B. Tech 3rdSem Civil Engineering **Contact Hours: 24**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18301	Engineering Mechanics	3	1	0	40	60	100	4
BTCE-18302	Introduction to Fluid Mechanics	3	1	0	40	60	100	4
BTCE-18303	Introduction to Civil Engineering	3	0	0	40	60	100	3
BTCE-18304	Building Materials and Construction	3	0	0	40	60	100	3
BTCE-18305	Engineering Geology	3	0	0	40	60	100	3
BTCE-18306	Surveying and Geomatics	4	1	0	40	60	100	5
BTCE-18307	Surveying and Geomatics Lab	0	0	2	30	20	50	1
BTCE-18308	Summer internship institutional training*				60	40	100	1
		19	**03**	**02**	**330**	**420**	**750**	**24**

***The marks will be awarded on the basis of 04 weeks Institutional Practical Training conducted after 2ndSemester**

B. Tech 4th Semester Civil Engineering **Contact Hours: 23**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18401	Solid Mechanics	3	1	0	40	60	100	4
BTCE-18402	Hydraulic Engineering	4	1	0	40	60	100	5
BTCE-18403	Energy Science and Engineering	3	0	0	40	60	100	3
BTCE-18404	Numerical Methods in Civil Engineering	3	1	0	40	60	100	4
BTCE-18405	Construction Machinery and Works Management	3	0	0	40	60	100	3
BTCE-18406	Solid Mechanics Lab	0	0	2	30	20	50	1
BTCE-18407	Hydraulic Engineering Lab	0	0	2	30	20	50	1
CEMC-I#	Management –I (Organizational Behaviour)	0	0	0	-	-	-	0
		16	**03**	**4**	**260**	**340**	**600**	**21**

#Students will give presentations on the subject

B. Tech 5th Sem Civil Engineering **Contact Hours: 23**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18501	Civil Engineering Societal and Global Impact	2	0	0	40	60	100	2
BTCE-18502	Irrigation Engineering-I	3	0	0	40	60	100	3
BTCE-18503	Structural Analysis-I	3	1	0	40	60	100	4
BTCE-18504	Environmental Engineering	3	0	0	40	60	100	3
BTCE-18505	Design of Concrete Structure-I	3	1	0	40	60	100	4
BTCE-18506	Disaster Management	3	0	0	40	60	100	3
BTCE-18507	Concrete Technology Lab	0	0	2	30	20	50	1
BTCE-18508	Structural Engineering Lab	0	0	2	30	20	50	1
BTCE-18509	Project-I (Survey Camp)	-	-	-	60	40	100	1
CEMC–II[#]	Essence of Indian Traditional Knowledge	-	-	-	-	-	-	-
		17	**02**	**04**	**360**	**440**	**800**	**22**

[#]Students will give presentations on the subject

***The marks will be awarded on the basis of 04 weeks Survey Camp conducted after 4th Semester**

B. Tech 6th Sem Civil Engineering **Contact Hours: 26**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18601	Geotechnical Engineering	3	1	0	40	60	100	4
BTCE-18XXX	Departmental Elective-I	3	1	0	40	60	100	4
BTCE-18XXX	Departmental Elective-II	3	1	0	40	60	100	4
BTCE-18XXX	Departmental Elective-III	3	0	0	40	60	100	3
BTCE-18XXX	Departmental Elective-IV	3	1	0	40	60	100	4
BTXX-18XXX	Open Elective-I (Humanities)	3	0	0	40	60	100	3
BTCE-18602	Computer-aided Civil Engineering Drawing	0	0	2	30	20	50	1
BTCE-18603	Geotechnical Engineering Lab	0	0	2	30	20	50	1
		18	**04**	**04**	**300**	**400**	**700**	**24**

B. Tech 7th Sem Civil Engineering **Contact Hours: 21**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18XXX	Departmental Elective V	3	1	0	40	60	100	4
BTCE-18XXX	Departmental Elective-VI	3	0	0	40	60	100	3
BTXX-18XXX	Open Elective-II	3	0	0	40	60	100	3
BTCE-18701	Transportation Engineering	3	0	0	30	20	50	3
BTCE-18702	Transportation Engineering Lab	0	0	2	30	20	50	1
BTCE-18703	Computer-aided Civil Engineering Design	0	0	2	30	20	50	1
BTCE-18704	Project- (Minor Project)	0	0	4	50	50	100	2
BTCE-18705	Summer internship*	-	-	-	60	40	100	1
		12	**01**	**08**	**320**	**330**	**650**	**18**

***The marks will be awarded on the basis of 06 weeks Industrial / Institutional l Training conducted after 6th Semester**

B. Tech 8th Sem Civil Engineering **Contact Hours: 18**

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-18XXX	Departmental Elective VII	3	0	0	40	60	100	3
BTCE-18XXX	Departmental Elective VIII	3	0	0	40	60	100	3
BTXX-18XXX	Open Elective-III	3	0	0	40	60	100	3
BTCE-18801	Professional Practice	3	0	0	40	60	100	3
BTCE-18802	Project- (Major Project)	0	0	06	100	50	150	3
		12	**00**	**06**	**260**	**290**	**550**	**15**

Departmental Elective I	Departmental Elective II
BTCE-18901 Structural Analysis-II	BTCE-18905 Design of Concrete Structures-II
BTCE-18902 Advanced Structural Analysis	BTCE-18906 Concrete Technology
BTCE-18903 Design of Structural Systems	BTCE-18907 Reinforced Concrete

Departmental Elective III	Departmental Elective IV
BTCE-18910 Physio-Chemical Processes For Water and Waste Water Treatment	BTCE-18915 Irrigation Engineering II
BTCE-18911 Ecological Engineering	BTCE-18916 Water Quality Engineering
BTCE-18912 Environmental Systems	BTCE-18917 Environmental Fluid Mechanics

Departmental Elective V	Departmental Elective VI
BTCE-18920 Design of Steel Structure	BTCE-18925 Offshore Engineering
BTCE-18921 Structural Dynamics	BTCE-18926 Foundation Engineering
BTCE-18922 Metal Structure Behaviour	BTCE-18927 Bridge Engineering

Departmental Elective VII	Departmental Elective VIII
BTCE-18930 Railway Engineering	BTCE-18935 Element of Earth Quake Engineering
BTCE-18931 Port and Harbour Engineering	BTCE-18936 Hydrology & Water Resources Engineering
BTCE-18932 Traffic Engineering and Management	BTCE-18937 Geographic Information Systems and Sciences

Open Elective II	Open Elective III
BTCE-18951 Metro Systems and Engineering	BTCE-18955 Urban Hydrology and Hydraulics
BTCE-18952 Public Transportation Systems	BTCE-18956 Water Quality Engineering
BTCE-18953 Intelligent Transportation Systems	BTCE-18957 Water Resources Field Methods

BTCE-18301 Engineering Mechanics

L T P
3 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.

1. Introduction to Engineering Mechanics Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. **(4)**

2. Friction Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. **(3)**

3. Basic Structural Analysis Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines; **(3)**

4. Centroid and Centre of Gravity Centroid of simple figures from first Principle, centroid of composite sections; Centre of Gravity and its implications; Area Moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite Sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. **(5)**

5. Virtual Work and Energy Method- Virtual displacements, principle of virtual Work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, Systems with friction, mechanical efficiency. Conservative forces and potential energy (Elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. **(5)**

6. Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (Rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained Motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, Power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). **(5)**

7. Introduction to Kinetics of Rigid Bodies Basic terms, general principles In dynamics; Types of motion, Instantaneous Centre of rotation in plane motion and simple Problems; D Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of Rigid body rotation. **(5)**

Course Outcomes:

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
3. Apply basic knowledge of maths and physics to solve real-world problems
4. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
5. Understand basic dynamics concepts – force, momentum, work and energy;
6. Understand and be able to apply Newton's laws of motion;
7. Understand and be able to apply other basic dynamics concepts - the Work-Energy
8. Principle, Impulse-Momentum principle and the coefficient of restitution

Text/Reference Books:

1. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
2. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
3. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
4. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
5. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
6. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

BTCE-18302 Introduction to Fluid Mechanics

L T P
3 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: This course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid Statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic Forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems.

1. Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility. **(5)**

2. Fluid Statics - Fluid Pressure: Pressure at a point, Pascal's law, and pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies. **(8)**

3. Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates **(8)**

4. Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number. **(9)**

Course Outcomes:

1. Understand the broad principles of fluid statics, kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Be able to apply the continuity, momentum and energy principles
5. Be able to apply dimensional analysis

Text/Reference Books:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli,

Oxford University Press, 2010

2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
4. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
5. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

BTCE-18303 Introduction to Civil Engineering

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering. To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness. To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

1. Basic Understanding: What are Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career. **(2)**

2. History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers **(2)**

3. Overview of National Planning for Construction and Infrastructure Development; Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works; **(1)**

4. Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities. **(2)**

5. Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes. **(2)**

6. Basics of Construction Management & Contracts Management: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management **(3)**

7. Environmental Engineering & Sustainability: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction; **(2)**

8. Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunneling. **(3)**

9. Hydraulics, Hydrology &Water Resources Engineering: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects**.** **(3)**

12. Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies. **(3)**

13. Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; **(3)**

14. Traffic &Transportation Engineering: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples. **(3)**

Course Outcomes:

1. Introduction to what constitutes Civil Engineering
2. Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering.
3. Exploration of the various possibilities of a career in this field
4. Providing inspiration for doing creative and innovative work
5. Infrastructure, and impressive projects to serve as sources of inspiration
6. Highlighting possibilities for taking up entrepreneurial activities in this field
7. Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering

Text/Reference Books:

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract
2. The National Building Code, BIS, (2017)
3. RERA Act, (2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration

BTCE-18304 Building Materials and Construction

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: To give an understanding to the students of the vast breadth and numerous available building materials used for different types of constructions and their characterization.

1. Building Stones & Bricks: Characteristics of a good building stone, Deterioration and preservation of stones, Artificial stones, Composition of good brick earth, Qualities of good bricks, Classification of bricks, Tests on bricks, Varieties of fire bricks. **(3)**

2. Cement: Types, uses and composition of cement, raw materials, manufacturing process, varieties and properties of cement, hydration of cement, testing of cement. **(2)**

3. Concrete: Introduction, constituents of concrete, batching of materials, manufacturing process of cement concrete, workability and factors affecting it, use of different waste materials in concrete, methods to determine workability, segregation and bleeding of concrete, strength of concrete and factors affecting it. **(4)**

4. Timber: Structure of a tree, classification of trees, qualities of good timber, defects in timber, seasoning of timber, decay of timber, preservation of timber. **(3)**

5. Foundation and Walls: Definition, types of foundation, causes of failures of foundation and remedial measures, types of wall and thickness considerations. **(3)**

6. Brick and Stone Masonry: Types of bond & their merits and demerits. Rubble and ashlar joints in stone masonry. Cement concrete hollow blocks and their advantages and disadvantage. **(3)**

7. Damp Proofing: Causes of dampness, preventive measures for dampness in buildings. **(2)**

8. Roofs: Classification of roofs and roof trusses, members of roof trusses different roof covering materials. **(2)**

9. Plastering and Pointing: Advantages of plastering and pointing, methods of plastering, materials and types, defects in plastering, different types of finishing plastered surface. **(3)**

10. Floors: Types of floors used in building & and their suitability, factors for selecting suitable floor for building. **(3)**

11. Miscellaneous Topics: Paints, Bitumen, Glass, Building services – Plumbing, Electrical, Air conditioning, Acoustics & sound insulation, Fire protection measures**.** **(3)**

Course Outcomes:

After completing this course, the student must demonstrate the knowledge and ability to:

1. Identify and characterize building materials
2. Understand the manufacturing process of bricks, cement and concrete.
3. Select the appropriate methods for preservation of timber and metals.
4. Evaluate the quality of building material through visual inspection or by laboratory testing.
5. Apply the knowledge to select suitable construction techniques for different building components.
6. Use the suitable techniques of damp proofing and fire resistance.

Text/Reference Books:

1. Rangwala – Building materials.
2. Bindra SP, Arora KR Building construction.
3. Shetty MS, Concrete Technology.
4. Punmia BC, Building construction.
5. Singh, Parbin, Building materials.
6. Sushil Kumar, Building Construction.

BTCE-18305 Engineering Geology

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: This Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

1: Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. **(1)**

2: Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. **(6)**

3: Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits**.** **(4)**

4: Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures. **(5)**

5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock

bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. **(3)**

6: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design.Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging Rock Quality Designation. Rock mass description. **(4)**

7: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures. **(4)**

8: Rock Mechanics- Sub surface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, bearing capacity of rocks. **(3)**

Course Outcomes:

1. Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice
2. The fundamentals of the engineering properties of Earth materials and fluids.
3. Rock mass characterization and the mechanics of planar rockslides and topples.
4. Soil characterization and the Unified Soil Classification System.
5. The mechanics of soils and fluids and their influence on settlement, liquefaction, and soil slope stability.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

BTCE-18306 Surveying and Geomatics

L T P
4 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:
With the successful completion of the course, the student should have the capability to:
a) Describe the function of surveying in civil engineering construction,
b) Work with survey observations, and perform calculations,
c) 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 levelling, and angular measurements.
d) 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.

1: Introduction to Surveying : Principles of surveying, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; Contouring Characteristics, methods and uses; areas and volumes. **(8)**

2: Theodolite Surveying: Introduction to triangulation**,** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods - triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric levelling. **(7)**

3: Curves Elements of simple and compound curves – Introduction of different types of curves, elements of curves, Method of setting out–Reverse curve, Transition curve, circular curve and vertical curves. **(7)**

4: **Modern Field Survey System:** 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. **(6)**

5: Photogrammetry Surveying : Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes. **(7)**

6: **Remote Sensing:** Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing. **(5)**

Course Outcomes:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
2. Translate the knowledge gained for the implementation of Civil infrastructure facilities
3. Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.

Text/Reference Books:

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

BTCE-18307 Surveying and Geomatics Lab

L T P
0 0 2

Internal Marks: 40
External Marks: 60
Total Marks: 100

List of Experiments:

1. Measurement of distance, ranging a line.
2. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
3. Different methods of leveling, height of instrument, rise & fall methods.
4. Measurement of horizontal and vertical angle by theodolite.
5. Determination of tachometric constants and determination of reduced levels by tachometric observations.
6. Plane table survey, different methods of plotting, two point & three point problem.
7. Determination of height of an inaccessible object.
8. Setting out a transition curve. Setting out of circular curves in the field using different methods.
9. Preapartion of Map using above methods and Total station.

BTCE-18308 Institutional (Workshop) Training

Institutional Training (Carpentry shop, Welding Shop, Fitting shop, Electrical Shop and Auto CAD Lab) will be imparted in the Institution at the end of 2nd semester for four (04) weeks duration (36 hours per week). Site visit will also form part of this training.

BTCE-18401 Solid Mechanics

L T P
3 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: This Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials.

1: Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law– stress strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications. **(4)**

2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain.Relationship between elastic constants. **(3)**

3: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments. **(5)**

4: **Flexural Stresses-**Theory of simple bending – Assumptions – Derivation ofbending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses –Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. **(4)**

5: Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections. **(3)**

6: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method.Use of these methods to calculate slope and deflection for determinant beams. **(4)**

7: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular

shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs. **(5)**

8: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures. **(3)**

Course Outcomes:

1. Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components;
2. Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods;
3. Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams; and Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading;
4. Apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members.

Text/Reference Books:

1. D.S. Bedi, Strength of Materials, Khanna Book Publishing Company.
2. E.P. Popov, Mechanics of Materials-(SI Version), Prentice Hall India.
3. R.S Lehri and A.S. Lehri, Strength of Materials, Kataria and Sons.
4. S.S.Rattan, Strength of Materials, Tata McGraw Hill.
5. Timoshenko and Young, Elements of Strength of Materials, East West Press (EWP).
6. James M Gere and Barry J. Goodno, Strength of Materials, Cengage Learning.
7. James M Gere, Mechanics of Materials, Thomson Brooks/Cole/Pearson, 2006.
8. R.C. Hibbeler, Mechanics of Materials, 6^{th} Edition, Pearson Education, 2007.

BTCE-18402 Hydraulic Engineering

L T P
4 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

1:Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. **(3)**

2:Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. **(4)**

3:**Boundary Layer Analysis**-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control. **(3)**

4:Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem. **(4)**

5: Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section**.** **(3)**

6:Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel. Computation of Uniform flow, Normal depth. **(4)**

7 :Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. **(9)**

8:Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow- Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation. **(5)**

9: Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three-reservoir problem. **(5)**

Course Outcomes:

1. Apply their knowledge of fluid mechanics in addressing problems in open channels.
2. Will possess the skills to solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
3. Will have knowledge in hydraulic machineries (pumps and turbines).

Text/Reference Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.
4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
5. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.

BTCE-18403 Energy Sciences and Engineering

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: This Course is to introduce energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.

1: Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. **(5)**

2: Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries). **(7)**

3: Energy & Environment: Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy. (6)

4: Civil Engineering Projects connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems**.** **(7)**

5: **Engineering for Energy conservation:** Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption. **(7)**

Course Outcomes:

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

Text/Reference Books:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
7. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
8. Related papers published in international journals

BTCE-18404 Numerical Methods in Civil Engineering

L T P
3 1 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: After completing this course the student must demonstrate the knowledge and ability to: 1. Demonstrate the concept of approximations and errors in the implementation and development of numerical methods. 2. Select an appropriate solution to an engineering problems dealing with the roots of equations through numerical methods. 3. Execute the solution using of problems involving linear algebraic equations and appreciate the application of these problems in fields of engineering.

1: Numerical Methods – 1 Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. **(15)**

2: Numerical Methods – 2 Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two-dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation. **(15)**

Course Outcomes:

1. Apply the techniques to fit curves to data and be capable of choosing the preferred method for any particular problem.
2. Evaluate the solution of the problems through the numerical integration and differentiation and solve ordinary and partial differential equations and Eigen value problems through various techniques.
3. Able to use various Numeric Method for civil engineering problems.

Textbooks/References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,

2006.

4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.

BTCE-18405 Construction Machinery and Works Management

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:

With the successful completion of the course, the student should have the capability to Understand the concept, and need of project planning and the related concepts, Utilize various management tools and techniques, such as PERT, CPM, etc. in the project planning.

1. Introduction: Need for project planning & management, time, activity & event, bar chart, Milestone chart, uses & drawbacks. **(4)**

2.PERT: Construction of PERT network, time estimates, network analysis, forward pass & backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems, probability of achieving scheduled project. **(10)**

3. CPM: Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance in project control, numerical problems. **(6)**

4. Cost Analysis and Contract: Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems, updating a project, when to update, time grid diagram, resource scheduling, planning of different components of civil engineering projects such as a house, workshop, dam, tunnel. **(8)**

5. Construction Equipment and Machinery: Dragline, Hoes. Line diagram of each, sizes, output, uses, factors affecting selection of each equipment, economic life of equipment, maintenance and repair cost, Hoisting &Transporting Equipments- Hoists, Winches, Cranes, Belt conveyors, Ropeways, trucks & Wagons, Construction Equipments, concrete pumps, Working flow diagram of RMC Plant, Bituminous Plant , Paver Plant. **(6)**

6. Software: Introduction of relevant software. **(2)**

Course Outcomes:

1. Develop a network and perform time estimates to find the critical path.
2. Assess the minimum total cost and do the project scheduling.

3. Perform cost analysis for a given activity and formulate a project contract.
4. Select appropriate construction equipment and machinery for a given construction activity.

Suggested Books:

1. Construction Planning and Equipment - R.L.Peurifoy - Tata McGraw Hill, New Delhi
2. PERT and CPM - L.S.Srinath, East West Press
3. Management Guide to PERT & CPM - Wiest & levy; Prentice Hall
4. Construction Equipment & Planning and Application. - Mahesh Verma Artec Publication.
5. Construction Planning and Management by U. K. Shrivastava; Galgotia Publications Pvt. Ltd.

BTCE-18406 Solid Mechanics Lab

L T P
0 0 2

Internal Marks: 40
External Marks: 60
Total Marks: 100

List of Experiments:

1. To draw Stress Strain curve for Ductile and Brittle material in tension.
2. To draw Stress Strain curve for Ductile and Brittle material in compression.
3. To draw shear stress, shear strain curve for ductile and brittle material in torsion strength testing
4. To draw load deflection curve for spring in loading and unloading conditions.
5. To determine the hardness of the given material by Rockwell and Brinell hardness testing machine.
6. To determine the fatigue strength of the material.
7. To determine the impact strength by Izod and Charpy test.
8. To determine the load carrying capacity of the leaf spring.
9. To test a mild steel and cast iron specimen in double shear.

BTCE-18407 Hydraulic Engineering Lab

L T P
0 0 2

Internal Marks: 40
External Marks: 60
Total Marks: 100

List of Experiments:

1. To determine the meta-centric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturimeter/orifice meter).
4. To determine the discharge coefficient for a Vee notch or rectangular notch.
5. To determine the coefficient of discharge for Broad crested weir.
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficient for pipes of different diameter.
8. To determine the head loss in a pipe line due to sudden expansion / sudden contraction/ bend.
9. To determine the velocity distribution for pipeline flow with a pitot static probe.

BTCE-18501 Civil Engineering Societal and Global Impact

Internal Marks: 40	**L T P**
External Marks: 60	**2 0 0**
Total Marks: 100	

Course Objectives: The course is designed to provide a better understanding of the impact, which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realize the impact that this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.

1. Introduction to Course and Overview: Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis. **(5)**

2. Understanding the importance of Civil Engineering in Shaping and Impacting the World: The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering. **(3)**

3. Infrastructure : Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability. **(4)**

4. Environment-Traditional & Futuristic Methods: Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability. **(4)**

5. Built Environment: Facilities management, Introduction to Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Introduction to Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs &

Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability. **(4)**

Course Outcomes:

1. Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels.
2. Awareness of the impact of Civil Engineering for the various specific fields of human endeavor.
3. Need to think innovatively to ensure Sustainability.
4. The Built Environment and factors influencing the Quality of Life.
5. The precautions to be taken to ensure that the above-mentioned impacts are not adverse but beneficial.
6. Applying professional and responsible judgement and take a leadership role.

Text/Reference Books:

1. Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
2. Charles J A. (2009) Robert Rawlinson and the UK public health revolution. Proc ICE Eng History and Heritage. 162 Nov. Issue EH4. p 199-206
3. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014

BTCE-18502 Irrigation Engineering–I

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Course Objectives: At the end of this course, the student should be able to know the basic concept of Irrigation & its use in crop production with the help of canal network system. The student should know the basics concept of controlled structures along with its components associated with them.

1. Introduction: Importance of Irrigation engineering, purposes of irrigation, objectives of irrigation, benefits of irrigation, advantages of various techniques of irrigation-- Furrow Irrigation, Boarder strip Irrigation, basin irrigation, sprinkler irrigation, drip irrigation. **(3)**

2. Methods of Irrigation: Advantages and disadvantages of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta, Duty of water, Base Period, relation between delta, duty and base period, Soil crop relation-ship and soil fertility. **(3)**

3. Canal Irrigation: Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories. **(5)**

4. Lined Canals: Types of lining, selection of type of lining, economics of lining, maintenance of lined canals, silt removal, strengthening of channel banks, measurement of discharge in channels, design of lined canals, methods of providing drainage behind lining. **(3)**

5. Losses in Canals, Water Logging and Drainage: Losses in canals-evaporation and seepage, water logging, causes and ill effects of water logging anti water logging measures. Drainage of land, classification of drains - surface and subsurface drains Design considerations for surface drains, advantages and maintenance of tile drains. **(4)**

6. Investigation and Preparation of Irrigation Projects: Classification of project, project preparation-investigations, design of works and drawings, concept of multi - purpose projects, major, medium and miner projects, planning of an irrigation project, economics & financing of irrigation works. Documentation of project report. **(4)**

7. Tube Well Irrigation: Types of tube wells - strainer type, cavity type and slotted type. Type of strainers, aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage. Yield or discharge of a tube well, assumptions, Theim's & Dupuit’s formulae, limitations of Theim's and Dupuit's formulae. Interference of tube wells with canal or adjoining tube-wells, causes of failure of tube wells, optimum capacity, duty and delta of a tube well. Rehabilitation of tube well. **(4)**

8. River Training Works: Objectives, classification of river-training works, Design of guide banks. Groynes or spurs - their design and classification ISI. Recommendations of approach

embankments and afflux embankments, pitched islands, natural cut-offs and artificial cut-offs and design considerations. **(4)**

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Identify the basic understanding of soil water plant relationship. 2. Understand different irrigation techniques and the related theories. 3. Apply different theories/methods to design lined and unlined canals. 4. Estimate the yield of tube-well using different formulae. 5. Design different hydraulic structures required for effective river training works. 6. Demonstrate the knowledge related to the water logging, losses, economics of lining, etc.

Text/Reference Books:

1. Principles & practice of Irrigation Engineering S.K.Sharma, S. Chand, Limited.
2. Irrigation & Water Power Engineering B.C. Punmia, Pande B.B.Lal, Laxmi Publications (P) Ltd
3. Fundamentals of Irrigation Engineering Dr. Bharat Singh, Nem Chand & Bros
4. Irrigation Engineering & Hydraulic Structure S.R.Sahasrabudhe, S. K. Kataria & Sons
5. Irrigation Engineering & Hydraulic Structure Varshney, Gupta & Gupta, Nem Chand and Brothers
6. Irrigation Engineering & Hydraulic Structure Santosh Kumar Garg, Khanna Publishers

BTCE-18503 Structural Analysis- I

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course Objectives: To understand the structural behavior before and after application of loads. **2.** To be able to analyze various structure analysis.

1. Displacements: Concept; Governing differential equation for deflection of straight beams; Following methods for determination of structural displacements:

I. Geometric Methods: Double integration; Macaulay's method; Moment area method; Conjugate beam method.

II. Energy Methods: Strain energy in members, , Betti's and Maxwell's Laws of reciprocal deflections, Concept of Virtual work and its applications, Castigliano's theorems, unit load method, deflections of trusses and 2D-frames. **(8)**

2. Determinate Structures : Concept of determinacy; analysis of determinate structural elements—truss, arch, beam, frame, cables; internal forces in determinate structures; determinate reaction diagram-- bending moment, shear force, radial shear, normal thrust diagrams for the determinate structures.

I. Analysis of plane trusses, compound and complex trusses using method of joints, method of sections, tension coefficients.

II. Analysis of three-hinged arch of various shapes under different loading conditions.

III. Analysis of simple portal frame, cables under different loading conditions. **(7)**

3. Moving Loads and Influence Line Diagrams: Concept of influence line diagram, rolling loads; bending moment and shear force diagrams due to single and multiple concentrated rolling loads, uniformly distributed moving loads; equivalent UDL; Muller Breslau principle; influence lines for different structural parameters in beams; calculation of the maximum and absolute maximum shear force and bending moment; concept of envelopes; influence line for displacements; influence line for bar force in trusses. **(7)**

4. Analysis of Cables and Suspension Bridges: General cable theorem, analysis of cables supported at same or different levels, shape, elastic stretch of cable, maximum tension in cable and back-stays, pressure on supporting towers, suspension bridges, three hinged stiffening girders. **(4)**

5. Analysis of Dams, Chimneys and Retaining Walls: Introduction, loadings for the dams, chimneys, and retaining walls; limit of eccentricity for no-tension criteria; concept of core; middle-third rule; maximum/minimum base pressures. **(4)**

Course Outcomes:

After completing this course, the student must demonstrate the knowledge and ability to:

1. Understand the concept of structural systems, loads, supports and displacements
2. Analyze different types of statically determinate structures including cables, beams, arches, frames and trusses.
3. Identify and apply a suitable analysis technique for statically determinate structures.
4. Assess the effect of rolling loads, support displacements and temperatures on response of statically determinate structures.
5. Develop and use the concept of influence line diagram for calculating maximum values of different structural quantities in a statically determinate structure, like BM, SF and displacement.
6. Evaluate the forces acting over dams, chimneys and retaining walls.

Text/Reference Books:

1. Basic structural Analysis C.S.Reddy; Tata McGraw-Hill Education
2. Analysis of Structures Vol- I and Vol.-II Vazirani & Ratwani; Khanna Publishers
3. Intermediate structural Analysis C.K.Wang; McGraw-Hill
4. Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee.
5. Theory of Structures, Vol. I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

BTCE-18504 Environmental Engineering

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Course Objectives: To understand the various aspects of environment engineering like water, air, solid waste management and building plumbing.

1. Water: Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes **(6)**

2. Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans. Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes. **(6)**

3. Air: Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations **(6)**

4. Noise: Basic concept, measurement and various control methods. **(2)**

5. Solid Waste Management: Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods-Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities. **(6)**

6. Building Plumbing: Introduction to various types of home plumbing systems forwater supply and waste water disposal, high rise building plumbing, Pressure reducing valves,

Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used. (**4)**

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Identify different types of water demands and select suitable source of water. 2. Predict future population and estimate future water demands 3. Demonstrate a firm understanding of various water quality parameters. 4. Design different water treatment units to meet the drinking water quality standards and criteria. 5. Plan and design the water transportation, pumping stations and pipe network 6. Design low cost water treatment techniques in the rural areas.

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.
3. Introduction to Environmental Engineering by P. AarneVesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.

BTCE-18505 Design of Concrete Structures-I

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Note: Relevant Indian Code of Practices is permitted in Examination.

Course Objectives: To be aware of various reinforced techniques to develop and designing of concrete structures.

Part A: Concrete Technology

1. Concretes & Admixtures: Various ingredients of concrete and their properties. Various types of admixtures and their uses. **(4)**

2. Properties of Concrete: Different properties of fresh and hardened concrete and their testing procedure. **(4)**

3. Mix Design: Concrete mix design as per IS method. Factors affecting strength and durability of concrete and acceptance criteria. **(4)**

Part B: Design of Reinforced Concrete Elements

4. Concept and Methods of Structural Design: Objectives, Properties of Concrete and Steel, Stress- Strain behavior of Steel and Concrete. **(3)**

5. Design Philosophies: Working Stress Method, Limit State Method. **(3)**

6. Design of Beams: Analysis & design of simply supported beams (Rectangular and Flanged Sections) using limit state method. Analysis & Design for Shear, Bond, Anchorage, Development Length and Torsion **(6)**

7. Design of Slabs: Analysis & Design of One and Two way Slabs using limit state method, Stairs**.** **(4)**

8. Design of Foundation: Isolated Footing (Square and Rectangular) **(4)**

Course Outcomes:

1. Identify the quality control tests on concrete making materials.
2. Understand the behavior and the durability aspects of the concrete under different loading and exposure conditions.
3. Design the concrete mixes as per various mix techniques.
4. Apply the stress-strain response of steel and concrete in the design of various RC elements.
5. Compare the fundamental concepts of different design philosophies available for RC elements.

6. Execute the solution using a logic and structured approach based on Limit State Method and IS code provisions for various RC elements, such as beams, slabs and stairs.

Text/Reference Books:

1. Properties of Concrete by A.M.Neville – Prentice Hall
2. Concrete Technology by M.S.Shetty. – S.Chand & Co.;
3. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
4. Concrete Technology by A.R. Santha Kumar, Oxford university Press, New Delhi
5. Advanced Design of Structures N. Krishna Raju
6. Advanced RCC Design Pillai & Mennon ; Tata MacGraw Hill
7. Limit State Design Ramachandra
8. Limit State Design A.K. Jain
9. Limit State Design of Reinforced Concrete P.C. Vergese

BTCE-18506 Disaster Management

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: This course is to introduce the knowledge about disaster Management useful in Civil Engineering applications. The course provides a first level exposure to the students to RSS and GIS in disaster management.

1. Introduction to Disaster Management: Define and describe disaster, hazard, emergency, vulnerability, risk and disaster management; Identify and describe the types of natural and non-natural disasters. Important phases of Disaster Management Cycle. **(4)**

2. Disasters classification: Natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility. **(5)**

3. Emergency Management Systems (EMS): Emergency medical and essential public health services, response and recovery operations, reconstruction and rehabilitation. **(4)**

4. Disaster Risk Reduction (DRR): Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programs in India and the activities of National Disaster Management Authority. **(5)**

5. Application of Geo-informatics and Advanced Techniques: Use of Remote Sensing Systems (RSS) and GIS in disaster Management, role of knowledge based expert systems in hazard scenario, using risks-time charts to plan for the future, early warning systems. **(4)**

6. Integration of public policy: Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management. **(4)**

7. Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods. **(4)**

Course Outcomes:

The student will develop competencies in:

1. The application of Disaster Concepts to Management
2. Analyzing Relationship between Development and Disasters.
3. Ability to understand categories of disasters and realization of the responsibilities to society.

Text/References Books:

1. Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill.Pub
2. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester
3. Disaster Management, R.B. Singh (Ed), Rawat Publications
4. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction.
5. Disaster Management –Future Challenges & Opportunities by Jagbir Singh, I.K. International Publishing House
6. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
7. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication

BTCE-18507 Concrete Technology Lab

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

1. To determine the specific gravity and soundness of cement.
2. To determine the standard consistency, initial and final setting times of cement and compressive strength of cement.
3. To determine the fineness modulus, bulk density, water absorption and specific gravity of fine and coarse aggregates.
4. To determine the slump, compaction factor and Vee-Bee time of concrete.
5. Mix design of concrete by IS methods.
6. To determine the compressive strength of concrete using cube and cylinder.
7. To carry out the split tensile and flexural strength of concrete.
8. Compressive strength of brick and tile as per IS standard.

Books/Manuals

1. Concrete Manual by Dr. M.L. Gambhir, Dhanpat Rai & Sons Delhi.
2. Concrete Lab Manual by TTTI Chandigarh
3. Concrete Technology, Theory and Practice by M.S.Shetty. S.Chand & Company.

BTCE-18508 Structural Engineering Lab

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the flexural rigidity of a given beam.
3. To verify the Moment- area theorem for slope and deflection of a given beam.
4. Deflection of a fixed beam and influence line for reactions.
5. Deflection studies for a continuous beam and influence line for reactions.
6. Study of behavior of columns and struts with different end conditions.
7. Experiment on three-hinged arch.
8. Experiment on two-hinged arch.
9. Deflection of a statically determinate pin jointed truss.
10. Forces in members of redundant frames.
11. Experiment on curved beams.
12. Unsymmetrical bending of a cantilever beam.

Books/Manuals

A Laboratory Manual on Structural Mechanics by Dr. Harvinder Singh, New Academic Publishing Comp. Ltd.

BTCE-18601 Geotechnical Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objective: 1. To provide a coherent development to the students for the courses in sector of Geotechnical Engineering & Soil Improvement Techniques etc. 2. To present the foundations of many basic Engineering tools and concepts related Geotechnical Engineering. 3. To give an experience in the implementation of engineering concepts which are applied in field of Geotechnical Engineering 4. To involve the application of scientific and technical principles of planning, analysis, design of foundation along with soil improvement techniques

1. Introduction:Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weights voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content-specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method. **(5)**

2. Plasticity Characteristics of Soil: Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups. **(4)**

3. Permeability of Soil: Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets. **(4)**

4. Effective Stress Principle: Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition. **(3)**

5. Compaction of Soil: Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control. **(3)**

6. Stresses in Soils: Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, new mark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory. **(3)**

7. Consolidation of Soil : Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation. **(3)**

8. Shear Strength: Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behavior of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. Unconfined compression test, vane shear test. **(3)**

9. Stability of Slopes: Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. **(3)**

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Understand the origin and identification of different soils. 2. Determination of different physical and engineering characteristics of soils. 3. Analyze the slopes for their stability by different methods. 4. Evaluate shear strength and permeability parameters of different soils. 5. Compute consolidation settlements. 6. Apply the principles of compaction to field problems.

Text/Reference Books:

1. Soil Mech. & Foundation Engg, by K.R.Arora Standard Publishers Distributors
2. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy
3. Geotechnical Engineering, by P. Purshotama Raj Tata Mcgraw Hill
4. Soil Mechanics by Craig R.F., Chapman & Hall
5. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons

BTCE-18602 Computer-Aided Civil Engineering Drawing

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

Course Objective: At the end of this course, the student should be able to create the computer aided Civil Engineering Drawing applications, especially in building drawing.

1. Introduction to computer aided drafting
2. Practice exercises on CAD software
3. Structural drawing of plans of buildings using software a) Single storied buildings b) multi storied buildings
4. Developing sections and elevations for structural elements like Beam, Column, Slabs, and Foundation etc.
5. Detailing of building components Roof Trusses.

Course Outcomes

With the knowledge of this subject students shall be able to develop civil engineering drawing with the use of computer.

Text/Reference Books:

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons,

BTCE-18603 Geotechnical Engineering Lab

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

1. Determination of in-situ density by core cutter method and Sand replacement method.
2. Determination of Liquid Limit & Plastic Limit.
3. Determination of specific gravity of soil solids by pyconometer method.
4. Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).
5. Compaction test of soil.
6. Determination of Relative Density of soil.
7. Determination of permeability by Constant Head Method.
8. Determination of permeability by Variable Head method.
9. Unconfined Compression Test for fine-grained soil.
10. Direct Shear Test
11. Tri-axial Test
12. Swell Pressure Test

Books:

1. Soil Testing Engineering, Manual By ShamsherPrakash and P.K. Jain. Nem Chand & Brothers

BTCE-18701 Transportation Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives:

• The course will enable the students to understand the factors influencing road vehicle performance characteristics and design.
• To strength the students' knowledge and technical knowhow to be efficient Transport Engineers by introducing the design of pavement and highway construction.
• To enable the students to understand the basic knowledge of traffic studies and speed studies and to apply the basic science principles in estimating stopping and passing sight distance requirements

Highway Engineering

1. Introduction: Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport. **(3)**

2. Highway Development & Planning: Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys. **(3)**

3. Highway Alignment: Requirements, Alignment of Hill Roads, Engineering Surveys. **(3)**

4. Highway Geometric Design: Cross Section Elements, Carriageway, Camber, Sight Distances, Horizontal Curves, Extra-widening, Super-elevation, Vertical Curves. **(5)**

5. Highway Materials: Properties of Sub-grade and Pavement Component Materials, Tests on Sub-grade Soil, Aggregates and Bituminous Materials. **(4)**

6. Highway Construction: Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements. **(4)**

7. Highway Drainage and Maintenance: Importance of drainage and maintenance, Surface Drainage and Subsoil Drainage, Construction in Water-logged areas, Pavement Failures, Pavement Evaluation, Maintenance and Strengthening Measures. **(4)**

8. Highway Economics & Financing: Total Transportation Cost, Economic Analysis, Sources of Highway Financing. **(3)**

Highway Engineering

9. Traffic Characteristics: Road User Characteristics, Driver Characteristics, Vehicular Characteristics. **(3)**

10. Traffic Studies: Volume Studies, Speed Studies, O-D Survey, Parking Study. **(3)**

11. Traffic Safety and Control Measures: Traffic Signs, Markings, Islands, Signals, Cause and Type of Accidents, Use of Intelligent Transport System. **(4)**

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Appreciate the importance of different modes of transportation and characterize the road transportation. 2. Align and design the geometry of pavement as per Indian Standards according to topography. 3. Assess the properties of highway materials in laboratory. 4. Understand the importance of drainage, construction methods for various roads, pavement failure and its maintenance. 5. Compute the transportation cost of highway project and outline the sources of highway financing. 6. Interpret the traffic data after conducting traffic survey and describe the traffic characteristics, traffic safety and traffic environment interaction.

Books Recommended:

1. Khanna S.K., and Justo, C.E.G. "Highway Engineering", Nem Chand and Brothers, Roorkee, 1998.
2. Kadiyali, L.R. "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 1997.
3. Flaherty, C.A.O. "Highway Engineering", Volume 2, Edward Arnold, London, 1986.
4. Sharma, S.K. "Principles, Practice & Design of Highway Engineering", S. Chand & Company Ltd., New Delhi, 1985.
5. Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, New Delhi.

BTCE-18702 Transportation Engineering Lab

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

Course Objectives: The course will enable the students to introduce; 1. The Bitumen and & its engineering behavior. 2. Aggregate & its engineering behavior. 3. Concept of traffic behavior.

I Tests on Sub-grade Soil
1. California Bearing Ratio Test

II Tests on Road Aggregates
2. Crushing Value Test
3. Los Angles Abrasion Value Test
4. Impact Value Test
5. Shape Test (Flakiness and Elongation Index)

III Tests on Bituminous Materials and Mixes
6. Penetration Test
7. Ductility Test
8. Softening Point Test
9. Flash & Fire Point Test
10. Bitumen Extraction Test

IV Field Tests
11. Roughness Measurements Test by Roughometer
12. Benkelman Beam Pavement Deflection Test

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Characterize the pavement materials as per the Indian Standard guidelines. 2. Evaluate the strength of subgrade soil by CBR test. 3. Conduct experiments to evaluate aggregate properties. 4. Determine properties of bitumen material and mixes 5. Evaluate the pavement condition by rough meter and Benkelman beam test. 6. Create a well-organized report and present the results appropriately

Books/Manuals Recommended:
1. Khanna S.K., and Justo, C.E.G. “Highway Material & Pavement Testing”, Nem Chand and Brothers, Roorkee.

BTCE 18703 Computer-aided Civil Engineering Design

Internal Marks:	**30**	**L T P**
External Marks:	**20**	**0 0 2**
Total Marks:	**50**	

Course Objectives: To impart knowledge to develop interactive software for analyzing the structures. To develop expert systems for applications in civil engineering.

1. Introduction to different Software for Analysis and Design like STAAD PRO, RIVET, MX Road, Arch. GIS etc
2. To analyze the beams with different end conditions using structural software.
3. To analyze & design the 2-D frames with computer aided software.
4. To analyze & design the 3-D structure with computer aided software.
5. To analyze the truss used in industrial structure.
6. To analyze the bridge deck for moving load as per IS guidelines.
7. To develop Road plan and layout.
8. To develop area Map and section.

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Use software applications effectively in the analysis and technical reports writing 2. Produce working structural drawings. 3. Analyze the buildings located in some seismic zone. 4. Design overhead water reservoir. 5. Understand and interpret design aids. 6. Design and draw the building for wind load.

Text/Reference Books:

1. “Principle of Interactive Computer Graphics” by William M. Newman And Robert F. Sproul.
1979
2. “Matrix Analysis of Framed Structures” by William Weaver. 1980
3. “Introduction to Expert Systems” by Jackson, P. 1998
4. “A guide to Expert Systems” Waterman, D.A. 1985

BTCE 18704 Project-(Minor Project)

Internal Marks:	**50**	**L T P**
External Marks:	**50**	**0 0 4**
Total Marks:	**50**	

Course Outcomes: After completing this course, the student must demonstrate the knowledge and ability to: 1. Find relevant sources of information 2. Conduct literature survey 3. Create a well-organized document 4. Acknowledge the work of other in a consistent manner 5. Understanding of ethical and professional issues 6. Demonstrate effective oral communication and present the results appropriately

The students will have to do the literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the Major project in 6^{th} semester. The same project problem is to be extended in the major project in $7^{th}/8^{th}$ semester. A group of students may carry out the minor project. The evaluation of the minor project will be held as per the rubrics. For report writing, the students have to follow the concerned guidelines.

BTCE-18801 PROFESSIONAL PRACTICE

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives:

• To familiarize the students with the various aspects of estimating of quantities for various civil engineering works.

• To provide hand on experience to the students regarding determination of project estimates and costs using various methods.

• To develop the knowledge about the procedure of estimating the material quantities, prepare a bill of quantities, performing rate analysis, making specifications and preparingsimple estimates.

1. Estimate of buildings-Method of building estimates, types, site plan index plan, layout plan, plinth area, floor area, Technical sanction, administrative approval, estimate of buildings, Arch masonry calculations **(6)**

2. **Specifications**- For different classes of building and Civil engineering works. **(3)**

3. Road estimating : Cutting and banking, Calculation of earthwork quantities using various methods, Calculation of quantities using reduced level of ground and formation level for fully or partly in banking and cutting, Estimate of metalled road. **(5)**

4. **Estimate of RCC works** : Various types of cranked bars, Hooks and their lengths, Schedule of bars, How to determine estimate of RCC works, Estimate of RCC beam, Estimate of RCC slab, Estimate of RCC column with footing, Estimate of RCC retaining Wall. **(6)**

5. Schedule of Rates, analysis of rates- For earthwork, concrete work, D.P.C., stone masonry, plastering, pointing, road work. **(4)**

6. Types of contracts- Tenders, tender form, submission and opening of tenders, measurement book, muster roll , piecework agreement and work order. **(3)**

7. Accounts-Division of accounts, cash, receipt of money, cash book, temporary advance, imprest, accounting procedure. **(3)**

8.Valuation : Valuation, Purpose of valuation, Types, Capitalized value, Depreciation, Escalation, Salvage value, Scrap value, Sinking fund, Land valuation, Value of building, Calculation of standard rent, Mortgage & lease **(3)**

Text/Reference Books:

1. Estimating and Costing by B.N. Datta, UBSPD, New Delhi
2. Estimating and Costing by G.S. Birdie, Dhanpat Rai Publication New Delhi .
3. Estimating and Costing by V.N. Chakravorty, Calcutta
4. Civil Engg. Contracts & Estimates by B.S. Patil, Orient-Longman Ltd., New Delhi.

BTCE-18901 Structural Analysis-II

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course objectives:

To impart the principles of elastic structural analysis and behaviour of indeterminate structures.
To impart knowledge about various methods involved in the analysis of indeterminate structures.
To apply these methods for analyzing the indeterminate structures to evaluate the response of structures
To enable the student get a feeling of how real-life structures behave.
To make the student familiar with latest computational techniques and software used for structural analysis.

1. Indeterminate Structures- Concept of indeterminate /redundant structures; Static and kinematic indeterminacies; stability of structures; internal forces; Conditions of stress-strain relationships, equilibrium and compatibility of displacements. **(7)**

2. Indeterminate Structural Systems-Pin-jointed and rigid-jointed structural systems; Deformation of redundant structures-sway and non-sway frames, elastic curve; Static equilibrium and deformation compatibility checks; Effects of support settlement and lack of fit; Fixed-end moments—member loading, sinking of supports, temperature; Analysis of redundant beams, frames, trusses, arches using following methods:

a) Conventional Methods slope deflection method; Moment distribution method; Rotation contribution method (Kani's Method).

b) Classical Methods Methods of consistent deformation; Theorem of three moments.

c) Approximate Methods Portal method; Cantilever method; Substitute frame method. **(15)**

3. Influence Line Diagram Concept and application in the analysis of statically indeterminate structures; Influence line for bar forces in the statically indeterminate trusses, beams and frames. **(8)**

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Distinguish statically determinate and indeterminate structural systems.
2. Analyze the beams and trusses using the Classical Methods of analysis.
3. Compute reactive forces in the beams, pin-jointed and rigid jointed frames using Conventional Methods of analysis.
4. Develop and apply the approximate methods of analysis for framed structures.

5. Predict the structural response under different types of loading, support displacements and temperature changes.
6. Apply the concept of influence lines for deciding the critical forces and sections while designing.

Text/Reference Books:

1. Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Indeterminate structural analysis - J. Sterling Kinney Addison-Wesley Educational Publishers
4. Theory of structures - B.C. Punima, Laxmi Publications

BTCE-18902 Advanced Structural Analysis

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: To impart knowledge on the analysis of indeterminate structures like continuous beams, trusses and portal frames.

1. Introduction to Matrix Methods of Analysis – static indeterminacy and kinematic indeterminacy – degree of freedom – coordinate system – structure idealization stiffness and flexibility matrices – suitability element stiffness equations – elements flexibility equations – mixed force – displacement equations – for truss element, beam element and tensional element. Transformation of coordinates – element stiffness matrix – and load vector – local and global coordinates. (8)

2. Assembly of Stiffness Matrix from Element Stiffness Matrix – direct stiffness method – general procedure – band matrix – semi bandwidth – computer algorithm for assembly by direct stiffness matrix method. (8)

3. Analysis of Plane Truss – Continuous Beam – plane frame and grids by flexibility methods. (8)

4. Analysis of Plane Truss – Continuous Beam – plane frame and grids by stiffness methods. (8)

5. Special Analysis Procedures – static condensation and sub structuring – initial and thermal stresses. Shear walls- Necessity – structural behaviour of large frames with and without shear walls – approximate methods of analysis of shear walls. (8)

Course Outcomes: The learner will be able to analyse different indeterminate structures using Matrix methods.

Text/Reference Books:

1. Matrix Analysis of Frames structures by William Weaver J.R and James M. Gere, CBS publications.Advanced Structural Analysis by Ashok. K. Jain, Nem Chand Brothers.
2. Basic Structural Analysis by C.S. Reddy, Tata Mc-Graw hill
3. Matrix Structural Analysis by Madhu B. Kanchi, John Willey publishers
4. Indeterminate Structural Analysis by K.U. Muthuet al., I.K. International Publishing House Pvt. Ltd.
5. Matrix Methods of Structural Analysis by J.L. Meek, Mc-Graw hill

BTCE-18903 Design of Structural Systems

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objective: This course is aimed aims at providing students with a solid background on principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed.

Topics of Study

1. Planning and Design Process **(4)**
2. Materials and Structural Design Criteria **(4)**
3. Loads and Design Safety **(3)**
4. Design of Structural Elements **(6)**
- Concrete Elements
- Steel Elements
- Structural Joints

5. Approximate Analysis Methods as a Basis for Design **(4)**
6. System Design Concepts **(3)**
7. Special Topics that may be Covered as Part of the Design Project Discussions **(6)**
- Cable Structures
- Pre-stressed Concrete Bridges
- Constructability and Structural Control
- Fire Protection

Text/Reference Books:

1. Nilson, A. H. *Design of Concrete Structures.* 13th edition. McGraw Hill, 2004.
2. McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J., 2003.

BTCE 18905 Design of Concrete Structures II

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: At the end of this course, the student should be able to impart understanding of designing specialized RCC structures. To prepare the detailed structural drawings for execution purpose

1. Design of foundations Design of combined trapezoidal and strap beam footings, design of raft foundations, pile foundations and pile caps. **(6)**

2. Retaining walls Components of counterfort retaining wall, stability criteria, complete design and detailing of counterfort retaining walls. **(6)**

3. Building frames Design loads on building frames including wind and earthquake loads, Earthquake resistant design using software, Introduction to IS: 13920 and concepts of ductile detailing in building frames. **(6)**

4. Beams curved in plane Design of circular beams supported on symmetrically placed columns, semicircular beams supported on equally spaced columns. **(4)**

5. Domes Types of domes, analysis and design of RCC spherical and conical domes, openings in domes. **(4)**

6. Liquid retaining structures Design concepts of liquid retaining structures, Design of tanks resting on ground, underground tanks and overhead service reservoirs, staging and foundation design. **(4)**

Course Outcomes:

By the end of this course the student will be able to:

1. Design advanced RCC structures.
2. Prepare detailed structural drawings for the designed RCC structures using software

Text/Reference Books

1). “Advanced Reinforced Concrete Design”, P.C. Varghese, Prentice Hall of India Pvt. Ltd.
2). “Plain & Reinforced Concrete”, Jain & Jai Krishan (Vol. I & Vol-II), Nem Chand and Bros.
3). “Reinforced Concrete Structures”, Syal and Goel, S. Chand & Company Pvt. Ltd.
4). “Reinforced Concrete Design”, S.U. Pillai & Devdas Menon, Tata McGraw Hill.
5). “Reinforced Concrete Limit State Design"' A.K.Jain, Nem Chand and Bros.

BTCE 18906: Concrete Technology

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: At the end of this course, the student should be able to learn the rheology, strength and durability characteristics of concrete and to design different types of concretes.

1. Structure of concrete Material properties, Workability of fresh concrete, rheology of concrete, parameters affecting strength of hardened concrete. Elasticity, shrinkage and creep of concrete **(4)**

2. Durability of hardened concrete permeability of concrete, effect of carbonation, acid attack on concrete, chloride and sulfate attack on concrete, efflorescence, abrasion of concrete, alkali-silica reaction, effect of freezing and thawing in concrete. **(4)**

3. Admixtures in concrete Types of chemical admixtures and their uses, Types of mineral admixtures – fly ash, silica fumes, Ground Granulated Blast Furnace Slag etc. and their use in concrete. **(4)**

4. High strength concrete Definition, materials used for HSC, properties of HSC, uses of HSC. **(3)**

5. High performance concrete Definition, materials used for HPC, properties of HPC, uses of HPC **(3)**

6. Self-compacting concrete Definition, materials used for SCC, properties of SCC, various tests of SCC, uses of SCC. **(4)**

7. Fiber reinforced concrete Use of different types of fibers in concrete, properties of FRC, **uses of FRC** **(4)**

8. Polymer concrete Different types of polymer concretes, properties and their uses. **(4)**

Course Outcomes:

By the end of this course, the student will be able to:
1. Identify the behaviour of concrete at different ages.
2. Design different types of concrete mixes.
3. Make use of different materials in concrete for special purposes.
4. Perform experiments for strength and durability characteristics of various types of concretes

Text/Reference Books

1. "Concrete Technology", M.S.Shetty, S. Chand Publications.
2. "High Performance Concrete", E.W.Navy,
3. "Concrete Technology" A.M. Neville, J.J.Brooks, Prentice Hall
4. "Concrete Technology", M. L. Gambhir, Tata McGraw Hill.
5. "Properties of Concrete", A.M. Neville, Prentice Hall

BTCE-18907: Reinforced Concrete

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: At the end of this course, the student should be able to design various RCC structural elements and to perform quality tests on constituent materials of concrete. The student should also be able to work with others in professional settings

1. Properties of Concrete Materials for concrete and their properties, concrete as composite material, properties of concrete in fresh and hardened state, workability, strength and durability, factors affecting workability, strength and durability, Indian Standard method of proportioning concrete mixes. **(4)**

2. Reinforced Concrete Design Loads, design philosophies, Working Stress method, Ultimate load method and limit state method of design, characteristic strength, characteristic load, design values and partial safety factors, stress strain relationship for concrete and steel. **(3)**

3. Design and Detailing of Beams Singly reinforced beams, modes of failure, moment of resistance and design of beams for flexure, analysis and design of doubly reinforced and flanged beams. Shear, bond, torsion. Limit state of serviceability, control of cracking, deflection and vibrations, design of continuous beams by co-efficient method as per IS code. Introduction to design of beams using software **(5)**

4. Design and Detailing of Slabs One way slabs, two-way slabs, continuous slabs. **(3)**

5. Design of Columns Types of columns, short columns, long columns, columns with helical reinforcement. **(3)**

6. Foundations Design concepts of isolated and combined rectangular footings, design of masonry walls and their footings **(3)**

7. Stair Cases Design of different type of stairs. **(3)**

8. Retaining Walls Types of retaining walls, stability criteria, design of cantilever retaining walls **(3)**

9. Pre Stressed Concrete Introduction to pre-stressed concrete, methods of pre-stressing, losses of pre-stress, analysis of simple pre-stressed beams. **(3)**

Course Outcomes:

1. Assess the quality of concrete making materials
2. Conduct quality control tests on concrete
3. Design and test concrete mixes as per relevant standard codes

Text/Reference Books:

1. “Plain & Reinforced Concrete (Vol. I & Vol-II)”, Jain & Jai Krishan, Nemchand and Bros. 2007
2. “Reinforced Concrete Design”, S.U. Pillai & Devdas Menon’ Tata McGraw Hill. Publications.
3. "Reinforced Concrete Limit State Design"' A.K.Jain, Nem Chand and Bros.
4. “Limit State Design of Reinforced Concrete”, Punmia and Jain (Vol.II), Laxmi Publications.
5. “Limit State Design of Reinforced Concrete”, Punmia and Jain (Vol.II), Laxmi Publications.
6. “Prestressed Concrete”, N.Krishna Raju, Tata McGraw Hill
7. “Concrete Technology”, M. L. Gambhir, Tata McGraw Hill.

18910 Physio-Chemical Processes for Water and Waste Water Treatment

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: Gain a fundamental and theoretical understanding of the key and most common physical / chemical unit processes applied in conventional water treatment processes. Learn how to use the theory to calculate and design the specific unit processes presented.

1. Water purification in natural systems, physical processes, chemical processes and biological processes. Primary, secondary and tertiary treatment. **(5)**

2. Unit operations, unit processes Aeration and gas transfer. Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects. **(5)**

3. Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters, mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, pre-coat filtration, design aspects. **(5)**

4. Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal. **(5)**

5. Adsorption: adsorption equilibria and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption. **(5)**

6. Ion Exchange-exchange processes, materials and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultra filtration, Electrodyalisis **(5)**

Course Outcomes:

After learning the course, the students should be able to do:

1. Identify the physical and chemical treatment units.
2. Relate the parameters with types of treatment required and identify the types of treatment required.
3. Evaluate the removal efficiencies of physico-chemical treatment units
4. Select optimized dose of chemical coagulation as well as disinfecting agents
5. Justify the types of disinfection process for treatment of water

Text/Reference Books:

1. Environmental Engineering", Howard S. Peavy, D.R. Rowe, G.Tchobanglous, Mc Graw Hill Book Co., New Delhi
2. Environmental Pollution Control Engineering", C.S. Rao, New Age International Publishers
3. Sewage Disposal and Air Pollution Engg", S.K. Garg, Khanna Publishers
4. Manual on Sewerage and Sewage Treatment", Expert Committee, Ministry of Urban Development, New Delhi

18911 Ecological Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objectives: At the end of this course, the student should be able to know the basic concept of ecology and the different ecosystem and ecosystem control, the different types of wetland and the factors polluting the wetland and treatment of wet lands.

1. Basic Concepts in ecology needed for ecological engineering design: ecosystem services, energy and mass flow though ecosystems, estimation of NPP, Defining biomes, ecoregions and watershed, defining the place: site, soils as living organisms. **(5)**

2. Designing community structure: Types of restoration design, Biotic interactions, regional processes, environmental and habitat impacts **(4)**

3. Ecosystem Control and Feedback systems: Population Control processes, community control processes, Feedback processes, designing ecosystem complexity **(5)**

4. Treatment wetlands: Non-Point Source Management of wastes in Engineered Ecosystems, Fundamentals of non-point source pollution including quantification of environmental impact and ecosystem management related to contaminants and nutrients and to planning and design of ecological systems, Biodiversity and Treatment Wetlands, Wetland creation and restoration, Case studies **(6)**

5. Restoration ecology: Restoration concepts, How to Restore an Ecosystem, Procedures and Policies, Case Studies of lake and river restoration **(5)**

6. Stream Restoration Design: Hydrology, sediment logy, geomorphology, habitat, connectivity, riparian corridor. **(5)**

Course Outcomes:

By the end of this course, the student will be able to:

1. Differentiate between different ecosystems
2. Know the treatment processes of wetlands
3. Know how to restore ecosystem.

Text/Reference Books:

1. Ecological Engineering design Restoring and conserving ecosystem services; Marty D. Matlock, Robert A. Morgan, Wiley, 2011
2. Applications in Ecological Engineering, Sven Erik Jørgensen, Academic Press, 2009
3. Ecological Engineering and Ecosystem Restoration**,** William J. Mitsch, Sven Erik Jørgensen**,** 2003
4. Ecology 2, Paul J Colinvaux, John Wiley, 2003

BTCE-18912 Environmental Systems

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objective: This course aims to introduce the theory and application of physical and chemical processes for the improvement of water quality in engineered water treatment plants and natural aquatic systems. The students will learn to design, engineer and analyze water treatment systems and the energy requirements will be considered.

1. Introduction Beneficial uses of water, water demand, per capita demand, variations in demand, for firefighting, population forecasting and water demand estimation. **(4)**

2. Water sources and development Surface and ground water sources; Selection and development of sources; Assessment of potential; Flow measurement in closed pipes, intakes and transmission systems. **(5)**

3. Pumps and pumping stations Types of pumps and their characteristics and efficiencies; Pump operating curves and selection of pumps; pumping stations. **(5)**

4. Quality and Examination of Water Impurities in water, sampling of water, physical, chemical and bacteriological water quality parameters, drinking water quality standards and criteria. **(5)**

5. Water treatment Water treatment schemes; Basic principles of water treatment; Design of plain sedimentation, coagulation and flocculation, filtration – slow, rapid and pressure; Disinfection units; Fundamentals of water softening, fluoridation and de-fluoridation, and water desalination and demineralization, taste and odour removal. **(6)**

6. Transportation of Water Pipes for transporting water and their design, water distribution systems and appurtenances; Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems. **(5)**

7. Rural water supply Principles, selection of source, rain water harvesting, quantitative requirements, low cost treatment techniques. **(3)**

Course Outcomes:

1. Describe the water quality standards.
2. Design and analyze water treatment reactors.
3. Apply physical processes to improve water quality.
4. Apply chemical processes to improve water quality.

Text/Reference Books:

1. Water Supply Engineering- Environmental Engg. (Vol.–I) by B.C. Punmia, Ashok

Jain, Arun Jain,Laxmi Publications, New Delhi.
2. Environmental Engg. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi.
3. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, mcgraw Hill, International Edition
4. Water Supply Engineering- Environmental Engg. (Vol. – I) by S.K. Garg, Khanna Publishers, Delhi.
5. Water Supply and Sewerage by Steel EW and mcghee, Terence J.; mcgraw Hill.

BTCE-18915 Irrigation Engineering-II

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course objectives: The objective of this course is to introduce the concepts of irrigation engineering in Civil Engineering applications. The course provides a theories of seepage and design of weirs, barrages etc. Using of hydraulic jump in energy dissipation, functions of diversion headwork, canal falls, and outlets all find useful applications in civil engineering problems. The topics included in this course are aimed to prepare a student to build a good knowledge to useful in the application-intensive courses by covering all topics in semester.

1. Theories of Seepage: Seepage force and exit gradient, salient features of Bligh's Creep theory, Lane's weighted Creep theory and Khosla's theory, Determination of uplift. Pressures and floor thickness. **(4)**

2. Design of Weirs: Weirs versus barrage, design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir. **(4)**

3. Energy Dissipation Devices: Use of hydraulic jump in energy dissipation, Factors affecting design, Types of energy dissipaters and their hydraulic design. **(4)**

4. Diversion Head Works: Functions and investigations: component parts of a diversion head work and their design considerations, silt control devices. **(4)**

5. Distributary Regulators: Off take alignment, cross-regulators – their functions and design, Distributary head regulators, their design, and canal escape. **(4)**

6. Canal Falls Necessity and location, types of falls and their description, selection of type of falls, Principles of design, Design of Sarda type, straight glacis and Inglis or baffle wall falls **(4)**

7. Cross-Drainage works: Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing. **(4)**

8. Canal Out-lets essential requirements, classifications, criteria for outlet behaviour, flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets. **(4)**

Course Outcomes:

1. The student will be able to describe the concepts and principles, of Bligh's, Creep and Khosla's theory and numerical problems also.
2. Apply the knowledge, techniques, skills in designing of weirs and barrages.
3. Students will must solve the numerical problems of canal falls and canal outlets.

Text/Reference Books:

1. Design of Irrigation Structures by S.K. Sharma.
2. Irrigation and Water Power Engg. By B.C. Punmia & Pande B.B. Lal.
3. Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe.
4. Irrigation Engg. Vol.I, II & III by K.R. Sharma.
5. Irrigation Practice and Design Vol. I to VII by K.B. Khushlani.
6. The Fundamental Principles of Irrigation and Water Power by B.B. Priyani.
7. Irrigation Engg. Vol. I & II by Ivan E. Houk.
8. Fundamentals of Irrigation Engg. by Dr. Bharat Singh. 9. I.S.I.Codes.

BTCE-18916 Water Quality Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: This course aims to introduce the theory and application of physical and chemical processes for the improvement of water quality in engineered water treatment plants and natural aquatic systems. The students will learn to design, engineer and analyze water treatment systems and the energy requirements will be considered.

1. **Quantity of Water:** Per-capita demand, design period, population forecast, fluctuation in demand General requirement: Sources of water, necessity of treatment, water quality standards for various water uses, Intake structures – Different types & design criteria, pumping and transportation of water Principles and design of aeration systems – two film theory, water in air system, air in water system. **(7)**

2. Principles of sedimentation: Types of settling and settling equations, design criteria and design of settling tanks. Principle of Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, and optimum dose of coagulant, design criteria and numerical examples. **(5)**

4. Filtration: Theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operational problems and trouble shooting. **(4)**

6. Disinfection: different types, disinfectants, factors affecting disinfection, methods of disinfection, and chemistry of chlorination. Water Softening: Ions causing hardness, Langelier index, various methods. Fluoridation and de-fluoridation - Principles and design. **(4)**

7. Adsorption Process: Types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations and their applications. **(4)**

8. Advanced water treatment: Ion exchange, electro-dialysis, Reverse Osmosis, Ultra filtration Distribution system design and analysis, distribution reservoirs and service reservoirs. **(6)**

Course Outcomes:

1. Describe the water quality standards.
2. Design and analyze water treatment reactors.
3. Apply physical processes to improve water quality.
4. Apply chemical processes to improve water quality.

Text/References Books:

1. Lawler, D. and M. Benjamin. 2003. Water Quality Engineering: Physical and Chemical Treatment Processes. McGraw-Hill.
2. American Water Works Association and J. Edzwald. 2010. Water Quality and Treatment: A Handbook on Drinking Water, 6th ed. McGraw-Hill.
3. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), "Environmental Engineering", McGraw Hill
4. Raju, B.S.N., (1995), "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt. Co. Ltd., New Delhi.
5. Fair, G.M., Geyer J.C and Okun, (1969) "Water and Wastewater Engineering" Vol II, John Wiley Publications.

BTCE-18917 Environmental Fluid Mechanics

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: The students should be able to calculate the steady-state profiles of open channel flows with variable geometry and discharge, and perform the preliminary design of hydraulic structures typically used in hydropower systems. To perform the main hydrological analyses needed for the design of hydropower systems and the simulation of its productivity, and assess river flow alteration due to hydropower operation.

1. Introduction: Review of basic hydraulic concepts. Fundamental equations, derivation of the one-dimensional cross-sectional averaged continuity and momentum equations. Steady flow in pipes: wall roughness, uniform flow, design. **(8)**

2. **Open channel flow resistance in free surface hydrodynamics:** uniform flow; stage-discharge curves in natural cross-sections. Steady-state profiles. Subcritical and supercritical flows; boundary conditions. Hydraulic jump. Gradually varied flows: effect of variable geometry and variable discharge. Unsteady flows: flood waves, celerity of propagation, simplified models. Numerical models for the simulation of open channel flows. **(8)**

3. Transport processes in rivers Basic concepts: Concentration of a scalar tracer. One-dimensional advection-diffusion equation; turbulent diffusion; dispersion. Mass and heat transport in rivers. **(7)**

4. Sediment transport Sediment characterization and types of transport: Review of empirical relationships for sediment load, settling velocity and equilibrium concentration. Morphological evolution: erosion and deposition. **(7)**

Course Outcomes:

1. The students should be able to perform the main hydrological analyses needed for the design of hydropower systems and the simulation of its productivity. Assessing river flow alteration due to hydropower operation is also an expertise that the students will develop
2. Calculate the steady-state profiles of open channel flows with variable geometry and discharge, and perform the preliminary design of hydraulic structures typically used in hydropower systems.

Text/References Books:

1. S. L. Dingman, Physical Hydrology, Prentice Hall, New Jersey, 1994
2. F. M. Henderson, Open Channel Flow, MacMillan Series in Civil Engineering, 1966.
3. H. Chanson, The Hydraulics of Open Channel Flow: An Introduction, Arnold, 1999.
4. S.A. Socolofsky & G.H. Jirka, Special Topics in Mixing and Transport Processes in the Environment, Coastal and Ocean Engineering Division, Texas A&M University, 5th Edition, 2005.

BTCE 18920 DESIGN OF STEEL STRUCTURES

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objective: At the end of this course, the student should be able to design of steel structural elements and their connections in accordance with the relevant codes of practice based on latest design practices.

1. Introduction Introduction to steel and steel structures, Introduction to design, Design loads and load combinations, limit state design, allowable stresses in structural steel. **(4)**

2. Design of bolted connections Terminology, Types of bolted connections, Modes of failure, Design of bolted connections for direct loads, for joints subjected to moment perpendicular to and in the plane of joint. **(4)**

3. Design of welded connections Terminology, Types of welded connections, Modes of failure, Design of welded connections for direct loads, for joints subjected to moment perpendicular to and in the plane of joint. **(4)**

4. Design of tension members Types of Tension members, strength of tension members, design criteria for tension members, tension member splices, lug angles. **(4)**

5. Design of compression members Types of compression members, buckling classes of compression members, design of compression members, design of laced and battened columns. **(4)**

6. Design of beams Design criteria for steel beams, web buckling, web crippling, design of built up beams, laterally supported beams, introduction to torsional buckling. Introduction to design of welded plate girder. **(4)**

7. Roof truss Introduction, Types of trusses, Roof coverings, detailed design of steel roof truss subjected to dead, live and wind loads. Introduction to design of roof trusses using software. (**3)**

8. Plastic design Introduction to plastic design, Moment curvature relationship, shape factor, plastic hinges, plastic moment of a section. **(3)**

Course Outcomes

By the end of this course the student will be able to:

1. Determine the properties of structural steel and its uses
2. Differentiate between compression and tension members
3. Understand the concept of plastic design of steel structures
4. Design various structural elements in steel and prepare detailed structural drawings.

Text/Reference Books:

1).“Design practices of Steel Structures”, N. Subramanayam, Oxford Publishing Press.
2). “Limit state design of Steel Structures”, S.K. Duggal, Tata McGraw Hill.
3). “Design of Steel Structures”, Arya & Ajmani , Nemchand and Bros
4). “Design of Steel Structures”, Syal and Satindra Singh, Standard Publisher Distributer
5). “Design of Steel Structures”, S.S. Bhavikatti, I.K. International Pub.House Pvt. Ltd.

BTCE 18921 Structural Dynamics

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objectives: To impart the knowledge for analysis of structures subjected to dynamic loading.

1. Single Degree of Freedom Systems Fundamental, Mass spring damper system, Analysis of free vibrations, Response to harmonic loading, periodic loading, Impulsive loading and general dynamic loading. Generalized SDOF, Vibration analysis by Rayleigh method. **(7)**

2. Multi Degree of Freedom Systems Two degree of freedom system – undamped, free & forced. Multi-degree of freedom system- undamped, Hozler's method, Stodola's method, Orthogonality condition, Damped system. Dynamic analysis and Response- Modal Analysis, Response spectrum analysis, Rayleigh's-Ritz method. **(6)**

3. Structures with Distributed Mass And Load Axial, shear and transverse vibration due to bending of beams, Uniform shear beam, Beam in bending, Numerical techniques for shear beam, Bending of beams, Forced vibration, Plates or slabs subjected to normal loads. **(6)**

4. Earthquake Motion And Response Introduction, Strong motion earthquake, Numerical method for spectra, Elastic spectra, Ground velocity and displacement, Inelastic spectra **(6)**

5. Machine Foundations Design of machine foundations, industrial floors subjected to dynamic loading. **(5)**

Course Outcomes:

With the knowledge of this subject, students shall be capable of analyzing the structures subjected to dynamic loads due to earthquake and vibrations due to machines etc.

Text/Reference Books:

1. Dynamics of Structures by John's Biggs. 1965
2. Elementary Earthquake Engineering by Jai Krishna & Chander Shekhran 2000
3. Dynamics of Structures by Janes Biggs. 1965
4. Earthquake Resistant Design by Dowrick-Wiley.1978.
5. Dynamics of structures by Anil K.Chopra.1980

BTCE-18922 Metal Structure Behaviour

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 1 0**
Total Marks:	**100**	

Course Objective: 1. To describe the basic elements of material science and its application to engineering fields. 2. To explain the concept of phase diagrams, solidification principles and engineering of ferrous, non-ferrous, ceramics and polymers.

1. Structure of metals and alloys Nature of metallic bonding, crystal structure of metals-Miller indices, Miller-Bravais indices, structure of alloys-Types of solid solutions, Hume Rothery Rules, Free energy of solid solutions, Intermediate phases, Numerical problems. **(6)**

2. Imperfections in crystals Point imperfections, Dislocations, High angle boundaries, Interaction between crystal imperfections. **(5)**

3. Equilibrium diagrams The Phase rule, Isomorphous systems, Lever rule, Coring, Eutectic system, Eutectoid, Peritectic, Peritectoid, Monotectic and Syntectic reactions, Micro structural changes during cooling-slow and non-equilibrium cooling, Study of Fe-Fe3C, Cu-Zn, Al-Si Binary diagrams, Numerical problems. **(5)**

4. Solidification in metals Energetics of solidification, Nucleation and Growth, Homogeneous Nucleation, Heterogeneous Nucleation, Growth of solid, Smooth or Stable interface growth, Temperature inversion in pure metals-Dendritic growth in pure metals, Constitutional super cooling, Dendritic Growth in Alloys, Freezing of Ingots, Segregation, Porosity. **(6)**

5. Diffusion in solids: Diffusion mechanisms, Fick's laws and their applications in various Metallurgical phenomena, Kirkendall effect, Numerical problems. **(4)**

6. Engineering alloys Ferrous Alloys and Nonferrous Alloys. **(4)**

Course Outcomes:

The student is able to establish his understanding for crystal structure, phase diagrams and their applications, principles of solidification of metal, polymers and inorganic glasses.

Text/Reference Books:

1. Physical Metallurgy Principles. Reza Abbaschian, Lara Abbaschian and Robert Reed-Hill, Cengage Learning India, 2013.
2. Fundamentals of Materials Science and Engineering, 5th Edition, W D Callister Jr., John Wiley and sons, 2001
3. S. H. Avner, Introduction to Physical Metallurgy, McGraw Hill, 1987.

BTCE-18925 Offshore Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objectives: Provides knowledge needed to solve engineering problems related to both fixed and floating offshore structures.

1- Introduction, History of Offshore Structures **(3)**

2- Codes of practice, **(4)**

3- Offshore project management, deep water, Overview of Field Development, Field-Development Cost, Multi criteria Concept Selection. **(6)**

4- Offshore site investigations, geophysical methods **(6)**

5- Types of Offshore Platforms- Drilling/Well-protector Platforms, Tender Platforms, Self-contained Platforms, Production Platforms, Quarters Platforms, Flare Jacket and Flare Tower Platforms, Auxiliary Platforms, Bridges, Heliport. **(6)**

6- Different Types of Offshore Structures- Concrete Gravity Platform, Floating Production, Storage and Offloading, Tension-Leg Platform, Minimal Offshore Structure. **(5)**

Course outcomes:

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

1. Understand the basic theoretical concepts in offshore engineering and apply them to actual problems.
2. They will be able to calculate wave forces on fixed and floating structures and calculate the dynamic response.
3. They will be able to use design codes to check the capacity of structural members.
4. They will be proficient in the use of finite element software to perform computer simulations, thus being prepared for the practical needs of the industry.

Text/Reference Books:

1. Offshore structures by Mohamed A. El Reedy
2. Offshore Engineering: An Introduction by Angus Mather
3. Ocean Engineering & Oceanography by Srinivasan Chandrasekaran , Gaurav Srivastava.
4. Offshore Platform Integration and Floatover Technology (Springer Tracts in Civil Engineering) by Gengshen Liu (Author), Huajun Li (Author)

BTCE-18926 Foundation Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objective: The objective of this course is to learn about types and purposes of different foundation systems and structures. To provide students with exposure to the systematic methods for designing foundation. To discuss and evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behavior. To build the necessary theoretical background for design and construction of foundation system. To Study the nature of the soil behavior for different foundation.

1. Soil Exploration Object of soil investigation for new and existing structures. Depth of exploration for different structures. Spacing of bore Holes. Methods of soil exploration and relative merits and demerits. Types of soil sample. Design features of sampler affecting sample disturbance. Essential features and application of the following types of samples- Open Drive samples, Stationery piston sampler,.Rotary sampler, Geophysical exploration by seismic and resistivity methods. Bore Hole log for S.P.T. ` **(3)**

2. Earth Pressure Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest. Rankine states of plastic equilibrium, Ka and Kp for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition. Coulomb's method for cohesion less backfill. Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load). **(8)**

3. Shallow Foundation Type of shallow foundations, Depth and factors affecting it. Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine's analysis and Terzaghi's analysis. Types of failures. Factors affecting bearing capacity. Skemptons equation .B.I.S. recommendations for shape, depth and inclination factors. Plate Load test and standard penetration Test. Bosussinesq equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams. Newmarks chart and its construction.2:1 method of load distribution. Comparison of Bosussinesq and Wester guard analysis for a point load. Causes of settlement of structures, Comparison of immediate and consolidation settlement, calculation of settlement by plate load Test and Static Cone penetration test data. Allowable settlement of various structures according to I.S. Code. Situation most suitable for provision of rafts, Proportioning of Rafts, Methods of designing raft, Floating foundation. **(8)**

4. Pile Foundations Necessity and uses of piles, Classification of piles, Merits and demerits of different types based on composition. Types of pile driving hammers & their comparison .Effect of pile driving on adjacent ground. Use of Engineering News Formula and Hiley's Formula for determination of allowable load. Limitations of pile driving formulae. Cyclic Pile Load Test, Separation of skin friction and point resistance using cyclic pile load test.

Determination of point resistance and frictional resistance of a single pile by Static formulas. Piles in Clay, Safe load on a Friction and point Bearing pile. Pile in sand, Spacing of piles in a group, Factors affecting capacity of a pile group, Efficiency of pile group by converse – Labare formula and feeds formulas. Bearing capacity of a pile group in clay by block failure and individual action approach. Calculation of settlement of friction pile group in clay. Related Numerical problems. Settlement of pile groups in sand, Negative skin friction. Related numerical Problem. **(8)**

5. Caissons and Wells Major areas of use of caissons, advantages and disadvantages of open box and pneumatic caissons. Essential part of a pneumatic caisson. Components of a well foundation. Calculation of allowable bearing pressure. Conditions for stability of a well, Forces acting on a well foundation. Computation of scour depth. **(5)**

Course Outcomes: Students who successfully complete this course will be able to:

1. Understand various Types of foundation.
2. Understand about In Situ test (field test of soil)
3. Understand about various analysis and design of foundation.
4. Understand reason behind .the structure and foundation failure.
5. Understand about behavior/nature of the soil.

Text/Reference Books:

1. Soil Mech. & Foundation Engg, by K.R.Arora, Standard Publishers Distributors
2. Geotechnical Engineering, by P. Purshotama Raj
3. Soil Mech. & Foundation Engg., by V.N.S.Murthy
4. Principle of Foundation Engineering by B.M.Das, CL Engineering
5. Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
6. Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education.

BTCE-18927 Bridge Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objectives: To develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality. To help the student develop an intuitive feeling about the sizing of bridge elements, ie. develop a clear understanding of conceptual design. To understand the load flow mechanism and identify loads on bridges. To carry out a design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements

1. Introduction: Definition and components of a bridge, Classification of bridges, Choice of a bridge type. **(2)**

2. Investigation for Bridges: Need for investigation, Selection of bridge site, Determination of design discharge for River Bridge, Linear waterway, Economical span, Vertical clearance, Scour depth, Afflux, Traffic projection. **(4)**

3. Standard Specifications for Road Bridges: IRC Bridge Codes, Width of carriageway, Clearances, Dead load, I.R.C. standard live loads, Impact effect, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current, Buoyancy effect, Earth pressure, Deformation stresses, Erection stresses, Temperature effects, and Seismic force. **(4)**

4. Reinforced Concrete Bridges: Types of RCC bridges; Culverts - Box Culvert, Pipe Culvert, Solid slab bridge, T-beam girder bridges, Hollow girder bridges, Balanced cantilever bridges, Continuous girder bridges, Rigid frame bridges, Arch bridges, Pre-stressed concrete bridges. **(4)**

5. Steel Bridges: Types of Steel bridges; Beam bridges, Plate girder bridges, Box girder bridges, Truss bridges, Arch bridges, Cantilever bridges, Cable stayed bridges, Suspension bridges. **(3)**

6. Sub-structure and Foundation: Piers and abutments, materials for piers and abutments, Types of foundations; Shallow, Pile, and Well foundations. Relative merits of piles and well foundations, Pneumatic Caissons, Box Caissons. **(4)**

7. Bearings, Joints & Appurtenances: Importance of Bearings, Different types of bearings Expansion Bearings, Fixed Bearings, Elastomeric Bearings, Expansion joints, Wearing Course, Approach Slab, Footpath, Handrails. **(5)**

8. Construction and Maintenance of Bridges: Methods of construction of concrete and steel bridges. Formwork and falsework for concrete bridges, Causes of Bridge failures, Inspection and maintenance. **(4)**

Course Outcomes:

1. To understand standard specification for bride design.
2. To perform design of various slab type reinforced concrete bridges.
3. To perform design of bridges sub-structures, bearings and joints.
4. To have knowledge of quality control and maintenance aspects of bridges.

Text/Reference Books:

1. Johnson, Victor, “Essentials of Bridge Engineering”, Oxford University Press.
2. Khadilkar, C. H., “A Text book of Bridge Construction”, Allied Publishers.
3. Rangwala, S. C., “Bridge Engineering”, Charotar Publishing House Pvt. Ltd.
4. Raina, V. K., “Concrete Bridges Handbook”, Shroff Publishers and Distributors.
5. Ponnuswamy, S. “Bridge Engineering”, McGraw Hill Education.

BTCE-18930 Railway Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: the objectives of this course is: 1.To know the basics and design of various components of railway engineering.2.To impart knowledge about methods of tunneling. 3.To impart in-depth knowledge about the aircraft characteristics, planning and airport components. 4.To study the types and components of docks and harbours.

1. Introduction to Railway Engineering: History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, LoadingGauge, Construction Gauge. (5)

2. Railway Track: Requirements of a Good Track, Track Specifications on Indian Railways, Detailed Cross-Section of Single/Double Track on Indian Railways. Components of Railway Track: Rails, Sleepers, Ballast, Subgrade and Formation, Track Fixtures & Fastenings, Coningof Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails. (6)

3. Geometric Design of Railway Track: Alignment, Gradients, Horizontal Curve, Super elevation, Equilibrium Cant, Cant Deficiency, Transition Curves. (3)

4. Points and Crossings: Functions, Working of Turnout, Various types of Track Junctions andtheir layouts, Level crossing. (4)

5. Railway Stations & Yards: Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards (4)

6. Signalling and Interlocking: Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signaling, Principal of Interlocking. (4)

7. Modernization of Railway Tracks: High Speed Tracks, Improvement in existing track for high speed, Ballast less Track, MAGLEV, TACV Track. (4)

Course Outcomes:

1. Comprehend the safety requirements and devices needed for any road to prevent accidents to an extent.
2. Understand the concept of railway engineering as an essential mode of transportation with its structural components.
3. Design the different geometrical layouts of a railway track with the latest technology available.

Text/Reference Books:

1. Chandra S., and Aggarwal, "Railway Engineering", M.M. Oxford University Press, New Delhi, 2007.
2. Saxena, S.C., and Arora, S.P., "A Text Book of Railway Engineering", Dhanpat Rai and Sons,
Delhi, 1997.
3. J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009
4. Khanna, S.K., Arora, M.G., and Jain, S.S., "Airport Planning and Design", Nem Chand & Bros. Roorkee, 1999.
5. Horenjeff, R. and McKelvey, F., "Planning and Design of Airports", McGraw Hill Company,
New York, 1994.
6. Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, "Airport Engineering: Planning, Design and Development of 21st Century", Wiley Publishers, 2011

BTCE-18931 Port and Harbour Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: 1.Introduce port and harbour engineering as a part of coastal and civil engineering. Equip students with knowledge of engineering applications at ports and harbours. 2.Develop the ability to analyze relevant topics pertaining to port and harbour engineering.

1. Introduction and Fundamentals: Ports and harbours – an infrastructure layer between two transport media, planning of ports and harbours. Tide and current conditions inside harbour, water circulation; breakwaters, jetties and quay walls; mooring, berthing and ship motion inside the port; model studies, physical and mathematical studies**.** **(6)**

2. Design Issues and Design of Port Infrastructures Sea port layout with regards to (1) wave action (2) siltation (3) navigability, berthing facilities. Design of port infrastructures with regards to (1) cargo handling (2) cargo storage (3) integrated transport of goods, planning multipurpose port terminals. **(6)**

3. Port Operations Allowable wave conditions for cargo handling, wave conditions for human safety on quays and breakwaters, forecasting / now casting of wave and current conditions for port operations, dredging an navigability, hazard scenarios; VTMS and management of computerized container terminal, safety & environment. **(6)**

4. Inland Waterways and Ports Maintenance of waterways, construction of environmentally engineered banks, dredging and disposal processing and storing of polluted dredged materials, development of river information services. **(6)**

5. Construction Aspects and Sustainability Planning and construction expansion and renovation of port and Inland Port Infrastructure. Global trade and port restructuring/reforms, impact of possible climate change scenarios, sustainable development strategies for cities and ports. **(6)**

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the significance of ports and harbours as a mode of transport.
2. Demonstrate the fundamental principles of wave hydrodynamics and port cargo handling.
3. Demonstrate the basic design of port layout.
4. Design, plan and integrate port and harbour infrastructure.

Text/Reference Books:

1. Muir Wood, A.M., and Fleming. C.A.,"Coastal Hydraulics Sea and Inland Port Structures", 1 st Edition, Hallstead Press, 2002.
2. Ozha & Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990

BTCE-18932 Traffic Engineering and Management

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: To introduce fundamental knowledge of traffic engineering so that students can understand and be able to deal with traffic issues including safety, planning, design, operation and control. Students will learn and be able to use software such as Highway Capacity Software and Synchro in traffic engineering projects.

1. Introduction: Elements of Traffic Engineering, Components of traffic system – road users, vehicles, highways and control devices. **(4)**

2. Vehicle Characteristics: IRC standards, Design speed, volume, Highway capacity and levels of service, capacity of urban and rural roads, PCU concept and its limitations. **(3)**

3. Traffic Stream Characteristics: Traffic stream parameters, characteristics of interrupted and uninterrupted flows. **(3)**

4. Traffic Studies: Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, parking studies, accident studies. **(4)**

5. Traffic Regulation and Control: Signs and markings, Traffic System Management, At-grade intersections, Channelization, Roundabouts. **(3)**

6. Traffic Signals: Pre-timed and traffic actuated. Design of signal setting, phase diagrams, timing diagram, Signal co-ordination. **(3)**

7. Grade Separated Intersections: Geometric elements for divided and access controlled highways and expressways. **(3)**

8. Traffic Safety: Principles and practices, Road safety audit. **(3)**

9. Intelligent Transportation System: Applications in Traffic Engineering **(4)**

Course Outcomes:

Students who successfully complete this course will be able to:

1. Use statistical concepts and applications in traffic engineering.
2. Identify traffic stream characteristics.
3. Understand elements of highway safety and approaches to accident Studies.
4. Understand about intelligent transportation system.
5. Design a pre-timed signalized intersection, and determine the signal splits.

Text/Reference Books:

1. William, R.M. and Roger, P.R., "Traffic Engineering", Prentice Hall.
2. Hobbs, F.D., "Traffic Planning and Engineering", Pergamon Press.
3. Khisty, C.J. and Kent, B.L., "Transportation Engineering – An Introduction", Prentice Hall of India Pvt. Ltd.
4. Kadiyali, L.R., "Traffic Engineering & Transport Planning", Khanna Publishers, New Delhi.
5. Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, New Delhi.

BTCE-18935 Elements of Earthquake Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objective: 1 To provide a coherent development to the students for the courses in sector of earthquake engineering 2 To present the foundations of many basic engineering concepts related earthquake Engineering 3To give an experience in the implementation of engineering concepts which are applied in field of earthquake engineering 4 To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Note: No Indian Codes of Practice and Design handbooks are permitted, so paper setter is expected to provide required data from relevant IS codes, for any numerical or design part.

1. Introduction to Earthquakes, Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters. Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings. **(5)**

2. Introduction to Theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, Spring action and damping, Equation of motion of S.D.O.F. systems, Undamped, Damped system subjected to transient forces, general solution, green's function. **(4)**

3. Lateral Force Analysis, Floor Diaphragm action, moment resisting frames, shear walls**.** **(4)**

4. Concepts of Seismic Design, Lateral Strength, Stiffness, ductility and structural configuration. **(3)**

5. Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake. **(4)**

6. Introduction to provisions of IS 4326. **(3)**

7. Introduction to provision of IS 13920. **(3)**

8. Base Isolation Techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures **(3)**

Course outcomes:

1. The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts, which are applied in field Structural Engineering.
2. The students will get a diverse knowledge of earthquake engineering practices applied to real life problems

3. The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.

Text/Reference Books:

1. Earthquake Resistant Design of Structures, PankajAgrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Structural Dynamics by Mario & Paz, Springer.
4. IS 1893-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures
5. IS 4326-1993 2002 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
6. IS 13920-1993 2002 Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.

BTCE-18936 Hydrology and Water Resources Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

1. Introduction: Hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. **(3)**

2. Precipitation: Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India. **(5)**

3. Abstractions from precipitation: Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modeling infiltration capacity, classification of infiltration capacities, infiltration indices. **(6)**

4. Runoff: Runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows. **(5)**

5. Ground water and well hydrology- Forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests. **(5)**

6. Dams and spillways- Embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site. **(6)**

Course Outcomes:

At the end of the course, students must be in a position to:

1. Understand the interaction among various processes in the hydrologic cycle.
2. Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for design of hydraulic structures
3. Understand the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions

4. Understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources

Text/Reference Books:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.

BTCE-18937 Geographic Information Systems and Sciences

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: 1. To introduce the fundamentals and components of Geographic Information System 2. To provide details of spatial data structures and input, management and output processes.

1 Introduction to GIS: Definitions, Evolution, Components and Objectives **(4)**

2 Hardware & Software Requirements: Hardware: Basic Blocks of Computer, Processor, Memory, Secondary Storage Devices, Input/Output Devices, Binary Numbers. Software: Operating System, Application, Compliers, Editors. Overview of GIS Software Packages **(6)**

3 Spatial Data: Types of Geographic Data, Levels Of Measurements. Concepts of Space and Time, Layers Coverage. Spatial Data Models, Representation of Geographic Features in Vector, Raster Data Models. Concept of Arc, Node, Vertices and Topology. Object Oriented Models: Advantages and Disadvantages. Computer Representation for Storing Spatial Data: Block Code, Run-Length Encoding, Chain Coding, Quad tree. Issues Governing Choice of Models. **(6)**

4 Non-Spatial Data: Advantages of Data Base Management System. Conceptual Implementation Models, Hierarchical, Network, Relational Models. RDBMS: Components, Concept, Database Schema, Tables and Relationships. Database Design Normalization (1NF, 2NF, 3NF Forms) Data Definition Manipulation Using SQL, SQL-Query Processing, Operations on Tables, Integrity Constraints, Database Security, Role of Database Administrator (DBA). Metadata **(8)**

5 Spatial Data Input: Digitization, Error Identification. Errors: Types, Sources, Correction. Editing and Topology Building **(4)**

6 Concepts of GPS: History, Types, Navigation Systems and Applications **(2)**

Course Outcomes:

1. The basic concepts and components of GIS
2. The techniques used for storage of spatial data and data compression
3. The practices used for input, management and output of spatial data
4. Concepts of spatial data quality and data standards

Text/References Books:

1. Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester
2. Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi
3. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
4. Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore
5. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi

BTCE-18951 Metro System and Engineering

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

1- Overview and Construction Methods: Elevated and underground Stations; Viaduct spans and bridges; **(6)**

2- Underground Tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; (**6)**

3- Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; (**6)**

4- Environmental and Social Safeguards **(6)**

5- Track Systems-Permanent Way. Facilities Management **(6)**

Text/References Books:

1. Transport Planning and Traffic Engineering by Coleman A. O'Flaherty
2. Transportation Engineering and Planning C. S. Papacostas and Panos Prevedouros
3. Dynamics of Rail Transit Tunnel Systems by Shunha Zhou
4. Fundamentals of Transportation Engineering: A Multimodal Systems by Jon D. Fricker and Robert K. Whitford
5. Railway Transportation Systems: Design, Construction and Operation by Christos N. Pyrgidis

BTCE-18952 Public Transportation Systems

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: 1. To introduce the key concepts of the urban transportation planning system. 2. To introduce the fundamental concepts of public transport system such as system, technology and quality of service.

1. System and Technologies: Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes. **(8)**

2.Comparing Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing. **(8)**

3. Transit System Evaluation: Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical capacities of major transit modes, and quantification of performance. **(8)**

4.City Traffic: Classification of transportation systems, conventional transportation systems, unconventional transportation systems, prototypes and tomorrow's solutions, analysis and interpretation of information on transportation systems, perspectives of future transportation **(8)**

Course Outcomes:

1. Ability to understand the important concepts about public transport system.
2. Ability to work in team and communicate with others effectively for transport related topics.

Text/References Books:

1. George E. Gray and Lester A. Hoel. “Public Transportation”, Prentice Hall, New Jersey.
2. Vukan R Vuchic, “Urban Public Transportation Systems and Technology”, Prentice Hall Inc., New Jersey
3. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York
4. John W. Dickey,' Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co. New Delhi.

BTCE-18953 Intelligent Transportation Systems

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: 1.To develop an understanding of system engineering processes 2.To describe the concepts of system architecture and their evolution 3.Understand the capability of key technologies 4.Understand impact of technology on different modes and movement

1. Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS. **(5)**

2. Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC).Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection. **(8)**

3.ITS User Needs and Services and Functional areas: Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). **(7)**

4. ITS Architecture : Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning. **(6)**

5.ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries. **(4)**

Course Outcomes:

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

1. Differentiate different ITS user services.
2. Select appropriate ITS technology depending upon site-specific conditions.
3. Design and implement ITS components.

Text books/References:

1. Fundamentals of intelligent transportation systems planning By Mashrur A. Chowdhury, Adel Wadid Sadek
2. Lawrence A. Klein, Sensor technologies and Data requirements of ITS
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
5. National ITS Architecture Documentation, US Department of Transportation, 2007

BTCE-18955 Urban Hydrology and Hydraulics

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course Objectives: The course is designed to appreciate the impact of urbanization on catchment hydrology. Understand the importance of short duration rainfall runoff data for urban hydrology studies. To learn the techniques for peak flow estimation for storm water drainage system design. Understand the concepts in design of various components of urban drainage systems. Learn some of the best management practices in urban drainage. Understand the concepts of preparation master urban drainage system.

1. Introduction: Urbanisation and its effect on water cycle – urban hydrologic cycle – trends in urbanisation – Effect of urbanisation on hydrology. **(4)**

2. Precipitation Analysis: Importance of short duration of rainfall and runoff data, methods of estimation of time of concentration for design of urban drainage systems, Intensity-Duration -Frequency (IDF) curves, design storms for urban drainage systems. **(6)**

3. Approaches to urban drainage: Time of concentration, peak flow estimation approaches, rational method, NRCS curve number approach, runoff quantity and quality, wastewater and stormwater reuse, major and minor systems. **(6)**

4. Elements of drainage systems: Open channel, underground drains, appurtenances, pumping, source control. **(4)**

5. Analysis and Management: Stormwater drainage structures, design of stormwater network- Best Management Practices–detention and retention facilities, swales, constructed wetlands, models available for stormwater management. **(6)**

6. Master drainage plans: Issues to be concentrated upon – typical urban drainage master plan, interrelation between water resources investigation and urban planning processes, planning objectives, comprehensive planning, use of models in planning. **(4)**

Course Outcomes:

1. The student will be able to develop intensity duration frequency curves for urban drainage systems.
2. develop design storms to size the various components of drainage systems.
3. apply best management practices to manage urban flooding.
4. prepare master drainage plan for an urbanized area.

Text/Reference Books:

1. 'Manual on Drainage in Urbanised area'by Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, (1987 – 2 volumes), UNESCO,
2. 'Urban Hydrology' by Hall M J (1984), Elsevier Applied Science Publisher.
3. 'Hydrology – Quantity and Quality Analysis' by Wanielista M P and Eaglin (1997), Wiley and Sons.
4. 'Urban Hydrology, Hydraulics and Stormwater Quality: Engineering Applications and Computer Modelling' by Akan A.O and R.L. Houghtalen (2006), Wiley International.

18956 Water Quality Management

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objectives: At the end of this course students understand the principle of water quality. Quality standards of water ,different indices and the study of water quality models.

1. Principles of Water Quality **(4)**

2. Water Quality Classification **(4)**

3. Water Quality Standards, Categories, Sampling and measurement, Standards and reports. **(6)**

4. Water Quality Indices, Water Quality Index (WQI), Water Quality Index Calculators, Applications of WQI in Newfoundland and Labrador. **(6)**

5. TMDL, Planning Process. Water Quality targets, Background, Calculation, Load allocation, Implementation. **(5)**

6. **Water Quality Models**. Adjective transport formulation, Dispersive transport Formulation, Surface Heat Budget Formulation, Dissolved Oxygen Saturation Formulation, Reaeration Formulation, Carbonaceous Deoxygenation Formulation. **(8)**

Course Outcomes:

After learning the course, the students should be able to do:

1. The students should be able to start developing master and strategic water resources planning.
2. The students should be able to deal with water Supply/Demand issues including water demand management, reservoir storage and other structural and non-structural methods.
3. The students should be able to understand the different Water quality models

Text/Reference Books:

1. Water Quality Management by Peter A. Krenkel
2. Principles of Water Quality by Thomas D. Waite
3. Water Quality Indices by S. A Abbasi and Tasneem Abbasi
4. Water Quality : Diffuse Pollution and Watershed Management by Vladimir Novotny

18957- Water Resource Field Method

Internal Marks:	**40**	**L T P**
External Marks:	**60**	**3 0 0**
Total Marks:	**100**	

Course objectives: To understand the concept of planning of water resources projects including feasibility studies and to learn the concept of relevant mathematical tools.

1. Scientific Principles of Measurement Technologies and Protocols used for water-resources. **(6)**

2. Measurements and Experimental Design of Field-scale water-resources and environmental studies. **(7)**

3. Planning Field Studies. (5)

4. Instruments and Protocols for surface-water, ground water, and water-quality sampling. **(8)**

5. Description of Data Quality. **(5)**

Course Outcomes:

Students will be able to make use of concept of planning, optimal design criteria and application of economics in water resources projects

Text/Reference Books:

1. Water Resources Engineering by Anand Parkash
2. Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series) by American Water Works Association, James Edzwald
3. Introduction to Water Resources and Environmental Issues by Karrie Lynn Pennington
4. Water Resources Engineering by Ray K Linsley, Joseph B Franzini, David L Freyberg