Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University) Andheri

(W), Mumbai – 400058

COURSE CONTENTS

Regulation 22

Sem. III

Year 2023-24 B.Tech. (Civil) ENGINEERING

Academic Year 2023-2024

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4	ES-BTC304	Building Drawing with CAD
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	Laboratory courses	
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LAPLACE LINEAR ALGEBRA AND COMPLEX ANALYSIS

Course Code	Course Name
BS-BTC301	Laplace linear algebra & complex analysis

Course pre-requisites	Std. XI, XII Mathematics, DCCN(BS-BT101) , ICDE(BS-BT201)

Course Objectives

The objectives of this course are
   1. To learn Laplace & Inverse Laplace transforms and its application to solve differential equations.
   2. To understand concept of complex variables and conformal mapping.
   3. To learn various matrices, operations and important theorems

Course Outcomes

Upon successful completion of the course, students should be able
   1. Solve problems based on Laplace and inverse Laplace transform. Apply theory of Laplace transforms to evaluate real integrals and solve initial & boundary value problems.
   2. Solve complex variable problems.
   3. Find rank of matrices, Eigen values and Eigen vectors of matrices

Course Content		
Module No.	*Details*	*Hrs.*
1	**Laplace Transforms** Function of bounded variation (Statement only) Laplace Transforms of $1, e^{at}, \sin at, \cos at, \sinh at, \cosh at, t^n, erf\left(\sqrt{t}\right), J_0(t)$,Shifting theorems, change of scale, $L\{t^n f(t)\}, L\left\{\dfrac{f(t)}{t}\right\}, L\left\{\dfrac{d^n f(t)}{dt^n}\right\}, L\left\{\displaystyle\int_0^t f(u)du\right\}$ Convolution theorem, Evaluation of real integrals using Laplace transforms.	07
2	**Inverse Laplace Transforms** Evaluation of Inverse Laplace Transforms using partial fractions, convolution theorem, shifting theorems and other properties. Application of Laplace Transform to solve initial & boundary value problems involving ordinary differential equation with one dependent variable.	06
3	**Complex Variables& Mapping** Functions of complex variable, Analytic functions, Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic functions, Analytic method and Milne Thomson methods to find f(z), orthogonal trajectories.	07

	Conformal mapping, Bilinear transformation, cross ratio, fixed points	
4	**Matrices** Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian & Unitary matrices and their elementary properties. Elementary operations and their use in getting the Rank, Normal form of a matrix, PAQ form, Consistency of system of linear homogeneous and non-homogeneous equations.	06
5	**Eigen values & Eigen vectors** Eigen-values and Eigenvectors of a matrix, Cayley- Hamilton theorem,	04

Text Books:

1. B S Grewal (2014), "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, ISBN 8174091955, 1315 Pages

Reference Books:

1. Erwin Kreyszig (2010), "Advanced Engineering Mathematics" Wiley EasternLimited, Singapore 10th edition, ISBN 8126554231, 1148 Pages.
2. Text book of Engineering Mathematics, N. P. Bali , Laxmi Publications, 9th edition, ISBN:978-81-318-0832-0.

Mechanics of Materials

Course Code	Course Name
ES-BTC302	Mechanics of Materials

Course pre-requisites	ES-BT104, ES-BT154, ES-BT204

Course Objectives
The objectives of this course are 1. To introduce the students to the behaviour of an elastic member Subjected to various types of forces such as axial force, shear force, bending moment, torsion etc. 2. To prepare the base for the students to study other structural engineering courses at a later stage.

Course Outcomes
Upon successful completion of the course, students should be able 1. To draw axial force, shear force and bending moment diagrams for determinate beams. 2. To analyse members subjected to axial force, shear force, bending moment, torsion in terms of stresses including principal stresses. 3. To estimate the stresses and strains in thin cylindrical and spherical shells. 4. To locate the shear center of thin walled cross sections.

Course Content		
Module No.	*Details*	*Hrs.*
1	**Stress & strain:** Stress, yield stress, ultimate stress, shear stress, factor of safety, strain, modulus of elasticity (E), modulus of rigidity (G), bulk modulus (K), Poisson's ratio, relationship between elastic constants (No derivations), bars of varying sections, stresses in composite section, temperature stresses. Stresses due to suddenly applied axial load & impact load (including derivations). Introduction to the concept of Fatigue.	07
2	**Axial force, shear force and bending moment in beams:** Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationships between intensity of loading, shear force and bending moment (including derivations).	05
3	**Simple theory of bending:** Flexure formula for beam, simple problems involving the application of flexure formula, section modulus, moment of resistance of a section, flitched/ composite beams.	06

4	**Shear stress in beams:** a) Distribution of shear stress across beam cross sections used commonly for beams. Maximum and average shear stress across the beam cross Sections. b) Shear Connectors **Shear Centre:** Concept of shear centre, determination of shear centre for simple cross sections such as angle, tee, channel, I, etc.	09
5	**Simple theory of torsion:** Torsion equation for circular shafts (No derivations) – Application of equation to solid and hollow circular shafts, stresses in shaft when transmitting power.	03
6	**Principal stresses:** General equations for transformation of stress, principle stresses and principal planes, maximum shear stress, determination using Mohr's circle.	05
7	**Thin cylindrical and spherical shells:** Stresses and strains in thin cylindrical shells subjected to internal pressure. Stresses and strains in thin spherical shells subjected to internal pressure.	03
Term Work	

Term work shall comprise of
1. At least 20 (twenty) solved problems based on the above modules shall be submitted as term work.
2. Course project*

*Course Project: There will be a course project where the students will be able to apply and integrate the knowledge gained during the course. The projects will be developed by teams of Two to Four students and will consist of design of any system having min. 5 to 6 components.

For Self-study (if any):

Text Books:
1. Popov, Egor P, (1978), "Mechanics of materials", Englewood Cliffs, N.J: Prentice- Hall, ISBN 0135711584 , 864 pages
2. S.B. Junnarkar (2007), "Mechanics of materials Vol-1", Charotar Publications, ISBN 8185594678, 447 pages
3. Dr.R.K.Bansal (2007),"Strength of Materials", Laxmi Publications, ISBN 81311800008, 1106 pages.
4. Bear & Johnson (2007), "Mechanics of materials", Tata McGraw-Hill, ISBN: 0070042845, 780 pages.
5. Ramamrutham S. (2011),"Strength of Materials", Dhanpat Rai Publishing

Co Pvt Ltd, ISBN 9788187433545, 1011 pages.

Reference Books:

1. Timoshenko & Gere (2006), "Mechanics of materials", Tata McGraw Hill, CBS Publishers & Distributors, ISBN 8123908946, 762 pages.
2. James M. Gere, Books/cole (2012), "Mechanics of materials", Cengage Learning, ISBN 1111577730, 1056 pages.
3. G.H. Ryder (2002), "Strength of materials" Macmillan Publishers India Limited, ISBN 0333935365, 352 pages.

Basics of Surveying

Course Code	Course Name
PC-BTC303	Basics of Surveying
Course pre-requisites	

Course Objectives
This course provides an introduction to the fundamental principles, techniques, and methods used in surveying. Students will learn about the basic concepts, instruments, and procedures involved in land surveying, including measurements, leveling, traversing, and mapping. The course emphasizes both theoretical knowledge and practical skills through hands-on exercises and fieldwork.

Course Outcomes
Students will be able to:

1. Understand the importance and applications of mathematics, basic surveying principles, terminology, and concepts, surveying techniques and skills, and surveying activities such as compass survey, traversing, area computations, levelling and contouring.

2. Utilize various surveying instruments and equipment for measurement and data collection, perform required calculations and draft reports.

3. Analyze and interpret survey data and control the accumulation of errors in projects.

4. Conduct basic traversing and mapping exercises.

Course Content		
Module No.	**Details**	**Hrs.**
1	**Introduction to Surveying:** Definition, scope, and applications of surveying, Historical development and advancements in surveying, Overview of different surveying disciplines and specialties, Principles of surveying, Various types of surveying, Classifications based on methods- Linear, angular and graphical methods, Classifications based on instruments – compass survey, theodolite survey, level survey, plane table survey, Surveying measurements - Units of measurement in surveying, linear measurements, angular measurements, elevation measurements.	6
2	**Levelling and Contouring:** Definitions, basic terms, types of instruments- dumpy level and Auto level, principal axes of dumpy level, temporary and permanent adjustments, Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of missing data, distance to the visible horizon, corrections due to curvature and refraction, reciprocal levelling, Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors, difficulties in levelling work, corrections and precautions work in levelling. Contouring: terms, contour, contouring, contour interval, horizontal equivalent, Direct and indirect methods of contouring, interpolation of contours, uses of Contours and characteristics of contour lines, Grade contour.	5
3	**Theodolite Surveying:** Various parts and axes of transit, technical terms, temporary and permanent adjustments of a transit, measurement of horizontal and	5

	vertical angles, Methods of repetition and reiteration, Different methods of running a theodolite traverse, Latitudes and departures, rectangular coordinates, traverse adjustments by Bowditch's, transit and Modified transit rules, Gales Traverse Table, Miscellaneous use of theodolite for various works such as prolongation of a straight line, setting out an angle, bearing measurements, Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing.	
4	**Indirect and Advanced Methods of Surveying:** Tacheometry - principle, objective, suitability and different methods of tacheometry, stadia formula, radial contouring , numerical on stadia method only, Modern surveying instruments - working principles, types, applications in surveying - electronic distance measurement (EDM), electronic / digital theodolites, digital level, and total station (TS).	4
5	**Plane Table Surveying, Areas and Volumes:** Definition, principle, accessories required for plane table surveying, merits and demerits, temporary adjustments, Different methods of plane table surveying, Areas: area of an irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods, Planimeter: types including digital planimeter, uses of planimeter, Volumes: computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans.	4

For Self-study (if any):

Text Books:

1. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.
2. Arora, K.R., Surveying, Vol-I, and II and, Standard Book House, 2015.
3. T.P Kanetkar (2000); "Surveying and Levelling Vol I", Pune VidyarthiGrihaNew Central Book Agency. ISBN-13 9788185825113.
4. N. N. Basak (2014); "Surveying And Levelling", Mcgraw Hill Education (India) Private Limited. ISBN-13: 978-9332901537.
5. R Agor (2009); "Surveying and Leveling", Khanna Publishers. ISBN-13: 978-8174092359.
6. Dr. B.C. Punamia (2005); "Surveying Vol –I", Laxmi Publications (P) Ltd., New Delhi. ISBN-13: 978-8170088530. 536 p.
7. Dr. B.C. Punamia (2005); "Surveying Vol-II". Laxmi Publications (P) Ltd., New Delhi. ISBN-13: 978-8170088837. 658 p.
8. R. Subramanian(2007); "Surveying And Levelling", Oxford University Press. ISBN-13: 9780195684247. 970p.

Building Drawing with CAD

Course Code	Course Name
ES-BTC 304	Building Drawing with CAD
Lecture: 02	Credit:02

Course pre-requisites	ES-BT 103,ES –BT-153.

Course Objectives
Course Objectives: 1. To understand the principle of planning for residential & Public building 2. To understand the regulations as per National Building Code 3. To identify the functional requirements and building rules 4. To understand the sketches and working drawings

Course Outcomes
Upon successful completion of the course, students should be able 1. Understand the conventions of formal Civil engineering drawing 2. Understand building rules, regulation and byelaws, Building codes 3. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, develop parametric designs and to produce designs using a combination of 2D and 3D software. 4. Communicate and transform a design concept graphically/ visually 5. Get a detailed study of an engineering artefact

Course Content		
Module No.	**Details**	**Hrs.**
1	**INTRODUCTION** Drawing practice, guidelines for building drawing, terms used in building construction, general conventions and symbols, Thumb rules for effective planning – location of rooms and sizes, Building permissions	04
2	**BUILDING REGULATIONS, BYE-LAWS AND CODES** Principle of architectural composition, Principles of Planning, Recommendations of CBRI, Roorkee, Importance of Building Codes and byelaws - plot area, built-up area, minimum size of rooms, margins, setbacks, heights, passages and corridors, ventilation, circulation, open space, water supply & sanitary, electrification, fire safety, other safety, lifts, Environment Approval procedure with respect to bye-law, Real Estate (Regulation and Development) Act, 2016 Sustainable design principles - provisions of National Building Code, ANSI, ASTM, ASHRAE, approval process, Green building principles-green building techniques-energy solutions, site solutions, exterior and interior solutions, Certification –BREEAM, GRIHA, NAHB, LEED, IGBC	06

3	**BUILDING PLANNING** Planning of Residential Buildings; Residential building forms, Basic areas in residential buildings, Process of planning-family requirement & analysis, conceptual plan outlines, Principles and techniques for functional planning, Climate and design considerations – orientation, Planning for service, Landscaping-concept of art, Structural system and functional classification of buildings, Creativity-role of architect and engineer. Planning of Public Buildings: Approach for activity analysis for public buildings such as educational institutes (schools, colleges, and institutional campus), health care centres, hospitals, office buildings or business parks, entertainment buildings – Space norms, basic areas, and functional setting areas. Planning of Building Services- Introduction to building services like water supply, drainage, electrification, ventilation, lightening, staircases and lifts, fire safety, acoustics and thermal insulation	10
4	**METHOD OF DRAWING** Terms, elements of planning a building drawing, selection of scales, Developing working and submission drawings – Plans ; layout plan, floor line plan, detailed plan, foundation plan, roof or terrace plan –drainage plans, plan showing drainage, water supply and electricity lines, Elevations, Cross sections, Structural drawings, Importance and purpose of preparing the above drawings, Details to be shown and location of the details	06
5	**PICTORIAL VIEW** Principles of perspective drawing; Perspective view of building. Fundamentals of Building Information Modelling (BIM)	04

For Self-study (if any):

Text Books:

1. N. KumaraSwamy and A. Kameshwara Rao (2012); "Building Planning & Drawing" Charotar Publishing House; ISBN-13: 978-9380358581. 434 p
2. V.B. Sikka (2013); "A Course in Civil Engineering Drawing" S.K. Kataria & Sons; ISBN-13: 978-9350142721. 550 p.

Reference Books:

1. M.G. Shah, C.M. Kale, and S.Y. Patil (2011); "Building Drawing with an Integrated Approach to Built Environment" McGraw Hill Education (India) Private Limited; ISBN-13: 978-0071077873. 408p.
2. Rangwala (2013); "Town Planning" Charotar Publishing House Pvt. Ltd.; ISBN-13: 978-9380358680. 344p.
4. B.P.Verma (2014); 'Civil Engineering Drawing and House Planning' Khanna Publishers; ISBN 81-7409-168-8,152p.

5. Reference Codes

National Building Code of India, 2016

IS 779-1978 Specification for water meter

IS 909-1975 Specification for fire hydrant

IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation

IS 1742-1983 code of practice for building drainage

Engineering Geology

Course Code	Course Name
BS-BTC 305	Engineering Geology

Course pre-requisites	Applied Physics-I, Applied chemistry-I,Applied Physics-II, Applied Chemistry-II

Course Objectives
The objectives of this course are

1. To classify the various branches of geology that are applicable to civil engineering
2. To describe the geological processes of agents modifying the earth's surface, weathering, earthquakes and preventive measures for structures constructed in earthquake prone areas.
3. Explain mineralogy, petrology, geological history and structural geology of India.
4. To discuss the importance and methods of surface and sub-surface investigations and geological considerations while selecting sites for dams, reservoirs, tunnels, etc.
5. Outline Ground water and its implications for foundations in civil engineering, types, causes and preventive measures for landslide prevention.

Course Outcomes
Upon successful completion of the course, students should be able

1. Relate the processes associated with the origin and formation of various earth surface features, rock types, especially in India
2. Carry out proper geological and geotechnical investigations for major engineering projects.
3. Examine and give opinions regarding the geological hazards, erosion, flooding, dewatering and seismic investigations and its impact on structures etc.

Course Content		
Module No.	Details	Hrs.
1	**Introduction:** Branches of geology useful to civil engineering, importance of geological studies in various civil engineering projects. **Physical geology:** Internal structure of the earth and use of seismic waves in understanding the interior, Agents modifying the earth surface, study of weathering and its significance in physical and engineering properties of rocks like strength and water tightness, durability etc., Geological action of river, wind and glaciers, erosion; transport and depositional landforms created by them. Earthquakes – earthquake waves, construction and working of seismographs, earthquake zones of India, Geological aspects earthquake resistance structures.	08
2	**Mineralogy:** Methods of mineral identification, physical properties of minerals,	03

	rock forming minerals, ore forming minerals, megascopic identification of common primary and secondary minerals family.	
3	**Petrology:** Study of igneous, sedimentary rocks, distinguishing properties between igneous, sedimentary and metamorphic rocks to identify them in field. Igneous petrology – mode of formation, textures, structures etc. Hatch's scheme of classification, study of common igneous rocks, Sedimentary petrology – mode of formation, textures, characteristics of shallow water types, residual like lamination, bedding, current bedding etc., classification of secondary rocks, types, residual deposits, chemically formed and organically formed deposits, commonly occurring sedimentary rocks, Metamorphic petrology –mode of formation, agents and types of metamorphism, metamorphic minerals, rock cleavage, structures and textures in metamorphic rocks, classification, commonly occurring metamorphic rocks.	08
4	**Structural geology:** Structural elements of rocks – dip, strike, outcrop patterns, unconformities, outliers and inliers, study of joints, faults and folds, importance of structural elements in engineering operations. **Stratigraphy :** Principle of stratigraphy and co-relation, geological time scale, physiographic divisions of India – study of formations occurring in peninsular India.	08
5	**Geological investigations:** Preliminary geological investigations and their importance to achieve safety and economy of the projects, supporting case histories of dams and tunnel projects in Maharashtra State, Methods of surface and sub surface investigations – trial pits, trenches, drill holes, geological logging, inclined drill holes, Resistivity method and seismic methods, Use of aerial photographs and satellite imageries in civil engineering projects. **Engineering properties of rock.** Requirements of good building stone, geological factors controlling properties of good building stones, consideration of common rocks as building stones, study of different building stone from various formation in Indian peninsula, geological factors controlling location of quarries, quarrying methods and quarrying operations	07
6	**Ground water:** Sources and zones, water table, unconfined and perched, springs, Factors controlling water bearing capacity of rocks, pervious and impervious rocks, cone of depression and its use in civil engineering, Methods of artificial recharge of ground water, geology of percolation tank.	04

	Role of engineering geology of Dam, Tunnel and Reservoir site: Importance of geological conditions while selecting the type of dam, ideal geological conditions for dam and reservoir site, favorable and unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of faults, folds, crushed zone, dykes and fractures on the dam site and treatment giving to such structures, tail channel erosion, Improvements of sites.	
7	**Tunneling:** Importance of geological considerations while choosing sites and alignment of the tunnel, Ideal site conditions for tunneling; geological conditions to be avoided. Tunneling to various types of rocks under various geological and structural condition, difficulties during tunneling and methods to overcome the difficulties. **Stability of hill slopes:** Landslides, their types, causes and preventive measures for landslides.	09

For Self-study (if any):

Text Books:

1. Singh Parbin (2012), "Engineering & General Geology", S K Kataria and Sons Ltd. ISBN-9350142678.
2. KesavuluChenna N. (2009), "Textbook of Engineering Geology", 2nd Edition, Trinity Press, ISBN-13: 9789380856278.
3. Winter J.D. (2011), "Principles of Igneous & Metamorphic Petrology", 2nd Edition Phi Learning Pvt. Ltd-New Delhi. ISBN-13: 9788120343979.

Fluid Mechanics

Course Code	Course Name
PC-BTC306	Fluid Mechanics

Course pre-requisites	NA

Course Objectives

The objectives of this course are
1. To study basic properties & classification of fluids.
2. To discuss the students to the basics of fluid statics, fluid kinematics, fluid dynamics as well as various flow measuring devices.
3. To describe the laminar, turbulent flow in pipes and boundary layer theory and understand development of drag and lift forces acting on submerged bodies.

Course Outcomes

Upon successful completion of the course, students should be able
1. Use the hydrostatic principle to the floating/submerged body analysis.
2. Understand the various flow measuring devices
3. Carry out estimation of boundary layer thickness, drag forces acting over flat and curved surfaces along with the principle behind boundary layer separation.

Course Content

Module No.	Details	Hrs.
1	**Properties of Fluids:** Mass density, weight density, specific gravity, specific volume, viscosity, compressibility, bulk modulus, surface tension, capillary action, vapour pressure, types of fluids, basic concepts.	03
2	**Pressures and Head:** Types of Pressure, Pascal's law of pressure at a point, Hydrostatic equation,Pressure and pressure head, Force Balance Pressure gauge, Electrical Pressure transducers.	05
3	**Static Forces on Surface and Buoyancy:** Fluid static, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, resultant force and center of pressure on a plane surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the metacentre relative to the center of buoyancy.	05
4	**Fluid Kinematics and Dynamics:** Description of fluid flow: Lagrangian method, Eulerian method, Streamlines, pathlines, streaklines, and classification of fluid flows, continuity equation, rotational flow, rotation and vorticity, velocity and stream function. Circulation, flow net. Eular's equation, Introduction Naviour	05

	Stokes Equation, Bernoulli's theorem, its application to real fluid, flow measuring devices, Venturimeter, Pitot tube, Orifice.	
5	**Laminar and Turbulent flow through pipes:** Reynold's experiment, Critical velocity, Steady laminar flow through circular pipes, Parallel plates Causes of turbulence, instability, mechanism of turbulence, Reynold's stresses, Prandtl's mixing length theory, Universal velocity distribution equation.	05
6	**Boundary Layer Theory:** Development of boundary layer over flat plate and curved surfaces, laminar and turbulent boundary layer, boundary layer thickness, displacement thickness, momentum thickness, energy thickness, drag forces on flat plate due to boundary layer, boundary layer separation and control. Drag and Lift forces exerted by flowing fluid on stationary body, Streamlined and bluff bodies.	05

For Self-study (if any):

Text Books:
1. Dr. R. K. Bansal(2005); "A Textbook of Fluid Mechanics", Laxmi publication. ISBN- 13: 978-8131802946. 501p.
2. Dr. P.N. Modi and S. M. Seth(2009); "Hydraulics and Fluid Mechanics" Standard Book House ISBN-13: 978-8189401269. 250p.
3. Dr. Jain A.K (2010); "Fluid Mechanics" Khanna Publishers. ISBN-13: 978- 8174091949.
4. Subramanaya K (2010); "Fluid mechanics & hydraulic Machines". McGraw Hill Education (India) Private Limited. ISBN-13: 978-0070699809.

Building Materials and Construction

Course Code	Course Name
PC-BTC307	Building Materials and Construction

Course pre-requisites	Engineering Materials

Course Outcomes
Upon successful completion of the course, students should be able 1. Identify different elements or components (structural and non-structural) of a building and recognizing good materials to be used for the construction work of a building 2. Define the methods, procedures and techniques of construction of a building 3. Select the materials, design and supervise the construction work and take suitable measures 4. Draw the details of various elements or components (structural and non-structural) of a building

Course Content		
Module No.	Details	No. of Lectures
1	**Building Materials** Role of material in construction, Stone as building material; Requirement of good building stones, Dressing of stones, Deterioration and Preservation of stone work. Bricks: Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick Earth, Different forms of bricks, Testing of bricks as per BIS. Defects of bricks. Blocks: Cement Concrete blocks, Stabilized Mud Blocks, Aerated concrete blocks, fly ash bricks /blocks, Sizes, and requirement of good blocks. Aggregates: Classification, Characteristics, Deleterious substances, Soundness, Alkali – aggregates reaction, Fine aggregates, Coarse aggregates, Testing of aggregates Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling Cement & Concrete: Cement: OPC: Composition, PPC, Slag cement, Hydration, setting time Concrete: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete Mortars: Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars Wood and Wood Products: Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Preservation of	12

	Timber Testing of Timber, Veneers and Laminates , Plywood, Fibre Boards, Particle Boards, Chip Boards , Black Boards, Button Board and Laminated Boards, Applications of wood and wood products	
	Paints, Enamels and Varnishes: Water based and oil paints, Composition and characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and colour wash, Varnish , French Polish, Wax Polish, melamine Polish	
	Miscellaneous Materials: Gypsum: Classification, Plaster of Paris, Gypsum wall Plasters, calcium silicate boards, Gypsum Plaster boards, Moisture resistant gypsum boards, cement boards Adhesives, Heat and sound insulating materials, Geosynthetics	
2	**Foundation** Function of Foundations, Essential requirement of good foundation, Types of structures based on load transfer, function and requirements of good foundation, preliminary investigation of soil, safe bearing capacity of soil, types of foundation - shallow foundations - introduction to spread, isolated, combined , strap, mat and deep foundations - pile foundation	03
3	**Masonry** Definition and terms used in masonry. Stone masonry, Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Brick masonry: Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall) Types of walls; load bearing, partition walls, cavitywalls	05
4	**Lintels, Arches, Floors And Roofs** Definition, function and classification of lintels, balconies, chajja and canopy. Arches; elements and stability of an arch. Floors, requirement of good floor, components of ground floor, selection of flooring material, laying of Concrete, mosaic, marble, granite, tile flooring, cladding of tiles – skirting, dado. Roof, requirement of good roof, types of roof, elements of a pitched roof, trussed roof, king post truss, queen ost truss, steel truss, different roofing materials, RCC slab	03
5	**Doors, Windows And Ventilators** Location of doors and windows, technical terms, Materials for doors and windows, Panelled door Flush door, Collapsible door, Rolling shutter, PVC Door, Toughened glass door, sliding door, automated door Panelled and glazed Window, Bay Window, French window. Ventilators. Sizes as per IS recommendations	02

	Glazing systems - unitized, semi unitized, stick systems. Hardware and locking systems - Dead locks, mortice locks, regular or concealed door closers, hold open door closers, pivot systems, types of hinges, concealed latch, regular latch.	
6	**Stairs** Definitions, technical terms and types of stairs, Requirements of good stairs. Geometrical design of RCC doglegged and open-well stairs.	02
7	**Plastering, Pointing And Painting** Purpose, materials and methods of plastering and pointing, defects in plastering-Stucco plastering, lathe plastering Damp proofing- causes, effects and methods. Paints- Purpose, types, ingredients and defects, Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.	03
8	**Formwork** Introduction to form work, types of formwork - scaffolding, shoring, under pinning, materials for formwork, requirement of good formwork	02
Term Work		

Term work shall comprise of
To prepare drawings of following works:

1. Signs and Symbols required in civil engineering drawings
2. Types of foundations
3. Types of masonry bonds
4. Types of stairs
5. Types of doors and windows
6. Types of floors and roofs
7. Types of pointing
8. Types of Damp Proofing Course
9. Types of Electrical Fittings and Plumbing Fixtures
10. Elements of building construction – typical cross section of a two storied building showing foundation, plinth, wall, lintel, chajja, door and window.

For Self-study (if any):

Text Books:

1. S. P. Bindra, S. P. Arora, Building Construction, Dhanpat Rai Publication, New Delhi, Fourth Edition, 1988.
2. M.G. Shah, C.M. Kale, S. Y. Patki, Building Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, Third Edition.
3. B. C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Basic Civil Engineering, Firewall Media, 2003.
4. M. L. Gambhir, "Concrete Technology", Tata McGraw Hill Publications,
5. M. S. Shetty, "Concrete Technology", S. Chand Publication

Reference Books:
1. Roy Chudley, Roger Greeno, Building Construction Handbook, Butterworth- Heinemann, Tenth Edition, 2006
2. Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain., "Soil Mechanics and foundations", Laxmi Publications (P) LTD, March 2005.

Mechanics of Materials (Lab)

Course Code	Course Name
ES-BTC 351	Mechanics of Materials (Lab)

Course pre-requisites	ES-BTC 302

Course Objectives

The objectives of this course are
   1. To investigate the behaviour of an elastic member subjected to various types of forces such as axial force, shear force, bending moment, torsion etc. and
   2. To test material properties of hardness and toughness.

Course Outcomes

Upon successful completion of the course, students should be able
   1. Develop collaborative skills to work in a team/group.
   2. Experimentally determine the various material properties.

List of experiments (At least eight to be performed)

1. Tension test on mild steel / tor steel rod.
   2. Transverse test on cast iron specimen.
   3. Shear test on metal specimens.
   4. Torsion test on mild steel / cast iron specimen.
   5. Load deflection test on metal specimens.
   6. Brinell hardness test on metal specimens.
   7. Rockwell hardness test on metal specimens.
   8. Charpy impact test on metal specimens.
   9. Izod impact test on metal specimens.
 	
*Report on experiments performed as detailed above shall be submitted as laboratory work

For Self-study (if any):

Text Books:

1. Popov, Egor P, (1978), "Mechanics of materials", Englewood Cliffs, N.J: Prentice-Hall, ISBN 0135711584 (pbk), 864 p.
2. S.B. Junnarkar (2007), "Mechanics of materials Vol-1", Charotar Publications, ISBN 8185594678, 447 p.
3. Bear & Johnson (2007), "Mechanics of materials", Tata McGraw-Hill, ISBN: 0070042845, 780 p.

Reference Books:

1. Timoshenko & Gere (2006), "Mechanics of materials", Tata McGraw Hill, CBS Publishers & Distributors, ISBN 8123908946, 762 p.
2. James M. Gere, Books/cole (2012), "Mechanics of materials", Cengage Learning, ISBN 1111577730, 1056 p.
3. G.H. Ryder (2002), "Strength of materials" Macmillan Publishers India Limited, ISBN 0333935365, 352 p.
4. William A. Nash (2005), "Strength of materials", Schaum's outline series, Tata McGraw-Hill Education, ISBN 0070601631, 216 p.

Basics of Surveying (Lab.)

Course Code	Course Name
PC-BTC352	Basics of Surveying Laboratory
Course pre-requisites	

Course Objectives
This course provides an introduction to the fundamental principles, techniques, and methods used in surveying. Students will learn about the basic concepts, instruments, and procedures involved in land surveying, including measurements, leveling, traversing, and mapping. The course emphasizes both theoretical knowledge and practical skills through hands-on exercises and fieldwork.

Course Outcomes
Students will be able to: 1. Utilize various surveying instruments and equipment for measurement and data collection. 2. Perform basic field measurements - distance, angles, and elevations, and conduct basic traversing and mapping exercises. 3. Analyze and interpret survey data. 4. Apply appropriate safety measures and ethical practices in surveying.

Course Content	
Experiment No.	***Details***
1	**Chain and Compass Traverse Survey:** a. Study of chain and compass. b. Measurement of included / internal angles of a traverse
2	**Levelling Survey** a. Study of dumpy level, auto level, digital level b. Simple and Differential levelling – methods of reduced level calculations
3	**Theodolite Survey** a. Measurement of horizontal angle by repetition and reiteration method b. Measurement of vertical angle c. Measurement of bearing of a line
4	**Tacheometry Survey** a. Determination of constants of Tachometer b. Stadia tachometry for distance and gradient measurement
5	**Plane Table Survey and Area measurement** a. Plotting / Mapping by radiation method b. Planimeter for area measurement
6	**Project Work:** Theodolite traverse survey – field survey of a closed traverse with at least four stations, traverse corrections, computation of the coordinates of the traverse, plotting of the traverse.

Assessment criteria for laboratory, i.e. weightage for assessment shall be as follows:
   i)   Attendance in Laboratory = 20%,
   ii)   Journal= 40%,
   iii)   Practical Examination (and/or) Mini project (and/or) Quiz (and/or) Seminar (and/or) Oral (and/or) Industry visit report= 40%.

Text Books:
1. T.P. Kanetkar and S.V. Kulkarni, *Surveying and Levelling*, 9th edition, Pearson India, 202.
2. S.S. Bhavikatti and A.M. Chandra, *Surveying: Theory and Practice,* 2nd edition, published by I.K. International Pvt. Ltd., 2017.
3. R. Subramanian, *Surveying and Levelling*, 2nd edition, Oxford University Press, 2012.

Reference Books:
1. Paul R. Wolf and Charles D. Ghilani, *Elementary Surveying: An Introduction to Geomatics,* 11th edition, Pearson Education International, 2005.
2. Barry Kavanagh, *Surveying: Principles and Applications*, 9th edition, Pearson / Prentice Hall, 2013.
3. N. N. Basak, *Surveying and Levelling*, 2nd edition, Mcgraw Hill Education (India) Private Limited, 2017.

E resources (if any):
1. https://nptel.ac.in/courses/105107122 : Introduction to surveying and Mapping – Lectures delivered by Prof. J.K. Ghosh, IIT Roorkee.
2. https://archive.nptel.ac.in/courses/105/104/105104101/ : Basics of Surveying – Lecture delivered by Dr. Bharat Lohani, Civil Engineering Department, IIT Kanpur
3. https://nptel.ac.in/courses/105104100 : Modern Surveying techniques – Lectures delivered by Dr. Onkar Dikshit, IIT Kanpur.

Fluid Mechanics Laboratory

Course Code	Course Name
PC-BTC353	Fluid Mechanics Laboratory

Course pre-requisites	NA

Course Objectives
The objectives of this course are 1. To summarize various principles and fluid properties. 2. To explain calibrations of various flow measuring devices. 3. To describe the laminar flow and turbulent flow in pipes and boundary layer theory and discuss the development of drag and lift forces acting on submerged bodies, airfoils, circular and cylindrical body.
Course Outcomes
Upon successful completion of the course, students should be able 5. To utilize various properties of fluids. 6. To carry out calibrations of various flow measuring devices. 7. Understand boundary layer formation along with the principle behind boundary layer separation.
List of experiments: (preferably eight to be performed)
1. Determination of Specific Weight of Fluid by using Buoyancy/Archimedes principle. 2. Determination of Specific Gravity of Fluid by using U-Tube Manometer. 3. Verification of Bernoulli's theorem 4. Determination of metacentric height 5. Calibration of Orifice 6. Calibration of venturimeter 7. Reynolds Experiment 8. Boundary Layer Theory 9. Laminar Flow through pipes 10. Calibration of notches 11. Calibrations of weirs

For Self-study (if any):

Text Books:

1. Dr. R.K. Bansal (2005); "A Textbook of Fluid Mechanics", Laxmi publication. ISBN- 13: 978-8131802946. 501p.
2. Dr. P.N. Modi (2009); "Hydraulics and Fluid Mechanics" Standard Book House ISBN- 13: 978-8189401269. 250p.
3. Dr. Jain A.K (2010); "Fluid Mechanics" Khanna Publishers. ISBN-13: 978- 8174091949.
4. K Subramanya (2008); "Flow in Open Channels" 978-0070086951. 576p.
5. Subramanaya K (2010); "Fluid mechanics & hydraulic Machines". McGraw Hill Education (India) Private Limited. ISBN-13: 978-0070699809.

Material Testing & Evaluation (Lab.)

Course Code	Course Name
PC-BTC 354	Material Testing & Evaluation (Lab.)

Course pre-requisites	Building materials and construction

Course Objectives
The objectives of this course are 1. To investigate the behavior of an elastic member subjected to compression, flexure, abrasion etc. and 2. To investigate various physical properties of cement.

Course Outcomes
Upon successful completion of the course, students will be able to 1. Experimentally determine the various material properties and physical properties of cement.

Course Content	
Sr. No.	**List of Experiments**
1	Water absorption and compression test of bricks.
2	Water absorption and transverse load test on tiles
3	Moisture content and flexural strength test on timber.
4	Compression test on timber (Parallel / perpendicular to the grains).
5	Physical properties of cement: Fineness, consistency, Setting time, Soundness, Compressive strength.
6	Compression test on Paver blocks
7	Water absorption, density and compression test on masonry blocks
8	Abrasion test on tiles

For Self-study (if any):

Text Books:

1. S. S. Bhavikatti (2012); "Building Materials", Vikas Publishing House Pvt Ltd.ISBN- 13: 978-9325960442. 488p.
2. Rangwala (2012);"Engineering materials", Charotar Publications. ISBN-13: 978- 9380358796.
3. S.K. Duggal (2010); "Building Materials", New Age International Publishers. ISBN- 13: 978-8122433791. 616p.
4. Varghese P. C (2005); "Building Materials" PHI. ISBN-13: 978-8120328488. 180p.
5. M. Gambhir (2011); "Building Materials Products, Properties and Systems" McGraw Hill Education (India) Private Limited. ISBN-13: 978-0071077606.
6. IS codes of different materials, BIS publications.

Building Drawing with CAD (Lab.)

Course Code	Course Name
ES-BTC 355	Building Drawing with CAD (Lab)
Practical: 02hrs.	Credit:01

Course pre-requisites	ES-BTC 304

Course Objectives
1. To draft the plan elevation and sectional views of the buildings using computer software.
Course Outcomes
Upon successful completion of this course, students will be able to :   1. Planning and designing of residential and public building by implementing the principles of planning of buildings, Green building principles, byelaws, regulations and codes for planning   2. Preparing various working and detailed drawing of the buildings in CAD.   3. Preparing layouts of various building services.
Course Content
Proposed Work: 1. Planning and designing a residential RCC framed building and preparation of working and detailed drawings - plan, elevation, section, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window, structural drawings and other details   2. Planning and designing a public building and preparation of working and detailed drawings for a residential building - plan, elevation, section, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window, structural drawings and other details and writing out a description of the facility in about 500700 words   3. Preparation of various layouts for building services for any one (residential or public) building – electrical services, water supply, drainage, waste water and storm water collection, gas supply, firefighting etc.   4. Perspective view of any one (residential or public) building

For Self-study (if any):

Text Books:
1. N. KumaraSwamy and A. Kameshwara Rao (2012); "Building Planning & Drawing" Charotar Publishing House; ISBN-13: 978-9380358581. 434 p
2. V.B. Sikka (2013); "A Course in Civil Engineering Drawing" S.K. Kataria & Sons; ISBN-13: 978-9350142721. 550 p.
3. Beginning AutoCAD, Cheryl Shrock, BPB Publication, 1st edition
4. Introduction to AutoCAD 2005:2D and 3D Design, Alf Yarwood

Reference Books/Code:
1. National Building Code of India, 2005
2. IS 779-1978 Specification for water meter
3. IS 909-1975 Specification for fire hydrant
4. IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation 5. IS 1742-1983 code of practice for building draina**ge**

Engineering Geology (Lab.)

Course Code	Course Name
BS-BTC 356	Engineering Geology (Lab.)

Course pre-requisites	Engineering Geology

Course Objectives
The objectives of this course are 1. Identification and description of physical properties of rock-forming and ore-forming minerals. 2. Identification and systematic description of megascopic features of Igneous, Sedimentary and Metamorphic rocks. 3. Description and drawing of vertical cross-section of structural geological maps and study of core samples and the engineering problems encountered on site.

Course Outcomes
Upon successful completion of the course, students will be able to 1. Identify the different properties of minerals and differentiate and identify the different rock types. 2. Interpret the cross-section of the geological maps and evaluate the suitability of site for different engineering projects from study of core samples.

Course Content	
Sr. No.	Name of Experiments
1	Study of physical properties of the minerals.
2	Megascopic identification of rock forming minerals – crystalline, crypto-crystalline and amorphous silica and their varieties, Orthoclase, Microcline, Plagioclase, Muscovite, Biotite, Hornblende, Asbestos, Augite, Olivine, Tourmaline, Garnet, Natrolite, Actinolite, Calcite, Dolomite, Gypsum, Corundum, Talc, Fluorite, Kyanite
3	Megascopic identification of ore forming minerals - Bauxite, Graphite, Galena, Pyrite, Hematite, Magnetite, Chalcopyrite, Chromite, coal
4	Identification of rocks – • Megascopic identification of Igneous rocks : Granite and its varities, Synite, Dionite, Gabbro, Pegmatite, Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic Tuffs. • Megascopic identification of Sedimentary rocks : Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestone, Melliolite, Laterite, • Megascopic identification of Metamorphic rocks: Slate, Phyllite, Mica, Schists, Hornblende schists, Granite gneiss and its varieties, Augen gneiss, Marbles and quartzite.
5	Study of Structural geological maps. (at least eight).
6	Study of core samples, percentage recovery, RQD, core logging and engineering problem based on field data collected during site investigation.

Text Books:

1. Singh Parbin (2012); "Engineering & General Geology", S K Kataria and SonsLtd. ISBN-9350142678.
2. KesavuluChenna N. (2009)" Textbook of Engineering Geology" 2nd Edition Trinity Press, ISBN-13: 9789380856278.
3. Winter (2011);"Principles Of Igneous & Metamorphic Petrology", 2nd Edition Phi Learning Pvt. Ltd-New Delhi. Isbn-13: 9788120343979.

Energy Science and Engineering

Course Code	Course Name
VA-BTC371	Energy Science and Engineering

Course pre-requisites	XII th Science

Course Objectives
The objectives of this course are: 1. To introduce energy systems and renewable energy resources, with a scientific examination of the energy field.   2. To help students explore society's present needs and future energy demands.   3. To examine conventional energy sources and systems, including fossil fuels and nuclear energy.   4. To focus on alternatives- renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear.   5. To emphasize energy conservation methods from Civil Engineering perspective.

Course Outcomes
Students will be able to learn,   1. List and generally explain the main sources of energy and their primary applications nationally and internationally.   2. Have basic understanding of the energy sources and scientific concepts/principles behind them.   3. Understand effect of using these sources on the environment and climate.   4. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.   5. List and describe the primary renewable energy resources and technologies.   6. To quantify energy demands and make comparisons among energy uses, resources, and technologies.   7. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.   8. Understand the Engineering involved in projects utilising these sources

Course Content		
Module No.	Details	Hrs.
1	**Introduction to Energy Science:** Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment.	04
2	**Energy Sources:** Overview of energy systems, sources, transformations, efficiency,	06

	and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries).	
3	**Energy & Environment:** Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.	05
4	**Civil Engineering** Projects connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems.	07
5	**Engineering for Energy conservation:** Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption.	06

Life Science

Course Code	Course Name
VA-BTC 372	Life Science

Course pre-requisites	XII th Science

Course Content		
Module No.	**Details**	**Hrs.**
1	Plant Physiology - Transpiration; Mineral nutrition. Ecology- Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids	06
2	Population Dynamics- Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity.	06
3	Environmental Management- Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant).	06
4	Molecular Genetics- Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g. Operon concept. Biotechnology- Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications.	06
5	Biostatistics - Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor)	06

Text Books:
1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher. Subramanaya K (2010); "Fluid mechanics & hydraulic Machines". McGraw Hill Education (India) Private Limited. ISBN-13: 978-0070699809.
5. Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Life Science (Lab)

Course Code	Course Name
VA-BTC 372	Life Science (Lab)

Course pre-requisites	NA

Course Contents

Laboratory & Fieldwork Sessions-
   a) Comparison of stomatal index in different plants; Study of mineral crystals in plants;
   b) Determination of diversity indices in plant communities; To construct ecological pyramids of population sizes in an ecosystem;
   c) Determination of Importance Value Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g., Airport, Thermal/Nuclear Power Plant/ Oil spill scenario);
   d) Preparation and extraction of genomic DNA and determination of yield by UV absorbance;
   e) Isolation of Plasmid DNA and its separation by Gel Electrophoresis; Data analysis using Biostatistical tool

For Self-study (if any):

Text Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher.
5. Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Introduction to Civil Engineering

Course Code	Course Name
VA-BTC 373	Introduction to Civil Engineering

Course pre-requisites	NA

Course Objectives
The students will learn about –   1. To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering.   2. To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.   3. To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.   4. To providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering

Course Outcomes
The students will be able to: 1. Learn what constitutes Civil Engineering   2. Identify the various areas available to pursue and specialize within the overall field of Civil Engineering   3. Highlight the depth of engagement possible within each of these areas   4. Explore the various possibilities of a career in this field.   5. Understand the vast interfaces this field has with the society at large.   6. Showcase the many monuments, heritage structures, nationally important infrastructure, and impressive projects to serve as sources of inspiration.   7. Highlight possibilities for taking up entrepreneurial activities in this field.

	Course Content	

Module No.	Details	Hrs.
1	**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.	04

2	**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.	06

	Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town 06 34 planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities	
3	**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	06
4	**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 Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;	07

5	**Structural Engineering:** Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies. 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.	06
6	**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.	06
7	**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.	

For Self-study (if any):

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

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University) Andheri
(W), Mumbai – 400058

COURSE CONTENTS

Regulation 22

Sem. IV

Year 2023-24 B.Tech. (Civil) ENGINEERING

Academic Year 2023-2024

List of Courses

Sr.No	Course Code	Course Name
Core Courses		
1	BS-BTC401	Probability and Statistics
2	PC-BTC402	Structural Mechanics
3	PC-BTC403	Concrete Technology
4	PC-BTC404	Surveying & Geomatics
5	PC-BTC405	Hydraulic Engineering
6	PC-BTC406	Transportation Engineering
7	PC-BTC407	Environmental Engineering-I
Laboratory courses Note(2&3)		
8	PC-BTC451	Concrete Technology (Lab)
9	PC-BTC452	Surveying &Geomatics(Lab.)
10	PC-BTC453	Hydraulic Engineering (Lab.)
Mandatory Course		
11	MC-BTC02	Indian traditional knowledge
Online Courses (Note 5)		
`12	OL-BTCxxx	Online Course
Value Added Course (Note 7)		
13	VA-BTC471	Disaster Preparedness & Planning
14	VA-BTC472	Civil Engineering -Societal & Global Impact
15	VABTC473	Development Engineering
Value Added Non-Technical Courses (Note10)		
16	VN-BTxxx	Refer Table-VNT

Probability, Statistics & Operation Research

Course Code	Course Name
BS-BTC401	Probability Statistics & Operation research

Course pre-requisites	Std. XI, XII Mathematics, DCCN(BS-BT101) , ICDE(BS-BT201) , LLACA (BS-BTC301)

Course Objectives

The objectives of this course are
  1. To provide an overview of probability and statistics to engineers
  2. Introduce Statistical methods ,probability distributions& testing of hypothesis
  3. Introduce Linear programming problems and various ways of solving the same.

Course Outcomes

Upon successful completion of the course, students should be able
  4. Solve problems in basic statistics and probability distribution
  5. Solve problems based on testing of hypothesis.
  6. Solve linear programming problem using Simplex and allied methods.

Course Content

Module No.	Details	Hrs.
1	**Statistics:** Correlation, Karl Pearson coefficient &Spearman's rank Correlation coefficient, linear regression, lines of regression.	06
2	**Discrete Random Variables:** Random variables, Probability distribution for discrete random variables, Expected value and variance, Binomial Distribution and Poisson Distribution.	06
3	**Continuous Random Variables:** Probability Density Function for continuous random variable, Normal Distribution	04
4	**Sampling Theory** Sampling distribution. Test of Hypothesis. Level of significance, critical region. Large and small samples. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Test for significance of the difference between sample S.D and population S.D, Test for significance of the difference between the S.D of two samples. T-Test Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples, Chi-square distribution and its properties.	06

5	**Simplex Method** Introduction, General & cannonical forms, types of solutions, Simplex method, Artificial variable method (Big M),Duality, Relationship between primal and dual. Dual simplex method.	06

Text Books:

1. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications,2010.

2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.

3. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

4. Murray Spiegel ,"Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill2012.

Structural Mechanics

Course Code	Course Name
PC-BTC402	Structural Mechanics

Course pre-requisites	ES-BT104, ES-BT154, ES-BT204, ES-BTC 302, ES-BTC351

Course Objectives
The objectives of this course are 1. To introduce the students to the behaviour and analysis of various determinate structures. 2. To prepare the base for the students to study other structural engineering courses at a later stage.

Course Outcomes
Upon successful completion of the course, students should be able to 1. Analyse for bending moment combined with axial loading and unsymmetrical bending. 2. Draw axial force, shear force and bending moment diagrams for rigid jointed frames and state the general theorems and write the expression for strain energy and find/calculate strain energy stored. 3. Find deflection in beams, rigid jointed and pin jointed frames using different methods. 4. Analyse column for buckling.

Course Content		
Module No.	Details	Hrs.
1	**Bending moment combined with axial loads:** Application to members subjected to eccentric loads, core of the section. Problems on chimneys, retaining walls.	05
2	**Unsymmetrical bending:** Moment of inertia about rotated axes, principal axes and principal moment of inertia, flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.	05
3	**Axial force, shear force and bending moment in frames:** Axial force, shear force and bending moment diagrams for statically determinate frames.	05
4	**General theorems:** Strain energy in elastic structures due to axial load, bending moment, shear force and twisting moment. Complementary energy. Principle of superposition, Principle of virtual work, Castigliano's theorems, Betti's Law and Maxwell's reciprocal theorem.	05
5	**Deflection of statically determinate structures:** Deflection of cantilever and simply supported beams by Double Integration	03

	Method, Macaulay's Method, Deflection of cantilever and simply supported beams due to loads using05 Moment area method, Conjugate beam method.	05
06	**Deflection of statically determinate structures:** Deflection of cantilever and simply supported beams for different types of loadings using Principle of virtual work (unit load method) and Castigliano's theorem. Deflection of determinate pin jointed and rigid jointed frames by principle of virtual work (unit load method) and Castigliano's theorem.	08
07	**Columns and Struts:** Short and long/slender columns, Concept of buckling in slender columns subject to axial loads, Euler's and Rankine's design formulae for columns with different support conditions.	04
	Term Work	
	Term work shall comprise of 1. At least 20 (twenty) solved problems based on the above modules shall be submitted as term work. 2. Course project* ***Course Project**: There will be a course project where the students will be able to apply and integrate the knowledge gained during the course. The projects will be developed by teams of Two to Four students and will consist of design of any system having min. 5 to 6 components.	

Text Books:

1. Popov, Egor P, (1978), "Mechanics of materials", Englewood Cliffs, N.J: Prentice Hall, ISBN 0135711584, 864 pages.

2. Bear & Johnson (2007), "Mechanics of materials", Tata McGraw-Hill, ISBN: 0070042845, 780 pages.

3. Reddy C.S. (1999), "Basic Structural Analysis", Tata McGraw hill, ISBN 0070702764, 540 pages.

4. Junnarkar S.B. (2013), "Structural Analysis, Vol. II" Charotar Publishers ISBN 9380358703, 986 pages.

5. S S Bhavikatti (2011), "Structural Analysis", Vikas Publishing House PVT. Ltd.Noida, ISBN 8125942696, 436 pages.

6. Devdas Menon (2009), "Structural Analysis", Narosa Book Distributors Pvt Ltd-New Delhi, ISBN 8173197504, 685 pages.

Reference Books:

1. Timoshenko & Gere (2006), "Mechanics of Materials", Tata McGraw Hill, CBS Publishers & Distributors, ISBN 8123908946, 762 pages.
2. Stephen P. Timoshenko, Donovan H. Young (1965), "Theory of Structures", Tata McGraw Hill, ISBN 0070648689, 629 pages.
3. John Benson Wilbur , Senol Utku , Charles H. Norris (1990), "Elementary Structural Analysis", Tata McGraw Hill, ISBN 9780070659339, 829 pages.
4. Harold I. Laursen (2007), "Structural Analysis", Tata McGraw Hill Higher Education, ISBN 0070366438, 468 pages.
5. B.G. Neal (1963), "Structural Theorems and Their Applications", Pergamon Press ISBN 0080108717, 208 pages.
6. Russell C. Hibbeler (2012), "Structural Analysis", Prentice Hall, IBN 013257053X, 695 pages.
7. Alexander Chajes (1982), "Structural Analysis", Longman Higher Education, ISBN 0138534080, 352 pages.
8. Aslam Kassimali (2014), "Structural Analysis", Cengage Learning, ISBN 1133943896, 613 pages.
9. Dr. Ramachandran Vaidyanathan, Dr. P. Perumal (2006), "Comprehensive Structural Analysis", Laxmi Publications, ISBN 8170088917, 466 pages.

Concrete Technology

Course Code	Course Name
PC-BTC403	Concrete Technology

Course pre-requisites	PC-BTC307, PC-BTC354

Course Objectives
The objectives of this course are: 1. To introduce the ingredients of concrete and types of admixtures. 2. To understand the behaviour of concrete and its types. 3. To introduce laboratory and non-destructive testing methods for concrete

Course Outcomes
Upon successful completion of the course, students should be able 1. Test properties of fresh and hardened concrete. 2. Design concrete mix. 3. Analyze a situation and recommend the suitable type of concrete and admixtures.

Course Content		
Module No.	Details	Hrs.
1	**Ingredients of Concrete:** **Cement:** Types of cement and their use, physical properties of 33 Grade, 43 Grade, 53 Grade ordinary Portland cement, Portland pozzolana cement, rapid hardening Portland cement, hydrophobic cement, low heat Portland cement and sulphate resisting Portland cement as per relevant I.S. codes, Hydration of cement. **Grades of concrete**: Manufacturing process, Concrete for ordinary work, light weight concrete, high density concrete, workability, durability and strength requirements, effect of w/c ratio, acceptability criteria, laboratory testing of fresh and hardened concrete, concreting under special conditions, work in extreme weather conditions, under-water concreting. **Aggregates:** Properties of coarse and fine aggregates and their influence on concrete. Micro structure of concrete **Admixtures:** Plasticizers, retarders, accelerators and other admixtures, test on admixtures, chemistry and compatibility with concrete.	12
2	**Concrete mix design:** Mix design for compressive strength by I.S. methods, road note method and British method, mix design for flexural strength. Self-Learning: Mix Design by road note method and British method.	05
3	**High performance concrete:** Constituents of high grade concrete, various tests and application of high performance concrete.	03

4	**Production of Concrete:** Production, transportation, compaction and curing of concrete, Requirements of RMC, transit mixer details, mix design of RMC.	05
5	**Non-Destructive testing of concrete:** Hammer test, ultrasonic pulse velocity test, load test, carbonation test, half-cell potentiometer test, and corrosion of steel test, core test and relevant provision of I.S. codes, pH test of concrete, chlorides &sulphates in concrete as per IS 456.	03
Term Work		

Term work shall comprise of
1. Exercises on the above topics.
2. Examination (MCQ) based on topics mentioned in latest GATE syllabus

Text Books:

1. R. Santhakumar (2006), "Concrete Technology", Oxford University Press (Rs), Isbn 0195671537, 771 pages.
2. Shetty M. S. (30 November 2000), "Concrete Technology - Theory and Practice", S Chand & Co Ltd, ISBN 8121903483, 658 pages.

Reference Books:

1. O.P. Jain &Jaikrishna (2007), "Plain & Reinforced Concrete -Vol. I", Nem Chand & Brothers ISBN 8185240086.
2. A. M. Neville (2012), "Properties Of Concrete", Trans-Atlantic Publications, Inc., ISBN 0273755803, 846 pages.
3. I.S. 10262 code, IS 456 & Relevant I.S. Codes.
4. Special Publication Of ACI On Polymer Concrete And FRC:
5. Proceedings Of International Conferences
6. Polymer Concrete And FRC
7. Concrete Micro structure and properties by P.K. Meheta.

Surveying and Geomatics

Course Code	Course Name
PC-BTC404	Surveying and Geomatics
Course pre-requisites	

Course Objectives
This course provides an in-depth understanding of surveying principles, techniques, and geomatics applications. Students will learn about various surveying methods, equipment, data analysis, and geospatial technologies used in the field of surveying and geomatics. The course covers topics such as land surveying, geodetic surveying, cadastral surveying, remote sensing, geographic information systems (GIS), and global positioning systems (GPS). Through theoretical knowledge and practical exercises, students will develop skills in data collection, data processing, and analysis for surveying and geomatics applications.

Course Outcomes

Students will be able to:

1. Understand the fundamental concepts, principles, and techniques of surveying and geomatics.
2. Demonstrate proficiency in using various surveying instruments and equipment.
3. Apply different surveying methods for land surveying, geodetic surveying, and cadastral surveying.
4. Analyze and interpret survey data using appropriate mathematical and statistical techniques.

Course Content		
Module No.	**Details**	**Hrs.**
1	**Setting out Curves:** Introduction - importance and applications , Types of curves: horizontal curves - circular curves, transition curves, vertical curves, Introduction to curve elements - radius, chord, tangent distance, and deflection angle, Curve calculations - calculation methods for determining curve elements, use of trigonometry and geometry in curve calculations, Surveying instruments and equipment for curve setting, Field techniques for curve setting - Marking and staking out curves on the ground, Use of offsets and reference points in curve layout	6
2	**Triangulation and Trilateration:** Principles and concepts of triangulation and trilateration, Applications and advantages of triangulation and trilateration methods, Network Design and Control Point Selection - network design considerations and criteria, control point selection and distribution, estimation of required network accuracy.	5
3	**Geodetic Surveying:** Difference between topographic surveying & geodetic surveying, Geodetic datums and coordinate systems, Geoid and ellipsoid models, Geodetic control networks, Geodetic positioning techniques.	5
4	**Remote Sensing and Photogrammetry:** Principles of remote sensing, Satellite and aerial imagery interpretation ,Photogrammetric techniques for data extraction, Applications of remote sensing in surveying	6

5	**Geographic Information Systems (GIS):** Introduction to GIS concepts and components, GIS data models and spatial analysis, Data capture and integration, GIS applications in surveying and geomatics	4
6	**Global Positioning System (GPS):** Principles of GPS and satellite positioning, GPS data collection techniques, Differential GPS and real-time kinematic (RTK) surveying, GPS applications in surveying and geomatics, Data Processing and Analysis in Surveying	5
7	**Setting out Construction works:** General, positioning of structure, setting out works - building, culvert, bridge, sewer line, tunnel surveys, surface and subsurface survey, transfer of tunnel alignment and reduced level through shaft.	5

Text Books:
1. T.P. Kanetkar and S.V. Kulkarni, *Surveying and Levelling*, 9th edition, Pearson India, 202.
2. S.S. Bhavikatti and A.M. Chandra, *Surveying: Theory and Practice,* 2nd edition, published by I.K. International Pvt. Ltd., 2017.
3. Madhu, N, Sathikumar, R and Satheesh Gobi*, Advanced Surveying: Total Station, GIS and Remote Sensing*, 2nd edition, Pearson India, 2018.

Reference Books:
1. Paul R. Wolf and Charles D. Ghilani, *Elementary Surveying: An Introduction to Geomatics,* 11th edition, Pearson Education International, 2005.
2. Barry Kavanagh, *Surveying: Principles and Applications*, 9th edition, Pearson / Prentice Hall, 2013.
3. N. N. Basak, *Surveying and Levelling*, 2nd edition, McGraw Hill Education (India) Private Limited, 2017.

E resources (if any):
1. https://nptel.ac.in/courses/105107122 : Introduction to surveying and Mapping – Lectures delivered by Prof. J.K. Ghosh, IIT Roorkee.
2. https://nptel.ac.in/courses/105104100 : Modern Surveying techniques – Lectures delivered by Dr. Onkar Dikshit, IIT Kanpur.
3. https://nptel.ac.in/courses/105108077 : Introduction, Basic concepts of remote sensing, Airborne and space-borne sensors, Passive and active remote sensing – Lectures delivered by Dr. D. Nagesh Kumar, IISc Bangalore
4. https://www.iirs.gov.in/edusat : Outreach (distance learning programme) of the Indian Institute of Remote Sensning (IIRS), Dehradun in the field of 'Earth Observation and Geo-information Techniques.'

Hydraulic Engineering

Course Code	Course Name
PC-BTC405	Hydraulic Engineering

Course pre-requisites	NA

Course Objectives
The objectives of this course are: 1. To describe the types of flow, pipe flow system and to learn about concepts of hydraulics in dynamic state and its applications. 2. To exemplify the fundamentals of impulse momentum principle and to explain the working of various hydraulic machines. 3. To summarize the uniform and non uniform flow applied to open channel flow. 4. To explain dimensional analysis techniques.

Course Outcomes
Upon successful completion of the course, students should be able 1. understand fundamentals of pipe flow, losses in pipe and analysis of pipe network in various conditions and able to differentiate between types of flow. 2. implement the dynamics and impulse momentum principle hydraulic machines and design the components of hydraulic turbines and Centrifugal pumps. 3. design hydraulically efficient open channels, appraise varied flow and understand the formation of hydraulic jump in open channels. 4. test the dimensional homogeneity in hydraulic engineering.

Course Content		
Module No.	Details	Hrs.
1	**Dimensional analysis:** Dimensional homogeneity, Buckingham's Π theorem, Rayleigh's method, Dimensionless groups, similitude, model studies, distorted and undistorted models, scale effects.	03
2	**Flow through Pipes:** Darcy-Weisbach's equation, major and minor losses, Hydraulic gradient and total energy line, Pipes in series and parallel, Power transmission through pipes and nozzles. Siphon pipe. Water hammer in pipes, Analysis of pipe network: Hardy cross method, three reservoir problem. Momentum and moment of momentum principle, its application.	05
3	**Impact of Jet:** Impulse momentum principle, Jet striking flat plates, stationary and moving normal, inclined plates, curved vanes, series of plates and vanes mounted on wheel. Jet propulsion of ships. Heads and efficiencies of turbines, Classification, working of Impulse turbine, Pelton wheel, Reaction turbine, Francis turbine, Kaplan turbine.	05
4	**Hydraulic Machines:** Heads and efficiencies of turbines, Classification, working of Impulse turbine Pelton wheel, Reaction turbine, Francis turbine, Kaplan turbine, Design of Pelton Wheel	05

5	**Centrifugal Pump:** Centrifugal Pumps: Work done, Head and efficiency, priming, minimum starting speed, pumps in series and parallel, multistage pumps, Characteristics curves.	04
6	**Flow through open Channels:** Classification, Uniform flow, Chezy's and Manning's equation, Prismatic and non-prismatic channels, hydraulically efficient channels, Notches and weirs, Venturiflume, Concept of Specific energy and specific force, applications of specific energy, momentum principle to open channels, Introduction to Gradually flow, Flow Profiles, Rapidly varied flow, hydraulic jump,	06

Text Books:

1. Dr. P.N. Modi and S. M. Seth (2009); "Hydraulics and Fluid Mechanics" Standard Book House ISBN-13: 978-8189401269. 250p
2. Dr. Jain A.K (2010); "Fluid Mechanics" Khanna Publishers. ISBN-13: 978- 8174091949.
3. K Subramanya (2008); "Flow in Open Channels" 978-0070086951. 576p
4. Subramanaya K (2010); "Fluid mechanics & hydraulic Machines". McGraw Hill Education (India) Private Limited. ISBN-13: 978-0070699809.
5. K.G. Ranga Raju. (1993) : Flow through open channels, New Delhi : Tata McGraw- Hill, c1993.
6. *Rajesh Srivastava* (2007): *Flow Through Open Channels*. Oxford University Press, 2007, pbk, 432 p, ISBN : 0195690385

Transportation Engineering

Course Code	Course Name
PC- BTC406	Transportation Engineering

Course pre-requisites	Building materials and construction, Materials testing and evaluation (Lab)

Course Objectives
1. To discuss and Compute orientation of Runway & taxiway, its geometric design, drainage, Gate and Gate positions, marking and lighting on Runway and taxiway, aircraft parking system, Terminal area & airport layout.
2. To summarize cross section of permanent way and track components, Computation of number of sleepers, fish plate, fish bolt, geometric elements of railway, Points and switches.

Course Outcomes
At the end of this course, the students will be able to
1. To Analyze and Design orientation of Runway & taxiway, its geometric design, drainage, Gate and Gate positions and able to prepare project report for new airport construction.
2. To acquire the knowledge of cross section of permanent way, function of each component and Geometric Design of Railway track including turnout signals, points and switches, selection of materials and method of Construction.

Course Content		
Module No.	Details	Hrs.
1	**Introduction:** Role of transportation in Society, objectives of transportation system, planning & coordination of different modes of transportation systems for Indian conditions.	03
2	**Airport Engineering** i. Aircraft component parts and its function, aircraft characteristics and their influence on airport planning. ii. Airport planning: topographical and geographical features, existing airport in vicinity, air traffic characteristics, development of new airports, factors affecting airport site selection. iii. Airport obstruction: zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones.	06

3	i. Airport layout: runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, geometric design, airport capacity, runway configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers and parking. ii. Marking and lighting of runways, taxiway, approach and other areas. Terminal area & airport layout: terminal area, planning of terminal buildings, apron: size of gate position, number of gate position, aircraft parking system, hanger, general planning considerations and blast considerations. Airport drainage: requirement of airport drainage, design data, surface drainage design.	06
4	**Railway Engineering** i Merits of rail transportation, railway gauges and problems due to non-uniformity of gauges. ii Cross section of permanent way and track components, sleeper – functions and types, sleeper density, ballast functions and different ballast materials. iii Rails: coning of wheels and tilting of rails, rail cross sections, wear and creep of rails, rail fastenings.	04
5	i Cross section of permanent way and track components, sleeper – functions and types, sleeper density, ballast functions and different ballast materials. ii Geometric elements: gradients, transition curves, widening of gauge on curves, cant and cant deficiency. iii Points and crossing: design of turnouts, description of track junctions, different types of track junctions. iv Yards: details of different types of railway yards and their functions.	06
Term Work		
At least 10 assignments covering entire syllabus shall be submitted as term work.		

Reference Books:

1. Saxena S C and Arora S P (2010); "A text book of Railway Engineering", Dhanpat Rai and Sons, New Delhi. ISBN-13: 978-8189928834.
2. Khanna & Arora (1999); "Airport Planning and Design" Nemchand Bros, Roorkee. ISBN-13: 978-8185240688.
3. Horonjeff and Mckelrey (1994); "Planning and Design of Airport", McGraw-Hill Professional. ISBN-13: 978-0070453456.
4. Rao G V (1992); "Airport Engineering",Tata McGraw-Hill Publishing Company ISBN -13: 9780074603178

Environmental Engineering – I

Course Code	Course Name
PC BTC 407	Environmental Engineering - I

Course Objectives
The objectives of this course are 1. Prepare a general layout of a water supply scheme and discuss the components of the water treatment plant on the basis of topography and source. 2. Design various units of Water treatment system.

Course Outcomes
Upon successful completion of the course, students should be able to 1. Design of water supply scheme for rural and urban areas. 2. Analyse and interpret the data related to water quality. 3. Design of water treatment units such as flocculator, sedimentation tank, filtration, ion exchange units 4. Evaluate and understand various eco-friendly technologies to facilitate conservation and regeneration of the natural resources.

Course Content		

Module No.	Details	Hrs.
1	**Water Engineering : Quality and Quantity** Water supply systems: need for planned water supply schemes, components of water supply system and determination of their design capacities, water distribution network, types of intake structure.(NBC norms) Quality of water: wholesomeness and palatability, physical, chemical, microbial standards.; Introduction to drinking water standard (BIS standard), standard for bathing water, recreation and industrial water standards. Ground water and its implications	04
2	**Water Treatment-Removal of Turbidity** i. Sedimentation: factors affecting efficiency, design values of various parameters, tube settlers. Advantages and Disadvantages ii. Coagulation and flocculation: mechanisms, common coagulations; Advantages and Disadvantages iii. Rapid mixing and flocculating devices, G and GT values, Jar test, coagulant aids- polyelectrolyte etc. Advantages and Disadvantages iv. Filtration: classification, slow and rapid sand filters, dual media filters, sand, gravel and under-drainage system, mode of action, cleaning, limitations, operational difficulties, performance, basic design consideration, pressure filters: construction and operation.	12

3	**Water Treatment- Removal of Pathogens** Disinfection: chlorination, chemistry of chlorination, kinetics of disinfection, chlorine demand, free and combined chlorine, break point chlorination, superchlorination, dechlorination, chlorine, residual, use of iodine, ozone, ultraviolet rays and chlorine dioxide as disinfectants, well water disinfection. **Advanced water Treatment** i.Water softening: Basis, lime soda and Base Exchange , processes, principle reactions, design considerations, sludge disposal. ii. Miscellaneous treatments: removal of iron and manganese, taste, odour, colour, defloridation, Iron and Manganese removal, principles technology.	02
4	**Water Distribution System** Types of Water distribution Systems, Design of Water Distribution Networks manually using Hardy Cross Method Design of Water distribution system using EPANET and Water G EMS, INODE for water treatment unit design	03
5	**Newer and emerging Technologies in water treatment** Membrane filtration- Low and high filtration membranes Reverse, osmosis, types, issues related to RO, advancements in Reverse osmosis, UV Irradiation Technology, RO/MEE Ozone with hydrogen peroxide.	03

Reference Books:

1. Nathanson J.A (2014) "Basic Environmental Technology: Water Supply, Waste Management and Pollution Control". Prentice Hall. ISBN-13: 978-0132840149. 456p.

2. J.W. Clark, W.Veisman, M.J.Hammer (2008); "Water Supply and Pollution Control" Prentice Hall. ISBN-13: 978-0132337175. 864p.

3. Gilbert Masters (2013); "Introduction to Environmental Engineering and Science" Pearson Education. ISBN 13 9781292025759. 700p.

4. S.K. Garg (2010); "Water Supply Engineering", Khanna Publications. ISBN 13: 978- 8174091208. 300p.

5. Vesilind (2013);' "Introduction to Environmental Engineering", PWS Publishing Company. ISBN 3: 9780534378127.

6. Peavy, Rowe, Tchobanoglous (2013); "Environmental Engineering", Tata Mc Graw Hill. ISBN-13: 978-9351340263. 736p.

7. Manual on Water Supply and Treatment, (latest Ed.): Ministry of & Housing. New Delhi

8. Manual on municipal Solid waste Management: Ministry of Urban Development, New Delhi

9. Relevant Indian Standard Specifications, BIS Publications

10. CPHEEO Manual on Water Supply & Treatment.

11. CPHEEO Manual on Sewage & Treatment.

Concrete Technology (LAB)

Course Code	Course Name
PC-BTC451	Concrete Technology (LAB)

Course pre-requisites	PC-BTC403

Course Objectives
The students will learn to: 1. To determine properties of cement, aggregates and concrete.
Course Outcomes

Upon successful completion of the course, students should be able:
   1. Develop collaborative skills to work in a team/group.
   2. Test physical properties of cement, aggregates and concrete.
   3. Evaluate the effects of admixtures on physical properties of concrete.
   4. Design the concrete mix.

List of Experiments
1. Study of properties of fine and coarse aggregates. 2. Marsh Cone test 3. Effect of w/c ratio on workability (slump cone, compaction factor, V-B test, flow table) 4. Effect of w/c ratio on strength of concrete. 5. Mix design in laboratory. 6. Non-destructive testing of concrete – some applications (hammer, ultrasonic) 7. Secant modulus of elasticity of concrete & indirect tensile test on concrete. 8. Study of admixtures & their effect on workability and strength of concrete. 9. Modulus of rupture of concrete. 10. Permeability test on concrete. 11. Tests on polymer modified concrete/mortar. 12. Tests on fibre-reinforced concrete.

Text Books:

1. R. Santhakumar (2006), "Concrete Technology", Oxford University Press (Rs), Isbn 0195671537, 771 p.
2. Shetty M. S. (30 November 2000), "Concrete Technology - Theory and Practice", S Chand & Co Ltd, Isbn 8121903483, 658 p.
3. O.P. Jain &Jaikrishna (2007), "Plain & Reinforced Concrete -Vol. I", Nem Chand & Brothers Isbn 8185240086.
4. A. M. Neville (2012), "Properties Of Concrete", Trans-Atlantic Publications, Inc., Isbn 0273755803, 846 p.
5. Relevant I.S. Codes.
6. Special Publication Of Aci On Polymer Concrete And Frc:
7. Proceedings Of International Conferences On Polymer Concrete And FRC

Surveying and Geomatics Laboratory

Course Code	Course Name
PC-BTC452	Surveying and Geomatics Laboratory
Course pre-requisites	

Course Objectives
This course provides an in-depth understanding of surveying principles, techniques, and geomatics applications. Students will learn about various surveying methods, equipment, data analysis, and geospatial technologies used in the field of surveying and geomatics. The course covers topics such as land surveying, geodetic surveying, cadastral surveying, remote sensing, geographic information systems (GIS), and global positioning systems (GPS). Through theoretical knowledge and practical exercises, students will develop skills in data collection, data processing, and analysis for surveying and geomatics applications.

Course Outcomes
Students will be able to:

1. Understand the fundamental concepts, principles, and techniques of surveying and geomatics.
2. Demonstrate proficiency in using modern surveying instruments and equipment.
3. Apply different surveying methods / technologies for land surveying and geodetic surveying.
4. Analyze and interpret survey data using appropriate mathematical, statistical and geospatial techniques and software.

Course Content	
Module No.	**Details**
1	**Setting out Curves:** a. Linear method b. Angular method
2	**Triangulation and Trilateration:** a. Reduced level and horizontal distance by one plane method b. Reduced level and horizontal distance by two plane method
3	**Modern surveying Instruments:** a. Study and use of electronic theodolite for horizontal (linear & angular) and vertical measurements on the ground b. Study and use of total station for determination of horizontal, vertical and sloping distance between any two ground points.
4	**Photogrammetry and GPS:** a. Study of aerial / satellite images and its interpretation b. Study and use of stereoscope for photogrammetry c. Study and use of GPS for coordinate capture / data capture and mapping
5	**Geographic Information Systems (GIS): (open source software)** a. Geo-registration of spatial data and digitization

	b. Map editing, vector and raster analysis of digitized map
	c. Preparation of contour map
6	**Setting out Construction works:**
	a. Setting out a given foundation plan of a building on the ground
7	**Project work (outside the campus):**
	a. Road project for a minimum length of 300 m including fixing of alignment, profile leveling, cross-sectioning, plotting of L section and cross section.
	b. Block contouring
	c. Tacheometric or radial contouring survey
	Project work includes
	i. field work with the help of relevant advanced instruments
	ii. office work - report preparation, drawing and contour maps prepared by using relevant software

Assessment criteria for laboratory, i.e. weightage for assessment shall be as follows:

i)   Attendance in Laboratory = 20%,

ii)   Journal= 40%,

iii)   Practical Examination (and/or) Mini project (and/or) Quiz (and/or) Seminar (and/or) Oral (and/or) Industry visit report= 40%.

Text Books:
1. T.P. Kanetkar and S.V. Kulkarni, *Surveying and Levelling*, 9th edition, Pearson India, 202.
2. S.S. Bhavikatti and A.M. Chandra, *Surveying: Theory and Practice,* 2nd edition, published by I.K. International Pvt. Ltd., 2017.
3. Madhu, N, Sathikumar, R and Satheesh Gobi, *Advanced Surveying: Total Station, GIS and Remote Sensing*, 2nd edition, Pearson India, 2018.

Reference Books:
1. Paul R. Wolf and Charles D. Ghilani, *Elementary Surveying: An Introduction to Geomatics,* 11th edition, Pearson Education International, 2005.
2. Barry Kavanagh, *Surveying: Principles and Applications*, 9th edition, Pearson / Prentice Hall, 2013.
3. N. N. Basak, *Surveying And Levelling*, 2nd edition, Mcgraw Hill Education (India) Private Limited, 2017.

E resources (if any):
1. https://nptel.ac.in/courses/105107122 : Introduction to surveying and Mapping – Lectures delivered by Prof. J.K. Ghosh, IIT Roorkee.
2. https://nptel.ac.in/courses/105104100 : Modern Surveying techniques – Lectures delivered by Dr. Onkar Dikshit, IIT Kanpur.
3. https://nptel.ac.in/courses/105108077 : Introduction, Basic concepts of remote sensing, Airborne and space-borne sensors, Passive and active remote sensing – Lectures delivered by Dr. D. Nagesh Kumar, IISc Bangalore
4. https://www.iirs.gov.in/edusat : Outreach (distance learning programme) of the Indian

Institute of Remote Sensning (IIRS), Dehradun in the field of 'Earth Observation and Geo-information Techniques.'

Hydraulic Engineering (Lab)

Course Code	Course Name
PC-BTC453	Hydraulic Engineering (Lab)

Course pre-requisites	NA

Course Objectives
Students will learn :

1. To describe the types of flow and pipe flow system and discuss the concepts of fluid dynamics and its applications.
2. To exemplify the fundamentals of impulse momentum principle and explain the working of various hydraulic machines
   To summarize the uniform and non uniform flow applied to open channel flow.

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

1. Use the fundamentals of pipe flow, losses in pipe and analysis of pipe network in various conditions and differentiate between types of flow.
2. Implement the dynamics and impulse momentum principle hydraulic machines and understand the components of hydraulic turbines and Centrifugal pumps
   Evaluate GVF and RVF in the formation of hydraulic jump in open channels.

Course Content	
Sr. No.	List of Experiments
	Group A (preferably Four from group A to be performed)
1	Losses in pipes
2	Impact of jet, flat plate, inclined plate, curved vanes
3	Performance of Pelton turbine
4	Performance of Francis Turbine
5	Performance of Kaplan Turbine
6	Performance of Centrifugal pumps
7	Pumps in series and parallel
	Group B (preferably Four from group B to be performed)
1	Chezy's roughness factor
2	Specific energy
3	Hydraulic Jump
4	Calibration of Broad crested weir
5	Calibration of Venturiflume
(Minimum Eight to be performed =any Four from Group A + any Four from Group B)	

Text Books:
1. Dr. P.N. Modiand S.M. Seth (2009); "Hydraulics and Fluid Mechanics" Standard Book House
ISBN-13: 978-8189401269. 250p
2. Dr. Jain A.K (2010); "Fluid Mechanics" Khanna Publishers. ISBN-13: 978-8174091949
3. K Subramanya (2008); "Flow in Open Channels" 978-0070086951. 576p
4. Subramanaya K (2010); "Fluid mechanics & hydraulic Machines". McGraw Hill Education (India)
Private Limited. ISBN-13: 978-0070699809

Reference Books:
R. K. Rajput (2010): Fluid Mechanics and Hydraulic Machinery, S. Chand and Company

Environmental Engineering I - Lab

Course Code	Course Name
PC-BTC454	Environmental Engineering I (Lab)
Course pre-requisites	Applied Chemistry Laboratory

Course Objectives
The students will learn to 1. To find various parameters of water 2. To analyze and interpret the usability of water for potable purposes 3. Utilize EPANET and WaterGEMS for design of water distribution system

Course Outcomes
The course will enable the students to 1. Analyze and interpret the data related to water parameters. 2. Design the water distribution system using EPANET and WaterGEMS

Course Content	
Exp. No.	*Details*
1	Determination of pH, Temperature and Color
2	Determination of Turbidity
3	Determination of Hardness
4	Determination of Alkalinity
5	Determination of Acidity
6	Determination of Solids(Total solids, Suspended Solids, Dissolved Solids)
7	Determination of Chlorides
8	Determination of Optimum dose of alum (Jar Test)
9	Determination of Most Probable Number (MPN)
10	Determination of Residual Chlorine
11	Demonstration of EPANET and Water GEMS and wastewater treatment

Term Work

Term work shall comprise of
   Reports of experiment performed shall be submitted as part of practical work along with assignments related to experimental work.
   The assessment will be based on practical performance, attendance and experimental work during semester.

Reference Books

[1] Eaton, A. D., Clesceri, L. S., Greenberg, A. E., Franson, M. A. H., American Public Health Association., American Water Works Association., &Water Environment Federation.(2000). *Standard methods for the examination of water and wastewater.* Washington, DC: American Public Health Association (APHA).
[2] Relevant Indian standards IS 3025 series (available online)
[3] E Laboratory IIT Bombay

Disaster Preparedness and planning

Course Code	Course Name
VA-BTC-471	Disaster Preparedness and planning

Course pre-requisites	NA

Course Objectives
The students will learn to: 1. An exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management. 2. Understanding of the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures. 3. The data, methods, tools, and geospatial techniques (including GIS) that can enhance vulnerability assessments and knowledge building and competencies to utilize mapping in mitigation planning and response operations

Course Outcomes
The students will be able to: 1. Applying management concepts and ideas to disaster 2. Analyzing relationship between development and disasters 3. Ability to understand categories of disasters 4. Realization of the responsibilities to society

Course Content

Module No.	Details	Hrs.
1	**Introduction Concepts and definitions:** Disaster, hazard, vulnerability, risk, severity, frequency and details, capacity, impact, prevention, mitigation	03
2	**Disasters:** Disasters classification; natural disasters (floods, drought, avalanches, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, flash floods, cloud burst, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); Disasters in global context, hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility, recent case studies	05
3	**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.	05

4	**Disaster Risk Reduction (DRR):** Disaster management cycle – its phases; prevention – significance of preventive action and measures, 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.	10
5	**Disasters, Environment and Development:** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.) – case studies, sustainable and environmental friendly recovery; reconstruction and development methods.	08
6	Hazard, Vulnerability Risk Assessment (HVRA) Definitions; risk, hazard, vulnerability, severity, exposure, Rating scale or classification of levels of exposure, vulnerability, threat, hazard, Hazard probability, Risk calculation, Hazard mapping, Risk mapping - use of geoinformatics for HVRA.	05

For Self-study (if any):

Text Books:
1. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
2. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

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.

Civil Engineering – Societal & Global Impact

Course Code	Course Name
VA-BTC 472	Civil Engineering – Societal & Global Impact

Course pre-requisites	NA

Course Objectives
The students will learn about :   1. To create awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels.   2. To create awareness of the impact of Civil Engineering for the various specific fields of human endeavour.   3. To think innovatively to ensure Sustainability.

Course Outcomes
The students will be able to: 1. The impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively.   2. The extent of Infrastructure, its requirements for energy and how they are met: past, present and future.   3. The Sustainability of the Environment, including its Aesthetics.   4. The potentials of Civil Engineering for Employment creation and its Contribution to the GDP.   5. The Built Environment and factors impacting the Quality of Life.   6. The precautions to be taken to ensure that the above-mentioned impacts are not adverse but beneficial.   7. Applying professional and responsible judgement and take a leadership role.

Course Content		
Module No.	Details	Hrs.
1	**Introduction to Course and Overview:** Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections.	05
2	**Past Impacts:** Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis.	05
3	Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and	04

	Wonders in the field of Civil Engineering; Future Vision for Civil Engineering.	
4	**Infrastructure:** Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability.	05
5	**Environment:** Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.	06
6	**Built environment:** Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability.	05
7	**Civil Engineering Projects:** Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.	06

Text Books:

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake
Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht.

2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition

3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.

4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options

6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx.

7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge Foundation for Water Research FR/R0014.

8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129- 130.

9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.

10. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63

11. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research. Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.

Development Engineering

Course Code	Course Name
VA-BTC 473	Development Engineering

Course pre-requisites	NA

Course Outcomes
Upon completion of this course,students will be able to:

1. Develop multi scaled perspective about decisions in the built environment, urban development, rural development and sustainable development.
2. Analyse and evaluate real world problems and provide technological solutions.

Course Content		
Module No.	Details	Hrs.
1	Introduction to Development Engineering Introduction to development engineering; need of development engineering; core disciplines and concept; major issues in development; urban development; rural development; socioeconomic development; Introduction to existing guidelines, standards, codes, policies and regulations, Census and other data sources, its elements and importance.	02
2	Research Formulation Scientific social research, formulation of research problem; field work and data collection, report drafting, logistics and planning, QoS assessment, third party audit, pre-feasibility studies – assessment - design, Cost effectiveness, assessment of outcomes.	03
3	Rural Development District administration, District Planning, Introduction to various sectors of rural areas and issues or challenges associated; drinking water, waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy, providing Various schemes and policies floated by state and central government, phases in the schemes; life cycle costing of these schemes, use of engineering and technological solutions for the real world issues, People's participation and role in development of rural areas Importance of use of renewable energy in rural development.	05
4	Urban Development Sustainable Community Development; concept and development of sustainable communities; Sustainable design principles, building regulations, codes and standards, Rating systems Town Planning; history of town planning in India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum	08

Year: 2022-23

	redevelopment – Sanitation and health issues; Smart city planning-introduction to city planning, infrastructure elements of smart city planning, dimensions of smart cities – global standards and performance benchmark; smart solutions- e governance, waste management, water management, energy management – renewable energy RE100, urban mobility, citizen services, other services such as tele medication and education, trade facilitation, skill development.	
5	Geoinformatics for Planning and Development Introduction to Geoinformatics, Advantages, benefits and limitations; Real world applications; Data extraction; Spatial risk identification, Spatial analysis, thematic mapping, forecasting, decision making, identification of trends based on temporal data.	06

Text Books:

1. Chand, M. and Puri, U.K.(1983),'Regional Planning in India', Allied Publishers, New Delhi.
2. Kaiser, E. J., et.al. (1995), 'Urban Landuse Planning', 4th (ed) Urbana, University of Illinois Press.
3. Desai, V. (2005), 'Rural Development of India', Himalaya publishing house, Mumbai.

Reference Books:

1. Sundaram, K.V. 1985 'Geography & Planning', Concept Publishing Co., New Delhi.
2. Ayyar, C.P.V. (1987), 'Town Planning in Early South India', Mittal Publications, Delhi.
3. Reeder, L. Hoboken, NJ, (2010), 'Guide to green building rating systems', John Wiley & Sons, Inc., 2010.
4. Longley, P. A., Michael F. Goodchild, Maguire, D.J., Rhind, D. W. (2005), 'Geographic Information Systems and Science', Second Edition 2005: John Wiley & Sons, New York.
5. Rau, S.K. (2001), 'Global Search for Rural Development', NIRD, Hyderabad.
6. Miles R. Simon, 1970, 'Metropolitan Problems' Methuen Publications, Canada
7. B.I.S., 1980, "National Building Code of India', ISI, New Delhi.
8. ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High Performance Green Buildings Except Low-Rise Residential Buildings.
9. ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings

Indian Traditional Knowledge

Course Code	Course Name
MC-BTC02	Indian Traditional Knowledge

Course pre-requisites	Higher Secondary Education

Course Objectives
The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course provides an introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system. The course also provides offers an overview of Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course Outcomes
Upon successful completion of the course, students should be able to

1. Explain basics of Indian tradition and Indian traditional knowledge systems.
2. Describe basics of Indian traditional health care, technologies and its scientific perspectives.
3. Explain basics of Indian artistic, linguistic and philosophical tradition.
4. Co-relate the Indian traditional knowledge in modern scientific perspective

Course Content		
Module No.	Details	Hrs.
1	**Indian Tradition:** Fundamental unity of India, India"s heroic role in world civilization, The Indian way of life, Introduction to Indian tradition, The Scientific Outlook and Human Values.	06
2	**Basic structure of Indian Knowledge System:** Indian Traditional Scriptures, Exposure to 4-Vedas, 4-Upvedas (Ayurveda, Dhanurveda, Gandharvaveda, Sthapatya etc.), 6-Vedangas (Shiksha, Kalp, Nirukta, Vyakaran, Jyotish), 6-Upangas (Dharmashastra, Meemansa, Puranas, Tarkashastra/Logic) etc.	06
3	**Indian Knowledge System and Modern Science:** Relevance of Science and Spirituality, Science and Technology in Ancient India, Superior intelligence of Indian sages and scientists.	06
4	**Indian Traditional Health Care:** Importance and Practice of Yoga, Pranayam and other prevailing health care techniques.	06
5	**Indian Artistic Tradition:** Introduction and overview of significant art forms in ancient India such as painting, sculpture, Civil Engineering, Architecture, Music, Dance, Literature etc.	06

6	**Indian Linguistic Tradition:** Ancient Indian languages and literary Heritages, Phonology, Morphology, Syntax and Semantics.	06
7	**Indian Philosophical Tradition:** (Sarvadarshan)- Nyay, Viaishepik, Sankhya, Yoga, Meemansa, Brief understanding of Philosophy of Charvaka, Bhagwan Mahaveer Jain, Bhagwan Buddha, Kabeer, Guru Nanak Dev and other eminent	06

Term Activities
The Term Activities will consist of one assignment on each module, group discussions, presentations, case study on various topics based on above curriculum. Required attendances, involvement in academic activities related to course and overall conduct carry weightage.

Text Books:

1. Ajwani L.H., *Immortal India*, Vora & Co. Publishers, 1997.
2. Swami Jitatmananda, *Modern Physics and Vedanta*, Bharatiya Vidya Bhavan, 2004.
3. Krishnamurthy, V. *Science and Spirituality- A Vedanta Perception,*

Bharatiya Vidya Bhavan, 2002.
4. Sharma D.S., The Upanishadas- An Anthology, Bharatiya Vidya Bhavan, 1989.
5. Raman V.V., *Glimpses of Indian Heritage,* Popular Prakashan,1993.

Reference Books:

1. Sivaramakrishnan, V., *Cultural Heritage of India- Course Material*, Bharatiya Vidya Bhavan, Mumbai 5th Edition, 2014.
2. Capra F., Tao of Physics, Shambhala, 2010.
3. Chaterjee S.C. and Datta D.M., *An Introduction to Indian Philosophy,*

University of Calcutta, 1984.
4. Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987.
5. Jha V.N., *Language, Thought and Reality*