roorkee. 2. Relevant IRC/BIS/ASTM Specifications 3. Relevant highway design software manual Relevant IRC/BIS/ASTM codes.

1	**Title of the course** (L-T-P-C)	**Geotechnical Engineering Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. Index properties of soils a. Determination of moisture content b. Determination of specific gravity c. Grain size analysis d. Determination of consistency limits e. Determination of relative density f. Determination of field density 2. Engineering Properties of soils a. Determination of the coefficient of permeability of a soil b. Determination of the relationship between the moisture content and density of soils c. Determining the settlement due to primary consolidation d. Measurement of undrained shear strength of cohesive soils having low shear strength (less than 30 kPa) for which triaxial or unconfined tests cannot be performed e. Measurement of shear strength of soils on a predefined shear plane f. Determination unconfined compressive strength of soils g. Determination of shear strength of soils h. Determination of Soil Suction i. Determination of CBR (California Bearing Ratio) j. Determination of swelling potential of soils 3. In-situ Properties of soils a. Determination of bearing capacity of a soil using plate load test b. Determination of in-situ shear strength of soils c. Determination of in-situ unconfined compressive strength d. To measure material's in-situ resistance to penetration.
4	**Texts/References**	Reading: 1. Head K.H. and Epps R. J. (2006). *Manual of Soil Laboratory Testing vol I*, 3rd Edition, Whittles Publishing. 2. Head K.H. and Epps R. J. (2011). *Manual of Soil Laboratory Testing vol II*, 3rd Edition, Whittles Publishing. 3. Head K.H. and Epps R. J. (2014). *Manual of Soil Laboratory Testing vol III*, 3rd Edition, Whittles Publishing. 4. Das B.M. (2022). *Soil Mechanics Laboratory Manual*, 10th Ed., London, OUP USA.

1	**Title of the course** (L-T-P-C)	**Environmental Engineering** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	*Module 1: Water:* -Surface sources, subsurface sources, physical, chemical and biological characteristics, Estimation of water demand, water consumption rate, fluctuations in rate of demand, design period, population forecasting methods. 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. *Module 2: Water Treatment:* aeration, sedimentation, coagulation flocculation, filtration, disinfection, *Module 3:* Wastewater treatment: *Sewage*- Domestic and Stormwater, 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. Module 4: Introduction to Advanced oxidation processes; emerging treatment technologies; Industrial wastewater treatment *Module 5: 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 *Module 6: Noise*- Basic concept, measurement and various control methods. *Module 7: 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. *Module 8: 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. *Module 9:* Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.
4	**Texts/References**	8. Masters G. M. (1991). *Introduction to Environmental Engineering and Science*, 1st edition, Pearson. 9. Vesilind P. A., Morgan S. M. (2008). *Introduction to Environmental Engineering*, Second Edition, Nelson Engineering.

		10. Peavy H. S., Rowe D.R, Tchobanoglous G. (1985) *Environmental Engineering*, Mc-Graw -Hill International Editions, New York. 11. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi. 12. *Manual on Water Supply and Treatment*. Ministry of Urban Development, New Delhi. 13. Patil S.M. (2007) *Plumbing Engineering. Theory, Design and Practice*, Third Edition. 14. Tchobanoglous G., Theissen H. & Vigil S. A. (1993). *Integrated Solid Waste Management*, Second Edition, McGraw Hill Publication. 15. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

1	**Title of the course** (L-T-P-C)	**Environmental Engineering Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**List of experiments** 1. Determination of the turbidity, electrical conductivity, and pH of the given sample 2. Determination of solids 3. Determination of alkalinity, acidity and hardness 4. Analysis of ions: copper, chloride and sulfate 5. Estimation of optimum coagulant dosage 6. Determination of Chemical oxygen demand (COD) 7. Determination of Dissolved Oxygen (DO), and Biochemical oxygen demand (BOD) 8. Determination of Break Point Chlorination 9. Bacterial estimation 10. Determination of specific gravity
4	**Texts/References**	1. APHA Manuals, 2. APHA/AWWA/WPCF Publishing, Washington, D.C., latest edition

1	**Title of the course** (L-T-P-C)	**Civil Engineering Software Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. AutoCAD- Computer-aided design software to create precise 2D and 3D drawings. 2. Autodesk Revit -To design a building and structure and its components in 3D. 3. Autodesk 3ds Max -A visualization tool for civil engineers and transport infrastructure planners. 4. Autodesk Civil 3D – A Civil Engineering design and documentation software that supports Building Information Modeling (BIM) workflows. 5. Staad Pro- Structural analysis & design computer program 6. PrimaVera- A project, program, and portfolio management tool 7. ArcGIS- A geospatial software to view, edit, manage and analyze geographic data and patterns. 8. PLAXIS 2D and 3D- A geotechnical finite element analysis software to model, simulate, analyze geotechnical engineering problems. 9. ANSYS with Civil FEM and CFD modules - A finite element analysis and design software for Civil Engineering Projects including Computational Fluid Dynamics (CFD) simulation package to predict the impact of fluid flows on structures. 10. GeoStudio- An integrated software for solving slope stability, groundwater flow, and Geo-Environmental challenges. 11. Vissim- A microscopic multi-modal traffic flow simulation software package
4	**Texts/References**	Reading: 1. Software manuals

Semester VI						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 306	Design of Steel Structures	2	1	0	6
2	CE 310	Sensors Technologies & Instrumentation in Civil Engineering	2	0	2	6
3	CE 308	Foundation Engineering	2	1	0	6
4	CE	Civil Engineering Credit Seminar	0	0	3	3
5	CE 309	Estimation and Costing in Civil Engineering	1.5	0	0	3
6		Institute Elective-II	2	1	0	6
7		HSS Elective-I [from Basket: 1 OR 2] (Professional/Applied Ethics)	2	1	0	6
		Total Credits				**36**

1	**Title of the course** (L-T-P-C)	**Design of Steel Structures** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	7. Introduction: General- Types of Steel – Mechanical behavior of steel – Measures of Yielding – Measures of Ductility – Types of Structures – Structural Steel Sections. 8. Methods of Structural design: Introduction-Design Philosophies-Working Stress method - Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor-Load-Load combinations-Classification of Cross sections- General aspects in the design. 9. Design of Steel fasteners: Types of fasteners – Riveted connections- Bolted connections- Assumptions- Failure of bolted joints – Strength of bolted joints – Design examples – Design of Welded connections – Butt weld- fillet weld – Design examples. 10. Design of Tension Members: General – Modes of Failure of Tension member- Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design. 11. Design of Compression Members: General – Strength of Compression members- Design Compressive strength- Example on analysis of Compression members – Design of Angle struts – Design Examples- Built up Columns- Design of Lacing – Design of Battens- Design Examples- Design of Roof members. 12. Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples. 13. Design of Beam Columns: Behaviour of members under combined loading – Modes of Failures – Design Examples. 14. Design of Column Splices and Column Base: Design of Column Splice-Design Examples- Design of Column Base- Slab Base- Gusseted Base- Design Examples.
4	**Texts/References**	**References:** 1. Limit State Design of Steel Structures – S.K.Duggal, TMH Education Pvt Ltd, 2nd Edition, 2014 2. IS-800-2007, BIS Publication 3. Steel Structures : Design and Practice- N.Subramanian, Oxford Pub, 2011 4. Design of Steel structures – S.S. Bhavikatti, IK International Pub Pvt Ltd, 4th Edition 5. Design of Steel structures – L.S. Negi, McGraw Hill Education, 2nd Edition, 2017

1	**Title of the course** (L-T-P-C)	**Sensor Technologies and Instrumentation in Civil Engineering** **(2-0-2-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	***Module 1: Fundamentals of Measurement, Sensing and Instrumentation*** Definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations; Pressure meters, Piezometer, Pressure cells, O-Cell, Sensors, Inclinometers, Strain gauges, Accelerometers, LVDT & Optical Encoder. ***Module 2: Sensor Installation and Operation*** i) Predict the response of sensors to various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty. ***Module 3: Data Analysis and Interpretation*** a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range). ***Module 4: Frequency Domain Signal Processing and Analysis*** Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution. ***Module 5: Intelligent Sensors*** General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.
4	**Texts/References**	**Reading:** 1. AS Morris (2001), Measurement and Instrumentation Principles, Butterworth Heinemann, 3rd edition. 2. DVS Murthy (2013), Transducers and Instrumentation, PHI, 2nd edition. 3. D Patranabis (2003), Sensors and Transducers, PHI, 2nd edition 4. S Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis, 1st edition. 5. AD Helfrick and WD Cooper (2015), Modern Electronic Instrumentation & Measurement Techniques, Pearson India, 1st edition. **References:** 1. I Gertsbakh (2010), Measurement Theory for Engineers, Springer, 1st edition. 2. AK. Ghosh (2012), Introduction to measurements and Instrumentation, PHI, 4th edition. 3. HKP Neubert (2012), Instrument Transducers Oxford University Press, 2nd edition. 4. DA Bell (2007), Electronic Instrumentation and Measurements, Oxford University Press, 2nd edition

1	**Title of the course** (L-T-P-C)	**Foundation Engineering** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**Soil Exploration**: Introduction and different methods – Direct methods, Semi-direct and Indirect methods; Sampling in soils and rocks; Subsurface exploration program - Preparation of bore logs and preparation of exploration report. **Lateral Earth Pressures:** Lateral earth pressure theory, Different types of earth pressures, Rankine's active and passive earth pressures, pressure distribution diagram for lateral earth pressures against retaining walls for different conditions in cohesionless and cohesive soils, Coulomb's active and passive earth pressure theory, Culmann's graphical construction, Problems **Shallow Foundations and Bearing Capacity:** Types of shallow foundations and choice, basic requirements, Significance of these foundations. Bearing capacity of foundation: Bearing capacity – Basic Definitions, Factors affecting bearing capacity, Estimation of Bearing capacity by different methods, Analytical measures – Terzaghi's and Meyerhof methods and calculations, Field measures – SPT, CPT and Plate load tests. **Settlement of foundation**: Settlement analysis – Types of foundation settlement, Components of settlements - their estimation, Allowable settlement values, Effects, Causes and remedial measures of total and differential settlements. **Deep Foundations** – types of deep foundations, pile foundations: Classification and uses, Load carrying capacity calculations by different methods – static methods, dynamic methods, in-situ penetration tests, piles load test; Negative skin friction; under reamed pile foundations; Pile groups – Necessity, Efficiency, Group capacity and settlements.
4	**Texts/References**	Reading: 1. Das, B. M. and Sobhan, K. (2017). Principles of Geotechnical Engineering, 9th Ed., Cengage India Private Limited, New Delhi. 2. Budhu, M. (2008). Foundations and Earth Retaining Structures, 1 st Ed., John Wiley & Sons, Hoboken. 3. Saran, S. (2018). Analysis and Design of Substructures: Limit State Design, 2 nd Ed., Oxford & IBH Publishing Co Pvt, New Delhi. 4. Salgado, R. (2022). The Engineering of Foundations, Slopes and Retaining Structures, 2 nd Ed., CRC Press, Boca Raton. References: 1. Varghese, P. C. (2009). Design of Reinforced Concrete Foundations, 1 st Ed., Prentice Hall India Learning Private Limited, New Delhi. 2. Som, N. N. and Das, S. C. (2003). Theory and Practice of Foundation Design, 1 st Ed., Prentice Hall India Learning Private Limited, New Delhi. 3. Katzenbach, R., Leppla, S. and Choudhury, D. (2019). Foundation Systems for High-Rise Structures, 1 st Ed., CRC Press, Boca Raton. 4. Guo, W. D. (2012). Theory and Practice of Pile Foundations, 1 st Ed., CRC Press, Boca Raton.

1	**Title of the course** (L-T-P-C)	**Estimation and Costing in Civil Engineering** **(1.5-0-0-3)**
2	**Pre-requisite courses(s)**	
3	**Course content**	1. Introduction to estimates: Purpose of estimating; Different types of estimates - their function and preparation; Building estimates: Schedule of rates, Units of measurements, units of works; Road Estimates Volume of earthwork, Different methods, Earthwork for hill roads; Railway and canal works Estimates for a new track railway line; earthwork in canals. 2. Analysis of rates: Preparation for analysis of rates. Quantity of materials per unit rate of work, labour estimate. 3. Specifications: Necessity, types of specifications, specifications for different civil engineering materials. 4. Contracts: Essentials of contracts, types of engineering contracts advantages and disadvantages. 5. Tenders: tender forms, tender documents & notices time limits, necessity. 6. Valuation: Purpose, difference between value and cost, qualifications and functions of a valuer, scrap & salvage value, sinking fund, capitalised value.
4	**Texts/References**	1. Chakraborti, M, Estimation, costing, specifications and valuation in civil engineering National Halftone Co. Calcutta, 2005. 2. Dutta B.N., Estimation and costing in civil engineering: theory and practice UBS Publishers Distributors Ltd, 2006. 3. Birdie, G.S. - Estimation and costing in civil engineering Dhanpat Rai Publishing co. ltd.

Semester VII						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 401	Construction Engineering & Management	2	1	0	6
2	CE 403	Civil and Infrastructure Engineering Design	1	0	1	3
3		Institute Elective-V	2	1	0	6
4		HSS Basket 1 or 2 (Elective-II)	2	1	0	6
5	CE	BTP-I/Program Elective-I	0	0	6	6
		Total Credits				**30**

1	**Title of the course** (L-T-P-C)	**Construction Engineering and Management** **2-1-0-6**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	**Fundamentals of construction project management**: Introduction, Project Initiation, and Planning, Time Value of Money, Investment Analysis, Cost-Benefit Analysis; Construction schedule management: Work Breakdown Structures, Development of project activity networks, Precedence Diagram Method, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Line Balance Methods in scheduling. **Construction material management**: Resources in construction, Resource levelling, the crashing of project schedules, earned value analysis **Construction Quality and safety**: Safety and occupational hazards in construction, Fundamentals of quality control in construction, Safety in construction - Cost of Accidents - Safety norms - Safety aids **Introduction to Construction Contracts**: Estimation, Tenders & Contracts - EOI- Prequalification - Types of Contracts - Terminology used, fundamentals of delay analysis and claims, Construction Finances – decision making, **Advances in construction management**: Introduction to Building Information Modelling (BIM), Lean construction, and Integrated Project Delivery in construction
4	**Texts/References**	**Reading:** 1. Kumar Neeraj Jha, “Construction Project Management: theory and practice” Pearson Education India; 2nd edition, 2015. 2. F. Lawrence Bennett, “The Management of Construction: A Project Lifecycle Approach”, Routledge; 1st edition, 2016. 3. S. Choudhury “Project Management”, McGraw Hill Education, 2017. **References:** 1. Riggs, James L., David D. Bedworth, and Sabah U. Randhawa., “Engineering Economics”, McGraw Hill Education; 4th edition, 2004. 2. Garold D. Oberlender, “Project management for engineering and construction”, McGraw Hill Education; Second edition, 2014. 3. Chitkara, K. K. “Construction Project Management”, McGraw-Hill; Forth Edition, 2019.

1	**Title of the course** (L-T-P-C)	**Civil and Infrastructure Engineering Design** **(1-0-1-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. Design of Shallow Foundation 2. Manual Design of G+2 Storey Building 3. Design of Deep Foundation 4. Design Rigid Pavement 5. Design of Flexible Pavement 6. Design of Concrete Gravity Dam 7. Design of a Retaining Wall 8. Design of G+10 Storey Building 9. Design of Beam Bridge 10. Design of a Sewage Treatment Plant
4	**Texts/References**	**References:** 6. Shah, V. L. and Karve, S. R. (2010). *Illustrated Design of Reinforced Concrete Buildings*, 9th Ed., Structures Publications, Pune. 7. Varghese, P. C. (2009). Design of Reinforced Concrete Foundations, 1st Ed., Prentice Hall India Learning Private Limited, New Delhi. 8. Huang, Y.H. (2008) *Pavement Analysis and Design*, Pearson Prentice Hall, New Jersey, USA. 9. Yoder, E.J. and Witczak. M.W. (2012) *Principles of Pavement Design*, Second Edition, John Wiley and Sons, New York, USA. 10. Victor, D. J. (2019). Essentials Of Bridge Engineering, Oxford& IBH Publishing Co. Pvt. Ltd., 6th Ed., New Delhi. 11. *A Water Resources Technical Publication: Design of Gravity Dams (2011)*, U.S. Department of the Interior, Books Express Publishing, USA. 12. Metcalf and Eddy (2002). *Wastewater Engineering, Treatment, Disposal and Reuse*, 4th Ed., Tata McGraw-Hill, New Delhi. .