Sardar Patel College of Engineering,
Andheri (West), Mumbai 400058

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

Government Aided Autonomous Institute under Mumbai University

Andheri (W), Mumbai - 400058

COURSE CONTENTS

Semester III

S. Y. B.Tech. CIVIL ENGINEERING with Minor (Working Professionals)

Academic Year: 2024-2025
Regulation 23

Sardar Patel College of Engineering,
Andheri (West), Mumbai 400058

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

Contents

Sardar Patel College of Engineering,
Andheri (West), Mumbai 400058

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(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.
2. Apply theory of Laplace transforms to evaluate real integrals and solve initial & boundary value problems.
3. Solve complex variable problems.
4. Find rank of matrices, Eigen values and Eigen vectors of matrices

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.	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	07

	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

Sr. No.	Examination	Module
1	T-I (15%)	1, part of2
2	T-II (15%)	Remaining part of2,3
3	End Sem (50%)	1 to 5

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Andheri (West), Mumbai 400058

Engineering Geology (BS-BTC302)

Course Code	Course Name
BS-BTC305	Engineering Geology
Course pre-requisites	BS-BTC102, BS-BTC202

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.

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, rock forming minerals, ore forming minerals, megascopic identification of common primary and secondary minerals family.	3

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. **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	04

	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

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.

Sr. No.	Examination	Module
1	T-I (15%)	1, 2
2	T-II (15%)	3, 4
3	End Sem (50%)	1 to 7

Mechanics of Materials (PC-BTC301)

Course Code	Course Name
PC-BTC302	Mechanics of Materials
Course pre-requisites	BS-BTC102, BS-BTC152, BS-BTC202

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 analyze 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 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.	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

Internal Evaluation

Internal Evaluation 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. S.B. Junnarkar (2007), "Mechanics of materials Vol-1", Charotar Publications, ISBN 8 185594678, 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 11 11577730, 1056 pages.
3. G.H. Ryder (2002), “Strength of materials” Macmillan Publishers India Limited, ISBN 0333 935365, 352 pages.

Sr. No.	Examination	Module
1	T-I (15%)	1, 2
2	T-II (15%)	3, 4
3	End Sem (50%)	1 to 7

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Basics of Surveying (PC-BTC302)

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

Course Objectives

The objectives of this course are

1. Describe the function of surveying in civil engineering construction,
2. Work with survey observations, and perform calculations,
3. Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
4. Be familiar with the principals of recording accurate, orderly, complete, and logical field notes from surveying operations, whether recorded manually or with automatic data collection methods,
5. Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses.
6. Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check levelling measurements.
7. Understand, interpret, and Prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities

Course Outcomes

At the end of the course the students shall be able to

1. Apply the knowledge, mathematics, techniques, skills, and applicable tools of the discipline to engineering and surveying activities such as compass survey, traversing, area computations, levelling and contouring, etc. and their applications in surveying.
2. Demonstrate their capability to use survey instruments in carrying out survey, collect data, perform required calculations and draft reports.
3. Able to control the accumulation of errors in projects.
4. Apply concept of surveying and its application in different construction work.

Course Content

Module No.	***Details***	***Hrs.***
1	**Introduction to Surveying :** Principles, Various types of surveying – based on methods and instruments, classifications ; Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, different types, compass – prismatic, surveyor, whole circle, reduced bearings, declination, local attraction.	06

2	**Levelling:** Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Difficulties in leveling work, corrections and precautions to be taken in leveling work, Errors in levelling.	05
3	**Contouring:** Contouring: Characteristics, methods, (direct and indirect methods of contouring) uses; methods of interpolation.	04
4	**Theodolite:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control – methods of repetition and reiteration, Different methods of running a theodolite traverse, Gales traverse table, balancing of traverse by Bow-Ditch's transit and modified transit rules, omitted measurements, Precautions in using theodolite, errors in theodolite survey.	06
5	**Plane table surveying, Areas and volume:** Plane table surveying, Different methods of plane table surveying, Two point problem, Errors in plane table survey. Areas and volumes: Area of a irregular figure by Trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods, Planimeter: types of planimeter including digital planimeter, area of zero circle, use of planimeter, Computation of volume by trapezoidal and prismoidal formula, volume from spot levels.	05

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.

Sr. No.	Examination	Module
1	T-I (15%)	1, 2 partial
2	T-II (15%)	Remaining 2, 3
3	End Sem (50%)	1 to 5

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Building Drawing with CAD (PC-BTC303)

Course Code	Course Name
PC-BTC304	Building Drawing with CAD

Course pre-requisites	BS-BTC201, BS-BTC252

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
	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	

3	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

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.

Sr. No.	Examination	Module
1	T-I (15%)	1, 2 partial
2	T-II (15%)	Remaining 2, 3
3	End Sem (50%)	1 to 5

Fluid Mechanics (PC-BTC304)

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 unders tand 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

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.

Sr. No.	Examination	Module
1	T-I (15%)	1, 2
2	T-II (15%)	3, 4
3	End Sem (50%)	1 to 6

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Concrete Technology (PC-BTC305)

Course Code	Course Name
PC-BTC307	**Concrete Technology**

Course pre-requisites	PC-BTC202, PCBTC253

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

Internal Evaluation

Internal evaluation 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. Mehta.

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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 should be able

1. Develop collaborative skills to work in a team/group.
2. Experimentally determine the various material properties.

Course Content

List of Experiments (atleast 8 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

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.

Sardar Patel College of Engineering,
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Basics of Surveying Lab. (PC-BTC352)

Course Code	Course Name
PC-BTC352	**Basics of Surveying Lab.**
Course pre-requisites	PC-BTC303

Course Objectives
The objectives of this course are 1. Describe the function of surveying in civil engineering construction, 2. Work with survey observations, and perform calculations, 3. Customary units of measure. Identify the sources of measurement errors and mistakes; understa nd the difference between accuracy and precision as it relates to distance, differential level ing, and angular measurements, 4. Be familiar with the principals of recording accurate, orderly, complete, and logical field no tes from surveying operations, whether recorded manually or with automatic data collection methods, 5. Identify and calculate the errors in measurements and to develop corrected values for differen tial level circuits, horizontal distances and angles for open or closed-loop traverses. 6. Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check levelling measurements. 7. Understand, interpret, and Prepare plan, profile, and cross-section drawings, Work with cross-se ctions and topographic maps to calculate areas, volumes, and earthwork quantities.
Course Outcomes
Upon successful completion of the course, students will be able to 1. Gain basic knowledge on minor and major surveying equipment. 2. Use equipment/instruments for conducting chain and compass traversing, levelling, theodolite travers ing, plane table survey in the field. 3. Record observations in the field book and represent the data graphically and prepare various types of maps.

Course Content

Sr. No.	***List of Experiments***
1	To find internal angles of a polygon with a prismatic and a surveyor compass.
2	Level simple and compound leveling, booking methods, practice on levels Dumpy, Tilting and Auto levels. Demonstration of Digital level.
3	Measurement of Horizontal angles by Repetition method
4	Measurement of Horizontal angles by Reiteration method

5	Measurement of Bearing of line using Theodolite
6	Measurement of vertical angle using Theodolite
7	Use of digital planimeter for measuring area of irregular figures
8	Plane table survey by Radiation method.

Recommended 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 Vidyarthi Griha New 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. IS BN-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: 978019 5684247. 970p.

Fluid Mechanics Lab. (PC-BTC353)

Course Code	Course Name
PC-BTC353	**Fluid Mechanics Lab.**
Course pre-requisites	PC-BTC306

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 1. To utilize various properties of fluids. 2. To carry out calibrations of various flow measuring devices. 3. 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
Recommended Books
1. Dr. R.K. Bansal (2005); "A Textbook of Fluid Mechanics", Laxmi publication. ISBN- 13: 978-81318029 46. 501p. 2. Dr. P.N. Modi (2009); "Hydraulics and Fluid Mechanics" Standard Book House ISBN-13: 978-81894 01269. 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) P rivate Limited. ISBN-13: 978-0070699809.

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Concrete Technology Lab (PC-BTC354)

Course Code	Course Name
PC-BTC354	Concrete Technology Lab.
Prerequisites	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 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. 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. 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

Building Drawing with CAD Lab. (PC-BTC355)

Course Code	Course Name
PC-BTC355	Building Drawing with CAD Lab.
Course pre-requisites	PC-BTC304

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

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 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	BS-BTC305

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.

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
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COURSE CONTENTS

Semester IV

S. Y. B.Tech. (CIVIL) ENGINEERING (Working Professionals) Academic Year: 2024-2025 Regulation 23

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

Course Contents for R23 for Semester IV

Probability, Statistics and Operational Research
(BS-BTC401)

Course Code	Course Name
BS-BTC401	**Probability, Statistics and Operational Research**
Course pre-requisites	BS-BTC101, BS-BTC201

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.

Course Outcomes

At the end of the course the students shall be able to

1. Solve problems in basic statistics and probability distribution
2. Solve problems based on testing of hypothesis.
3. Apply statistical methods for analyzing experimental data.

Course Content

Module No.	*Details*	*Time (Hrs)*
1	**Statistics:** Correlation, Karl Pearson coefficient & Spearman's rank, Correlation coeffici ent, linear regression, lines of regression, Curve fitting by the method of least squares.	08
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 significan ce of the difference between sample mean and population means, Test for significa nce of the difference between the means of two samples. Test for significance of the dif ference between sample S.D and population S.D, Test for significance of the difference between the S.D of two samples.	06
5	**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 Distri bution and its properties.	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-Hill

2012

Sr. No.	Examination (% weightage)	Modules
1	In semester Test 1 (T1) (15%)	1, 2(Part)
2	In semester Test 1 (T2) (15%)	2(Part),3
3	End Semester (50%)	1 to 5

Structural Mechanics (PC-BTC402)

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. Analyze 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 g eneral 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. Analyze column for buckling.

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.	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 fra mes.	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 simpl y 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.	05
	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	05

	principle of virtual work (unit load method) and Castigliano's theorem.	
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.	05

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, 78 0 pages.
3. Reddy C.S. (1999), "Basic Structural Analysis", Tata McGraw hill, ISBN 0070702764, 540 pa ges.
4. Junnarkar S.B. (2013), "Structural Analysis, Vol. II" Charotar Publishers ISBN 9380358703, 9 86 pages.
5. S S Bhavikatti (2011), "Structural Analysis", Vikas Publishing House PVT. Ltd.Noida, ISBN 8 125942696, 436 pages.
6. Devdas Menon (2009), "Structural Analysis", Narosa Book Distributors Pvt Ltd- New Delhi, I SBN 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 00 70366438, 468 pages.
5. B.G. Neal (1963), "Structural Theorems and Their Applications", Pergamon Press ISBN 008010 8717, 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 013853408 0, 352 pages.
8. Aslam Kassimali (2014), "Structural Analysis", Cengage Learning, ISBN 1133943896, 613 pag es.
9. Dr. Ramachandran Vaidyanathan, Dr. P. Perumal (2006), "Comprehensive Structural Analysis", Laxmi Publications, ISBN 8170088917, 466 pages.

Internal Evaluation comprising tutorials shall comprise of

1. At least 20 (twenty) solved problems based on the above modules shall be submitted as Internal e valuation.
2. Course project*

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

Sr. No.	Examination (% weightage)	Modules
1	In semester Test 1 (T1) (15%)	1, 2 and Part of 3
2	In semester Test 1 (T2) (15%)	Part of 3, 4 and 5
3	End Semester (50%)	1 to 7

Surveying & Geomatics (PC-BTC403)

Course Code	Course Name
PC-BTC403	Surveying & Geomatics
Course Pre-requisites	PC-BTC303, PC-BTC352

Course Objectives

The objectives of this course are

1. Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments.
2. Be able to identify hazardous environments and take measures to insure one's personal and team safety,
3. Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments.
4. Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for a closed traverse,
5. Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse, Use appropriate software for calculations and mapping.
6. Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
7. Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
8. Calculate, design and layout horizontal and vertical curves,

Course Outcomes

Upon successful completion of the course, students should be able

1. Design elements of horizontal, vertical and transition curve.
2. Understand the effectiveness of modern surveying instruments such as Digital levels, Electronic theodolites, Electronic Distance Measurement, Total Station, GPS recievers, etc. to improve accuracy and to save time and for surveying operations.
3. Understand the basic principles of aerial photogrammetry, Global positioning systems, remote sensing, hydropgraphic surveying and its applications
4. Analyze and map the geospatial data in geospatial software such as CAD and GIS.

Course Content

Module No.	***Details***	***Hrs.***
1	*Tacheometric surveying:* Principles and uses, advantages, stadia formula, different methods of tacheometer, subtense bar method, location details by tacheometer, stadia diagram and tables, error and accuracy in tacheometry survey work. *Setting Out Curves:* Elements of simple and compound curves, office and field work, linear methods of setting out of curves, Angular methods for setting out of curves, two Theodolite and Rankine's deflection angle methods. Elements of Reverse curve.	06

2	*Transition and Vertical Curves*: design of transition curves, shift, spiral angle, Composite curves – office and field work, setting out of curve by angular method, composite curve problems ; Vertical curves definitions, geometry and types, tangent correction and chord gradientmethods, sight distance on a vertical curve	06
3	*Modern Field Survey Systems*: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station Parts of a Total Station – Accessories –Advantages and Applications; Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.	04
4	*Remote Sensing* and *Photogrammetry Surveying*: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing. *Photogrammetry:* Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial Photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.	07
5	*Triangulation and Trilateration:* methods -triangulation -network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.	03
6	*Hydrographic surveying:* General, methods of hydrographic surveying; tides; tide gauges; sounding; equipment for sounding; locating the sounding; stream gauging.	05
7	*Construction surveying*: General, positioning of structure, setting out works for building; culvert; bridge; sewer line; tunnel surveys; surface and subsurface survey; transfer of tunnel alignment and Reduced level through shaft.	05

Text Books

1. Anji Reddy, M., Remote sensing and Geographical information syste m, B.S.Publications, 2001.
2. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.
5. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, a. 2002.
6. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS b. and Remote Sensing, Pearson India, 2006..
7. N. N. Basak (2014); "Surveying And Levelling", Mcgraw Hill Education (India) c. Private Limited. ISBN-13: 978-9332901537.
8. R Agor (2009); "Surveying and Leveling", Khanna Publishers. ISBN-13: 978- d. 8174092359.
9. Dr. B.C. Punamia (2005); "Surveying Vol-II". Laxmi Publications (P) Ltd., New Delhi. ISBN-13: 978-8170088837.

Sr. No.	Evaluation	Module
1	T-I (15 %)	1, 2
2	T-II (15%)	3, 4
3	End Sem (50%)	1 to 7

Hydraulic Engineering (PC-BTC404)

Course Code	Course Name
PC-BTC404	Hydraulic Engineering

Course Pre Requisites	PC-BTC306

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

Sr. No.	Evaluation	Module
1	T-I (15 %)	1, 2
2	T-II (15%)	3, 4
3	End Sem (50%)	1 to 7

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. 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

Internal Evaluation

At least 10 assignments covering entire syllabus shall be submitted as a part of Internal Evaluation

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

Sr. No.	Examination	Module
1	T-I (15%)	1,2(Part)
2	T-II (15%)	2(Part),3
3	End Sem (50%)	1 to 5

Water Supply Engineering (PC-BTC406)

Course Code	Course Name
PC-BTC406	Water Supply Engineering
Course pre-requisites	BS-BTC102, BS-BTC202

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

1. Analyse and interpret the data related to water quality.
2. Design of water supply scheme for rural and urban areas.
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.	07
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.	16

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.	05
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.	05

Reference Books

11. Nathanson J.A (2014) "Basic Environmental Technology: Water Supply, Waste Management and Pollution Control". Prentice Hall. ISBN-13: 978-0132840149. 456p.
12. J.W. Clark, W.Veisman, M.J.Hammer (2008); "Water Supply and Pollution Control" Prentice Hall. ISBN-13: 978-0132337175. 864p.
13. Gilbert Masters (2013); "Introduction to Environmental Engineering and Science" Pearson Education. ISBN 13 9781292025759. 700p.
14. S.K. Garg (2010); "Water Supply Engineering", Khanna Publications. ISBN 13: 978-8174091208. 300p.
15. Vesilind (2013);' "Introduction to Environmental Engineering", PWS Publishing Company. ISBN 13: 9780534378127.
16. Peavy, Rowe, Tchobanoglous (2013); "Environmental Engineering", Tata Mc Graw Hill. ISBN-13: 978-9351340263. 736p.
17. Manual on Water Supply and Treatment, (latest Ed.): Ministry of & Housing. New Delhi
18. Manual on municipal Solid waste Management: Ministry of Urban Development, New Delhi
19. Relevant Indian Standard Specifications, BIS Publications
20. CPHEEO Manual on Water Supply & Treatment.
21. CPHEEO Manual on Sewage & Treatment.

Sr. No.	Examination	Module
1	T-I	1, 2 Partial
2	T-II	2,3
3	End Sem	1 to 5

Introduction to Sustainability and Sustainable Development (MI-BT031)

Course Code	Course Name
MI-BT031	Introduction to Sustainability and Sustainable Development
Course pre-requisites	NA

Course Objectives

1. This course provides an in-depth understanding of sustainability and sustainable development goals to create a better- informed engineer, which will lead to a more sustainable action by all and for all.

Course Outcomes

Students will be able to:

1. Understand the basic concept of Sustainability and Sustainable Development (SD), history of SD, the environmental, social and economic dimensions of SD and be able to discuss the SD concept on the national as well as on the global scale with respect to engineering
2. Apply the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required for creating sustainable solutions for society.
3. Apply sustainable practices by utilizing the engineering knowledge and principles.
4. Deliberate on potential strategic options and tools for assessing SD (efficiency, sufficiency).

Course Content

Module No	Contents	Time (Hrs)
1	**Introduction**: What is sustainability and sustainable development? – definitions, Concept & components of sustainability **Limits to exponential growth on a finite planet**, Complexity of growth and equity, Environmental issues and crisis, Resource degradation, greenhouse gases, global warming, desertification, social insecurity, industrialization, globalization. **An Engineers role in sustainability**	02
2	**Sustainability perspective for Energy, Materials, Water, Food and Shelter:** World energy usage, Problems with fossil fuels Alternatives - reduction, efficiency, renewable energy. Impacts of material production, sources of waste, Problems with current waste management, Suggestions for reducing the impact of material use Water resource and use worldwide, Associated problems with current water systems, Sustainable water management, World food production, Usage of resources and environmental impacts, Alternatives - organic/local Current building styles and associated problems, Retrofit vs new build Sustainable Architecture	06
3	**Social & Economic Sustainability** Social sustainability - Components - equality, diversity, democracy, social cohesion, Issues - gender issue, poverty, environmental degradation, peace & justice, social sustainability performance - community engagement, community development, empowerment, health, volunteerism, etc. Economic sustainability - Relationship between macroeconomics policies, poverty and environment, Trade-offs between economic growth, social equity, and environmental sustainability, Role of international environmental agreements, green economy and climate change	05

	policies.	
4	**Governance for Sustainable Development Systems**: Socio-economic policies for sustainable development, Strategies for implementing eco-development programmes, Policy responses to environmental degradation, Public participation - Demographic dynamics and sustainability, Integrated approach for resource protection and management.	03
5	**Strategies and measurements of SD**: Introduction to Sustainability assessment, Environment Sustainability metrics – simple and complex indicators, Sustainability methods and assessment - green buildings, Renewable energy, CSR, Biodiversity, Technologies, human development index (HDI), sustainability development index (SDI), LCA	03
6	**The road to Sustainable Development** - National and International Contribution: National Contribution: Societal transformations. Institutional theory, Rural and Urban development, Action plan for implementing sustainable development International Contribution - Brundtland, Rio summit, SDGs, Conventions, Protocols & Agreements, Action plan for implementing sustainable development, Moral obligations and Operational guidelines, Role of developed countries in the sustainable development.	03
7	**Project Presentations**	04

Text Books:

1. Harris, J.M., Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at:http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20 Development.PDF
2. Mackenthun, K.M., Basic Concepts in Environmental Management, 1 st edition, Lewis Publication, London, 1998.
3. Hjorth, P. and A. Bagheri, Navigating towards Sustainable Development: A System Dynamics Approach, In Futures, 38(1): 74-92, 2006.
4. Mog, J.M., Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs, World Development 32(12): 2139–2160, 2004.

Reference Books:

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-
2. Rating System, TERI Publications – GRIHA Rating System
3. Indian Green Building Council, IGBC Green Buildings rating system (New & Existing) - Abridged Reference Guide, Pilot Version, 2017.
4. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)

Courses to refer

Sustainability and Engineering :
https://rdmc.nottingham.ac.uk/bitstream/handle/internal/112/Engineering%20Sustailability

Surveying & Geomatics Lab. (PC-BTC451)

Course Code	Course Name
PC-BTC451	Surveying & Geomatics Lab.

Course pre-requisites	PC-BTC403

Course Objectives

Students will learn :

1. Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments.
2. Be able to identify hazardous environments and take measures to insure one's personal and team safety.
3. Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments.
4. Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for a closed traverse.
5. Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse, Use appropriate software for calculations and mapping.
6. Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
7. Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion.
8. Calculate, design and layout horizontal and vertical curves.

Course Outcomes

Students will be able to

1. Design and set different types of horizontal curves.
2. Determine the location of any point horizontally and vertically using modern surveying instruments like Digital levels, Electronic theodolites, Electronic Distance Measurement, Total Station, GPS receivers.
3. Acquire geospatial techniques such as Geographical Information System (GIS), Global Positioning System (GPS) and Remote Sensing in the field of surveying and Mapping.
4. Perform setting out foundation plan for load bearing and framed structure with surveying instruments.

Course Content

Sr. No.	***List of Experiments***
1	Determination of Tacheometric constants.
2	Height and distance calculation using tacheometric formulae.
3	To set out circular curves by linear method (offset from tangent and from long chord)
4	To set out circular curve by angular method (Rankine's and two Theodolite method)
5	Determination of RL and horizontal distance of object by one plane method.

6	Determination of RL and horizontal distance by of object by two plane method.
7	Setting out a simple foundation plan in the field.
8	Use of total station to determine co-ordinates of points, MLM, REM.
9	Determination of co-ordinates of points using GPS and preparing Map.

In Semester Evaluation

Report on experiments conducted, the term work shall comprise of:
Three A1 size drawing sheets comprising practical work on: L section and cross section block contouring, Tacheometric survey. Office and field work for minimum two types of curves by angular method, plotting of a contour plan on computer using suitable software,

Assessment criteria for laboratory/Tutorial work. i.e. weightage for assessment shall be as follows:

i. Attendance in Laboratory/Tutorial = 20%,
ii. Journal/Drawing sheet/Sketch book = 40%,
iii. MCQ/Oral/Test = 40%.

Text Books

1. Anji Reddy, M., Remote sensing and Geographical information system, B.S.Publications, 2001.
2. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010.
4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006..
6. N. N. Basak (2014); "Surveying And Levelling", Mcgraw Hill Education (India) Private Limited. ISBN-13: 978-9332901537.
7. R Agor (2009); "Surveying and Leveling", Khanna Publishers. ISBN-13: 978-8174092359.
8. Dr. B.C. Punamia (2005); "Surveying Vol-II". Laxmi Publications (P) Ltd., New Delhi. ISBN-13: 978-8170088837.

1. Vasant N. Deasai (2004) A manual on Theodolite Surveying and Total Station.

Hydraulic Engineering Lab. (PC-BTC452)

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

Course pre-requisites	PC-BTC404

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. N	*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	PC-BTC406

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 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

Internal Evaluation

Internal evaluation 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 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