Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
Government Aided Autonomous Institute under Mumbai University
Andheri (W), Mumbai - 400058

Course Contents

Semester III and Semester IV

S. Y. B.Tech. CIVIL ENGINEERING with Minor (XXXX)

Working Professional

Academic Year: 2025-2026
Regulation 23

Sardar Patel College of Engineering,
Andheri (West), Mumbai 400058 (R23, AY: 2025-26)

List of Courses for S.Y B. Tech. (Civil) Sem III

Table of Contents

Programme Outcomes and Programme Specific Outcomes

Programme Outcomes (POs) and **Programme Specific Outcomes (PSOs)** as per **NBA guidelines** for **B.Tech in Civil Engineering** at institutions like **SPCE (Sardar Patel College of Engineering), Mumbai**. SPCE typically aligns its outcomes with AICTE/NBA graduate attributes.

1. **Engineering Knowledge:**
   Apply mathematics, science, and engineering fundamentals to solve complex problems.
2. **Problem Analysis:**
   Identify and analyze complex problems using principles of science and engineering.
3. **Design/Development of Solutions:**
   Design solutions that meet specified needs with societal and environmental considerations.
4. **Investigations:**
   Conduct research and experiments to draw valid conclusions.
5. **Modern Tool Usage:**
   Use modern tools and techniques for engineering practice with awareness of limitations.
6. **The Engineer and Society:**
   Assess societal, health, safety, and legal aspects in engineering solutions.
7. **Environment and Sustainability:**
   Understand the impact of engineering solutions on the environment and promote sustainability.
8. **Ethics:**
   Apply ethical principles and professional responsibilities.
9. **Individual and Team Work:**
   Work effectively as an individual and in diverse teams.
10. **Communication:**
    Communicate effectively in both technical and non-technical contexts.
11. **Project Management and Finance:**
    Apply engineering and management principles in projects and teams.
12. **Life-long Learning:**
    Engage in lifelong learning to keep pace with technological change.

PSO 1:
To simulate and analyse problems in civil engineering domains such as structural, geotechnical, hydraulics and water resources, transportation, geoinformatics, building design, materials & construction, construction management, civil engineering economics & estimation, and environmental engineering using advanced tools and laboratory techniques.

PSO 2:
To formulate sustainable civil engineering solutions for societal challenges through innovative projects, aiming to bring transformational changes in rural and urban developme

SEM – III
Regulation 23

Laplace Linear Algebra and Complex Analysis (BS-BTC301)

Course Code	Course Name
BS-BTC301	Laplace Linear Algebra & Complex Analysis

Course pre-requisites	Std. XI, XII Mathematics, DCCN, ICDE

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 will be able to

1. Solve problems based on Laplace and inverse Laplace transform.
2. Solve initial & boundary value problems by applying theory of Laplace transforms to evaluate real integrals
3. Solve complex variable problems.
4. Determine rank of matrices, Eigen values and Eigen vectors of matrices

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	2	-	-	-	-	-	-	-	1	3	-
CO2	3	-	2	2	-	-	-	-	-	-	-	1	3	-
CO3	3	-	2	1	-	-	-	-	-	-	-	-	2	-
CO4	3	-	2	2	1	-	-	-	-	-	-	-	3	-

Course Content

Module No.	Details	Time (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, $$L\{t^n f(t)\},\ L\left\{\frac{f(t)}{t}\right\},\ L\left\{\frac{d^n f(t)}{dt^n}\right\},\ L\left\{\int_0^t f(u)du\right\}$$ Convolution theorem, Evaluation of real integrals using Laplace transforms.	06
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 equations with one dependent variable.	06
3	**Complex Variables & Mapping**	06

	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. 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 Eastern Limited, 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

Engineering Geology (BS-BTC302)

Course Code	Course Name
BS-BTC302	Engineering Geology
Course pre-requisites	Engineering Chemistry, Engineering Physics

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. Explain the geological processes responsible for the formation of earth surface features and classify various rock types with specific emphasis on Indian geology.
2. Conduct geological and geotechnical site investigations and interpret the findings for application in major civil and infrastructure projects.
3. Assess geological hazards such as erosion, flooding, dewatering, and seismic activities, and evaluate their impact on structural safety and project planning.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	1	2	3
CO2	3	2	3	3	2	-	-	-	-	-	-	1	3	3
CO3	2	2	3	3	2	1	-	-	-	-	-	2	2	3

Course Contents

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, dur ability 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	04

2	**Mineralogy:** Methods of mineral identification, physical properties of minerals, rock forming minerals, ore forming minerals, megascopic identification of common primary and secondary minerals family.	**04**
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.	**06**
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.	**06**
5	**Introduction to the application of geology to civil engineering** *Geological investigations* Preliminary geological investigations, 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. *Dam 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. *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 conditions.	**08**

Text Books
1. Singh Parbin (2012), "Engineering & General Geology", S K Kataria and Sons Ltd. ISBN- 9350142678.
2. Kesavulu Chenna 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.

Mechanics of Materials (PC-BTC301)

Course Code	Course Name
PC-BTC301	Mechanics of Materials
Course pre-requisites	Engineering Physics, Engineering Mechanics- I, Engineering Mechanics-II

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 will be able to:

1. Explain the fundamental concepts of stress, strain, elastic constants, and analyse stress in bars of varying and composite sections.
2. Determine axial force, shear force, and bending moment in statically determinate beams and construct their respective diagrams under various loading conditions, including beams with internal hinges.
3. Apply the theory of bending, shear, and torsion to calculate stresses in beams and shafts
4. Determine principal stresses and principal planes using analytical methods and Mohr's Circle, and evaluate stresses and strains in thin cylindrical and spherical shells subjected to internal pressure.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	2	–	–	–	–	–	–	–	–	2	2	–
CO2	3	3	3	–	–	–	–	–	–	–	–	1	2	–
CO3	3	3	3	–	–	–	–	–	–	–	–	1	2	–
CO4	3	2	3	–	–	–	–	–	–	–	–	1	2	–

Course Contents

Module No	Contents	Time (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.	08
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).	08

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**

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 9 788187433545, 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 (PC-BTC302)

Course Code	Course Name
PC-BTC302	Basics of Surveying
Course pre-requisites	Engineering Mathematics, Engg. Mechanics, Engg. Physics

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
Upon successful completion of the course, students will be able to:

1. Explain the importance and applications of surveying in civil engineering by understanding key mathematical concepts, surveying principles, standard terminology, and techniques including compass surveying, traversing, area measurement, levelling, and contouring.

2. Operate basic surveying instruments and equipment for accurate field measurements, perform relevant computations, and prepare field book and technical reports.

3. Evaluate and interpret field survey data, identify and minimize errors, and apply appropriate checks and corrections for accuracy in surveying projects.

4. Apply surveying techniques to conduct basic traversing and mapping tasks, demonstrating the ability to plan, execute, and present small-scale survey operations.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	3	2	3	-	-	-	-	-	-	3	2
CO3	2	2	3	3	2	-	-	-	-	-	-	-	3	2
CO4	2	2	2	2	1	-	-	-	-	-	-	-	3	2

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.	06
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	05

	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.	
3	**Theodolite Surveying:** Various parts and axes of transit, technical terms, temporary and permanent adjustments of a transit, measurement of horizontal and 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.	**05**
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).	**06**
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.	**06**
Text Books		

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.

Building Drawing with CAD (PC-BTC303)

Course Code	Course Name
PC-BTC303	Building Drawing with CAD

Course pre-requisites	Engineering Graphics and Engineering Graphics Lab

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 and submission drawings

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Explain the basic principles, conventions, and terminology used in building construction and drawing, and interpret thumb rules and building permissions relevant to planning.
2. Interpret and apply building regulations, byelaws, and sustainable design principles from standards like NBC, GRIHA, LEED, and RERA to the planning and approval of buildings.
3. Develop conceptual and functional plans for residential and public buildings based on user requirements, space norms, services, and climatic considerations.
4. Create and present building drawings using CAD software, including layout plans, elevations, sections, service plans, and perspective views, while demonstrating an understanding of BIM fundamentals

CO-PO- PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	2	3	-	-	-	-	-	-	-	3	2
CO2	2	-	3	2	3	-	-	-	-	-	-	-	3	2
CO3	2	-	2	2	2	-	-	-	-	-	-	-	2	2
CO4	3	-	3	2	3	-	-	-	-	-	-	-	3	2

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	**06**

	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.	
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	08
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

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.

   B.P.Verma (2014); 'Civil Engineering Drawing and House Planning' Khanna Publishers; ISBN 81-7409-168-8,152p.

Fluid Mechanics (PC-BTC304)

Course Code	Course Name
PC-BTC304	Fluid Mechanics
Course pre-requisites	Engineering Mechanics

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 will be able

1. Explain the fundamental properties of fluids and the concepts of pressure, head, and fluid classification.
2. Analyse fluid statics to compute hydrostatic forces, buoyancy, and stability of submerged and floating bodies.
3. Apply principles of fluid kinematics and dynamics, including Bernoulli's theorem, to evaluate fluid flow and use flow measuring devices.
4. Differentiate between laminar and turbulent flow, and examine boundary layer behaviour, drag, and lift on submerged bodies.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO2	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	-	2	3	2	-	-	-	-	-	-	-	3	-
CO4	3	-	2	2	1	-	-	-	-	-	-	-	3	-

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.	**07**
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.	**07**

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.	**07**
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 Navier Stokes E quation, Bernoulli's theorem, its application to real fluid, flow measuring devices, Venturimeter, Pitot tube, Orifice.	**07**
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.	**07**
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.	**07**
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.

Concrete Technology (PC-BTC305)

Course Code	Course Name
PC-BTC305	Concrete Technology
Course pre-requisites	Building Materials and Construction, Material Testing Lab

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. Explain the types and properties of cement, aggregates, admixtures, and grades of concrete, and their influence on concrete performance under various conditions. 2. Design concrete mixes for compressive and flexural strength using Indian and international methods, including high-performance and ready-mix concrete. 3. Describe the processes involved in the production, transportation, compaction, and curing of concrete, and assess the requirements for concreting in special conditions. 4. Explain the procedures for evaluation of the quality of concrete using laboratory and non-destructive testing methods in accordance with relevant IS codes and standards.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	2	2	1	-	-	-	-	-	-	3	2
CO2	3	-	2	3	2	1	-	-	-	-	-	-	3	2
CO3	2	-	2	2	2	-	-	-	-	-	-	-	3	2
CO4	3	-	3	3	2	-	-	-	-	-	-	-	3	2

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	12

	Admixtures: Plasticizers, retarders, accelerators and other admixtures, test on admixtures, chemistry and compatibility with concrete.	
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**

Text Books

1. R. Santhakumar (2006), "Concrete Technology", Oxford University Press (Rs), ISBN 0 195671537, 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 & Br others ISBN 8185240086.
2. A. M. Neville (2012), "Properties Of Concrete", Trans-Atlantic Publications, Inc., IS BN 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. Mehta.

Mechanics of Materials Lab. (PC-BTC351)

Course Code	Course Name
PC-BTC351	**Mechanics of Materials (Lab)**
Course pre-requisites	PC-BTC302

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 will be able to:
   1. Conduct tests to determine mechanical properties of materials
   2. Analyse, interpret, and report experimental results to understand material behaviour under different loading conditions.
   3. Demonstrate teamwork, and adherence to laboratory safety and testing standards in the execution of experiments

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	-	-	3	-
CO2	3	3	2	3	2	-	-	-	-	-	-	-	3	-
CO3	2	3	-	2	1	-	-	-	-	-	-	-	2	-

Course Content

List of Experiments:
   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. Brinell hardness test on metal specimens.
   6. Rockwell hardness test on metal specimens.
   7. Charpy impact test on metal specimens.
   8. Izod impact test on metal specimens.
*Report on experiments performed as detailed above shall be submitted as laboratory work

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. 4. William A. Nash (2005), "Strength of materials", Schaum's outline series, Tata McGraw-Hil Education, ISBN 0070601631, 216 p.

Basics of Surveying Lab. (PC-BTC352)

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. Demonstrate the use of various surveying instruments and equipment for measurement and data collection on the field.

2. Perform basic field measurements - distance, angles, and elevations, and conduct basic traversing and mapping exercises.

3. Analyze and interpret the survey data and draw conclusions for decision-making.

4. Apply standard safety measures and ethical practices during surveying, ensuring professional integrity and responsible conduct.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	-	-	-	3	-	-	-	3	2
CO2	3	-	3	3	2	-	-	-	3	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	3	-	-	-	3	2
CO4	2	-	-	2	1	1	-	-	3	-	-	-	2	2

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.

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

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 Lab. (PC-BTC353)

Course Code	Course Name
PC-BTC353	**Fluid Mechanics Lab.**
Course pre-requisites	Engineering Mechanics - I, Engineering Mechanics - II

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 will be able to: 1. Conduct tests to determine properties of fluids 2. Analyse, interpret, and report experimental results to understand fluid behaviour 3. Calibrate flow measuring devices 4. Demonstrate teamwork, and adherence to laboratory safety and testing standards in the execution of experiments

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO2	3	-	2	2	2	-	-	-	-	-	-	-	3	-
CO3	3	-	3	2	2	-	-	-	-	-	-	-	3	-
CO4	2	-	-	2	1	1	-	-	-	-	-	-	2	-

List of experiments

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

Recommended 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.

Concrete Technology Lab (PC-BTC354)

Course Code	Course Name
PC-BTC354	Concrete Technology Lab.
Pre-requisites	PC-BTC307

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 will be able to:

1. Conduct tests to determine physical properties of concrete and its ingredients.
2. Evaluate the effects of admixtures on physical properties of concrete.
3. Design the concrete mix.
4. Demonstrate teamwork, and adherence to laboratory safety and testing standards in the execution of experiments

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	1	-	-	-	-	-	-	3	2
CO2	3	-	2	2	2	1	-	-	-	-	-	-	3	2
CO3	3	-	3	3	2	-	-	-	-	-	-	-	3	2
CO4	2	-	-	2	1	1	-	-	-	-	-	-	2	2

List of Experiments

1. Study of properties of fine and coarse aggregates.

2. Physical properties of cement.

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.

Reference 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. 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

Building Drawing with CAD Lab. (PC-BTC355)

Course Code	Course Name
PC-BTC355	Building Drawing with CAD Lab**.**
Course pre-requisites	Engineering Graphics and Engineering Graphics Lab

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. Plan and design a residential and public building by implementing the principles of planning of buildings, Green building principles, byelaws, regulations and codes for planning 2. Prepare working and detailed drawings of the buildings in CAD. 3. Prepare layout drawing 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

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	-	3	2	3	-	-	-	-	-	-	-	3	2
CO2	3	-	3	2	3	-	-	-	-	-	-	-	3	2
CO3	2	-	2	2	2	-	-	-	-	-	-	-	2	2

Text Books
1. N. KumaraSwamy and A. Kameshwara Rao (2012); "Building Planning & Drawing" Charotar 2. Publishing House; ISBN-13: 978-9380358581. 434 p 3. V.B. Sikka (2013); "A Course in Civil Engineering Drawing" S.K. Kataria & Sons; ISBN-13: 978-9350142721. 550 p. 4. Beginning AutoCAD, Cheryl Shrock, BPB Publication, 1st edition 5. Introduction to AutoCAD 2005:2D and 3D Design, Alf Yarwood

Reference Codes
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 IS1742-1983 code of practice for building drainage

Engineering Geology Lab. (BS-BTC356)

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

Course pre-requisites	---

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 3. Evaluate the suitability of site for different engineering projects from study of core samples.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	-	3	2	1	-	-	-	-	-	-	-	2	3
CO2	3	-	2	2	1	-	-	-	-	-	-	-	2	3
CO3	3	-	3	3	2	-	-	-	-	-	-	-	3	3

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.
Recommended Books

Recommended 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.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

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

Course Contents

Semester IV

S. Y. B.Tech. CIVIL ENGIEERING with Minor (XXXX)

Academic Year: 2025-2026
Regulation 23

List of Courses for S.Y B. Tech.(Civil) Sem IV

Contents

SEM – IV

Regulation 23

Probability, Statistics and Operational Research (BS-BTC401)

Course Code	Course Name
BS-BTC401	Probability, Statistics and Operational Research
Course pre-requisites	---

Course Objectives
The students will learn about – 1. To provide an overview of probability and statistics to engineers 2. Introduce Statistical methods and probability distributions 3. Introduce testing of hypothesis. 4. Introduce linear programming problem and methods to solve.

Course Outcomes
Upon successful completion of the course, students will be able to 1. Solve problems involving basic statistical measures and probability distributions. 2. Apply appropriate methods to test hypotheses using large and small sample data. 3. Solve linear programming problem using Simplex and allied methods.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	2	-	-	-	-	-	-	-	1	2	-
CO2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO3	2	-	2	2	2	-	-	-	-	-	-	1	2	-

	Course Content	
Module No.	**Details**	**Time (Hrs)**
1	**Statistics:** Correlation, Karl Pearson coefficient & Spearman's rank, Correlation coefficient, linear regression, lines of regression.	**07**
2	**Discrete Random Variables:** Random variables, Probability distribution for discrete random variables, Expected value and Variance, Binomial Distribution and Poisson Distribution.	**05**
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:	**06**

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

Reference 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. Operation research Prem klumar Gupta & Dr.D.S.Hira S.Chand 7 Company pvt ltdText Books

Structural Mechanics (PC-BTC402)

Course Code	Course Name
PC-BTC402	**Structural Mechanics**
Course pre-requisites	Mechanics of materials
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 will be able to
1. Analyze bending moment with axial loading and unsymmetrical bending.
2. Draw AFD, SFD and BMD for rigid jointed frames, state the general theorems and write the expression for strain energy and evaluate the strain energy stored in determinate beams, rigid jointed frames and pin jointed frames.
3. Find deflection in beams, rigid jointed and pin jointed frames using different methods.
4. Analyze column for buckling.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	3	3	2	-	-	3	3	3	-	2	3	-
CO2	3	2	3	3	2	-	-	3	3	3	-	2	3	-
CO3	3	2	3	3	2	-	-	3	3	3	-	2	3	-
CO4	3	2	3	3	2	-	-	3	3	3	-	2	3	-

Course Content

Module No.	Details	Time (Hrs)
1	**Bending moment combined with axial loads:** Application to members subjected to eccentric loads, core of the section. Problems on chimneys, retaining walls.	**06**
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.	**06**
3	**Axial force, shear force and bending moment in frames:** Axial force, shear force and bending moment diagrams for statically determinate frames.	**06**
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.	**06**

5	**Deflection of statically determinate structures** Deflection of cantilever and simply supported beams by Double Integration Method, Macaulay's Method. Deflection of cantilever and simply supported beams due to loads using Moment area method, Conjugate beam method.	**06**
6	**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.	**06**
7	**Columns and Struts:** Short and long/slender columns, Concept of buckling in slender columns subjected to axial loads, Euler's and Rankine's design formulae for columns with different support conditions.	**06**
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 &
2. Distributors, ISBN 8123908946, 762 pages.
3. Stephen P. Timoshenko, Donovan H. Young (1965), "Theory of Structures", Tata McGraw Hill,
4. ISBN 0070648689, 629 pages.
5. John Benson Wilbur , Senol Utku , Charles H. Norris (1990), "Elementary Structural Analysis", Tata McGraw Hill, ISBN 9780070659339, 829 pages.
6. Harold I. Laursen (2007), "Structural Analysis", Tata McGraw Hill Higher Education, ISBN 0070366438, 468 pages.
7. B.G. Neal (1963), "Structural Theorems and Their Applications", Pergamon Press ISBN 0080108717, 208 pages.
8. Russell C. Hibbeler (2012), "Structural Analysis", Prentice Hall, IBN 013257053X, 695 pages.
9. Alexander Chajes (1982), "Structural Analysis", Longman Higher Education, ISBN 0138534080, 352 pages.
10. Aslam Kassimali (2014), "Structural Analysis", Cengage Learning, ISBN 1133943896, 613 pages.
11. Dr. Ramachandran Vaidyanathan, Dr. P. Perumal (2006), "Comprehensive Structural Analysis", Laxmi Publications, ISBN 8170088917, 466 pages

Surveying & Geomatics (PC-BTC403)

Course Code	Course Name
PC-BTC403	Surveying and Geomatics
Course pre-requisites	Basics of Surveying
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. Explain the fundamental concepts, principles, and techniques of traditional methods of surveying and modern geomatics.

2. Demonstrate the ability to use modern surveying instruments and equipment for field data collection.

3. Apply appropriate surveying methods for land surveying, geodetic surveying, and cadastral surveying.

4. Analyze and interpret spatila and non-spatial data using appropriate mathematical and statistical techniques.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	3	-	-	-	-	-	-	-	3	2
CO2	3	-	3	3	3	-	-	-	-	-	-	-	3	2
CO3	3	-	3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	-	2	2	2	-	-	-	-	-	-	-	3	2

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	10
2	**Triangulation and Trilateration:** Principles and concepts of triangulation and	04

	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.	
3	**Geodetic Surveying:** Difference between topographic surveying & geodetic surveying, Geodetic datums and coordinate systems, Geoid and ellipsoid models, Geodetic control networks, Geodetic positioning techniques.	05
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	08
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	05
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	06
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.	04

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

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 Sensing (IIRS), Dehradun in the field of 'Earth Observation and Geo-information

Techniques.'

Hydraulic Engineering (PC-BTC404)

Course Code	Course Name
PC-BTC404	Hydraulic Engineering
Course Pre Requisites	Fluid mechanics
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 will be able to
1. Explain fundamentals of pipe flow, losses in pipe and analysis of pipe network in various conditions and able to differentiate between types of flow.
2. Apply the concepts of 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.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO2	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO4	3	-	2	2	1	-	-	-	-	-	-	-	3	-

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.
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.
6. K.G. Ranga Raju. (1993) : Flow through open channels, New Delhi : Tata McGraw-Hill, c1993.
7. Rajesh Srivastava (2007): Flow Through Open Channels. Oxford University Press, 2007, pbk, 432 p, ISBN : 0195690385

Transportation Engineering (PC-BTC405)

Course Code	Course Name
PC-BTC405	Transportation Engineering

Course pre-requisites	NA

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. Design geometric features, drainage and plan layout of airports
2. Explain rail track components, materials, and alignment geometry.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	1	-	-	-	-	-	-	3	3
CO2	3	-	3	3	2	1	-	-	-	-	-	-	3	3

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.	05
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.	08

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

Water Supply Engineering (PC-BTC406)

Course Code	Course Name
PC-BTC406	Water Supply Engineering
Course pre-requisites	Engineering Physics, Engineering Chemistry, Fluid mechanics

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 will be able   1. Analyse and interpret water quality data .   2. Design water supply systems for various regions.   3. Design water treatment units like sedimentation and filtration.   4. Evaluate eco-friendly technologies for water conservation

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	-	3	3	-	-	-	3	3
CO2	3	3	3	3	2	1	-	1	-	-	-	-	3	3
CO3	3	3	3	3	2	1	-	1	-	-	-	-	3	3
CO4	3	3	2	2	1	2	-	-	-	-	-	-	3	3

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.	**05**

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.	03
4	**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.	04
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	04

Reference Books

1. Nathanson J.A (2014) "Basic Environmental Technology: Water Supply, Waste
2. Management and Pollution Control". Prentice Hall. ISBN-13: 978-0132840149. 456p.
3. J.W. Clark, W.Veisman, M.J.Hammer (2008); "Water Supply and Pollution Control" Prentice Hall. ISBN-13: 978-0132337175. 864p.
4. Nathanson J.A (2014) "Basic Environmental Technology: Water Supply, Waste
5. Management and Pollution Control". Prentice Hall. ISBN-13: 978-0132840149. 456p.
6. J.W. Clark, W.Veisman, M.J.Hammer (2008); "Water Supply and Pollution Control" Prentice Hall. ISBN-13: 978-0132337175. 864p
7. Gilbert Masters (2013); "Introduction to Environmental Engineering and Science" Pearson, Education. ISBN 13 9781292025759. 700p.
8. S.K. Garg (2010); "Water Supply Engineering", Khanna Publications. ISBN 13: 978-8174091208. 300p.

9. Vesilind (2013);' "Introduction to Environmental Engineering", PWS Publishing Company. ISBN 13: 9780534378127.
10. Peavy, Rowe, Tchobanoglous (2013); "Environmental Engineering", Tata Mc Graw Hill. ISBN-13: 978-9351340263. 736p.
11. Manual on Water Supply and Treatment, (latest Ed.): Ministry of & Housing. New Delhi
12. Manual on municipal Solid waste Management: Ministry of Urban Development, New Delhi
13. Relevant Indian Standard Specifications, BIS Publications
14. CPHEEO Manual on Water Supply & Treatment.
15. CPHEEO Manual on Sewage & Treatment

Surveying & Geomatics Lab. (PC-BTC451)

Course Code	Course Name
PC-BTC451	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
Upon successful completion of the course, students will be able

1. Comprehend the practical aspects of fundamental concepts and principles related to surveying and geomatics.
2. Operate modern surveying instruments and equipment with accuracy and technical competence.
3. Execute various land and geodetic surveying methods using conventional and advanced geomatics techniques, such as, GPS and GIS.
4. Process, analyze, and interpret field survey data using relevant mathematical, statistical, and geospatial tools and software.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	3	-	-	-	-	-	-	-	3	2
CO2	3	-	3	3	3	-	-	-	-	-	-	-	3	2
CO3	3	-	3	3	3	-	-	-	-	-	-	-	3	2
CO4	3	-	2	2	2	-	-	-	-	-	-	-	3	2

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

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

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. (PC-BTC452)

Course Code	Course Name
PC-BTC452	Hydraulic Engineering (Lab.)

Course pre-requisites	Fluid mechanics

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
Upon successful completion of the course, students will be able to: 1. Apply fundamentals of pipe flow and network analysis.   2. Implement momentum principles in turbines and pumps.   3. Evaluate GVF and RVF in hydraulic jump analysis

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO2	3	-	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	-	3	3	2	-	-	-	-	-	-	-	3	-

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. 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

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

Water Supply Engineering Lab (PC-BTC453)

Course Code	Course Name
PC-BTC453	Water Supply Engineering Lab

Course pre-requisites	Engineering chemistry

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
Upon successful completion of the course, students will be able to 1. Analyze and interpret the data related to water parameters. 2. Design the water distribution system using EPANET and WaterGEMS 3. Demonstrate teamwork, and adherence to laboratory safety and testing standards in the execution of experiments

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	-	3	1	-	-	-	3	3
CO2	3	-	3	3	3	2	-	-	1	-	-	-	3	3
CO3	2	-	-	2	1	1	-	-	3	3	-	-	2	2

Course Content	
Exp.No.	*Details*
1	Determination of pH, Temperature and conductivity
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 and use of Jaltantra, EPANET and Water GEMS for water distribution design
Reference Books	

1. Eaton, A. D., Clesceri, L. S., Greenberg, A. E., Franson, M. A. H., American PublicHealth Association., American Water Works Association., &Water Environment Federation.(2000). *Standard method 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